

## Spatial data geoportal for Local Administration – smart solution for a secure and valuable cultural heritage

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### Abstract

Implementing a spatial data geoportal at Local Administration level using EU non-refundable funds could be a smart solution for managing secure and valuable property based on IoT meant to reinforce Europe's cultural diversity by making our heritage and our cultural creations available to a wider number of citizens.

One of the strategies developed by the European Commission refers to Digital Single Market and includes tasks such as investing on network and technologies by funding research that enables new technologies like 5G and Internet of Things (IoT). The aim is to benefit European citizens with fast and accessible Internet for the future and make cities more sustainable in view of Europe's 2020 targets. Romania, as a member state, has aligned its priorities to the EU and is constantly trying to develop smart solutions in the interest areas that also permit funds attracting. Timișoara Municipality has set its goal to become one of Europe's smart cities and communities, thus developing (among others) a cultural strategy for 2014 – 2024. Competing and winning the title for “European capital of culture” initiative implied involving the entire community in embarking socio-economic and infrastructure projects supported by an information platform which ensures efficient data management for the municipality. This platform facilitated a good visibility of the candidate city in the context of enhancing the contribution of culture to its long-term development in accordance with its priorities and strategies.

### Keywords

Sustainability, valuable property, cultural heritage, geoportal, European capital of culture.

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### 1. Urban planning strategies and sustainable development policies for smart cities

Nowadays, the cities are faced with challenges such as growing population (Fig. 1), traffic congestion, space, resource management, climate changes, tighter city budgets, aging infrastructure and population that lead to the need for smarter cities [1].

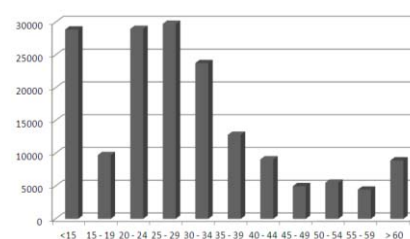


Fig. 1. Migration of Romania's population to urban areas based on age groups in 2015

The European Commission stipulates into the Digital Agenda for Europe [2] the following definition: “A smart city (Fig. 2) is a place where the traditional networks and services are made more efficient with the use of digital and telecommunication technologies, for the benefit of its inhabitants and businesses.”



Fig. 2. EU Smart Cities and Communities Initiative (Source: <https://eu-smartcities.eu>)

Sustainable urban planning is the one that seeks to minimize the negative environmental impact of buildings by efficiency and moderation in the use of materials, energy, and development space. It uses a conscious approach to energy and ecological conservation in the design of the built environment with a view of stimulating investments, attracting tourists and increasing the inhabitants' living standards. [3]

A smart city based on the policies of sustainable development takes into consideration the following:

- balance between urban modernization, controlled urban growth through development of rural areas and conserving spaces dedicated to agricultural activities;
- social and urban functions' diversity, both in the rural and urban environment;
- balanced and economical use of natural, urban, conurbation and rural areas, controlling the movement and car traffic necessity, conserving air, water, soil, underground resources, green spaces, natural or urban landscapes' quality, reducing noise pollution, protecting valuable urban developments and national heritage buildings, preventing foreseeable natural and technological hazards and general pollution. [4]

Smart cities functioning based on the idea of sustainability take into account the following development directions:

- environmental sustainability and efficiency;
- sustainable homes and buildings;
- efficient use of resources;
- efficient and sustainable transportation systems;
- better urban planning.

2. *Smart Mobility*: local accessibility, (inter-)national accessibility, availability of infrastructure, sustainable, innovative and safe transport systems.
3. *Smart Environment*: attractiveness of natural condition, less pollution, environmental protection, sustainable resource management.
4. *Smart Governance*: participation in decision-making, public and social services, transparent governance, political strategies & perspectives.
5. *Smart People*: level of qualification, affinity to lifelong learning, social and ethnic plurality, flexibility, creativity, cosmopolitanism/open mindedness, participation in public life
6. *Smart Living*: cultural facilities, health conditions, individual safety, housing quality, education facilities, touristic attractiveness, social cohesion.

