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SMART TOURISM – CITY TOURISM RADAR: A Tourism Monitoring Tool at the City of Lisbon

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Abstract

The increasing demand for Lisbon has led to an uncontrolled access to the city's main attractions, which is reflected in the number of visitors that can be encountered at the city. Smart tourism destinations are gaining relevance in smart cities in everyday life, and technology is intricately more than ever in the cities and its citizens. In the present work it is proposed a conceptual model to a city tourism dashboard and its materialization using open data from the city's public portal, produced by the Lisbon City Council and other partners. It is also suggested a method to the conception of this tool and the main indicators that must be included based on the actual state of the art. It concludes with a proposal of future developments to perform on the smart tourism destinations area.

Keywords: Information and Communication Technologies; ICTs; Information Management; Open Data; Smart City; Tourism Monitoring Tool.

1. INTRODUCTION

Citizens are at the hearth of a Smart City process and technologies are the key enablers (Eurocities, 2016). People are the sensors that provide anonymous data, availability of city services and events detection (Goodchild, 2007). Haklay (2013) proposed four levels of citizen participation: Crowdsourcing, distributed intelligence, participatory science, and extreme participation, characterized by the level of citizenship collaboration. In most cities, citizen science is still in the earliest phase, and by rethinking governance, design and creation, there's an increase of innovative solutions, where data has tremendous importance, while standards and interoperability are crucial for a Smart City (Mitchell, Villa, Stewart-Weeks, & Lange, 2013).

Nowadays, the stream of tourists at any trendy destination is increasing every day, leading to urban transport challenges, even on smaller cities. It is a priority to investigate on tourism demand growth and its social impacts (Faulkner & Tideswell, 1997). Several Tourism Management and Smart Tourism Destinations researchers present limited findings that presently require further research to validate and to expand the theoretical contributions of such (Buhalis & Amaranggana, 2014). Also, *"the application of the concept of sustainable development as an achievable and practical objective*

for tourism has not yet matured." (Ko, 2005, p. 431). A need has emerged to investigate deeper, having motivated this paper. Its aim is to research whether it is possible to build an artefact to help monitor the tourism of Lisbon using Open Data from the city Open Data Portal, and also propose the indicators that should be involved.

Although there are currently some Portuguese organizations working on this topic, namely the Lisbon City Council (*Câmara Municipal de Lisboa – CML*), *Turismo de Portugal* and *Turismo de Lisboa* associations, none provides a conceptual model on how to monitor the city tourism yet. Further study was required on how different stakeholders, such as local citizens, tourists, companies, tourism developers and the government, can benefit from a city tourism monitoring tool and this motivated the research question of this work. As a research approach after a theoretical background review, other examples from other countries dashboards on tourism were analysed. This research may represent an important stage by warning to the need for a deeper knowledge of the tourism development at a particular city, and how can it be explored and managed more intelligently by different participants.

2. LITERATURE REVIEW

2.1. Open Data

According to the Open Data Guide (Dietrich et al., 2012, p.6), "*Open data is data that can be freely used, re-used and redistributed by anyone - subject only, at most, to the requirement to attribute and sharealike*". Open data is defined by the Open Definition as having:

1. **Availability and Access:** the data must be available as a whole and at no more than a reasonable reproduction cost, preferably by downloading over the internet. The data must also be available in a convenient and modifiable form.
2. **Re-use and Redistribution:** the data must be provided under terms that permit re-use and redistribution, including the intermixing with other datasets.
3. **Universal Participation:** everyone must be able to use, re-use and redistribute - there should be no discrimination against fields of endeavour or against persons or groups. For example, 'non-commercial' restrictions that would prevent 'commercial' use, or restrictions of use for certain purposes (e.g. only in education), are not allowed.
4. **Machine Readability:** Data must be available in form readily processable by a computer and where the individual elements of the work can be easily accessed and modified.

According to Open Knowledge International, Open Data is non-confidential data, produced with public money, that can be edited and used by everyone, without restrictions on its usage or distribution (Janssen, Charalabidis, & Zuiderwijk, 2012; Neto, Neves, Rego, & Cartaxo, 2017). “*Open means anyone can freely access, use, modify, and share for any purpose (subject, at most, to requirements that preserve provenance and openness)*” (Open Knowledge Foundation, 2009, n.a.). At Portugal, a study on the Open Data national scenario was performed by Neto et al. (2017). It is known that the public sector is following the public entities strategy on providing Open data to the citizens.

