

CO-TAMP: Transnational Platform for Territorial Attractiveness Monitoring in the Danube Region

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Abstract. Besides the carefully selected set of indicators, geographical visualization or geovisualization is also one of the success factors of any territorial monitoring system. Utilizing the latest GIS-based applications, geovisualization is today more than a plain – static – visual presentation of the territorial structures and dynamics using the maps and different computer graphics; it's about a set of tools, methods and techniques that enables interactivity and exploration capabilities over the monitoring system content, which includes different geospatial data. Deployment of these capabilities results in the various interactive visual analyses, leading to the recognition and presentation of the previously invisible spatial relations and data patterns, which are of shared importance for the spatial planning stakeholders and territorial development policy decision-makers, on all levels. Relaying on the rapidly developing interactivity feature, which is being fed by the increasing number of geospatial data from various sources, there is a growing number and variety of the monitoring systems in Europe, from local via national and transnational to European level. One of those transnational monitoring systems, namely Common Territorial Attractiveness Monitoring Platform (CO-TAMP), has been developed as a part of the Danube Transnational Programme's project Attractive Danube, which aimed to provide support to the territorial attractiveness policy priorities identification, decision-making and implementation throughout the Danube region. The aim of this paper is to research geovisualization feature and its advantages on the transnational level, and to present them in case of the CO-TAMP platform.

Keywords: Geovisualization · Transnational monitoring system · Common Territorial Attractiveness Monitoring Platform (CO-TAMP) · Attractive Danube project · Danube region

1 Introduction

The potential of spatial planning for the coordination of territorial impacts of sectoral policies in Europe has been increasingly recognized since the introduction of European Spatial Development Perspectives (ESDP), as Dühr confirmed [3]. Also, connected to

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the success and continuous development of the European Observation Network for Territorial Development and Cohesion (ESPON) since 2002, his claim that cartographic presentations can be powerful instruments for communicating the objectives of territorial development strategy or policy has been confirmed by the growing number and variety of territorial monitoring system initiatives on the different levels within European area [15]. However, due to the many factors, especially a difference between spatial planning systems – or traditions – among the European countries, and thus their different expectations from the cartographic presentation for spatial planning and territorial governance, geovisualization has been a particularly challenging within a transnational spatial planning context, where examples of the transnational territorial development visioning have been scarce until these days [3, 4].

Thus, in recent years of the ESPON Programme [7], which has been established as the main knowledge platform for monitoring the Cohesion Policy [14] and other related – thematic – policies and development priorities implementation on the different territorial levels, there were notable improvements also in domain of the transnational spatial planning and monitoring system development, as well as within the macroregional strategies geovisualization field [3].

Additionally, in the recently published Final report of the ESPON project COMPASS [10], territorial development stakeholders have been encourage to use more the tool kits developed by the ESPON projects for strategic visioning and dimensioning of spatial planning, where the monitoring of territorial development and its relation to the other strategies and narratives should get critical role at all levels, especially transnational [10]. The main aim of these COMPASS project's conclusions and recommendations is to strengthen the role of spatial planning in shaping the future territorial development policy in Europe, as well as to support national spatial planning and territorial development policy priorities to be more reflected in the next Cohesion Policy 2021–2027, and vice versa [17].

Therefore, the aim of this paper is to research ESPON-promoted geovisualization feature as well as its components and advantages using the transnational CO-TAMP platform as an example. This platform is developed as a result of the Interreg Danube Transnational Programme (DTP) project "Improving Capacities for Enhancing Territorial Attractiveness of the Danube Region" or Attractive Danube [13, 16].

After the Introduction chapter, the paper structure continues with definition and description of the geovisualization elements and advantages, in general and within transnational monitoring system context in Europe. Afterwards, relevant information about the Attractive Danube project (aim, objectives, concept, CO-TAMP application) are provided, followed by the description of methodology and steps performed for the CO-TAMP platform establishment. Paper is closing with the chapter discussing current platform advantages and disadvantages, as well as proposals for the potential future directions of CO-TAMP development and/or improvement, after paper finishes with concluding remarks.

Innovative aspect of the here presented research refers to (1) methodology of the transnational monitoring system development that combines existing knowledge and results produced by the other European initiatives, like ESPON, INSPIRE, etc., and (2) the Attractive Danube project's practical approach to the building of CO-TAMP application.

CO-TAMP platform has been chosen as the example for the transnational monitoring system geovisualization research because the authors were involved in the Attractive Danube project implementation.