## 2. The contribution of Internet of Things (IoT) and Cultural Heritage (CH) to secure and valuable properties of smart cities

One of the strategies developed by the European Commission refers to Digital Single Market and includes tasks such as investing on network and technologies by funding research that enables new technologies like 5G and Internet of Things (IoT). The aim is to benefit European citizens with fast and accessible Internet for the future and make cities more sustainable in view of Europe's 2020 targets.

One of the priorities of the Commission of the European Parliament Council regarding "i2010 – A European Information Society for growth and employment" says, quote: "In launching the partnership for growth and jobs as a new start for the Lisbon strategy, the 2005 Spring European Council called knowledge and innovation as engines of sustainable growth and stated that it is essential to build a fully inclusive information society, based on the widespread use of information and communication technologies (ICT) in public services, SMEs and households". More than that, the document shows that ICT can strongly contribute to improvements in the quality of life. ICT are capable of improving the health of our citizens via new ICT enabled medical and welfare services. In light of the demographic challenges facing Europe, ICT can help make public health and welfare systems more efficient and effective. ICT can be a strong force for reinforcing Europe's cultural diversity by making our heritage and our cultural creations available to a wider number of citizens. ICT are also a tool for environmental sustainability, i.e. through monitoring and disaster management and through clean, low energy and efficient production processes. ICT can help to make transport safer, cleaner and more energy efficient. [6]

Timișoara has one of the widest architectural heritage area in the country, of important value to both Romania and Europe. The preservation of this Cultural Heritage (Fig. 4) is a duty of both the authorities and the owners. [7]

Nowadays, referring to Cultural Heritage objects, one of the first aspects implies not only the object itself, but also

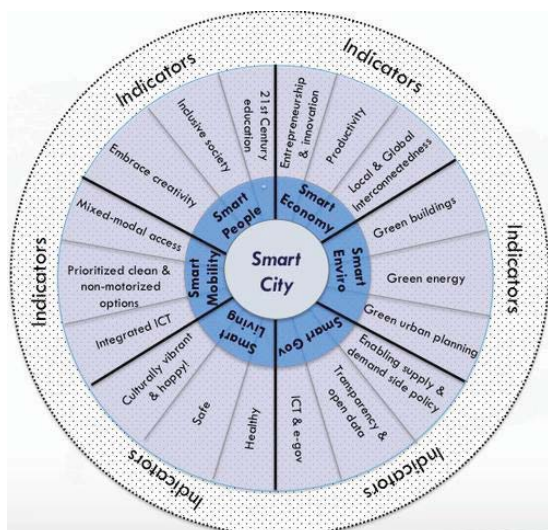


Fig. 3. The Smart Cities Wheel developed by Cohen

The Smart City concept (Fig. 3) is therefore based on a six pillars model [5], with the corresponding indicators:

1. *Smart Economy*: innovative spirit, entrepreneurship, economic image & trademarks, productivity, flexibility of labour market, international embeddedness, ability to transform.

creating 3D models using different technologies starting with simple measurements upon the object, using facilities of total stations, close range photogrammetry and also laser scan technologies [8]. Therefore, data collection is varied from simple to very complex and depends on the type, time, manner and technology used for measuring the object.

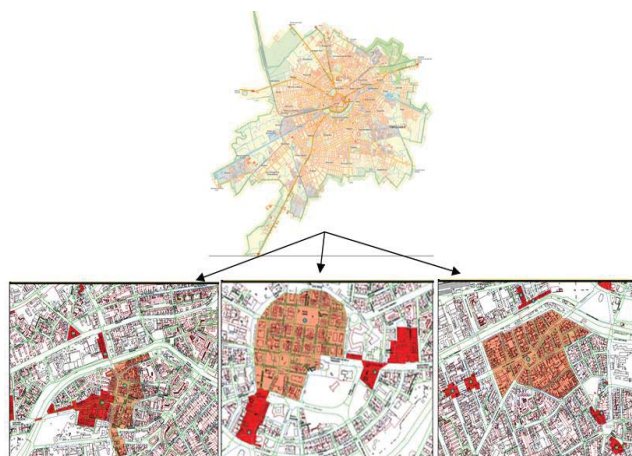


Fig. 4. Map of Timișoara highlighting areas with historical buildings

### 3. Timișoara as a smart city

Sustainable urban mobility plan covering the growth pole in Timișoara (Fig. 5) consisting of the city and 15 adjacent villages and concerns joint strategic objectives such as: accessibility, safety and security, the environment, economic efficiency and the quality of the urban environment.