2.2. *Smart Structures*

The Smart City concept emerged on the problems that modern cities faced as a result of a higher influx of citizens in the urban areas. As so, living in a city has become an increasing challenge, both to citizens and governance (Perera, Zaslavsky, Christen, & Georgakopoulos, 2013). But what makes a city truly smart or intelligent? Deakin & Al Waer (2011) compared both notions by taking Hollands (2008) work on the stated definition of a city as smart as the starting point to study the transition from a Smart to an Intelligent City. Most Smart Cities solutions did not have a complete impact on the city challenges, such as its sustainability, competitiveness and employment. According to Komninos (2011), knowledge on making a city intelligent is still lacking, as cities tend to be digital only. We assist to a few challenges on making a city not only technologically capable, but also spatially intelligent, even having the technological resources fully present.

2.3. *Smart Tourism Destinations*

According to Buhalis & Amaranggana (2014), Smart Tourist Destinations represent a destination with embed technology, having as priorities the improvement of tourists travel experience; efficient gather and distribution of information; enable an efficient allocation of tourism resources; and distribution of the sector benefits at the local society. Following this, the Information and Communications Technologies (ICTs) improve city services, by coordinating them and leading to engaged and better-informed citizens.

Every tourist has a limited knowledge of the visited destination, but the development of crowdsourced applications by using their input can give a valuable insight on their demands and expectations. Some cities have started presenting exploratory smart city case studies by producing mobile tourist guides, which is the case of Natal, a city at Brazil that used the FIFA World CUP 2014 event to collect more knowledge on smart cities’ initiatives and mobile applications. By

personalizing and making tourists aware of tourism services locally available, and thus improving the tourist experience, the tourism industry was empowered with the collected data from every user at the time (Cacho et al., 2016).

3. DASHBOARD RESEARCH METHODOLOGY

For the present paper development the Design Science Research Methodology presented by Vaishnavi, Kuechler, & Petter (2004) was used, as demonstrated in Figure 1. Initially, a problem identification and the paper motivation were done, where the increase of tourism in Lisbon with few insights occurred on the city council open data portal. As no tourism conceptual model had been proposed, an artefact on how to monitor was believed to add value on achieving a better understanding and gaining information of the city tourism patterns. Secondly, the objectives were defined: to develop a conceptual model to monitor the tourism in Lisbon using open data from the Lisbon Open Data Portal; to demonstrate it in an empirical tool; and to propose it in a way that it can be replicated with other cities open data. Thirdly, the design and development phase was performed choosing among the identified indicators from tourism dashboards from New Zealand, Japan, United Arab Emirates, United States of America, Hawaii and Australia, and from scientific publications on tourism destinations, smart tourism, tourism sustainability and destination competitiveness (Appendix A), which helped gaining insights on the existing work and to start designing the artefact. Fourthly, the tool was demonstrated by producing mock-ups and developed using Microsoft Power BI software (Microsoft, 2019) to assess for the usage of the conceptual model in several reports, using Lisbon Open Data. This article concludes by exploring the main findings, present limitations and proposed work.



Figure 1: Design Science Research Methodology proposal.

3.1. Conceptual Model

After performing a theoretical background review and analyzing the main sources, the selected indicators were combined in a conceptual model to initiate the creation of the future dashboards. This research represents an important phase by alerting to the need of better understanding tourism processes at a particular city, and how can it be intelligently explored. Conceptualizing the reviewed

theoretical background and after the data collection, a tool for measuring and to help monitor the urban tourism in a city is proposed in Figure 2.

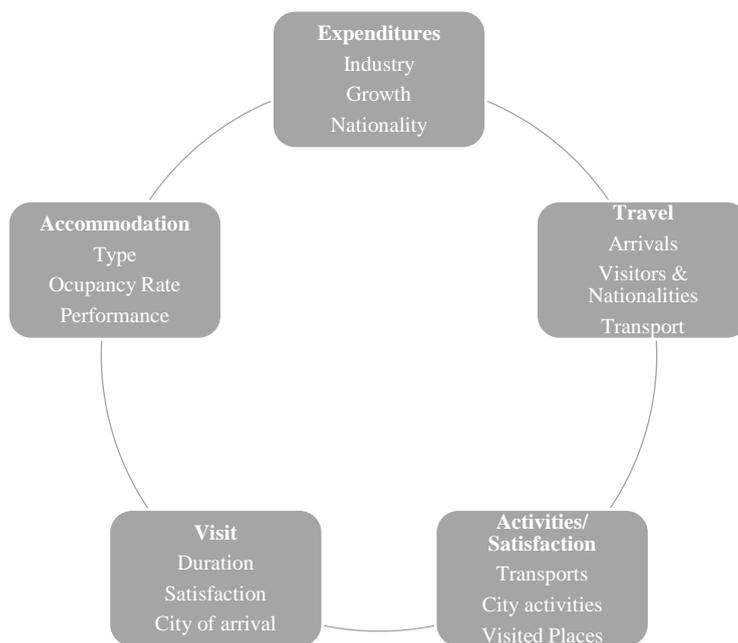


Figure 2: Conceptual model proposal diagram.

