S.LI.DES
Smart strategies for sustainable tourism in LIvely cultural DEStinations

2014 - 2020 Interreg V-A
Italy - Croatia CBC Programme
Priority Axis: Environment and cultural heritage
Specific objective: 3.1 - Make natural and cultural heritage a leverage for sustainable and more balanced territorial development

Deliverable 3.1.2.
Datahub prototype

Work Package:	**3 - The S.LI.DES Smart Destination Ecosystem**
Activity:	**1 - Building the Destination data hub**
Responsible Partner:	**INSTITUTE FOR TOURISM**
Partners involved:	**LP – University of Cà Foscari (IT)** **PP1 - CISET (IT)** **PP2 - Ecipa (IT)** **PP3 - SIPRO Ferrara (IT)** **PP4 - City of Bari (IT)** **PP5 - City of Venice (IT)** **PP6 –CAST-University of Bologna (IT)** **PP7 – Institute for Tourism** **PP8- Craft College- Institution for adult education Subsidiary Rijeka** **PP9- Development Agency of the City of Dubrovnik-Dura** **PP10-Sibenik Tourist board**

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INTRODUCTION

This document presents the general Smart Destination Ecosystem methodology (one of the main outputs of WP3) and the Smart Destination Datahub (the second main output), describing the Datahub Prototype (Deliverable 3.1.2.).

Section 2 provides the definition of the main objectives of the S.LI.DES project and introduces the concept of the S.LI.DES Smart Destination Ecosystem, in terms of general vision and main structure, while Section 3 identifies the Smart Destination Datahub prototype, describes its main features and functionalities, and discusses the problems encountered during the process. Section 4 goes into detail about the technical development. In Section 5, there is a brief review of the state of the art in data hub development and data import process.

1. The S.LI.DES project: main objectives

The S.LI.DES project aims at fostering cross-border cooperation among destinations oriented primarily on cultural tourism in the Programme area and the joint planning of smart strategies to support more sustainable and balanced territorial development through the promotion of tangible and intangible cultural heritage, in particular those assets shaping the identity of the destinations (local arts and crafts). The project will provide local authorities with an innovative dynamic knowledge system that will enhance their decision-making process regarding the management of most popular sites, especially by exploiting the tourism potential of“minor” cultural assets, as leverage to revitalization the urban and social environment and diversify the local economy. S.LI.DES activities will contribute to the achievement of the objectives of Pillar 4 “Sustainable Tourism” of EUSAIR Macroregional Strategy, especially where it sets out that“sustainability in tourism should be strongly linked to commercial and business perspectives”.

1.1. The S.LI.DES Smart Destination Ecosystem (WP3) objectives

The scope of the WP3 is to create a cross-national Smart Destination Ecosystem, which provides decision-makers with enhanced and dynamic knowledge on the sustainability in tourism destination, the evolution of

visitors'mobility patterns, and the potential of tangible and intangible cultural heritage to promote new visitor experiences.

Main activities are:

- Creation of a central destination data hub, which collects data on urban functions (social, economic, environmental, cultural, and tourist data) of involved destinations – Venice, Ferrara, Bari, Dubrovnik, and Sibenik - from external sources, and 3.2. and 3.3. activities;
- The development of visitors'mobility data-driven models to analyse visitors density and use of space in real-time through video-cameras and mobile sources, and consequently provide forecasting and simulations;
- The mapping of tangible and intangible cultural heritage, with a focus on living heritage (handicrafts, Cultural and Creative Industries);
- The design of a"destination dashboard" format that extracts knowledge from the data hub and dynamics models and maps to monitor competitive profile and sustainable performance.

The decision-makers of the destinations will be the main beneficiaries of the WP3 outputs. Some information will also be accessible to other stakeholders, according to the rules defined by decision-makers. The development of WP3 activities will require the co-operation of local stakeholders: they will be directly involved in these activities and will assess the main WP outputs.

2. The S.LI.DES Datahub Goals, Requirements, and Challenges

2.1. Main goals and the general vision

Smart Destination Datahub is a tool to store multidimensional information about cultural destinations in the Adriatic area and their sustainable approach.

It is a first concrete step towards the creation of a smart territorial“control room” that will actively support the involved destinations in measuring their tourism performance in real-time; assessing and monitoring social, environmental, and economic impacts of tourism activities; sharing information and practices/experiences with local stakeholders and with other partner cities (see Figure 1).

