Usage of linked open data for the measurement of mining tourism POIs' impact on the competitiveness of a destination: Research notes part 1

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The manuscript deals with the issue of mining tourism's impact on a destination's competitiveness by raising awareness about the linkage between relevant mining POIs datasets and the destination's efficiency. The aim is to propose a possible concept of linking the relevant partial content of chosen applications into one comprehensive application that, with the definition of appropriate evaluation indicators, could push the monitoring and evaluation process of mining heritage POIs to the next level. The manuscrip highlight five web-based applications available for linking tourism and mining POIs with possible value and impact indicators, which are used for creating structured information and knowledge about the position of single POIs and clustered POIs within the value chain of a destination's offer. The manuscript analyses the following applications: i) tourism app at montanistika.eu, ii) the Smart POI dataset and iii) the Ecosystem services evaluations app, both created on the principles of open geospatial data and APIs within the project SDI4apps, iv) the DBIS's questionnaire module and v) the Foursquare API module for developers. The desired concept considers three levels for monitoring according to the character of the potential end users. The conducted analysis resulted in a new concept of application for mining POIs evaluation participated by tourism stakeholders.

Key words: *POI, mining tourism, points of interest, linked data, destination management and data evaluation.*

1 Introduction

The 20th century has brought the end of many traditional mining sites due to the evolution of the highly competitive global mineral market, the evolution of extractive technologies and the higher perception of environmental issues. In the last decades, there have been many successful stories of transformation of closed mining sites and related industrial heritage into partial tourism products (M. Conesa, 2016). Examples like the Wieliczka salt mines (located in Poland), Almadén Mining Park (located in Spain), Bartolomej and Glanzerberg tunnels in the Banská Štiavnica district (located in Slovakia), Major Mining Sites of Wallonia (located in Belgium) and others show that mining tourism is capable of positive impact on a destination's economy.

On the other hand, there are huge amounts of industrial objects related to mining heritage still waiting for their glory's resurrection. Agaliotou (2015) reports that the resurrection of industrial spaces is linked with the development of culture in many cases. For example, old industrial buildings are transformed into museums, exhibition halls and all kinds of other multipurpose facilities (Agaliotou, 2015). It is important to mention that these processes depend primarily on the contribution of public and private resources.

What about objects of mining heritage like centuries old abandoned tunnels, mining car cables, flooded surface mining sites, mining clockers, rails and other objects that may have the potential to become or already have the status of a place with high interest of visiting? Are there technologies, indicator systems to determine whether they are or have the potential to become an asset to the destination? Are there artificial neural networks for advanced value estimations of immovable properties (Yalpir et al., 2014)?

Indicator systems cumulate simple information into a framework of structured knowledge about the examined phenomena. One of their advantages is that they are capable of organising information into structures that can identify relationships between different variables (Torres-Delgado and Palomeque, 2014). The treatment of information through GIS comes together with several problems (Blistan and Blistanova, 2011). The aim of the article is to examine whether it is possible to evaluate mining heritage objects' marketing potential as POIs by existing web geographic information systems (GIS) based applications powered by web services, evaluation methods and indicator systems based on open and linked data.

For the purposes of the research reported in the manuscript, the objects and places of interest of mining heritage and tourism will be referred as POIs. A POI, or point of interest, is a specific point location affiliated to a place that someone might find useful or interesting to locate or visit (Wikipedia, 2016). From the perspective of tourism POI data properties is mainly used to provide a geolocation based service to tourists, consisting of GPS coordinates and POIs of tourism usually consisting of useful information for tourist like capacity (e. g.

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accommodation facilities), opening hours (e. g. museums, restaurants) and other (Joshi et al., 2011). From the perspective of destination management, POIs may represent partial components of the destination's offer. Categorised POI databases used in GIS-based web services and related apps are one of the basic gateways to evaluate the level of interest of tourists. According to McKenzie et al. (2015), POIs are inextricably linked to modern (mobile) search, recommender systems, location-based social networks, navigation and tourism systems, predictive geo-analytics such and so forth. Regarding their computational representation, POIs can be described and categorised in different ways. Typical approaches are either based on features or functionality and can be described and categorised by aggregating data about how people behave towards e.g. intensity of visits, type of response, etc. (McKenzie et al., 2015).

