CITIZENS AND GOVERNANCE IN A KNOWLEDGE-BASED SOCIETY

caENTI

Coordination action of the European Network of Territorial Intelligence

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Portal on institutional territorial indicators available on internet in Europe

Delivrable D59

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Preamble

Within the framework of the CAENTI European project (coordination action of European Network of Territorial Intelligence) of the FP6 (Sixth European framework program), research on the territorial indicators, their treatment and their mode of representation, was undertaken. The objective is to represent, for actors implied in several sectors (in particular social), data which they use for the method CATALYSE.

After multiple research on the indicators, their accessibility and their definition in the European Union of twenty-seven (CHEN *and Al*, 2006; CAENTI 2008), it was necessary to treat the problem of the installation of the territorial portal of information for the actors, available on Internet. Concretely, it is a question of allowing the visualization of data characterizing the socio-economic environment of the populations to increase the comprehension of the territories, their dynamic and their problems, and of allowing a prospective view of the data collected by the actors near the populations at a more appropriate scale.

The cartographic representation was privileged to allow a better legibility of information, the comprehension of the space disparities and the possibility of comparison with other areas. All in all, although the reading of maps is not acquired for all, it is a powerful communications tools.

It was decided that this tool would be available for free on Internet, which generates complex technical and legal constraints, in terms of treatments, of representation and spread of information. Nevertheless, thanks to this free use, this tool will be used by the local actors, often confronted with budgetary and human important restrictions.

Our work was thus focused on the following tasks, in order to emit a list of specification for the creation of a European gate of territorial information, and to improve the current data (offers, distribution):

- obtaining the contextual and geographical data (administrative cuttings and statistics);
- the study and the implementation of the representation modes of cartographic on-line information;
- the study and the implementation of the techniques of information and meta-information storage;

This delivrable will initially treat of territorial information and geographical files (shapefiles) collection making it possible together to create cartography of socio-economic and environmental contextual information. This part will take into account the constraints related

to the mode of representation selected and will determine the essence of the characterization of this one. The second part will give the broad outlines of the cartographic representations selected for the prototype of the cartographic tool. The third part will treat management of the data and metadata within the system. The fourth part concerns the presentation of portal. Then we will conclude.

1. GEOGRAPHICAL INDICATORS AND DATA FOR THE EUROPEAN ACTORS

1.1. Data-gathering

The data-gathering is a crucial step in the realization of the gate of territorial information: without those, it is obvious that the project does not have substance. In order to carry out cartography of the indicators or data, two types of files are necessary: on the one hand, data to be represented, and on the other hand a file representing spatial cutting in entities (communes, country…). It is within the entities of the latter that the values of the indicators will be represented.

1.1.1. Contextual data

The contextual data form an integral part of the analysis by the method CATALYSE (CAENTI, 2006c). In order to limit the data retrievals, indicators were selected on the basis of European guide (CAENTI, 2006a). They are 15, and their availability near the European Office of the Statistics (EUROSTAT) and the national suppliers of statistics was studied (CAENTI, 2008). Nevertheless, the creation of a gate of information is not summarized with the simple visualization, new constraints thus appeared.

a. Constraints

Various constraints quickly emerged: whereas certain sites of statistics provide the data on a tabular format, others allow only one posting and a visualization of information on screen. It is however essential to have a tabular form to allow the introduction of the data into the cartographic software. Certain Internet sites generally force the users to digitalize information, which is a long and expensive operation.

The cost of acquisition of the data remains indeed an important problem since it will generally be paid by the end users, what we want to avoid. We thus supported the data obtaining for free on Internet sites. EUROSTAT allows this, and certain national sites also put a broad offer of free socio-economic data at the users disposal. Nevertheless, the majority of the consulted statistical sites ask money for the most precise or specific data. They are primarily the data at the communal or infra communal level, like the statistical sectors.