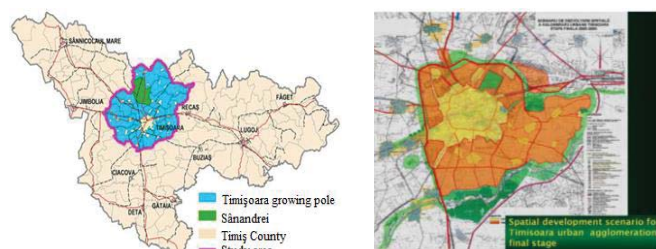


Fig. 5. a) Timișoara growing pole; b) Spatial development scenario for Timișoara urban agglomeration (2005-2050)

Timișoara is already active as regards the European Innovation Partnership on Smart Cities and Communities initiative, by the partnership formed by Politehnica University of Timișoara, Timișoara City Hall and the Smart City Association submitted the Commitment 7711, related to the use of Open Data Sets for creating smart applications to the benefit of citizens. The result consisted in an increased number of data sets made available by Timișoara City Hall on the governmental portal which located it on the first place in Romania.

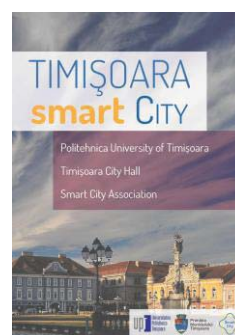


Fig. 6. Timișoara Commitment for the EIP on Smart Cities

Other studies conducted by specialists of Politehnica University Timișoara revealed that the owners of individual houses from Timișoara are interested for their property's value not to drop in investments such as learning, sports and relaxation facilities, quietness, public transport, edilitary and road infrastructure. At the same time, the entrepreneurs from Timișoara, that operate in the investments domain, aim to work within a long-term strategy, to have as big a profit as possible and favourable execution conditions in order for the bureaucracy to be reduced.

The scenario for the spatial development of the urban agglomeration of Timișoara, initiated in 2004 and approved by the Local Council Timișoara in 2005 started from the relation between the city of Timișoara with the larger whole – Europe, DKMT Euroregion, the Western Region of Development, the Metropolitan Area of Timișoara, and resulted in nine different strategies: the electronic city by applying the GIS, the city of infrastructure, the residential city, the commercial city, the city of services and industry, the green city, the social city, the multicultural city and the university city, with specific objectives, development directions and measures.

The strategy of the electronic city by applying the GIS includes the objective of continuous updating of the cadastral and topographic surveys in Stereo 70 on a magnetic support, of the edilitary and road infrastructure, of the Building Permits (BP), of the dismemberments and property transactions, of the overlapping of the laws referring to constitution and reconstitution of the properties, as well as the objective of obtain satellite images and orthophotoplans every year.

The City Hall of Timișoara is the first institution in Romania starting the GIS [9] for urban planning purposes [10], at present, being the most advanced city in this domain.

The implementation of the GIS started in 1996 and covered a total area of 129,2km<sup>2</sup>; 34 Cadastral Sectors; 900 blocks and 27000 property sheets. Positioning of each entity is made on the reference given by the cadastral digital plan, 1:500. Updating this plan is based on a photogrammetric plan by using existing records, parcelling projects, urbanism certificates, documentations from archives, documents on land retrocession, and modifications on the street scanning as a consequence of systematization etc. aiming to extend this system throughout the metropolitan area. An eloquent example of updating of the database for the Urban GIS (Fig.



7) implied acquisition of all information regarding the cemeteries, project carried out between 2007 and 2009 by Politehnica University Timișoara. [11]



Fig. 7. a) Map of cadastral sectors; b) Overview of urban GIS

Timișoara Municipality has set its goal to become one of Europe's smart cities and communities, thus developing (among others) a cultural strategy for 2014 – 2024. The strategy includes, besides the context of strategy's elaboration, methodology and analysis of the external environment, general objectives, measures and action plan, procedures and indicators for assessing the implementation of the necessary tools, mapping of cultural resources.