2 Material and methods

Within our research, we chose five different GIS-based apps, each with own POI datasets and scalable vector graphic layers. The approaches and functions of these apps were compared and analysed, with the aim to examine whether if it is possible to combine their data and integrate with measurable indicators.

Application 1: Multimedia travel guide of mining tourism

The current state in Slovakia regarding open access to geospatial datasets for mining heritage shows that there have already been put efforts to develop a GIS-based application for potential mining tourism target groups. The web-based application named "Montanistika – Multimediálny sprievodca banským turizmom" (Multimedia travel guide of mining tourism) responsive to smartphones currently contains more than 250 mining POIs, most of them situated in the Banská Štiavnica district (over 150 POIs). The application also contains POIs of tourism services. Each of the POI contains geographic coordinates (WGS), some basic information and a representative image (montanistika.eu, 2011).

The app runs on an expanded Google Maps API module. From the perspective of functionality and user friendliness, the app corresponds to its purpose and date of origin (the year 2011), and the map server's database reuse is restricted to „manual collection" or authorization by the server's admin. On the other hand, the geospatial dataset of mining POIs is uniquely extensive, and the web domain is connected to Google Analytics.

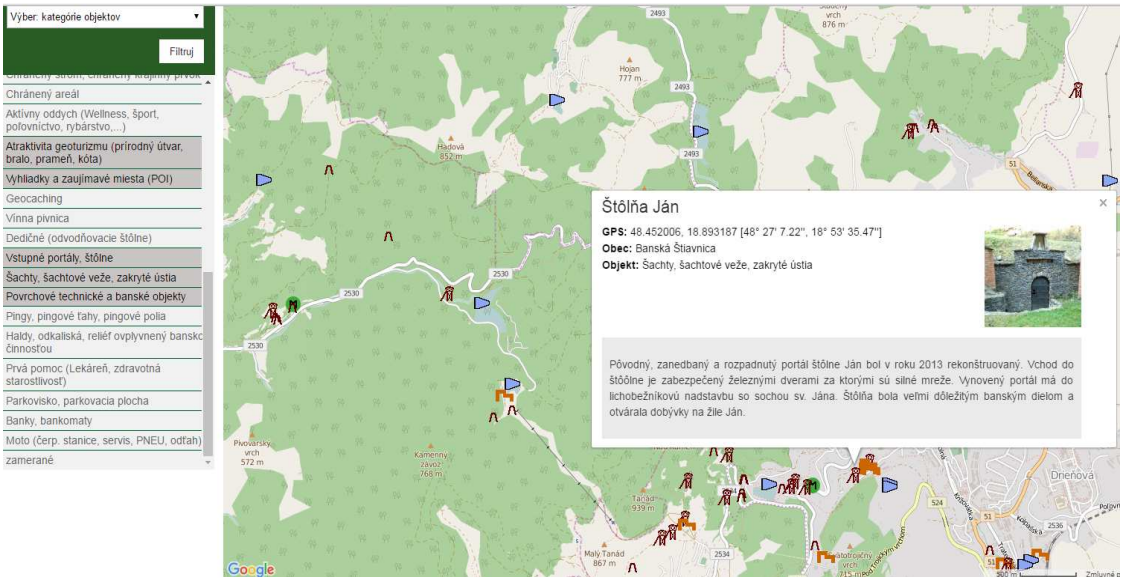

Fig. 1. The application's web graphic user interface (source: www.montanistika.eu, 2011).