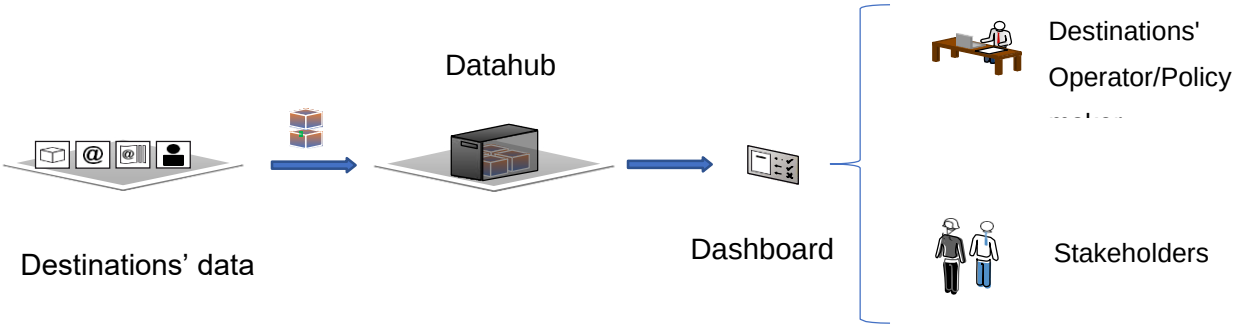

Figure 1. Illustration of a S.LI.DES Datahub general vision

2.2. Project's datahub requirements

At the core, a datahub needs to be a single access point that will have the following features:

- High scalability,
- Dynamics,
- Flexibility,
- Geospatial support,
- Easy to query,
- Must integrate with a web dashboard,
- User ACL (at least on Dashboard).

To ensure the above-mentioned features, data collected by each partner need to be delivered with API (Application Protocol Interface), in .cvs, or .xsls format. Static data were delivered mostly by spreadsheets.

Dynamic data were delivered by API or data scraping. Before data storage in Mongo DB[1] processes such as harmonization and re-indexing were performed (more details about processes are provided in the next section).

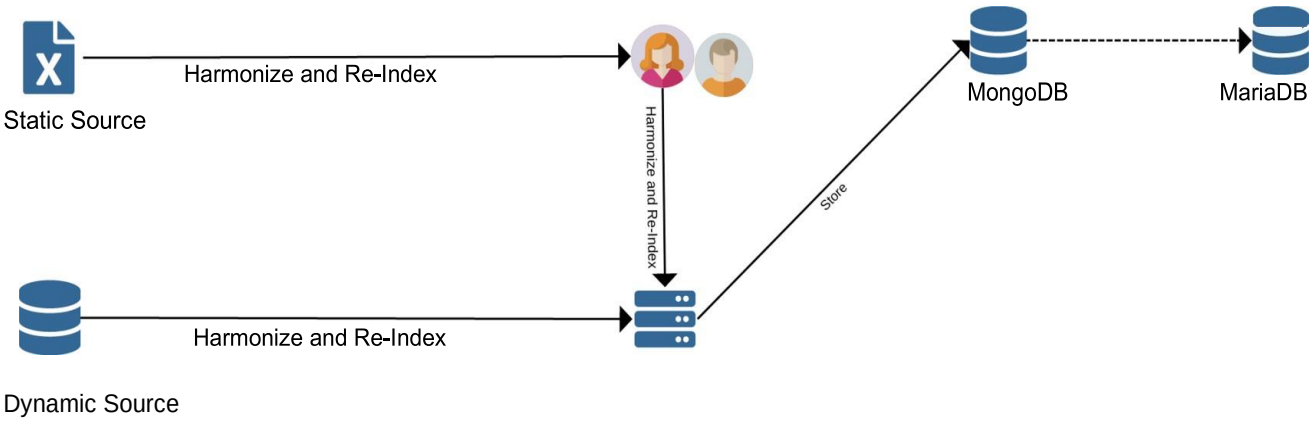

Figure 2. Process of data collection, data pre-processing, and data storage

2.3. Challenges

The commitment to develop the Datahub prototype faced several challenges that arose in each city, concerning both territorial and external sources. Namely:

- Inhomogeneity of data
- Data import from social media channels
- Import of mobility data
- Import of tangible and intangible heritage data

More details on each of the above-mentioned challenges are provided in the following sections.