The collection of information is thus subjected to a double constraint, depending on the format and on the acquisition costs of the data. Concretely, that considerably reduces the data availability for their insertion, whereas the preceding statements brought a very promising vision of the accessibility of the data at the European level (CHEN *and al.*, 2006).

Moreover, the problem of the data update remains not exhausted today. Indeed, the comparison of the situation statements on Internet between the years 2006, 2007 and 2008 showed a strong variability of the web-addresses giving access to the information sources. It seems complex to consider an automatic update without preliminary convention with the statistical partners.

Country	Institution	Website
Austria	Statistics Austria	http://www.statistik.at/
Belgium	FPS Economy - Directorate-general Statistics	http://www.statbel.fgov.be/
Bulgaria	National Statistical Institute of Bulgaria	http://www.nsi.bg/
Cyprus	Statistical Service of Cyprus	http://www.mof.gov.cy/mof/cystat/
Czech Republic	Czech Statistical Office	http://www.czso.cz/
Denmark	Statistics Denmark	http://www.dst.dk/
Estonia	Statistics Estonia	http://www.stat.ee/
Finland	Statistics Finland	http://www.stat.fi/
France	INSEE	http://www.insee.fr
Germany	Statistisches Bundesamt Deutschland	http://www.destatis.de/
Greece	General Secretariat of National Statistical Service of Greece	http://www.statistics.gr/
Hungary	Hungarian Central Statistical Office	http://portal.ksh.hu/portal/
Ireland	Central Statistics Office Ierland	http://www.cso.ie/
Italy	Istituto nazionale di statistica	http://www.istat.it/
Latvia	Central Statistical Bureau of Latvia	http://www.csb.lv/
Lithuania	Statistics Lithuania	http://www.stat.gov.lt/
Luxembourg	STATEC	http://www.statec.public.lu/
Malta	National Statistics Office	http://www.nso.gov.mt/
Netherlands	Statistics Netherlands	http://www.cbs.nl/
Poland	Central Statistical Office	http://www.stat.gov.pl/
Portugal	Instituto Nacional de Estatistica	http://www.ine.pt/
Romania	Institutul National de Statistica	http://www.insse.ro/
Slovakia	Statistical Office of the SR	http://portal.statistics.sk/
Slovenia	Statistical Office of the Republic of Slovenia	http://www.stat.si/
Spain	Insitituto Nacional de Estadistica	http://www.ine.es/
Sweden	Statistics Sweden	http://www.scb.se/
United-Kingdom	Office for National Statistics	http://www.statistics.gov.uk/

Table 1 : List of national data provider in Europe

b. Results

The difficulty of information collection appeared as of the use of the files resulting from EUROSTAT. As proposed previously (CAENTI, 2008), EUROSTAT mainly collects furnished information with thirds (national institutes…), which generates information gaps within the databases. In this case, it is sometimes necessary to use older years under review, by taking into account the dynamics of constitution of the European Union and thus the disparities of information for the countries integrated more recently. Moreover, certain

indicators of the European Office of the Statistics are named in an unsuitable way, or by creating a confusion: indicators which one thinks acquired can appear not very relevant according to their method of calculating.

On the level of the national suppliers, it is the multitude which increases the difficulty of obtaining the data. Acquisition can moreover be expensive for certain very small spatial levels (for example for the communes in France and for the statistical sectors in Belgium). Major indicators (total population, unemployment rate,…) are often free, even for restricted spatial levels. But as soon as the indicators become more complex, they are not free anymore (cost can rapidly increase). It is indeed necessary to take into account the number of countries and the number of entities which gear down the costs of acquisition, without ensuring regular updates for all.

Within four pilot countries, we could collect several simple indicators (total population, population density, unemployment rate, and foreigner rate, income of households…) in a continuous way, from the NUTS 1 until the LAU2/NUTS5. More complex indicators present in a systematic way of the gaps and discontinuities, either verticals (of the space levels low towards highest), or horizontal (between entities of the same administrative level).