Mapping has been centred on three types of resources: cultural spaces (current and potential), cultural workers (organizations and public institutions of culture) and cultural events (events and large-scale projects, relevant for the city). Joint documentation efforts have meant sending 12 requests for information to the authorities and public institutions, specific documentation, more than 40 interviews with resource persons from the city, interviews and sending questionnaires to the religious institutions in the city and Neighbourhood Advisory Councils.

Thus, data from the sociological research carried out within the project Cultural Poles in 2013, also general data regarding social economy of the county, cultural statistics, including cultural vitality, and information provided by cultural operators on special meetings has been corroborated. Mapping of cultural resources (Fig. 8) provides a general image on both cultural life profile and cultural operators from Timișoara, compared to the region and the rest of the country and highlights most performant cultural domains (in terms of cultural vitality) and those which need support to develop. It includes visual arts; show arts; libraries, publishing houses and written culture; audience development and cultural expressions diversity; cultural education; audience development; amateur arts, multicultural diversity; cultural and creative industries; broadcasting and cinematography; training and support for business ideas incubation in the field the Cultural and Creative Industries (CCI); encouragement of the CCI market through competitive public acquisitions and creative interventions for aesthetic city; workspaces for business incubators, creative hubs; museums; music; architecture – cultural heritage – built environment; contemporaneous architecture; arts and culture spaces; natural heritage.

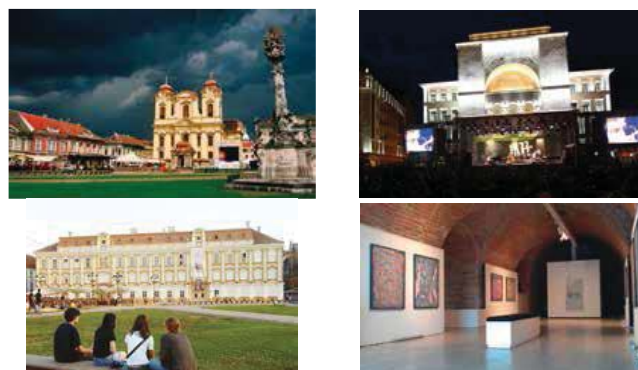


Fig. 8. Mapping of Timișoara's cultural resources

“The award title of European capital of culture will continue to rely on a cultural program created specifically for European capital of culture, which should have a strong European dimension. The program should also be part of a long-term strategy with sustainable impact on economic, cultural and social development”.

By recognizing the role of culture for development and quality of life, contemporary cultural policies call attention to the need to inherently integrate the cultural sector in other areas of public life. Concern for the cultural life of the city of Timișoara implies a strong relationship between culture and urbanism, architecture, environment, education and contributes to local and regional development.

The city is prepared to invest in its heritage and to foster cultural phenomena. The potential offered by the Euroregion of historical Banat represents the foundation for the projects and initiatives meant to support the development of a common identity based on a natural collaboration between people and organizations. Moreover, culture represents an investment for the local economy, which, through the development of tourism based on cultural heritage and on major events, aims to draw visitors and transform the city and the region in a cultural pole with wide international opening.

Competing and winning the title for “European capital of culture” initiative implied involving the entire community in embarking socio-economic and infrastructure projects supported by an information platform which ensures efficient data management for the municipality. This platform facilitated a good visibility of the candidate city in the context of enhancing the contribution of culture to its long-term development in accordance with its priorities and strategies.

#### 4. Spatial data geoportal for Local Administration – smart solution for a secure and valuable cultural heritage

Implementing a spatial data geoportal at Local Administration (Timișoara City Hall) level using EU non-refundable funds could be a smart solution for managing secure and valuable property based on IoT meant to

reinforce Europe's cultural diversity by making our heritage and our cultural creations available to a wider number of citizens.