[1] MongoBD is a document-oriented NoSQL database used for high volume data storage

2.3.1. Inhomogeneity of data

Receiving data from cities, due to its complexity, was an activity that was taking longer than expected (for more details see Final report on Deliverable 3.1.1. The S.LI.DES Datahub framework).

Data arriving from cities were not homogenous, meaning that cities used different templates, different variable names, same names with several meanings, etc. The process of harmonizing data was time-consuming, but it was necessary in order to make data homogeneous, comparable, and linkable to other data so that they can be displayed on the S.LI.DES Dashboard (see Figure 3).

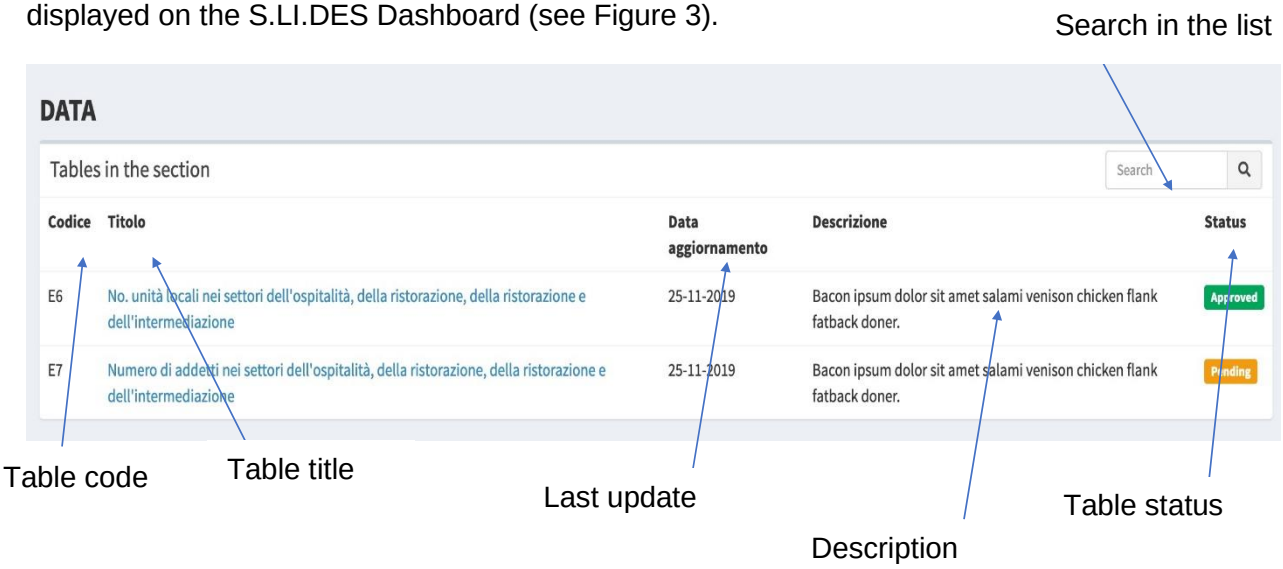

Figure 3. The layout of data upload from S.LI.DES datahub to S.LI.DES dashboard

2.3.2. Data import from social media channels

Research on how to use social media channels to obtain useful sets of mobility-related data was performed. The social media channels in focus were Facebook, Instagram, Flickr, Panoramio, Foursquare, Google Trend, and Tripadvisor. For each social media, legal control on privacy and other types of legal restrictions was carried out,

as well as a technical assessment on the possibility to use API for the import of data in the datahub. The research concluded that the data import is technically possible, but some legal troubles arose.

In particular:

- In the case of Facebook, Panoramio, Foursquare, and Instagram was not possible to use data because of the restrictions related to user licenses;
- In the case of Flickr, emerged the possibility to use data from photos. The places where the photos were taken were extracted in order to reconstruct the main tourist routes. Moreover, it was possible to create (from a published photo) a geolocation per year and month. The only issue related to Flickr is that the number of posts in less touristic cities is significantly minor than in more famous cities. Moreover, Flickr is a niche social media and is not common as Instagram;
- For Google Trend, the official API is not accessible, but the test on API has been done by third parties. Results showed that data are not as reliable as the official ones and they are not going to be used in the S.LI.DES datahub. Instead, the manual import of the historical Google Trend data (from 2004 to 2019) was carried out.