1.1.2. Geographical data

The geographical data constitute the base of the spatial representation of the indicators. Primarily exchanged and distributed in the form of file vector "shapefiles", we tried to preserve the homogeneity of the format for the whole of the collected data. The national and international distributors of geographical data propose generally various alternative formats, although the shapefiles are dominant.

a. Constraints

The cartography of various countries in the same interface and in a continuous way can be confronted with various problems. They primarily result from the methods and characteristic of the various cartographic products. Indeed, the creation of the shapefiles in general, and layers of information on administrative cuttings particularly, underlies a certain number of variables which can differ from a creator of data to the other. Among those, we will retain the reference levels of the digitalization, the basic scale of the cartography, the inaccuracy being able to reach several kilometers or employed projections.

Many of these constraints can find an answer by the exploitation of the possibilities of the cartography software, which has function of correction or modification of projections. However, the problems of inaccuracy cannot find an easy solution. The risk of the assembly

of shapefiles of different origins for the European countries is thus to create inconsistencies and discontinuities in the cartography.

In addition, the constraints related to the cost of the data also remain for geographical information.

b. National suppliers

Each country has its official supplier of geographical data, even if this one can sub-contract the resale of information as well as their creation. In certain nations, only one institute deals with the digitalization of the administrative limits and their distribution, but this case of figure remains rare.

The data generally have a cost, which varies according to the country, the zone which one wishes to acquire and the administrative level of cuttings. The countries which give the geographical data free are a minority in European space. The majority of them require a price growing according to the precision of the data and in certain cases the format (certain data are free in image format but need to be paid in shapefile format).

In addition, all the countries do not distribute the geographical files. Certain personally contacted national institutes confirmed that they do not place the data of administrative cuttings at the disposal of third, not even to have it in formats usable by the software cartography. These answers are certainly debatable, but it illustrates the difficulty of obtaining such information.

Our work of collection of information was thus made more complex by the multitude of suppliers, the incompatible data formats with the most widespread software of cartography, and the often prohibitory costs of the data moreover subjected to certain legal restrictions in terms of diffusion. In addition, fears concerning the disparities of resolution, reference frame and projection proved founded. The inconsistencies noted at the borders are consistent and make interpretations of the indicators very difficult.

The only official organization providing administrative cuttings for the whole of the European Union at an infra national level is the European Office of the Statistics. Its Internet site places for free at the disposal of all a map of the administrative level divisions NUTS 1, NUTS 2 and NUTS 3. But the precision of these data is poor (scale of reference 1: 1.000.000) and does not resolve the problem of the supra-communal, communal and infra-communal levels, which are the most important levels for the local actors.

c. Single supplier

No traditional public agency provides data from the level of the countries to the communes. This level is the main objective of our collection of information since the “communes2” are a basic unit present in all the European countries. Our research thus led us to seek private or

parapublic distributers for these data. The use of products of a single supplier having in addition harmonized the data makes it possible to be freed from a big number of constraints quoted before.

We found only one distributer of data for the whole of the European Union and certain countries partenaires3. This supplier, EuroGeographics, places at the disposal various products at the scale of the Union of which a map of administrative cuttings having for geometrical base the administrative communes or equivalents. Moreover, the base assignee of these files ensures the relation between certain infra-communal entities and the higher entities. The base assignee of this supplier also eludes the question of the diversity of the identifiers (met for national suppliers) since those are harmonized according to European nomenclature NUTS/LAU. Each of the 125.286 entities represented is thus identified by its single code. The data are regularly updated by the company.

In order to constitute its product, EuroGeographics joined the various national distributers. Those thus remain holders of the copyright but EuroGeographics can diffuse the products of the various countries.