A tool design proposal has utmost importance on a smart tourism destination. Few authors have proposed such and a “change in focus from the traditional principle of accountability to a concept of citizen empowerment” is the main point on exploring open data (Janssen et al., 2012; Sandoval-Almazan et al., 2012). Based on the current state of the art in this area, it is essential to collect cases where similar work has been done. The monitoring tool design began with the identification of relevant dashboards, followed by a selection of relevant indicators on each. After being assessed for their objectives and measurable Key Performance Indicators (KPIs) (Zahra, 2011), the design of mock-ups followed with the appropriate visual presented to each indicator. Finally, the results were evaluated and explored on its relevance and appropriateness, and finally implemented and trailed on the tool future conditions and importance.

Considering the previous method, a selection of the indicators that were required to use on a tourism monitoring tool was made and assembled on the next table and originated five major categories – Expenditures, Travel, Activities/Satisfaction, Visit and Accommodation. The indicators were chosen based on the authors’ publications and the number of different indicators that referred to the same topic, as summarized on the table at Appendix A. The selected indicators are useful as they endorse

future dynamic exploration and analysis on upcoming developed dashboards, allowing the local government and the citizens to improve their knowledge on valuable metrics at the city.

3.2. Data Collection and Preparation

Data collection was performed in two stages. Initially, several articles on tourism management and Smart Tourism Destinations were examined, but few had useful information on managing tourism demand or on any tool that had been developed to do so, as the topic is early and very few practical cases have been presented so far in scientific publications. As so, a second approach was taken where six countries have been considered regarding tourism dashboards.

Six countries' dashboards on tourism were chosen as they presented solid produced work on this subject. All the displayed indicators were registered in a frequency table and its analysis contributed to realize that the studied indicators were spread across several dashboards or reports, and were not present at a single site or document, which also occurs on the Open Data used for the present paper at the Lisbon Open Data portal. Following this, the table below summarizes the sources, datasets and the obtained datasets after some data profiling and cleansing, which were used to develop a dashboard on Lisbon's tourism areas.

SOURCES	DATASETS	OBTAINED DATASETS
Accessed on November 2017: http://tomslee.net/airbnb-data-collection-get-the-data	Airbnb_lisbon_2017-07-27 CSV file	Airbnb (July 2017)
Accessed on January 2018: https://www.ine.pt/xportal/xmain?xpid=INE&xpgid=ine_publicacoes&PUBLICACOEStipo=ea&PUBLICACOEScoleccion=107668&selTab=tab0&xlang=pt	"INE 2016 - Estatísticas Turismo: Quadro 6.2.24 - Estada média, segundo o tipo dos estabelecimentos, por regiões (NUTS II)" Excel file "ET_2017: Quadro 2.24 - Estada média, segundo o tipo dos estabelecimentos, por regiões NUTS II" Excel file	Nights per accommodation type (2016 and 2017)
Accessed on January 2018: http://travelbi.turismodeportugal.pt/pt-pt/bi/Paginas/default.aspx?datasetId=ACAF829121D04B2AB24F196BBF3B3940 http://dados.cm-lisboa.pt/dataset/taxas-ocupacao-estabelecimentos-hoteleiros_on on January 2018.	"Hospedes 2016 AM Lisboa_Tipologias" and "Hospedes 2017 AM Lisboa_Tipologias" from TravelBI (Guests per accommodation type) "Taxas de ocupação 2016 Tipologias - LISBOA" and "Taxas de ocupação 2017 Tipologias - LISBOA" from CML open data portal (Occupancy rates)	Guests per accommodation (2016 and 2017)

SOURCES	DATASETS	OBTAINED DATASETS
Accessed on January 2018: https://www.ine.pt/xportal/xmain?xpid=INE&xpgid=ine_publicacoes&PUBLICACOESStipo=ea&PUBLICACOEScolecao=107668&selTab=tab0&xlang=pt	"INE 2016 - Estatísticas Turismo: Quadro 6.2.25 - Estada média na hotelaria, segundo as regiões (NUTS II), por países de residência" "ET_2017: Quadro 2.25 - Estada média na hotelaria, segundo as regiões (NUTS II), por países de residência"	Nights per country of origin (2016 and 2017)
Accessed on April 2018: http://travelbi.turismodeportugal.pt/pt-pt/bi/Paginas/default.aspx?datasetId=780E95AA10F8470592C8C1DA15D81FCB	TravelBI_hóspedes e dormidas (2016-2017)	Guests per country of origin (2016 and 2017)
Shared by Turismo de Lisboa on 20th February 2018	"LISBOA CIDADE - estabelecimentos hoteleiros (moradas)" Excel dataset	Lisbon Hotels addresses (2017)
PowerBI file obtained on 15 th of December of 2017 through advisor share.	Lisbon parishes PowerBI file	Parishes (Up to date)

Table 1 - Source files and obtained datasets.