Regarding Tripadvisor, it was necessary to purchase a large set of data that will identify the major points of interest in the cities. The need for a non-disclosure agreement (NDA) emerged to ensure the usability and the vision of Tripadvisor data. The official contract was stipulated between Tripadvisor and Lead Partner for a period of one year, untill March 2, 2021. Purchased TripAdvisor data consist of a list of Points of Interest in the five cities and their reviews by national and international tourists.

A series of indicators and possible correlations were created in order to test if it is possible to obtain a time series by review related dates (see Table 1). For example, the correlation between the research of the word “Venice” on Google trends and the tourism arrival in Venice in the same period was examined[2].

[2] These types of analysis are possible only on the data uploaded in the datahub.

Internalisation of tourism index (no.international arrivals/total arrivals)		
Cod.	**Data label**	**Notes**
TripAdvisor	No.of reviews related to the top POIs/total reviews (% share)	To check if it is possible to select the list of POIs indicated by domestic visitors (by language or user location) and to build a time-series (by review date)
Market differentiation index: International market (no. of international arrivals in the first 3-5 countries/total international arrivals)		
TripAdvisor	No.of reviews related to the top 5 POIs/total reviews (% share)	To check if it is possible to select the list of POIs indicated by domestic visitors (by language or user location) and to build a time-series (by review date)
Seasonality index (no. of international arrivals in high season/total international arrivals)		
TripAdvisor	No.of reviews related to the top 5 POIs/total reviews (% share)	To check if it is possible to select the list of POIs indicated by domestic visitors (by language or user location) and to build a time-series (by review date)
Domestic tourism arrivals/Domestic tourism nights		
TripAdvisor	No. of total cultural POIs	To check if it is possible to select the list of POIs indicated by domestic visitors (by language or user location) and to build a time series (by the date of related reviews)
TripAdvisor	No. of total cultural POIs by category	To check if it is possible to select the list of POIs indicated by domestic visitors (by language or user location) and to build a time series (by the date of related reviews)

TripAdvisor	No. of total reviews related to POIs	To check if it is possible to select the list of POIs indicated by domestic visitors (by language or user location) and to build a time series (by the date of related reviews)
TripAdvisor	No. of total reviews related to POIs, by category	To check if it is possible to select the list of POIs indicated by domestic visitors (by language or user location) and to build a time series (by the date of related reviews)
TripAdvisor	No. of reviews related to the top 3-5 POIs	To check if it is possible to select the list of POIs indicated by domestic visitors (by language or user location) and to build a time series (by the date of related reviews)
TripAdvisor	No. of total reviews related to POIs showing highest growth of reviews in the last 8 years (2010-2018)	To check if it is possible to select the list of POIs indicated by domestic visitors (by language or user location) and to build a time series (by the date of related reviews)
TripAdvisor	No. of total reviews related to POIs by category, showing highest growth of reviews in the last 8 years (2010-2018)	To check if it is possible to select the list of POIs indicated by domestic visitors (by language or user location) and to build a time series (by the date of related reviews)
International tourism arrivals/International tourism nights		
TripAdvisor	No. of total cultural POIs	To check if it is possible to select the list of POIs indicated by international visitors (by language or user location) and to build a time series (by the date of related reviews)
TripAdvisor	No. of total cultural POIs by category	To check if it is possible to select the list of POIs indicated by international visitors (by language or user location) and to build a time series (by the date of related reviews)
TripAdvisor	No. of total reviews related to POIs	To check if it is possible to select the list of POIs indicated by international visitors (by language or user location) and to build a time series (by the date of related reviews)