2 Geovisualization and Territorial Monitoring Systems

Supported by the technological possibilities of nowadays computers and GIS-based applications, geovisualization assumes by definition the ability of maps, graphics and images to make existing spatial relationships and underlying spatial data patterns visible and understandable to the territorial development decision-makers and other stakeholders [3]. However, geovisualization is more than cartographic presentation or communication of the results by maps, since the same includes also capabilities of an interactive mapping application (that is, interactive user interfaces), like adding and removing data layers during the visual exploration, interactive map or spatial queries, etc. According to MacEachren "interaction is a key factor distinguishing geovisualization from traditional cartography", where geovisualization "is an active process in which an individual engages in sorting, highlighting, filtering, and otherwise transforming data in a search for patterns and relationships" [1]. On one side, these additional qualities of geovisualization indicate shift in the spatial planning and territorial development domain: from map as a product for communication, to the map as basis for visual thinking. On the other side, geovisualization initiates also general move from rational comprehensive planning tradition with rigid structures for responding to the spatial dynamics, to the communicative spatial planning system led by the development principles and goals as an implementation lead [5], especially for the territorial development planning and visioning on transnational level [4].

This change in usage of the maps and mapping in general is best described by 'cartography cube', as a new geovisualization model (Fig. 1). Following this model, the usage of maps and mapping tools for the visualization in domain of spatial planning and territorial development is increasingly shifting towards the need for higher human-map interaction, as well as revealing the unknown by exploration, analysis and synthesis during the customized visual thinking phase. Thus, the main goal of territorial monitoring systems development today is to become the advanced user-driven interactive map tools for better decision-making.

Identified shift in geovisualization feature supports findings of Soria-Lara et al. [5] that evaluation of the maps within territorial monitoring systems or spatial planning observatories should be based on their performance; for example, in what degree maps (1) facilitate decision-making process, and (2) allow stakeholder groups (decision-makers, planners and public) to learn and understand the existing development problems.

Finally, although there is no generally accepted definition of the territorial monitoring systems, it could be said that objectives of transnational monitoring systems in Europe today are [7, 15]:

– To enable collection, storage, processing, dissemination and geovisualization of the territorial development indicators in consistent and reproducible way;

– To provide information for the territorial development indicators' usability assessment and their values interpretation;
– To provide possibilities for connecting to the other relevant policy monitoring systems on different European level, and thus improve coordination among policies from the same and different domains as well as their integrated delivery; and
– To be reliable – evidence-based – platform with relevant and updated indicators for the territorial development and spatial planning decision-making, as well as policies management in general; etc.

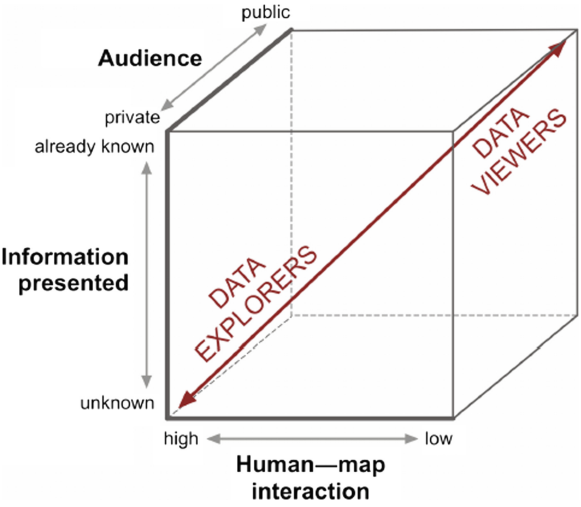

Fig. 1. MacEachren's graphic characterization of visualization through the use of maps [3]

2.1 Monitoring Territorial Dynamics and Policy Implementation in Europe

After the introduction of common main principles and long-term objectives for the territorial development and spatial planning in Europe by the ESDP document, and launching of the ESPON Programme for knowledge and information creation for the EU policies spatial impacts assessment, a number of territorial monitoring initiatives for the policies implementation support have emerged in Europe [15]. And, while these initiatives are differing by their specific objectives, territorial scopes as well as the other functional and thematic elements, just some of them have geovisualization capabilities, in sense of interactivity needed for the data exploration and user-driven customization of maps necessary for the visual thinking and communication of its results (Fig. 2).