Afterwards, the Lisbon tourism data was collected and the datasets to create the tourism tool were obtained according to this table. As it can be observed, some datasets were created by modifying or aggregating some original datasets, which were obtained at TravelBI, INE, CML open data portal and at a non-organizational site.

3.3. Indicators Construction, Treatment and Relations

Considering the indicators presented previously, each dataset was constituted by some specific measures, as follow:

- Airbnb (July 2017)

This dataset original attributes were the **room type**, **parish**, **latitude** and **longitude**. The created measures at PowerBI, using DAX scripting language, were:

- The number of Airbnb accommodations per parish, as **AIRBNB**, calculated as:

$$\text{AIRBNB} = \text{COUNT}(\text{'Airbnb_Jul_2017'}[\text{Parish}])$$

The percentage of Airbnb accommodations per parish, as **%AIRBNB**, calculated as

$$\% \text{ AIRBNB} = [\text{AIRBNB}] / \text{Parishes}[\text{ACCOMMODATIONS}] * 100$$



Figure 3 - Airbnb (July 2017) dataset attributes and created measures (view from PowerBI relationships tab).

- Nights per accommodation type (2016 and 2017)

This dataset original attributes were the **accommodation** (type), **year** and **average nights**. No further measures were created.



Figure 4 - Nights per accommodation (2016 and 2017) dataset (view from PowerBI relationships tab).

- Guests per accommodation (2016 and 2017)

This dataset original attributes were the **accommodation type, month, year, number of guests, earnings** and **average bed occupancy rate**. No measures were created at PowerBI, but instead at the resulting dataset on Excel, which were:

- The number of the month, as **MONTH NR**,
- The percentage of guests, as **%GUESTS**, calculated as

$$\%Guests = \frac{\text{Number of guests (month)}}{\text{Total number of guests (year)}}$$

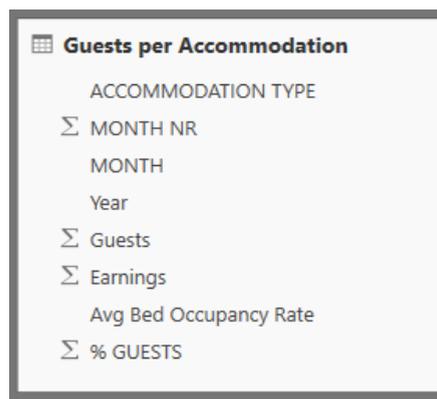


Figure 5 - Guest per accommodation (2016 and 2017) dataset attributes and created measures (view from PowerBI relationships tab).

- Nights per country of origin (2016 and 2017)

This dataset original attributes were the **average nights, year** and **country**. No further measures were created.



Figure 6 - Nights per country (2016 and 2017) dataset attributes and created measures (view from PowerBI relationships tab).

- Guests per country of origin (2016 and 2017)

This dataset original attributes were the **country, month_name, year** and **guests**. No measures were created at PowerBI, but instead at the resulting dataset on Excel, which were:

- The number of the month, as **Month**,
- The percentage of guests, as **%GUESTS**, calculated as

$$\%Guests = \frac{\text{Number of guests (month)}}{\text{Total number of guests (year)}}$$

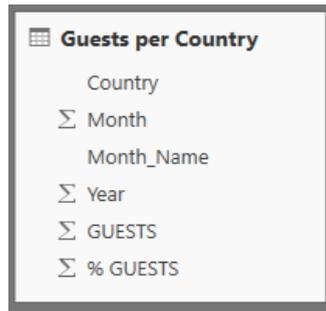


Figure 7 - Guests per country (2016 and 2017) dataset attributes and created measures (view from PowerBI relationships tab).

- Lisbon Hotels addresses (2017)

This dataset original attributes were the **hotel** and **address**. The **parish, classification** and **zip code** were manually added at the resulting dataset on Excel, which were. The created measures at PowerBI, using DAX scripting language, were:

- The number of Hotels per parish, as **HOTELS**, calculated as:

$$\text{HOTELS} = \text{COUNT}(\text{Moradas_Hoteis}[\text{Parish}])$$

- The percentage of Hotels per parish, as **%HOTELS**, calculated as

$$\% \text{ HOTELS} = (\text{Moradas_Hoteis}[\text{HOTELS}] / \text{Parishes}[\text{ACCOMMODATIONS}]) * 100$$

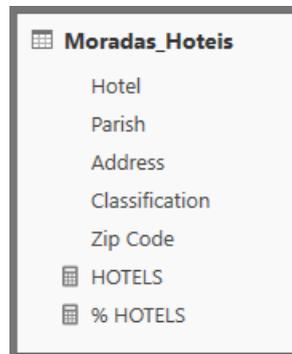


Figure 8 - Lisbon Hotels addresses (2017) dataset attributes and created measures (view from PowerBI relationships tab).