Application 2: Pilot Open Smart Tourist Data of the SDI4apps project

The GIS-based pilot app is one of the outcomes of the project SDI4apps, which has collected over 23 000 000 tourism POIs so far from all around the world in an open dataset based on linked data principles via reuse of multiple standardised formats and vocabularies. According to the developers Čerba et al. (2016), the „*SPOI data set includes a harmonised combination of selected data from project OpenStreetMap and project GeoNames, experimental geo-ontologies developed at the University of West Bohemia and local data"* (Čerba et al., 2016). The app itself collects, integrates and presents a wide range of input data sets related to tourism infrastructure and offer. As Čerba emphasised, „*the data is provided in the Resource Descriptor Framework format with use of several standards and respected features (Basic Geo Vocabulary, Simple Features Topological Relations or*

classification used in Waze or OpenStreetMap layers). The visualisation and querying are provided by Virtuoso server and HS Layers" (SDI 4 Apps, 2016).

Developers can use the partial API modules of the application and also extend the dataset by other relevant external input data. In this way, a developer can get easily new thematically categorised layers of POIs into one application. Although the multilingual open access harmonised date set is a huge advantage, it should be mentioned that the multilingual Pilot publishes only limited categorised POIs properties, consisting of GPS coordinates, basic thematic categories (lodging) and in most cases also subcategories (for example Hostel). From the perspective of the Pilot's technological solution, it falls into the category of Smart tourism solutions, because it includes all four vital aspects: cloud computing, Internet of Things, mobile communication and artificial intelligence technology (Wang et al., 2016).

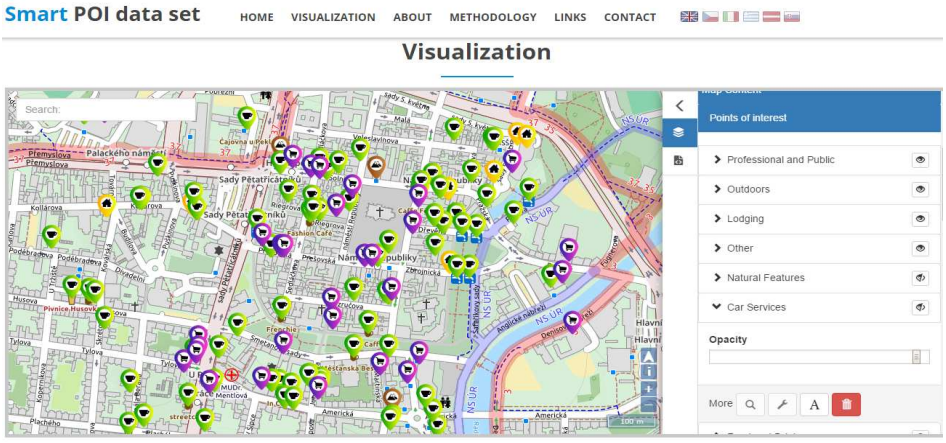

Fig. 2. User interface of the Smart POI dataset's Pilot (source: www.sdi4apps.eu/spoi/,2016).

Application 3: Pilot Ecosystem Services (ESS) Evaluation

The pilot application developed by the Slovak Environment Agency and partners within the project SDI4apps is a cloud-based multi data layer Web GIS aiming at the evaluation of direct and indirect contributions of ecosystems to the humankind. (SDI 4 Apps, 2016). The system is developed using open APIs for both services and client-side components widely used by a geospatial community. Geospatial web services based on standards developed by Open Geospatial Consortium (e.g. Web Map (WMS) or Coverage Service (WCS) (Cetl et al., 2016)) are used to integrate heterogeneous sources in an integrated system based on Spatial Data Infrastructure principles (Bordogna et al., 2016). As Tuchyna et al. (2015) emphasised, the pilot's first outcomes were aimed at the identification, calculation and visualization of six interactive layers expressing the volume of benefits provided by the chosen ecosystem service's impact: *wood (paper pulp) production; number of livestock per hectare of pasture; carbon sequestration based on land types; landscape quality from tourism perspective; biodiversity; overall assessment of the ESS (Tuchyna, et al., 2016).* For the purpose of our research, the layer indicating the *landscape quality from tourism perspective*s should be emphasised. The volume layers take into account as variables evaluated protected areas, their access restrictions and concentration of significant tourism POIs. The highest rated areas are visualised via dense heat zones. Since the application is designed for linking open data and its interface is user-friendly (the user may easily filter the dataset categories and also the density of visualised volume), it has a great potential for visualising all kinds of tourism POI's and their impact volume as well as for a destination's efficiency indicator.