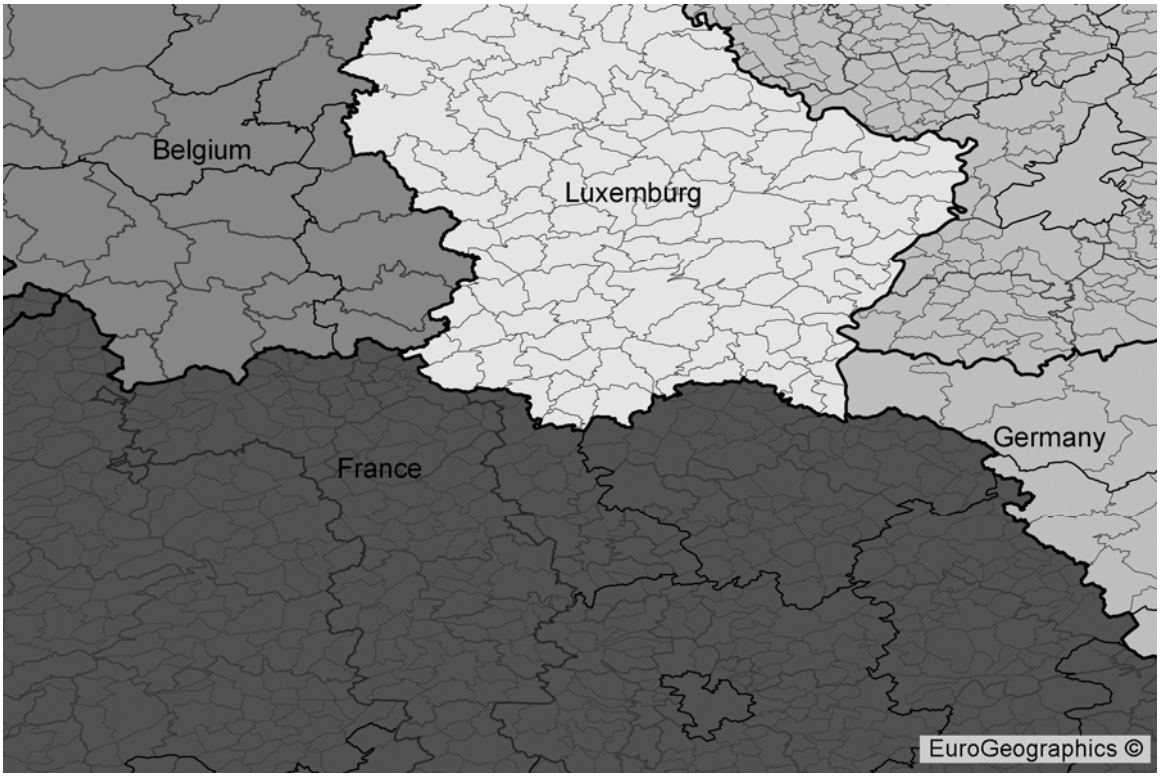


Fig. 1 : Extract of EuroGeographics geographical file

The cost of implementation of these data is prohibitory; a license for a single user must be acquired for 15.340 euros for the UE27 and for a 2 years duration. Additional expenditure must be taken into account for diffusion on Internet. Nevertheless, EuroGeographics has agreements with the European Union: the European research projects can have the EuroGeographics data during the duration of the project and for interns use only.

The use of such a product is optimal because it makes it possible to have uniform layers of information whose precision is satisfactory taking into consideration the objective of the tool. Nevertheless its cost in the long term makes its exploitation impossible for a big number of local actors having reduced financial means. It would be interesting to be able to develop in a near future a similar product, of which accessibility would not be subjected to such financial constraints.

1.2. Infra-communal level: accessibility and territorial information management

1.2.1. Introduction

It was putted forward that the most relevant contextual data for the local actors, mainly implied in the socio-economic fields, are at the statistical sector scale. The cartographic representation of the contextual data (socio-economic) can have an increased relevance with very fine cuttings. That is particularly true when the actors work on a communal or infra-communal level (district…). Consequently, it is possible to highlight disparities within the territory and to refine the comprehension of its dynamic. The reduction in the size of the zones considered also makes it possible to refine the statistics on geographically targeted populations.