- Parishes (Up to date)

This file original attribute was Lisbon **parishes**. The **ACCOMMODATIONS** was the created measure at PowerBI using DAX scripting language as the total number of hotels (in 2017) and Airbnb (up to July 2017) accommodations per parish, being calculated as:

$$\text{ACCOMMODATIONS} = \text{'Moradas_Hoteis'}[\text{HOTELS}] + \text{'Airbnb_Jul_2017'}[\text{AIRBNB}]$$

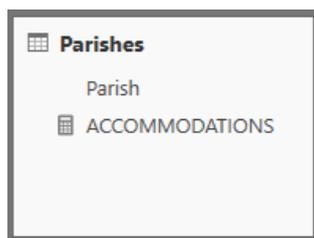


Figure 9 - Parishes (up to date) file attributes and created measures (view from PowerBI relationships tab).

Besides the indicators, there were also introduced two relations between the Airbnb - Parishes, and Parishes - Lisbon Hotels addresses datasets at the PowerBI tool. This was important to map so the first report at the PowerBI tool (Parishes) could exhibit the selected parish for both Airbnb and Hotels accommodations in the displayed maps.

- Airbnb (July 2017) – Parishes

This relation was set from many – to one, as many parishes at the **Airbnb (July 2017)** dataset corresponded to a single parish at the **Parishes** dataset.

- Parishes - Lisbon Hotels addresses (2017)

This relation was set from many to one, as one parish at the **Parishes** dataset corresponded to many parishes at the - **Lisbon Hotels addresses (2017)** dataset.

4. EMPIRICAL OUTPUT

After the data collection, treatment and the tool design at Microsoft PowerBI (Microsoft, 2019), the final Lisbon tourism management tool development was performed and is presented at this chapter. In order to test the proposed conceptual model and its resulting prototype, some laboratorial tests were performed to assess the information adequacy in the resulting dashboard and its future utilization by the stakeholders.

4.1. *Lisbon Open Data portal*

Since 2017, Lisbon has been displaying an open data portal at <http://lisboaaberta.cm-lisboa.pt/> intitled *Lisboa Aberta*, or open Lisbon, where the council follows the idea that the data produced by municipal services, companies and other public entities that have a high activity in the city should be available to anyone, contributing to a clear strategy where all the citizens can be involved and the city can increase the quality of the offered services. The site, represented in the picture below, is currently available in Portuguese only, and the plan for Lisbon open data is part of a tool of planning and coordination of the annual activities, which the city council and its partners are dedicated to

follow. The quality and consistency are kept by the entities through regular updates. The portal also contains several other fields of interest, such as economy, innovation, energy and communication, environment and sports, and allows for the user registration for regular notifications on new datasets publications.

4.2. TravelBI portal on national tourism

Lisbon is clearly a big data producer, and other portals and apps have emerged recently to achieve the definition of a smarter city. TravelBI (<http://travelbi.turismodeportugal.pt/>) is a portal that belongs to the Portuguese tourism entity *Turismo de Portugal* (<http://www.turismodeportugal.pt/>), and contains the statistics for tourism for the whole country and allows to look for lodging, market trends, consumer behaviour, international tourism and the main markets in Portugal. Although there is the option for the English display, only the Portuguese version was available at the moment of this article creation.

4.3. Proposed Tourism Monitoring Tool

For the present work, a Tourism Monitoring Tool was designed based on the proposed conceptual model, constituted by five categories:

- Parishes

At this report, displayed in the next figure, all the city parishes can be selected at the parish list or directly in any of the maps. The number of Hotels and Airbnb accommodations and its rate comparing to the total number of leisure accommodations at Lisbon are exhibited, and can be seen when making a mouse over the maps. It is possible to see that the Airbnb accommodations reached 98,5% of all the city lodging in July of 2017, which is a phenomenon and can indicate that the tourism at the city has largely increased in the past years with the increase of Airbnb lodging in the city, specially at the coastal and central parishes like *Estrela*, *Misericórdia*, *Santo António*, *Santa Maria Maior*, *São Vicente* and *Arroios*. Regarding the hotels, these spaces are heavily located near downtown, in parishes like *Avenidas Novas*, *Santo António*, *Santa Maria Maior* and *Arroios*, and only constituted 1,5% of the total city accommodations in 2017.

- Guests per Country

At this report, displayed in the figure below, the number and the rate of guests are displayed per country and also by making a mouse over the maps. It is possible to select the data per year and month, showing an interesting evolution of the tourism trend in the city, and also the country of interest.