The authors propose a workflow diagram (Fig. 9) with the actual working process for creating the 3D cultural heritage model, step by step, to be used in the geoportal. [12]

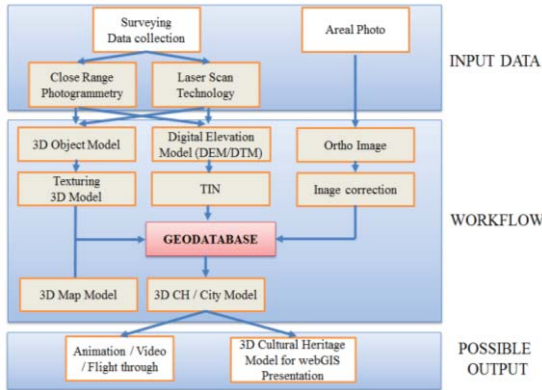


Fig. 9. Workflow diagram – logical scheme

As regards the creation of the 3D models of cultural heritage objects, there are several technologies available for data collection: close-range photogrammetry, laser scanning, UAVs (Unmanned Aerial Vehicles).

For processing and creating 3D models, the alternatives are: model in specialized software (e.g. Cyclone, Solid Scan, GeoVerse, JRC 3D Reconstructor), model directly in 3D CAD (Civil 3D), model only surface (for pure restoration purposes – created from photographs – Corel Draw).

For the present objective the data was collected using the Zoller + Fröhlich scanner from Politehnica University Timisoara. The scanning survey may be divided into three phases: planning, scanning and registration and QA/QC (Quality Assurance/Quality Control). In the processing phase, the scans from different stations are brought in a common reference system and then merged to create a complete model. During this process, registrations are created, namely target to target or cloud to cloud registration in order to obtain the unified point clouds (Fig. 10) and clear the noise.

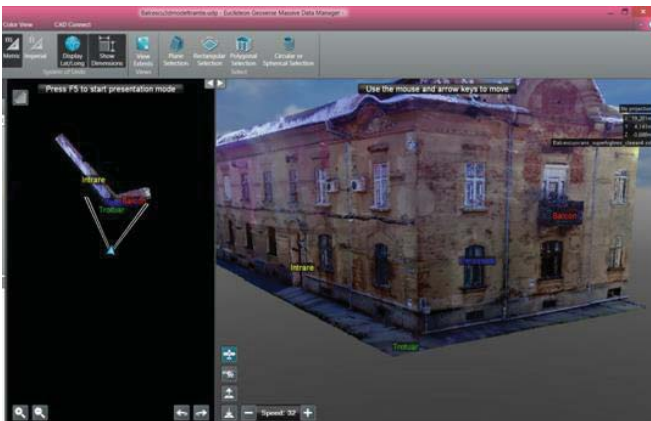


Fig. 10. Point cloud obtained by scanning a historical building from Timisoara

After the 3D models of the cultural heritage objects are created (Fig. 11, 12), they should be uploaded on the geoportal (Fig. 13) in order to appear when it is interrogated.