So, as Soria-Lara et al. research also confirmed [5], maps are excellent tools for the territorial development and spatial planning, since they can improve the process of learning and understanding on the present and future territorial development problems, on all governance levels. Also, as Lindberg and Dubois concluded [4], comparing to the traditional cartography and its methods of presentation, geovisualization is "a key

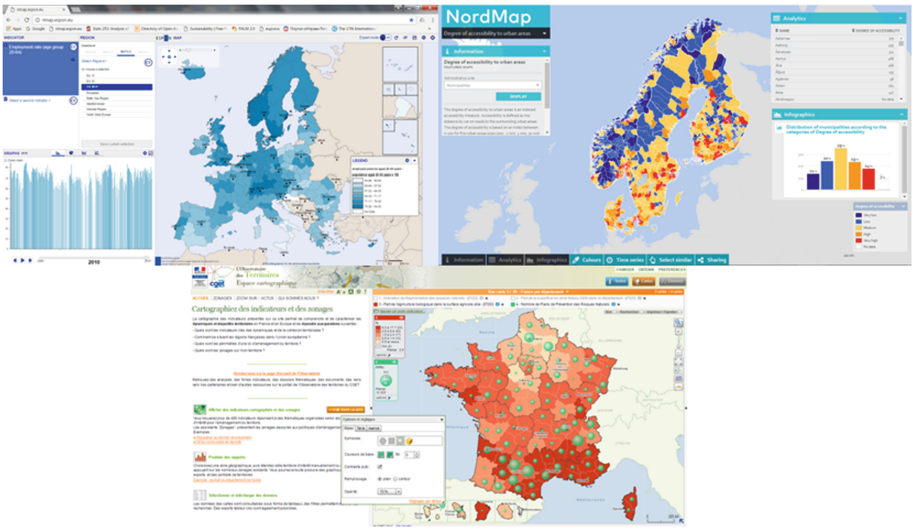

Fig. 2. Examples of geovisualization for territorial monitoring systems on European, macro-regional and national levels (respectively): RIMAP (http://rimap.espon.eu/) (top left), NordMap (http://nordmap.org/) (top right) and l'Observatoire des territories (http://www.observatoire-des-territoires.gouv.fr/observatoire-des-territoires/en/node) (bottom)

feature supporting spatial visioning and the co-production of a shared transnational understanding of the spatial planning in Europe". Additionally, these authors also stress that the transnational as well as monitoring systems on other levels in order to be successful should: (a) address specific and relevant themes of strategic importance for the current political ambitions using the selected indicators, and (b) provide continuously updated information.

This means that, besides the limited set of right indicators as well as their appropriate geovisualization, relevance and usability of territorial monitoring systems also demand their thematic durability. In other words, territorial monitoring systems should have well prepared documentation and traceable information on the selected territorial development indicators, like a fact sheet, which would ensure reproducibility and consistency of the performed analyses over time, and thus secure comparability of the spatial development indicators' values across time and space [4, 16, 17].

Therefore, appropriate presentation of the territorial dynamics by the territorial development indicators within the transnational monitoring system should include [15, 16, 18]: (1) the fact sheet for each territorial development indicator with its definition and core metadata, needed for the indicator usability assessment, analysis and values interpretation, and (2) the set of tools, methods and techniques that support interactive visualization of indicators' values. Hence, these elements needed for the description, interpretation and presentation of the transnational development dynamics were also critical for the concept and design methodology of here presented transnational monitoring system – CO-TAMP.

3 Attractive Danube Project

3.1 Project Aim and Objectives

Within the 1st Call of DTP [13], under the priority "Well-governed Danube Region" and targeting the specific objective "Improve institutional capacities to tackle major societal challenges", 12 financing project partners from 11 Danube countries[1] implemented the Attractive Danube project [11].

The aim of this project was to strengthen multilevel, cross-sectoral and transnational governance and institutional capacities of the policy planners involved in territorial development within the Danube region. Also, recognizing the lack of good quality data as one of the common challenges and obstacle of partner-countries for efficient and effective territorial attractiveness policy priorities management, next project objectives were specified [16]:

- To make quality territorial attractiveness-related data available to the policy planning stakeholders;
- To improve and strengthen multilevel and cross-sector territorial attractiveness development planning; and
- To increase the skills, knowledge and capacities of territorial attractiveness policy planning stakeholders.

In next lines, territorial attractiveness concept and related indicators along the Common territorial monitoring framework are presented first, while the CO-TAMP development methodology and platform features are described in the following Chaps. 4 and 5.