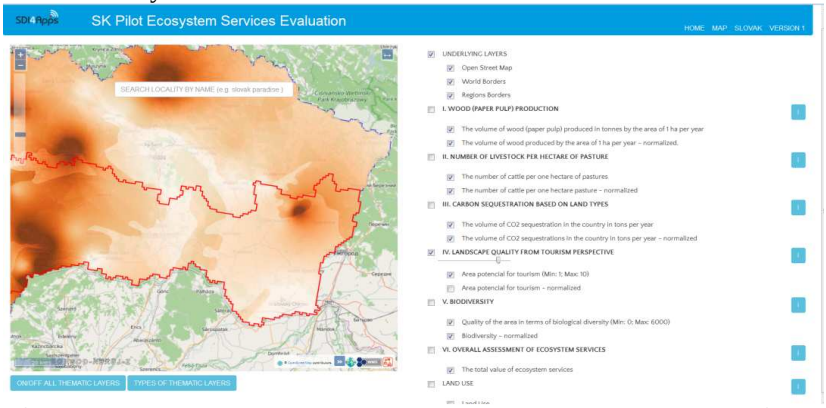

Fig. 3. User interface of the Ecosystem Services Evaluation web application visualising the landscape quality from the perspective of tourism via heat map (source: http://skpilot-viewer.virt.ics.muni.cz/ol3/eng/map-dev.html#).

Application 4: The Foursquare API for developers

Foursquare is a geo-tagging or location-based social network with about 45 million users (mostly smartphone users) all around the world. The user check-ins via the application when located at the place of interest and has the choice to evaluate it by raking or even with a short review. Other users within his connections (usually friends or followers) may see his movement and his actions. All of the POI's check-in, rankings and reviews are publicly available for all the other network's users (Golbeck, 2015). If a destination has a reasonable dataset of POIs uploaded on the network and the destination has a critical mass of active users, it is one the easiest and cheapest way to monitor the POIs' efficiency from the perspective of visitor flow and evaluation.