TripAdvisor	No. of total reviews related to POIs, by category	To check if it is possible to select the list of POIs indicated by international visitors (by language or user location) and to build a time series (by the date of related reviews)
TripAdvisor	No. of reviews related to the top 3-5 POIs	To check if it is possible to select the list of POIs indicated by international visitors (by language or user location) and to build a time series (by the date of related reviews)
TripAdvisor	No. of total reviews related to POIs showing highest growth of reviews in the last 8 years (2010-2018)	To check if it is possible to select the list of POIs indicated by international visitors (by language or user location) and to build a time series (by the date of related reviews)
TripAdvisor	No. of total reviews related to POIs by category, showing highest growth of reviews in the last 8 years (2010-2018)	To check if it is possible to select the list of POIs indicated by international visitors (by language or user location) and to build a time series (by the date of related reviews)
Total tourism arrivals/Total tourism nights		
TripAdvisor	No. of total cultural POIs	To check if it is possible to build a time series (by the date of related reviews)
TripAdvisor	No. of total cultural POIs by category	To check if it is possible to build a time series (by the date of related reviews)
TripAdvisor	No. of total reviews related to POIs	To check if it is possible to build a time series (by the date of related reviews)
TripAdvisor	No. of total reviews related to POIs, by category	To check if it is possible to build a time series (by the date of related reviews)
TripAdvisor	No. of reviews related to the top 3-5 POIs	To check if it is possible to build a time series (by the date of related reviews)

TripAdvisor	No. of total reviews related to POIs showing highest growth of reviews in the last 8 years (2010-2018)	To check if it is possible to build a time series (by the date of related reviews)
TripAdvisor	No. of total reviews related to POIs by category, showing highest growth of reviews in the last 8 years (2010-2018)	To check if it is possible to build a time series (by the date of related reviews)

Table 1. Examples of correlation using TripAdvisor data

2.3.3. Import of mobility data

Collection of the mobility data was performed using cameras and sensors installed in each of the partner cities. In Dubrovnik, six sensors were installed to expand the wireless network for monitoring tourist flows in the historical center. In Šibenik, mobility data was collected using four video cameras. Venice is already equipped with enough monitoring devices. For the purpose of mobility data collection, only software designed for this particular task was provided. In Ferrara, there are currently six sensors installed. But, because of the great interest of local stakeholders, the monitoring area will be expanded with more devices. The city of Bari has decided, as well as Venice, to take advantage from the already installed video cameras between the station and the historical centre. They will only purchase software to collect data from cameras.

Firstly, the dataflow from sensors and cameras was managed. There were few technical issues with the signal that were successfully resolved. Data were sent in geojson format to the datahub for visualization. This activity needed a testing phase to be sure the data flow works. The system allows real-time data acquisition that is integrated into visitors' mobility models of the cities that simulate and forecast the tourist mobility in the historical centers.

2.2.4. Import of tangible and intangible heritage data

WP 3 foresees also the creation of a tangible and intangible heritage database (WP3.3, D 3.3.1), to be included in the dashboard. The first step was the identification and mapping of the tangible and intangible cultural heritage, handicraft, and CCIs in five cities. By application form, some categories were already identified. The main task was the creation of a common methodology in order to catalogize all heritage, crafts, and CCIs in the project area. It was decided to mainly consider small and medium-sized artisans that have a tangible or intangible cultural heritage production. Also, the research on the existing best practices was carried out. Furthermore, Venice, Ferrara, Bari, Sibenik and Dubrovnik consulted several secondary sources:

- official registers provided by official institutions such as the local Chamber Commerce, who has quite updated and reliable lists and related information;
- lists of craftsmen, artisans, etc. associated to local trade organisations and/or to associations of local products in the destination;
- craftsmen, artisans, etc. mentioned in press releases, relevant trade magazines etc.;
- lists of craft businesses and artisans involved in main events and initiatives organised in recent years in the destination by public and/or private entities for promoting handcrafts and CCIs.

In addition, the mapping activity was refined by consulting local stakeholders such as experts of the city, opinion leaders, handcrafts and CCIs and their trade associations, tourist operators, etc.

Considering the project datahub, the main task was to import data. For this purpose, an excel file was created with all usable criteria to classify craft activities according to product and typologies to define their number, size, location, and concentration/density (“critical mass”) as well as their evolution over time. To avoid problems with inhomogeneity of data faced in WP3.1., a Google Module was created. The module was sent to each of the five destinations and it was disseminated among their contacts. A module was exportable in CSV and the obtained data were homogenous.

3. The S.LI.DES Datahub Prototype: Development Process

3.1. Defining the structure of a database

In the old days, data was consistently structured, relatively small scale, and could easily fit into the relational model. However, billions of people on the Internet and using smartphones, as well as billions of sensors and IoT devices, created new data problems. Usually, there is too much data to fit in one database or on one server. For these reasons, S.LI.DES datahub will be NoSQL, meaning non-relational, schema-less, open-source, cluster-friendly, and suited for 21st-century data and web. One of the main reasons to choose a NoSQL database are:

- Large scale data (data-intensive applications),
- Distributed,
- Massively parallel,
- Run on commodity servers,
- Easier development (faster time to market, no rigid relational database agents),
- Web services (new distributed architecture).