3.2 Territorial Attractiveness: Concept and Indicators

The definition of territorial attractiveness adopted by the Attractive Danube project combines the ESPON's ATTREG [12] and SEE Programme's Attract-SEE projects' results [18], as well as Europe 2020 [6] and TA 2020 goals [2], and it describes territorial attractiveness quality as "capacity of certain Territorial Capitals and Assets to attract and retain target groups (tourists, residents, migrants and companies/investments) by already existing or developed advantages (environmental, economic and human, anthropic, socio-cultural, and institutional), imposed by relevant policies and their goals."

In order for the above identified definition and concept in general to be measurable and manageable, each territorial advantage – i.e. capital – is described with the several territorial attractiveness relevant indicators (Table 1) needed for the regular territorial monitoring, both on national and transnational levels.

[1] Slovenia (Geodetic Institute of Slovenia - Lead partner), Hungary (Lechner Ltd., EMFIE), Czech Republic (CENIA), Slovakia (TUKE), Germany (aifora GmbH), Bulgaria (BIFORUM), Romania (URBASOFIA), Serbia (IAUS), Croatia (KCKZZ), Montenegro (ISSP), and Bosnia and Herzegovina (FMPU).

Table 1. List of transnational territorial attractiveness relevant indicators compiled by the Attract-SEE project partners from different sources/databases, like EUROSTAT, OECD, EC, EEA, UN, UNESCO, WB, ESPON projects [18]

No.	Indicator	No.	Indicator
1	Air pollution: Ozone concentration	12	Research & Experimental Development expenditure as % of GDP
2	Population connected to urban waste water treatment with at least secondary treatment	13	Employment rate 20–64 years by sex [%] (regional)
3	Electricity generated from renewable sources	14	Youth unemployment rate
4	Consumption of water per capita	15	Share of employment by sector
5	% of terrestrial area protected (total and by ecological region)	16	Number of overnight stays of tourists per capita per year
6	Population (or households) with accessibility to high-speed broadband (1 Mbit/second up and down)	17	Share of tourism related employment in total employment
7	European cultural sites on the UNESCO World Heritage List, 2010	18	% of GDP of foreign direct investment
8	Life expectancy at birth by sex	19	Population growth rate (%)
9	Gross disposable household income	20	% of population in age 20–64 years
10	People at risk of poverty or social exclusion, or % in risk of poverty	21	Ageing index
11	Population aged 25–64 with tertiary education	22	Number of foreign students and/or professors

In the course of the Attractive Danube project implementation, here identified 22 quantitative indicators were planned to be collected and used for the standardized and consistent monitoring and coordination of the transnational – or macro-regional – advantages and protection of diversities in the Danube region, through the selective social, economic, cultural and environmental development goals identification and territorial attractiveness relevant policies integration [17].

In order for the Attractive Danube project results to be sustained and CO-TAMP platform to be durable, data for those 22 indicators were planned to be collected by the project partners up to 2021, i.e. 3 years after the project ends.

3.3 Common Territorial Monitoring Framework

Aiming for the CO-TAMP platform to be designed and built as durable interactive visualization platform, which could support the informed and timely territorial attractiveness-related decision-making and policy management in the each partner-country as well as on the Danube region level, project partners have established comprehensive framework for territorial monitoring, so-called Common territorial

monitoring framework [18]. This framework includes elements that would provide underlying context for the CO-TAMP platform sustainability and relevance in the long run. These elements include variety of 'soft' and 'hard' tasks, which regularly performed would support the emergence of specific co-creation process needed for keeping the social and technical components of CO-TAMP platform integrated.

Thus, after identifying main elements for the transnational monitoring system during the Attract-SEE project[2], and their reconsideration and minor adjustments against the DTP goals as well as the contexts of Danube region countries at the beginning of Attractive Danube project, stakeholders along the focus groups were invited – as part of participatory approach – to join the activities for building requirements-driven interactive Web mapping application named CO-TAMP.

In next lines, development methodology for the establishment of CO-TAMP platform would be described, and afterwards resulting Web mapping application features would be presented.

4 Methodology

During the initiation phase, the Attractive Danube project partners have upgraded those 22 transnational indicators selected during the previous Attract-SEE project, as well as relevant national databases. Also, relying on the previously defined Common territorial monitoring framework and its elements, they agreed on the methodology consisting of a 3-step approach for CO-TAMP platform development.