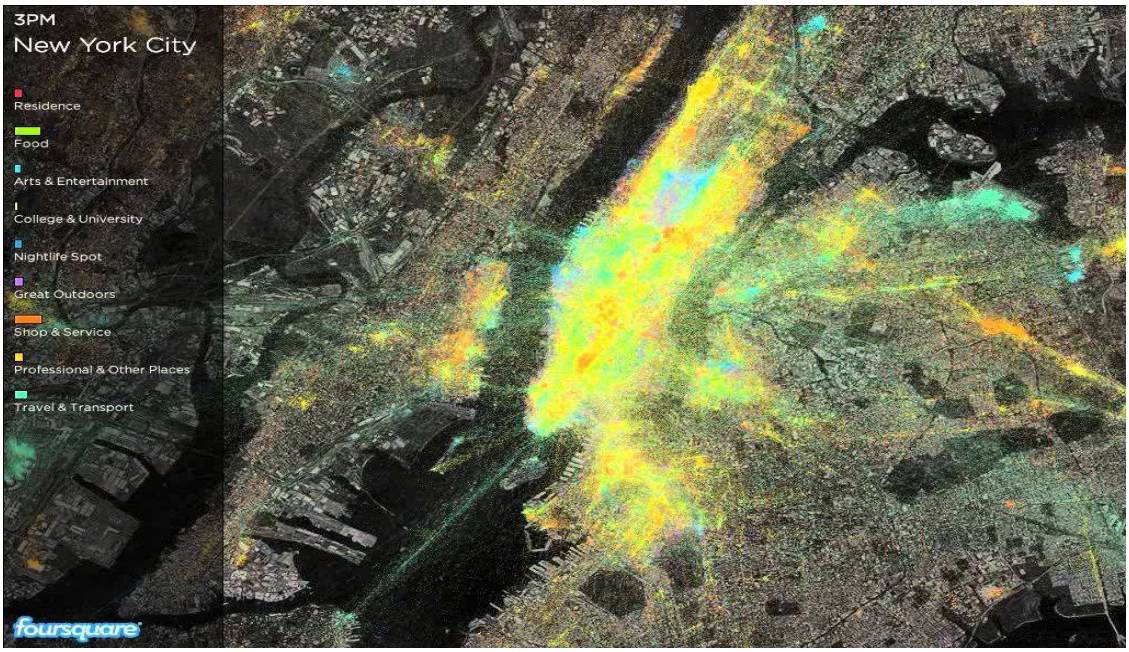

Fig. 4. The visualisation of Foursquare user's real-time sequences check in, New York (source: YouTube, 2016).

The applications' owners provide different types of APIs for developers that can provide all kinds of knowledge from the network's datasets. For the research addressed by the manuscript, one of them is highly significant. The Venues database allows the developer to search the application's database and find information including tips, photos, check-in counts, and live check-ins. The general rules are that the developer must acknowledge applications contribution and must not redistribute the obtained data for commercial purposes. Another interesting aspect is that the API allows to combine obtained data with own data (if the original app data is not misinterpreted) and even with data obtained from other social networks like Facebook (Developer.foursquare.com, 2016).

From the perspective of the desired concept, the Venue service API gives great options for linking a huge amount of POIs with already recounted efficiency indicators (number of check-in, ranking, review) and own evaluation indicators (economic efficiency, overnight stays, etc., results of own questionnaires, etc.). Also, the API allows the developer to fill in the gaps in the Foursquare database (option to enlist mining heritage POIs). With the option to even connect data from Facebook, there is a possibility for benchmarking the POIs communicated content via Facebook (the range of the content's outreach, structures of followers, etc.).

Application 5: DBIS's questionnaire module

DBIS or Destination business information system is currently being developed by living lab project at the Technical University of Kosice aiming at improving destination stakeholder's decision making within the managing and planning processes within the destination management via building own knowledge structures. It has already a fully functioning questionnaire module with the function to conduct target e-questionnaires that are responsive also to smartphones (also with GPS coordinates recording). The results are automatically aggregated and visualised within the platform's interface. The questionnaires may also be exported to external websites and are reasonable compensation for classic paper forms.

Within the desired concept the DBIS's questionnaires may work as extended modules for POIs evaluation in the field, for example at events or even within individual field surveys conducted by local destination management organisations (from now on DMOs), other stakeholders or volunteers. The outcomes of the platform's questionnaires are available for any tourism stakeholders on the open access principles. The only

rules are to create a user account and share the collected data for aggregations and further analysis performed by the platform's administrators.