For the creation of a NoSQL database, it was used MongoDB (which is short for huMONGOus document-oriented DataBase). It uses "rich" JSON internally stored as BSON format (Binary JSON). It is a data platform with a suite of tools such as Visualisation Charts, BI Connectors, GUI- Compass. Some of the MongoDB features are:

- Ad-hoc queries,
- A rich and expressive query language,
- Aggregations,
- Indexing,
- Replication,

- Load balancing.

After identifying the indicators, set-up and implementation of the NoSQL MongoDB database were performed and the import of data from 5 destinations began.

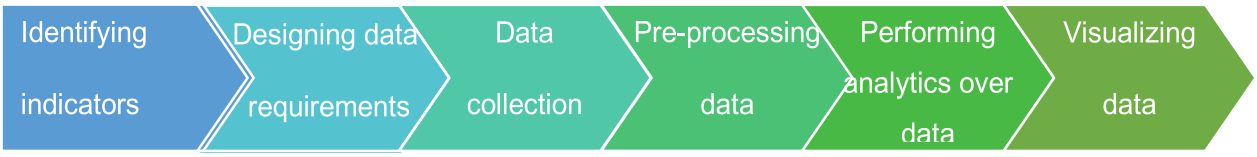

Figure 4. The S.LI.DES datahub development process

3.2. Test environment creation

A test environment is a server that allows running the test cases previously defined. The test environment includes more than just setting up a server to run tests on. It also involves hardware and network configuration. In other words, a test environment enables to create identical environments every time when testing a product. It is the most important tool that provides confidence in the testing results. To ensure confidence in the S.LI.DES datahub results, following servers, were used:

- Local server [Linux ubuntu 16.04]
- Remote server [Debian 9.13]

Also, constant server management (updating, monitoring) was performed.

3.3. FTP environment creation

FTP (File Transfer Protocol) is a widely used network protocol for transferring files between computers over a TCP/IP-based network, such as the Internet. FTP allows people and applications to exchange and share data within their offices and across the Internet. FTP is one of the first technologies developed to solve this common need, and it remained, with several generations of enhancements, the second most popular protocol used today

(after HTTP or the "World Wide Web")[3]. For the purpose of the S.LI.DES. datahub, an FTP environment for transferring files was also created.

3.4. Database structure implementation

By definition, a data structure is a data organization, management, and storage format that enables efficient access and modification. More precisely, a data structure is a collection of data values, the relationships among them, and the functions or operations that can be applied to the data. The implementation of a data structure usually requires writing a set of procedures that create and manipulate instances of that structure. The efficiency of a data structure cannot be analyzed separately from those operations. This observation motivates the theoretical concept of an abstract data type, a data structure that is defined indirectly by the operations that may be performed on it, and the mathematical properties of those operations (including their space and time cost) (Seymour (2014), *Data structures*).

For the S.LI.DES datahub, the database structure implementation was performed using MongoDB and MySQL. But, since in the case of S.LI.DES datahub there is no exact data's definitions structure, databases were constantly reviewed.

3.5. Data import scripts/data cleaning/data analysis

Data received from cities were mostly in .xlsx files and had no real standardization, so every file needed its own importer, cleaning, and analysis routine. Also, data import from Tripadvisor's API requested consistency check and analysis. For this purpose, the development and installation of cron jobs were required. A cron job is a time-based job scheduler in Unix-like computer operating systems. Users that set up and maintain software environments use cron to schedule jobs (commands or shell scripts) to run periodically at fixed times, dates, or intervals. It typically automates system maintenance or administration, though its general-purpose nature makes

[3] https://www.serv-u.com/what-is-file-transfer-protocol

it useful for things like downloading files from the Internet and downloading emails at regular intervals. Besides, a file quality analysis for interval and idiosyncratic issues was performed.