4.1 Data Sources Identification, Their Analysis and Data Collection

In this first step, following those 22 indicator definitions, all project partners had first to identify the available data sources or datasets on national level for those indicators calculation. Then, project partners performed detailed analysis of identified data sources, in sense of their reliability, conditions of availability, existing data formats, data access methods, data collection frequency, standards, coverage, etc. After extensive analysis of the data sources for indicators, project partners had to determine the collection and calculation methods for every indicator. The main challenge in this first step was to find the national data source for each indicator with the same measurement method and unit as well as specified period of time (from 2008 to 2021 as planned) for all project partners, in order for the indicators' values to be standardize and, thus, mutually comparable.

4.2 Indicators Definition, Values Storage and Quality Assessment

In order for the Attractive Danube project results to be sustainable and developed CO-TAMP platform to be durable, appropriate documentation had to be prepared for keeping the analytical work results consistent, reproducible and traceable. In

[2] Common territorial monitoring framework includes CO-TAMP goals, institutional, legal and financial frameworks (except technological one), its content and users.

accordance with the good practice, this documentation was planned to consist of the fact sheet – or indicator methodological sheet – and metadata information for each indicator and its source.

Further, using the collected and processed datasets from identified data sources, the indicators' values were calculated, input and stored within the CO-TAMP platform database by using one of the two methods (depended on the project partner capacities): (1) by keying-in indicator values directly to the Web mapping application as attributes of the spatial units (NUTS regions), and (2) by filling indicator values into the Excel table and their later migration to the database.

Finally, calculated and input indicators' values had been subject to the data quality assessment procedure, conducted in a view of achieving one of the main project objectives, that is, to make quality territorial attractiveness-related data available for the Danube region. This data quality assessment procedure included the indicators' values verification against the four standard quality criteria: completeness, consistency, accuracy and logical sense of the calculated values.

4.3 Geovisualization Tool for Territorial Monitoring

CO-TAMP as transnational monitoring system was planned to support the collection, storage, analysis and management in general of the standardized, reliable, updated and relevant indicators data, on one side; and to provide diversified model of tools, methods and techniques for the geographical visualization through the interactive user interfaces, on the other side. Required interactivity of the CO-TAMP platform was found necessary for appropriate informing territorial attractiveness policy process in each partner-country[3], as well as to support coordination of the national policies and EU priorities within the Danube region.

Relying on the results of previous EU-funded project, and aiming to efficiency and effectiveness in general, the Attractive Danube project partners have decided to adapt the already developed STAGE II Web mapping application as a basis for the CO-TAMP platform development.

STAGE II Web Mapping Application

STAtistics&GEography or STAGE II solution (http://gis.stat.si/index.php) is an integrated platform and a freely accessible interactive cartographic application for the analysis, display, evaluation and dissemination of the geospatial statistics and usage of data (like images, charts, files) on a mobile phone, tablet and desktop computer. This user-friendly application is developed[4] and maintained by the Geodetic Institute of Slovenia, the Lead partner of the Attractive Danube project, in association with the Statistical Office of the Republic of Slovenia [9].

For purpose of the Attractive Danube project, existing STAGE II registry with the four types of aggregating spatial units for Slovenia was extended with the spatial units for project partner countries (from NUTS0 to NUTS3), which are stored within the

[3] http://www.interreg-danube.eu/approved-projects/attractive-danube/section/attractiveness-indicators.

[4] Project was funded by the EUROSTAT.

EuroGeographics[5] database. For CO-TAMP application, national and federal state[6] boundary data were used for the indicators' values aggregation, management and geovisualization.

5 CO-Tamp

Based on the STAGE II solution, CO-TAMP platform[7] was developed as an interactive cartographic solution for collecting, processing, archiving and visualizing the territorial attractiveness relevant indicators for the Danube region. This transnational monitoring system consists of the two closely linked parts, Web map viewer and the powerful analytical tools for geovisualization, which would be described in more details in the next three chapters.

5.1 Architecture Framework

The CO-TAMP user interface is a Web application, which central part consists of the interactive map with alternative cartographic background (MapBox, OpenStreetMap, White background; see Fig. 7) and the overlay layer in form of an interactive mapping tool, showing the indicators' values by the national and federal spatial units. The menu placed on the left side of Web map viewer allows user the selection of indicator for presentation as well as dynamic time and space variations of the indicator values. Besides mentioned variables, user can change through the menu existing color scheme, transparency and distribution of the selected indicator's values by grade.

The system has modular design and it is hierarchically arranged in the six structurally connected sets (Fig. 3). The bottom OS layer is a platform independent, which means that CO-TAMP application can be installed in any environment that supports Java 8. The servers' layer consists of the open source PostgreSQL database with PostGIS add-on. Also, GEO network is used as a tool for handling mandatory INSPIRE [8] regulations. However, besides installed INSPIRE Network Services (CSW, WMS and WFS), this solution allows any Web mapping service to be included without modifying the program code.