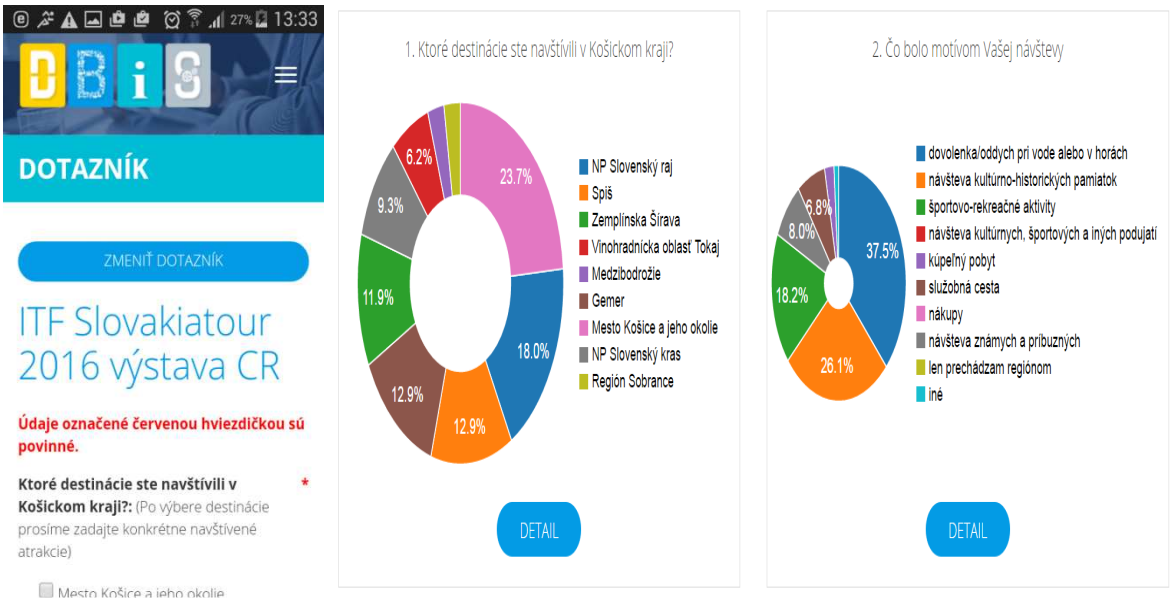

Fig. 5. Example of DBIS's questionnaire's frame and visualisation of results – (source: Dbis.fberg.tuke.sk, 2016).

Results and Discussions

The idea of the concept is to reuse relevant datasets and partial components resulting from the reviewed applications and connect them with the Foursquare API into a new comprehensive module. This section describes proposed essential components and a process of integrating into a phase of implementation.

Component 1: Basic linked dataset

The datasets of POIs from montanistika.eu (POIs of mining heritage) and Pilot SPOI (POIs of tourism offer and services) will be used for the creation of a new linked dataset. The first step is to obtain the licensed geospatial dataset from the montanistika.eu platform's administrator legally. Even if the SPOI app's datasets are open access, it's appropriate to contact the app's admin for reasons of potential data update. The newly created dataset will give an opportunity to evaluate mining heritage POIs from the perspective of their relationship to existing tourism services (for example distance lodging, food services, public transportation, parking, other tourism POIs, etc.).

Component 2: The GIS interface

As mentioned, the pilot applications of the SDI4apps project are powered by open APIs. For the purposes of the new app, the functions of the apps will be merged into a single environment. The SPOI's functions will be used to create necessary categories of POIs with individual basic evaluation indicators (for example capacity, price, economic efficiency of service providers, etc.) The web GIS functionalities of the ESS pilot will be used to visualise the volume of results for individually evaluated categories (volume of mining heritage POIs within the destination, volume of POIs providing services, etc.) and relationships between POI categories (for example, volume of overnight stays whose primary purpose was to visit mining heritage POIs, etc.). The merged GIS module could run on the DBIS platform. The APIs of the applications are publicly available, but from the perspective of potential bugs, the new GIS module should be discussed with SDI4apps developers.

Component 3: Linked Foursquare API

Linking the Foursquare datasets via its API with the new GIS module is essential. Firstly, to compare the two datasets (merged SPOI and montanistika vs. Foursquare) and identify missing POIs on both sides. According to the rules, developers are allowed to update Foursquare's database with new POIs. In this way, the missing mining heritage POIs will be visible on the network with more than 45 million users, and they will have a new possibility to raise interest about themselves. From the perspective of evaluation, the Foursquare API provides its results to the developers (number of check-in at POIs, qualitative ranking, user reviews). By this way, the new application will gain new knowledge in real time sequences about relevant POIs from

the perspective of tourists' attitude (number of check-ins per time unit), satisfaction (ranking, reviews) and about the character of target groups (country of origin, language).