Examples of data collected and uploaded on the datahub:

DESTINATION: VENICE

Filename	Title
A9.xls	Total Arrivals
A10.xls	Total overnight stays
A11.xls	International arrivals
A12.xls	INTERNATIONAL OVERNIGHTS
A13.xls	NATIONAL ARRIVALS
A14.xls	NATIONAL STAYS
A16.xls	ARRIVALS OF INTERNATIONAL TOURISTS BY COUNTRY
A17.xls	National arrivals by region
A18.xls	INTERNATIONAL ARRIVALS BY MONTH
A19.xls	NATIONAL ARRIVALS MONTH
A21.xls	Cruise passengers
A23.xls	STRUTTUREALBERGHIERE
A24.xls	BEDS, HOTEL STRUCTURES
A25.xls	NON-HOTEL STRUCTURES

A26.XLS	BEDS, NON-HOTEL STRUCTURES
VCE_2019.xls	Card Arrivals / Departures
e1.xls	Income taxes
e2.xls	No. local units
e3.xls	No. Total employees
e5.xls	No. Employees of local units ICT SERVICES
e7.xls	No. Employees of local tourism units (55 + 56 + 791)
e8.xls	No. CULTURE employees (90 + 91)
e9.xls	Employment and unemployment rate. Municipality of Venice -Year 2015: 2018
e10.xls	Active businesses in the municipality of Venice. Years 2010: 2018
e11.xls	New businesses registered in the municipality of Venice. Years 2010: 2018
en1.xls	Square meters of green areas
en3.xls	Total production of municipal waste (tons collected / year)
Source	**Description**
GTrends	**Keyword**
	artigianatov enezia-italia-2004-2019
	artigianato venezia-m-2004-2019
	venezia-italia-tutto-2004-2019
	venezia-mondo-tutto-2004-2019
	venezia-italia-viaggi-2004-2019

	venezia-mondo-viaggi-2004-2019
Flickr	Data imported from API
	Flickr Routes
	Flickr Markers
	Flickr Postes
Survey2018	Venezia Municipality Survey

DESTINATION: FERRARA

Filename	Title
T1.xls	total tourism arrivals in the city per year
t2.xls	Total tourism nights in the city
t3.xls	Total international tourism arrivals in the city
t4.xls	Total international tourism nights in the city
t5.xls	Total domestic tourism arrivals in the city
t6.XLS	Total domestic tourism nights in the city
t11.XLS	International arrivals by month
t12.xls	International nights by month
t13.xls	Domestic arrivals by month
t14.xls	Domestic nights by month
E1.xls	Redditi Irpef
E2.xls	No. local units
E3.xls	No. of employees Total
E4.xls	No. of employees of local units HIGH-KNOWLEDGE SERVICES
E5.xls	No. of employees of local units ICT SERVICES
E6.xls	No. local units TOURISM
E7.xls	No. employees in local tourism units
E8.xls	No. of CULTURE employees

Source	Description
GTrends	**Keyword**
	Ferrara ItaliaTutto
	Ferrara Italia Viaggi
	Ferrara Mondo Tutto
	Ferrara Mondo Viaggi
Flickr	Data imported from API
	Flickr Routes
	Flickr Markers
	Flickr Postes

DESTINATION: BARI

Filename	Title
T1.xls	Total Arrivals
T2.xls	Total Nights
T3.xls	International Arrivals
T4.xls	International Nights
T5.xls	Domestic Arrivals
T6.xls	Domestic Nights
T7.xls	International Arrivals By Country of Origin
T8.xls	International Nights By Country of Origin
T9.xls	Domestic Arrivals by region
T10.xls	Domestic Nights by region
T11.xls	International arrivals by month
T12.xls	International nights by month
T13.xls	Domestic arrivals by month
T14.xls	Domestic nights by month
T16.xls	HotelEstablishments
T17.xls	Hotel bed places
T18.xls	Non-Hotel Establishments
T19.xls	Non-Hotel bed places

E1.xls	Income taxes /Irpef
E2.xls	No. local units
E3.xls	No. of employees Total
E4.xls	No. of employees of local units HIGH-KNOWLEDGE SERVICES
E5.xls	No. of employees of local units ICT SERVICES
E6.xls	No. local units TOURISM
E7.xls	No. employees in local tourism units
E8.xls	No. of CULTURE employees

DESTINATION: DUBROVNIK

Filename	Title
T1.xls	Total arrivals
T2.xls	Total nights
T3.xls	International arrivals
T4.xls	International nights
T5.xls	Domestic arrivals
T6.xls	Domestic nights
T7.xls	International Arrivals By Country of Origin
T8.xls	International arrivals by month
T9.xls	Domestic arrivals by month
T10.xls	International nights by month
T11.xls	Domestic nights by month