This part of deliverable briefly deals with the use of the infracommunal data by the local actors. It puts forward the operational requirements of these data.

1.2.2. Socio-economic data

1. Available data

The available data at the infra-communal level are very variable according to the country considered. Indeed, the main source of data for this territorial level is the census, whose sets of themes can vary from one country to another. Other methods can feed these statistics, although the topics are more particular: it is in particular a question of exploiting the data resulting from administrative procedures (imposition, etc).

Principal indicators or territorial information (unemployment rate, total population, foreigners rate…) are naturally evaluated at the statistical sector level, within the framework of the

censuses. Other data are moreover available. Indeed, it is mainly at the time of the censuses that the residences, the structure of the households, etc. are evaluated.

Considering the contents, the main variable is thus the schedule of conditions of each country on the matter, although the tendency is at the harmonization of the approached topics.

On their side, the methods of calculating and the definitions of the indicators vary between the various countries. Among the traditional indicators, we will retain the unemployment rate or the size of the households whose acceptances can strongly vary from one country to another. Information have thus to be carefully interpreted, in particular by knowing the metadata for each indicator.

2. Accessibility of the data

The data resulting from the censuses are primarily distributed by the national statistical institutes, at a price which can be important for the wide geographic coverages or the precise data. Some countries give access to the data of this infra-communal level for free: we will primarily retain the Netherlands which in addition of the data distribution, makes it possible to visualize them in the Google Earth software, what increases its visibility.

The statistical data thus generally have a high cost on this level, regularly too expensive for the local actors. After their purchase, the data are available in directly exploitable tabular format.

1.2.3. Statistical cuttings

1. Methods of cuttings creation

The method of creation of statistical cuttings strongly varies from one country to another. In Belgium the division is statistical sectors is primarily based on the morphology of the built spaces, notably by isolating the rural environment in the built-up areas. In France the base of the cutting is the system IRIS 2000, which contain between 1800 and 5000 inhabitants by gathering several continuous small islands. Other systems can prevail in certain European countries, in particular based on historical cuttings (old parishes, etc).

This cutting methods diversity can lead to situations where there are cuttings with different nature on a same territory. Nevertheless, the most precise statistical cuttings can generally be aggregated in order to get reliable approximations of the larger-scale administrative and statistical cuttings.

This variability of the cutting methods, notably considering the population thresholds or the town and country planning morphology, has an influence on the statistics themselves. Indeed, more important population numbers can have moderating effects on the collected data. In addition of the consideration of the absolute surface and thus the spatial precision of the data, these elements must be taken into account for the interpretation.

2. Accessibility of the geographical data

The geographical data concerning infracommunal cuttings make it possible to chart the statistics. The mode of presentation is often in the "shapefile[1]" format of file, owner format but largely widespread in the world of the cartography.

Several types of suppliers were noticed in the European Union:

- the statistical institutes (or ministries) which sub-contract the digitalization of the entities and resell the finished product;
- the institutes of cartography which creates a cartographic product and distributes it such as other products of this kind;
- the third companies to which the statistical institutes (or comparable) give the right to sell the cartographic files.

The price of these data strongly varies from one country to another, in particular following the precision and the extent of the map. The noted prices are from about several hundred of euros up to several thousands of euros according to the products.

The census data are not always accessible to the third parties, insofar as the protection rules of pivate life can forbid the diffusion. Although there can be this situation at the commune scale for specific data (for example, concerning the study of the foreign population by nationality), the low volume of population in some statistical sectors implies this situation often occurs. The threshold diffusion depends on the right of each country concerning private life protection, which is different from a country to another one. Generally, we cannot diffuse some frequencies inferior to a threshold, for example we cannot publish the number of number of persons on income support when it is inferior to five in a commune.