An important feature of the CO-TAMP application is that the spatial units and indicators' values are stored independently within the database, and their dependence is only reflected within the distribution environment, that is, in display. This enables quick and easy – independent – updating of these two datasets.

The language of CO-TAMP application is (only) English for the moment. So, when user opens application, first obligatory step is the selection of a variable, that is, indicator which would be displayed and/or analyzed (Fig. 4). By default, the choropleth map containing the latest available indicator values for selected variables is rendered.

[5] https://eurogeographics.org/.

[6] Only for Germany.

[7] http://cotamp.gis.si/attractive_danube/.

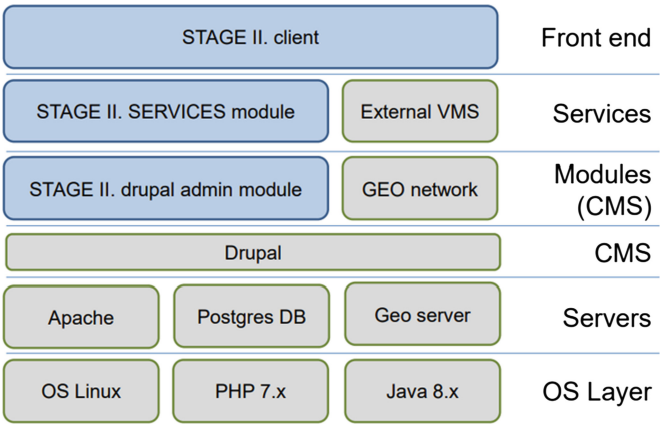

Fig. 3. CO-TAMP web mapping application: architecture framework

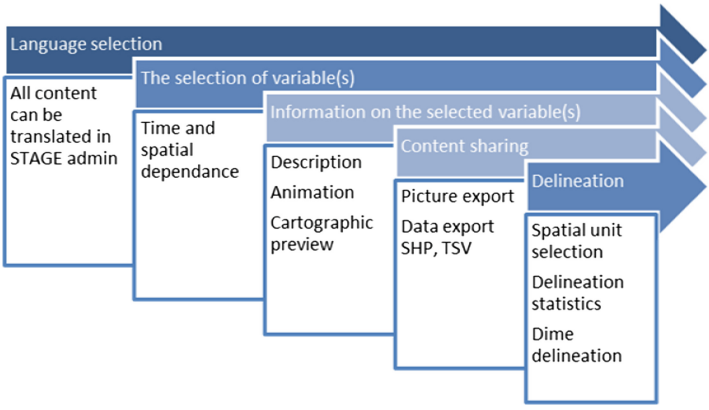

Fig. 4. CO-TAMP web mapping application: client work-flow diagram

The CO-TAMP application offers various operations that can be performed on the choropleth maps, like data export, picture export and spatial querying.

However, since CO-TAMP application is implemented as the centralized database, i.e. as client-server model, requirements in the sense of hardware and software may vary depending on the expected number of users. Also, on the client side, CO-TAMP application was tested within Chrome, Mozilla and Edge browsers for the desktop users, and within Chrome and Safari browsers for the mobile users.

Finally, CO-TAMP application is the highly scalable solution, and it can be used even globally since it is coordinate system independent.

5.2 Documentation

The CO-TAMP platform is designed around those 22 indicators (Table 1.), which values are derived from the various data sources. These data sources are, in most of the cases, databases on national or EU level that have data needed for the calculation of indicators' values. Majority of these sources are managed by the state authorities in partner countries, so these databases have already metadata (data update frequency, quality, etc.) and, thus, it is relatively easily to incorporate them (data) into the CO-TAMP database. By storing and archiving of data into the CO-TAMP application database users can recreate indicators values and visualize them even in the case when methodology of indicator calculation is changed, and original data source doesn't store that data anymore.

Anyway, in order for the analytical work performed by using CO-TAMP application to be traceable and reproducible, and obtained results to have consistency and relevance, project partners have created relevant documentation. Thus, besides the fact sheet for each indicator in the Territorial Attractiveness Atlas of the Danube Region, metadata accessible within the CO-TAMP application complement those fact sheets information by providing the basic information about data sources for indicators – that is, used databases – for all partner countries (Fig. 5).