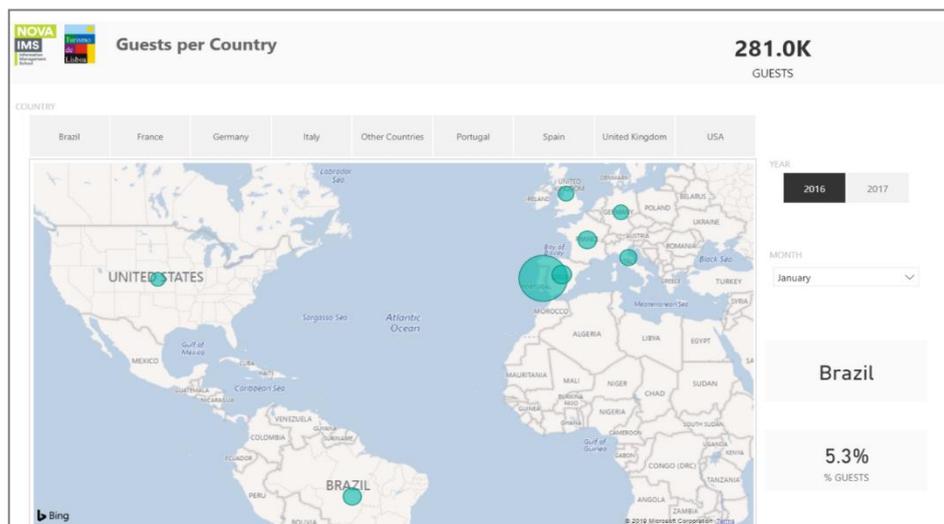


Figure 10: Guests per country final report (at PowerBI report tab).

Although the highest value of guests in Lisbon occurs for the Portuguese guests, with 32,1% for 2016 and 28,3% for 2017 of the total number of guests for these years, this trend is followed by the “Other countries” category, Spain and France for both years. It is important to remind that the countries at the other countries’ category are not disclosed in the original datasets.

- Guests per Accommodation

At this report, displayed in the next figure, the number and rate of guests per accommodation type are represented. The clustered column chart displays a comparison of both years trend, clearly stating that the number of guests increased from 2016 to 2017 in all categories, except for the “Inn/Hostel”. This increase was from 5,6 million to 6,2 million guests, summing to 11,8 million guests in Lisbon city for both years.

It is possible to state that the most chosen type of accommodation for both years is the four star hotel, followed by the three and the five stars, throughout all year. Also, the rate of guests should be ignored for both years and only considered when only one of the years is selected, as there’s no possible way of solving this value if both years are selected, which was intended to have the bar chart comparison.

- Occupancy per Accommodation

At this report, displayed in the figure below, the bed occupancy rate evolution and the yearly earnings for both years of 2016 and 2017 are shown, according to the type of accommodation. Using the mouse over the funnel visual, the accommodation with highest rate for is the three star hotel, followed by the Inn/Hostel and the four star hotel for the year of 2016, and for 2017 the trend changed with the three star hotel with the highest rate, followed by four star hotel and the one and two star

hotel. It is also possible to see that at the year of 2016 the total earnings were close to 876 million of euros, and in 2017 it increased to 1,065 million.

- Stay per Accommodation

At this report, displayed in the next figure, the average number of nights spent at Lisbon are displayed according to the type of accommodation and year. By passing the mouse over the trend per accommodation visual, the apartment hotel and the tourist apartment are the types of accommodation where the guests spend more nights for both years.

Also, the visual at the bottommost allows for the study of the evolution of nights spent at Lisbon for each country between 2016 and 2017. At the tool, by clicking the play button the circle correspondent to a selected country, or all the countries represented, will move towards a higher or a lower value of average spent nights. Denmark, Sweden and Germany are the countries with a higher average number of spent nights at Lisbon for both years.

5. DISCUSSION

As stated previously, a tool design proposal is important on a Smart Tourism destination, and changing from the traditional focus to a citizen empowerment concept, as suggested by Janssen et al. (2012) and Sandoval-Almazan et al. (2012), is the core of exploring Open Data. This was the trigger to start identifying similar tools and to select important indicators in each analysed dashboard, leading to the design of mock-ups. This approach started by observing six countries tourism dashboards – New Zealand (MBIE - Ministry of Business, 2019d, 2019b, 2019a, 2019c), Japan (Agency, 2013), United Arab Emirates (Dubai Department of Tourism and Commerce Marketing, 2018), United States of America (Office, 2016), Australia (Australia, 2017) and England (VisitEngland, 2018) – as they presented solid produced work on this field.

The proposed model allows a dynamic exploration and analysis on future developed dashboards, allowing the local government and the citizens to improve their knowledge on valuable metrics at the city. If published at a public portal or domain, those tools can provide a graphic perspective and the access to clean public data, transforming it in relevant information and even knowledge within the community. It also may improve the concept of spatial intelligence (Komninos, 2011), where the citizens can make use to their intellect and infrastructures to deal with different society challenges (Buhalis & Amaranggana, 2014).