1.2.4. Example : the Commune of Seraing (Wallonia – Belgium)

[1] *Shapefiles is a format of file initially implemented by the company ESRI, de facto reference in the software of cartography and geographical information system (GIS). This format is used (and compatible) by a majority of software SIG / cartography. It contains a geographical layer of information being able to be used as support with the cartography of contextual data.*

The commune of Seraing belongs to the urban center of Liege (Belgium) and knows similar problems, related to the strong industry decline in this area (specialization in steel). Although an important part of the population still lives thanks to this industrial sector, some neighborhoods of Seraing encountered a strong population gentrification. This dynamics is however not spatially continuous, and certain neighborhoods of the Commune accommodate relatively young and dynamic populations, with an unemployment rate lower than the average.

In order to fight the social problems generated by this situation, various associations with different objectives work in the Commune. The working scale appreciably differs from one organization to another, it goes from the neighborhood scale to the scale of the Commune, or even more.

The territory disparities imply that the analysis on the commune scale is not very relevant. It is for example necessary to be at the statistical sectors level to perceive the neighborhoods the more affected by unemployment. The observation of the poorest populations present in bottom of the valley could also have been noticed on the ground, but the situations are not necessarily so clear.

The cartography intervenes then as a tool of decision-making aid for the policy and operational options, in particular in terms of public expenditure and/or human means to allocate for the populations. In the long run, this cartography must also show the effect of the policies on the territory within the framework of a control of the effectiveness of the action undertaken.

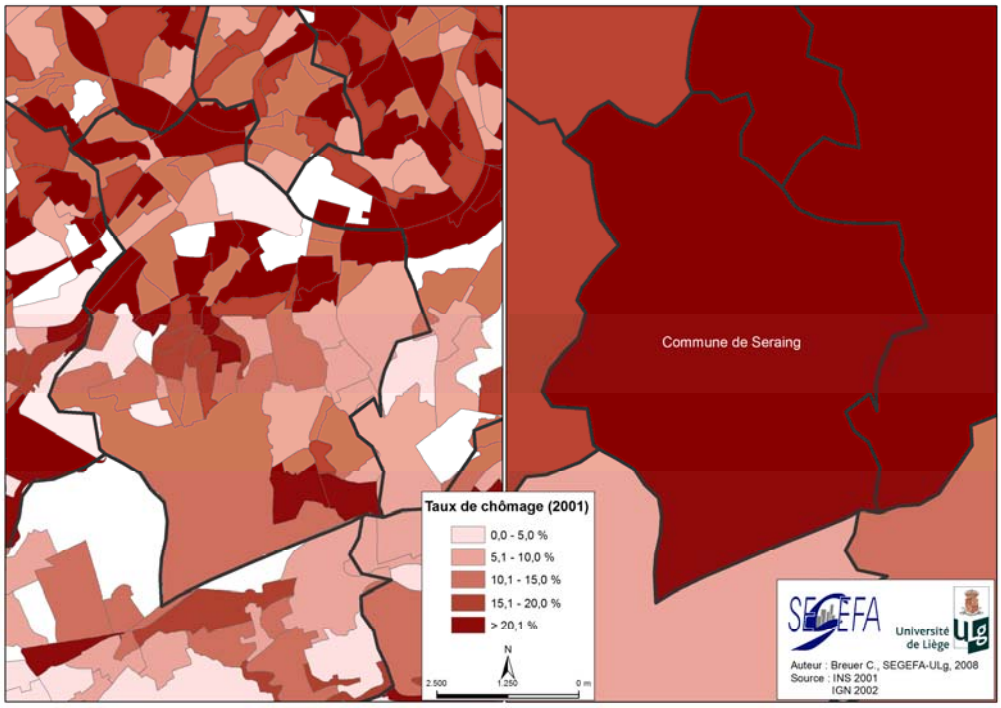


Figure 2 : Comparison between communal and Statistical cuttings in Seraing (Wallonia – Belgium)

1.2.5. Conclusion

The communal level as a base for the analysis is relevant because it is, in Europe, a democratic level presents in each country, even if the names can differ. However, a finer analysis, in particular the level of the statistical sectors (and related) makes it possible to put in front in a more relevant manner the disparities within the communal territory, and consequently to direct the action as well as possible.