Additionally, due to its modular design, the CO-TAMP application is extendable and upgradable, and it's relatively easy to update its content and information, which is important for this transnational monitoring system durability.

Type of indicator	Transnational (CO-TAMP), collection at national level
Annual range	2008/2021
Data source for indicator	Statistical office of the Republic of Slovenia (SURS) http://pxweb.stat.si/pxweb/Dialog/varval.asp?lang=2&ma=0867325S&path=../Database/Dem_soc/08_zivljenjska_raven/08_silc_kazalniki_revsc/15_08673_porazdel_dohodka/&ti=
Key statistical data used	/
Spatial level	National, Regional, County
Data completeness	Data available for the period 2008-2016 (by 09.01.2018), annual periodicity.
Policy/goals	This indicator measures the disposable income of the households and by extension, individuals; it is an indicator with a high degree of comparability which provides relevant information on the welfare of the citizens over a certain period, as well as the level of poverty.
Contact person if available	On behalf of the ATTRACTIVE DANUBE partner: Blaž Barborič, e-mail: blaz.barboric@gis.si
Conditions of use	Indicators available for download

Fig. 5. Indicator metadata (Example indicator: Gross disposable household income)

5.3 Geovisualization Features

Besides core functionalities available on the administrator side, which are used for the general – that is, default – adjustment of variable parameters and geospatial layers, CO-TAMP application offers the three groups of functionalities on the client – user – side (Fig. 6). All user functionalities are designed to be intuitive, and could be approached from the single point – menu – making thus CO-TAMP application highly user-friendly.

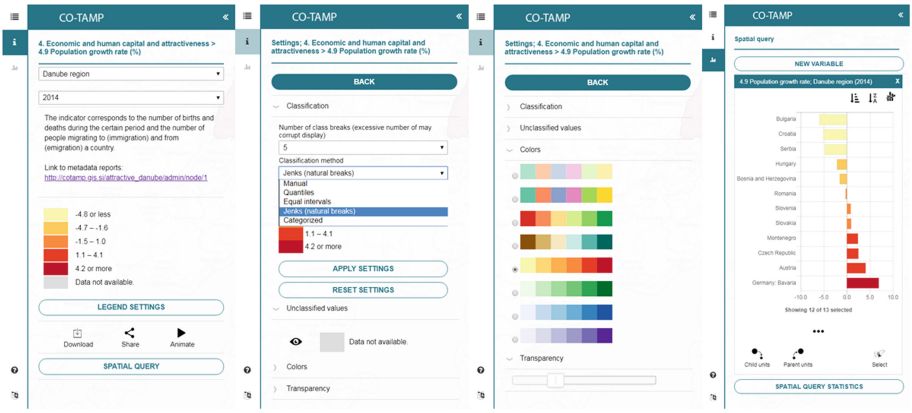

Fig. 6. CO-TAMP application: menu with the three groups of user functionalities (Example indicator: Population growth rate (%) in the Danube region in 2014)

The first group of user functionalities is activated by selecting one of those 22 indicators from the menu on the left side, which is the main place for interacting with the indicators data stored in the CO-TAMP database. After selecting indicator, short description and link to the metadata information for that indicator become available, both necessary for its usability evaluation and values interpretation. Besides this information, dynamic time and space variations fields become also accessible for the selected indicator values, where value domain for time ranges from 2008 to 2017 year and space field has default value "Danube region". Also, part of this first group of the CO-TAMP user functionalities includes Download, Share and Animate options.

The second group of the user functionalities, gathered under the Legend Settings option in the CO-TAMP application, provides tools for customization of the selected indicator's values display in the map view by making available: (1) list of different types of classification, (2) several color palettes, (3) distinct color for the unclassified, and (4) color transparency possibility.

Finally, option Spatial Query presents third group of the CO-TAMP user functionalities, where delineation function is used for getting the insights into relations between data stored in the CO-TAMP application database, thus providing better understanding of the territorial attractiveness status and issues in the Danube region. Selected indicators' values are here displayed using the method of a bar chart, which

combined with the available filtering methods (by point, circle, rectangle or other polygon) allows indicators' values and their relations to be further analyzed, specified and compared.

On the other side, in the CO-TAMP map view (Fig. 7), choropleth map is rendered according to the various options set for the selected indicator's values through the menu, which are limited by the general settings made within the administrator module. Also, at the moment, the choropleth mapping technique is the only method for thematic mapping and spatial presentation of indicators' values within the CO-TAMP application. Therefore, display in the CO-TAMP map view depends mainly on the classification method chosen from Legend Settings, where available options for data optimization correspond to those in the other GIS applications, like Jenks, Manual, Quantiles, Equal intervals and Categorized.