6. CONCLUSIONS

The development of a conceptual model to monitor the tourism in Lisbon was achieved, as the proposed model allows the city direction to monitor its dynamics and development in a long term using present and historical data from the past years, whereas its citizens can benefit from the evolution of the city in a more intelligent and informative way. However, the Lisbon Open Data is still not structured nor available in a way that provides the necessary insights for these points to be fully achieved. Although the methodological approach on a tourism monitoring tool design was followed, the conceptual model covers the primary indicators in a city tourism and the prototype validates this model considering a real scenario, where the lack of open data availability and with the desired quality constitute a limitation on this topic.

The proposed model was tested through a digital dashboard prototype, using Lisbon Open Data portal datasets and creating dashboards in one category - Accommodation. To achieve more solid results in accordance to this goal, the empirical tool should:

- Include all the proposed categories, Visit, Expenditures, Travel and Activities/Satisfaction, which was not possible to achieve in the present paper due to data unavailability, unstructured data or lack of data quality. The tested category represented the one with the higher number of indicators presented in the model, being chosen for that reason.
- Be deployed in a real environment, such as in a public website like the city council or the data portal itself, where maintenance is a regular basis that keeps data updated, and all the historical data should be included in this tool. Although it was not part of the scope of this article, it is believed that the empirical tool constitutes an important resource to the city management by helping to gain insights on the city development, and constitutes a clearer perception for all the citizen when containing this type of data.

Finally, having used Lisbon's data as a sample and considering the previous constraints, the proposed model is expected to be used in other cities using their Open Data, and thus making Lisbon the first trial on this prototype.

6.1. *Research findings*

The quality of government data and the creation of a culture of open government, together with the availability of tools and instruments to use the data with, is crucial and justifies further research on this impending topic. Also, the fast technology advancement turns a smart tourism destination in a living lab, where tests and research can be conducted before truly implementing innovative technologies and changing real-life environments, fostering innovation and improvements. In a local

government, it is imperative that quality assurance, a component of BI, is tracked by the Chief Information Officer and a robust team that controls quality and assures all users, inside and outside the community, have the same insights on data. Also, maturity can have importance in measuring the ability of an organization for continuous improvement in a particular area.

Open data is a concept that displays its status as citizens use government data to develop new apps and for other purposes, which should be promoted as a trend of collaboration between both. As very few countries reveal information displayed statistically or visually, the size of the analysed countries in the present study is small, and a monitoring tool should be developed further.

6.2. Present Limitations and Future Research

This study presents several limitations that can encourage future research. Firstly, the main data gathered for the construction of the conceptual model was only originated from developed countries, and may hide other relevant indicators that were not presented and may have biased the proposal. Also, the sample may not be representative, as very few countries were investigated due to the lack of information on tourism. It is necessary to research on tourism in other countries, which may promote the usability of such indicators and test whether it applies to other cases, or if a new model should be projected. The categories proposed in the conceptual model - Visit, Expenditures, Travel and Activities/Satisfaction – should also be included in future research and prototyping.

Secondly, the access to the Open Data should be maintained and unaltered at all times. During the data research period for this work, a high number of URLs, portal names and addresses changed in a short period of time, and were not guiding the user to the most recent location where the data should've been moved to.

Thirdly, it is important to also mention that the datasets from the Lisbon Open Data Portal were replaced by the most recent ones and kept only the previous two years of data with a monthly granularity, being the oldest datasets aggregated per year and lacking the month detail that can be useful in future works that require higher precision. The reason may be that the portal was still very recent by the time of data collection, but data from all the previous years should be available at any time and not changed in a less detailed form. Further developments need to be done on a tourism monitoring tool, as it currently constitutes the first step of assessing the usefulness of the proposed and broadly used metrics and its replicability, and also relevant stakeholders should test and validate the proposed model.

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APPENDIX

Appendix A - Proposed conceptual model on the indicators to present on a smart tourism destination.