DESTINATION: SIBENIK

Filename	Title
T1.xls	Total Arrivals
T2.xls	Total Nights
T3.xls	International arrivals
T4.xls	International nights
T5.xls	Domestic arrivals
T6.xls	Domestic nights
T7.xls	International arrivals by country
T8.xls	International arrivals by month
T9.xls	Domestic arrivals by month
T10.xls	International nights by month
T11.xls	National overnight stays per month
T12.xls	Cruise passengers
T13.xls	Ferry passengers
T14.xls	Cruise calls
T17.xls	Ferries calls

3.6. Access to datahub

Every user has a username and password which are stored on a relational database. Furthermore, every user has at least one role (not logged in- Anonymous role; logged in: LoggedInUser role). There is no limit on the number of users or hierarchy. Basic hierarchy: LoggedInUser > Anonymous. Typical hierarchy: Admin - > Operator ->User ->Anonymous.

Public routes are on the Anonymous security level. Every public route request goes through a security process. The role of the user asking for content must be at least at the same security level given to the route[4]. Operators can see everything that users can, but not what only Admin can.

Logged in contents: since the security process goes against the routes, it is possible to easily define a minimum role for an entire dashboard subsection.

- { path: ^/admin, roles: Admin }
- { path: ^/venice, roles: OperatorVenice }
- { path: ^/sibenik, roles: OperatorSibenik }
- { path: ^/notpublic, roles: User }

In the above example, Operator Venice and Sibenik are siblings. This means that both can see the /notpublic contents but Venice can't see all the path that starts with /sibenik and Sibenik can't see all the path that starts with /venice.

All of the above-mentioned processes (3.1. - 3.6.) can be illustrated with the following schema:

[4] Note: the route, not the content itself.

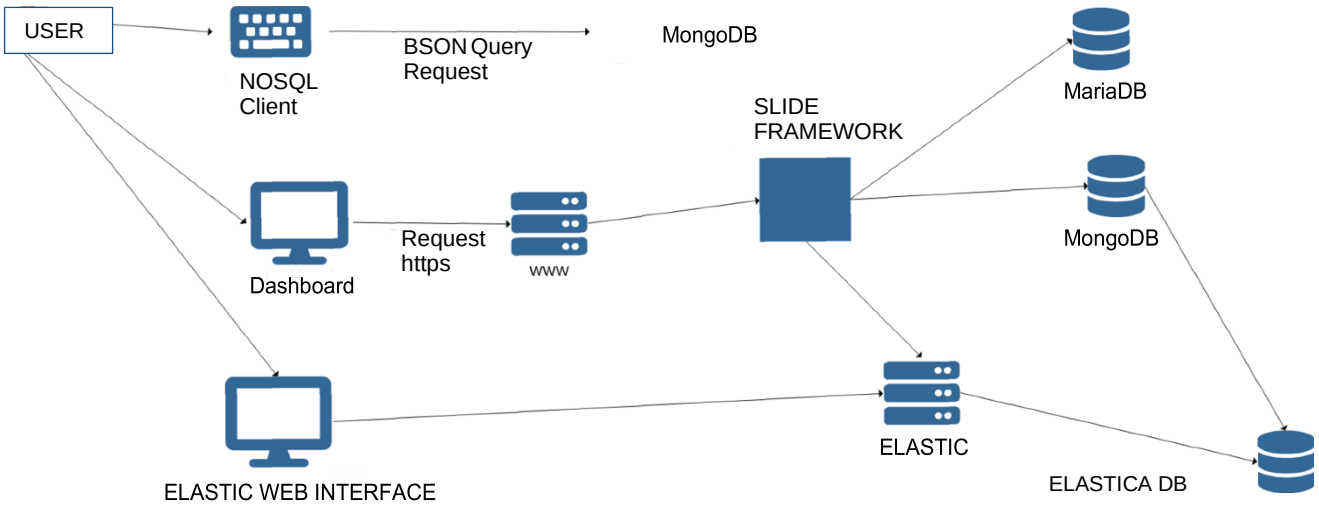

Figure 4. Datahub processes[5]

[5] Elastic is a full-text search engine. It requires a full re-index and a huge amount of data to work properly.