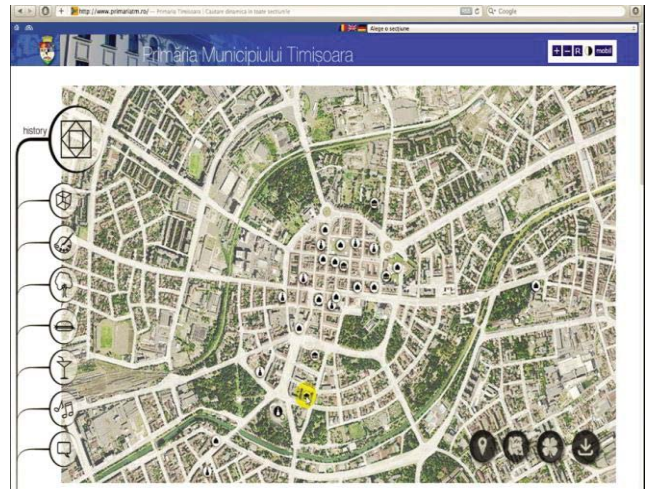


Fig. 11. Selecting a cultural heritage object from the geoportal

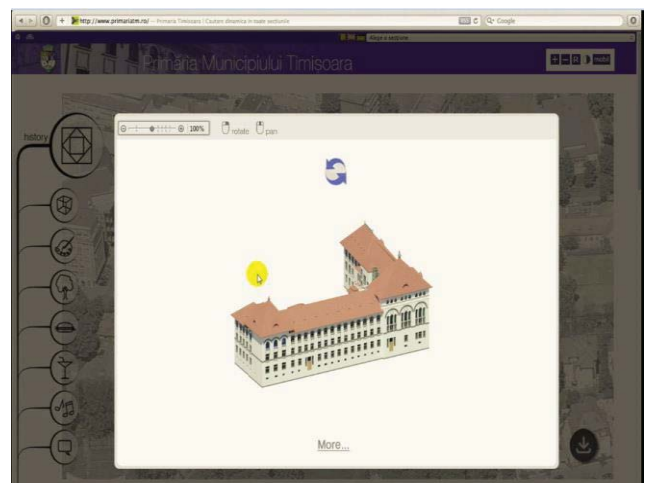


Fig. 12. 3D model of the cultural heritage object



Fig. 13. Link to the geoportal on the City Hall's webpage [13]



Also, as attributive data of the cultural heritage objects, the authors suggest adding a brief description of the object's history as in the example illustrated below (Fig. 14).

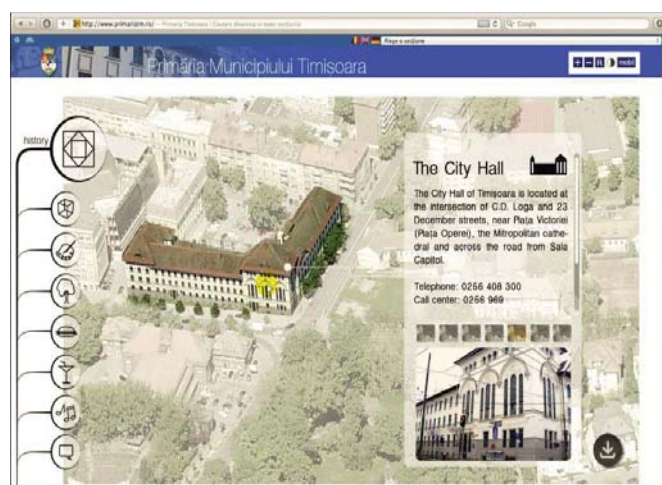


Fig. 14. Information regarding the cultural heritage object

From the applicative point of view such a webGIS solution brings added value for all the institutions that manage and operate with Cultural Heritage objects.

The fact that information is available at a glance as a webGIS resource for different users in an attractive and intuitive manner, it provides a powerful tool for cultural heritage conservation as an efficient strategy of urban planning.

## 5. Conclusions

In this paper the authors proposed implementing a spatial data geoportal at Local Administration level (Timișoara City Hall) to streamline the data workflow and provide easy access to it in order to increase the visibility of cultural and historical heritage of the municipality. The need of this geoportal arises from the fact that Timișoara has the widest architectural heritage area in the country, of important value to both Romania and Europe. The dedicated geoportal for the management of heritage objects represents a smart solution which completes the existing urban GIS primarily aiming to contribute to fostering the urban planning and the sustainability of the “European capital of culture” project. This geoportal should include the 3D models of the cultural heritage objects for better preservation over time or restauration purposes and offer virtual tourism tours if they are made available by means of webGIS. The technical basis for this project should be represented by geodetic measurements, laser scanning, IoT and architectural support ensured by an unceasing teamwork of different specialists.

The actuality of the paper arises from using webGIS solution in the “Internet of Things” (IoT) context to merge physical and virtual worlds, creating smart environments that represent the next natural step towards the digitisation of our society and economy.

The authors insist on the idea of creating a geoportal for cultural heritage objects as the future brings changings in

terms of replacing desktop solutions by WEB solutions in order to allow the dissemination of the results and to increase the possibility of international collaboration between specialists. WebGIS solutions have several advantages among which we mention the access to spatial data characteristic to cultural heritage documentation either for specialists or ordinary users and different purposes.

An efficient urban planning strategy implies creating WebGIS for cultural heritage as the next natural step forward for both conservation and preservation of these objects, and also for understanding and promoting them. Also, together with the unlimited possibilities offered by the World Wide Web, creating physical virtual replicas of Cultural Heritage objects has become more and more attracting and interesting.

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