DIMENSION	INDICATORS	SOURCE	REFERENCE
<i>Expenditures</i>	Average expenditures by industry	New Zealand Tourism Portal	http://www.mbie.govt.nz/info-services/sectors-industries/tourism/documents-image-library/key-tourism-statistics.pdf
	Average expenditure growth by month/year	New Zealand Tourism Portal	http://www.mbie.govt.nz/info-services/sectors-industries/tourism/tourism-research-data/monthly-regional-tourism-estimates
	Average expenditure per foreign visitor (by year/month/total)	Japan Tourism Portal	http://www.mlit.go.jp/common/000991725.pdf
<i>Travel</i>	Monthly arrivals	Australia Tourism Portal	http://www.tourism.australia.com/en/markets-and-research/tourism-statistics/international-visitor-arrivals.html
	Monthly arrivals per country of origin	Australia Tourism Portal	http://www.tourism.australia.com/en/markets-and-research/tourism-statistics/international-visitor-arrivals.html
	Number of visitors by country of origin	Hawaii Tourism Portal	http://dbedt.hawaii.gov/economic/current_economic_conditions/tourism-dashboard/
		New Zealand Tourism Portal	http://www.mbie.govt.nz/info-services/sectors-industries/tourism/documents-image-library/key-tourism-statistics.pdf http://webrear.mbie.govt.nz/summary/new-zealan
		Australia Tourism Portal	http://www.tourism.australia.com/en/markets-and-research/tourism-statistics/international-visitor-arrivals.html
		Japan Tourism Portal	http://www.mlit.go.jp/common/000991725.pdf
		UAE Tourism Portal	https://www.visitdubai.com/en/tourism-performance-report
	Transport type	Scientific paper USA Tourism Portal	Park & Jamieson (2009) https://www.trade.gov/travelindicators/travel-performance-indicators.pdf
City number of Visitors (compared with the previous year)	Japan Tourism Portal	http://www.mlit.go.jp/common/000991725.pdf	
Number of visitors per country region	Japan Tourism Portal	http://www.mlit.go.jp/common/000991725.pdf	
Average growth per city	New Zealand Tourism Portal	http://www.mbie.govt.nz/info-services/sectors-industries/tourism/documents-image-library/key-tourism-statistics.pdf	

DIMENSION	INDICATORS	SOURCE	REFERENCE
<i>Travel</i>	Total arrivals by purpose of visit	New Zealand Tourism Portal	http://www.mbie.govt.nz/info-services/sectors-industries/tourism/documents-image-library/key-tourism-statistics.pdf
	Travel Promotion Fees Collected	USA Tourism Portal	https://www.trade.gov/travelindicators/travel-performance-indicators.pdf
	Travel preparation level	Scientific paper	Huang, Goo, Nam, & Yoo (2017)
<i>Activities/ Satisfaction</i>	Level of satisfaction with the available public transportation	Scientific paper	Ko (2005)
	Level of satisfaction with the available activities in the city/country		
	Number of visited main points of interest		
<i>Visit</i>	Length stay	Hawaii Tourism Portal	http://dbedt.hawaii.gov/economic/current_economic_conditions/tourism-dashboard/
	Length stay	New Zealand Tourism Portal	http://www.mbie.govt.nz/info-services/sectors-industries/tourism/documents-image-library/key-tourism-statistics.pdf
	Length stay by accommodation type	England Tourism Portal	https://www.visitbritain.org/latest-england-research-reports
	Satisfaction level	New Zealand Tourism Portal	http://www.mbie.govt.nz/info-services/sectors-industries/tourism/documents-image-library/key-tourism-statistics.pdf
	Willingness of visiting the country/city again	Japan Tourism Portal	http://www.mlit.go.jp/common/000991725.pdf
	City of Arrival	Japan Tourism Portal	http://www.mlit.go.jp/common/000991725.pdf
	Rate of returning visitors (not the first time visiting the city)	Hawaii Tourism Portal	http://dbedt.hawaii.gov/economic/current_economic_conditions/tourism-dashboard/
	Safety feeling level compared with other cities	Scientific paper	Gomezelj & Mihalič (2008)
<i>Accommodation</i>	Accommodation occupancy rate	Scientific paper	Gomezelj & Mihalič (2008)
	Average nights spent	New Zealand Tourism Portal	http://webrear.mbie.govt.nz/summary/new-zealan http://www.mlit.go.jp/common/000991725.pdf
		New Zealand Tourism Portal	http://www.mbie.govt.nz/info-services/sectors-industries/tourism/tourism-research-data/ivs/international-visitors-nights-interactive-map

DIMENSION	INDICATORS	SOURCE	REFERENCE
<i>Accommodation</i>	Average nights spent per visitor's country of origin	New Zealand Tourism Portal	http://webrear.mbie.govt.nz/summary/new-zealan
	Number of traveling companion partner(s)	Scientific paper	Soukiazis & Proença (2008)
	Hotel Performance	Hawaii Tourism Portal	http://dbedt.hawaii.gov/economic/current_economic_conditions/tourism-dashboard/
	Hotel Inventory by category and performance KPIs (YTD)	UAE Tourism Portal	https://www.visitdubai.com/en/tourism-performance-report
	Room Occupancy	England Tourism Portal Japan Tourism Portal	https://www.visitbritain.org/latest-england-research-reports http://www.mlit.go.jp/common/000991725.pdf
	Total sales per room	Japan Tourism Portal	http://www.mlit.go.jp/common/000991725.pdf
	Average room rate	Japan Tourism Portal	http://www.mlit.go.jp/common/000991725.pdf