Component 4: Linked DBIS questionnaire module

Connecting the questionnaire module to the new application is crucial for further evaluation of POIs at the level of destination management (evaluation of subjective attractiveness, etc.) and linking other external data (public statistics of efficiency, stakeholders statistics, etc.). It is possible to create a tailored questionnaire for each category of POI. This way, the application will have the possibility to gain even more information for its knowledge base. The questionnaire module should work at three levels as follows: i) tourists' interest and satisfaction (field research), ii) efficiency according to official statistics (online research); and iii) subjective evaluation of attractiveness (both online and on-field research).

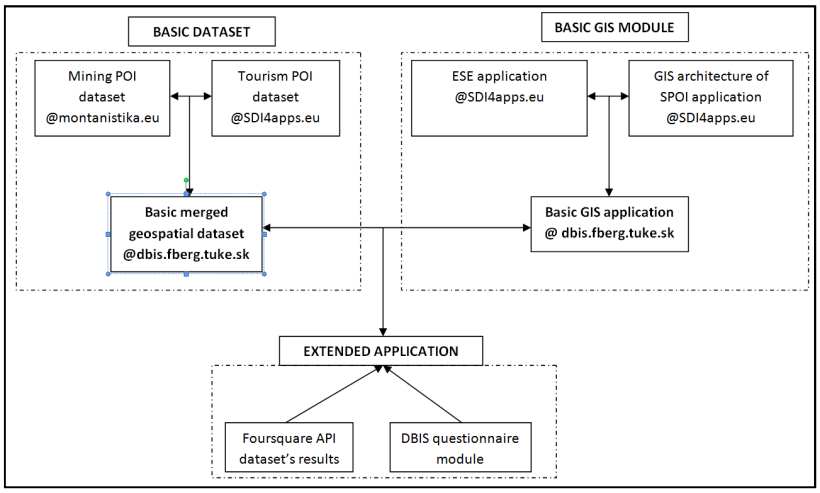

Fig. 6. The scheme of linking open datasets and APIs into a new GIS application (Kršák et al., 2016).

Conclusion and future work

The case study has reviewed five applications and underneath datasets and a potential for the purpose of evaluation of mining heritage POIs in terms of a destination management. Since the data of interest for reuse and update available from montanistika.eu have a licensed ownership, the concept of a new linked application depends on the relation of the applications' administrators towards the EU principles of new accessible open knowledge. On the other hand, the implementation of the concept will provide new structured knowledge to all of the stakeholders. The issue of data licensing is a matter of open discussion among relevant stakeholders and data owners.

From the perspective of a technological solution based on designed concept (Fig. 6), we assume its practical implementation as relatively easy task and realistic because all essential modules run on open APIs. The most important components are available from web-based source code management system GitHub, and some developers from the SDI4apps project have already declared the interest in the topic of extending their applications usability in practice. The newly developed application will be deployed on the DBIS server and will work on the principles of open access knowledge for research purposes.

The next parts of the case study will be aimed at the definition of necessary sets of POI indicators and variables for identifying essential relationships between mining heritage POIs and tourism services POIs within a destination. For this purpose, six methods will be reviewed and tested. The data envelopment analysis for on-line data analysis according to Azual et. al, the revisioned method for assessment of attractiveness (value) of geotouristic objects according conducted by Štrba and Rybár, the DG's European Tourism Indicators System for sustainable destination management, the Geoheritage inventory system by Randrianaly et al., FCEM-AHP and IPA approach by Wang et al. and the empirical study of mediating role of tourists' attitude conducted by several research works (Alzua-Sorzabal et al. 2015; Štrba and Rybár, 2015; Directorate-General, 2016; Randrianaly et al., 2016; Wang et al., 2016; Reitsamer et al., 2016).

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