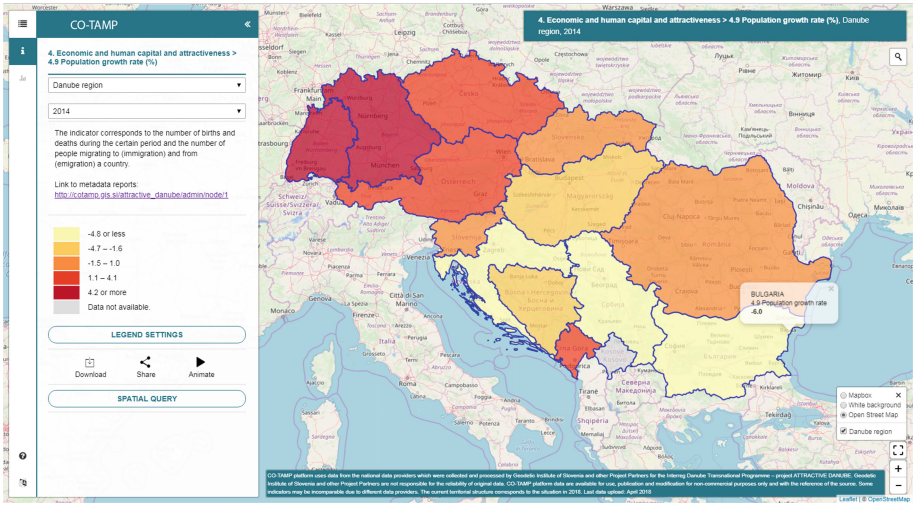

Fig. 7. CO-TAMP application: map view (Example indicator: Population growth rate (%) in the Danube region in 2014)

6 Discussion

Here developed and implemented solution – CO-TAMP – for the transnational monitoring and dissemination of the Attractive Danube project's results, provides advantages of the interactive geovisualization needed for better analysis, visualization and understanding of the territorial attractiveness quality and spatial dynamics in the Danube region. Moreover, this Web mapping application contains the components necessary for its analytical procedures consistency and reproducibility that would secure the CO-TAMP durability, mandatory for this platform to be successful in supporting efficient and effective decision-making and policy management in the Danube region.

On technology side, the open source CO-TAMP application with its modular design and scalability feature, provides easily accessible and flexible solution. These capabilities open possibilities for its future simple adjustments to the new user requirements, as well as additional or changed content handling; furthermore, these capabilities make feasible simple upgrading and/or combining of CO-TAMP application with the new technologies and data management concepts.

On the user side, related to the CO-TAMP content and geovisualization feature, this platform's structure and tools create user-friendly and intuitive environment that lead the user actions logically towards discovering and displaying known as well as new insights of the relations between spatial phenomena and their dynamics within the Danube region.

In future, research and development of the CO-TAMP platform should generally be focused on the introduction of advanced data analysis, as well as further development of application in general. In other words, this platform has a great potential for the advanced data analysis and data mining, since it transparently organizes data across different spatial units and time periods, making them thus readily available for input to the multivariate analysis techniques and other geostatistical data analysis.

7 Conclusions

In order for the spatial planning to understand and respond appropriately to the current and future spatial dynamics challenges, it needs the evidence-based decision-making and policy management information platform that could support highly customized – user-driven – approach to the maps creation. Proved to be useful tool for the territorial development community gathering and empowering, these maps should trigger and shape the individual visual thinking and public communication of its results, especially on the transnational level in Europe where stakeholders have different spatial planning traditions and expectations in this domain.

In this paper presented the transnational CO-TAMP platform, which is the result of Attractive Danube project, has been designed and implemented to provide the various geovisualization features in order for the territorial attractiveness policies and priorities to be monitored and evaluated by the Danube countries against the national, EUSDR as well as the other EU and regional policies and initiatives goals. Also, here introduced transnational monitoring system solution is based on the knowledge created by the ESPON and other EU-related initiatives and projects, producing thus new knowledge and lessons learnt that could be applied in the other projects, but also serve as input for the new development programming round in Europe (2021–2027).

Finally, with emergence of new technologies and the growing complexity of spatial relations and development challenges, it could be expected that number of transnational and territorial monitoring systems in general would increase in future, and that geovisualization for spatial planning and territorial development purposes is going to see rapid development in the coming years.

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