The accessibility of these data is however weak. Indeed, if the distributers, for both the socio-economic and geographical data, are largely identified and known, the cost of acquisition remains prohibitory. This difficulty seems to curb the effective use of the cartographic tool on an adapted scale.

2. WEBMAPPING

2.1 Introduction to web mapping technology

Web mapping technology (also: Web GIS (~ Server); Internet GIS (~ Server); Geospatial server) is a technology that enables the remote delivery of maps on the Internet. It includes several processes: designing, implementing, generating and publishing the map. On the user's side web browser is used as a client and usually no software installation is necessary. Maps may be accessed from desktop and portable computers. Web Mapping technology is an important component of a wider system, called Geographic information system (GIS), which is an information system for capturing, storing, analyzing, managing and presenting data which are spatially referenced (i.e. data linked to location).

Web Mapping enables delivery and publication of high-quality interactive maps, data from GIS, and associated metadata, with the ability to query, manipulate, and interact with data. It can display both raster and vector data structures, enabling the dissemination of a wide variety of data types, for example satellite imagery, topographic data, and thematic maps. Maps may also be linked to databases and other information sources, allowing it to be visualized and queried. The system can also be extended to link to other resources and allow multimedia components, like photographs, video, sound etc. to be displayed for particular features of the map.

Web mapping technology uses a server-client technology to exchange information trough the HTTP protocol. Client (i.e. web browser on user's side) requests the map or other information with certain parameters from the server. The server responds with map data and ancillary information.

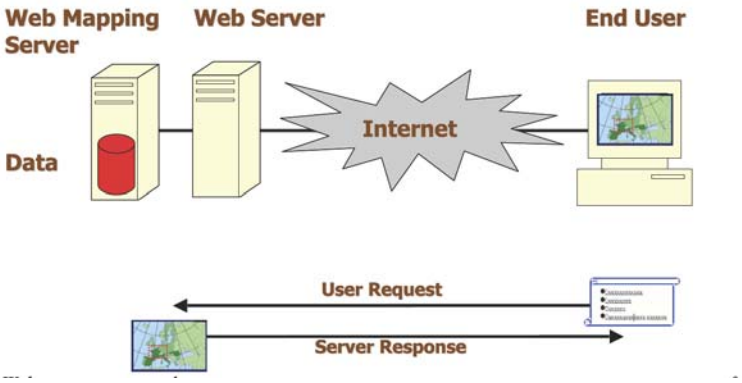


Figure 3: Web mapping system has very complex architecture. It uses server-client technology to transfer user requests to maps as an output.

Web mapping system has very complex architecture. However on conceptual level four basic components are found:

- *Data*: This is essential component of the system! Data can be vector or raster type, stored on data-server in variety of different formats, organized as files or databases.
- *Map / Mapping software*: Web mapping software is server-side program that can dynamically produce a map out of the Data according to the client's request. Map is composed of data-layers, displayed in selected projection, rendered in defined manner.
- *Map Tools / Web application*: Map Tools contain user tools to manipulate and explore the map as well as to retrieve textual information. Map Tools are delivered in the form of HTML and web-scripting-based Web application that is used as a wrapper around the Map.
- *Client / Web browser*: On user's side ordinary web browser is used as a client to open the Web application and explore the map. No other additional software is required; some solutions however require download of additional plug-in component for the browser.

The first three components are present on the server side and the fourth one on the client side. pre-acts - 6th annual international conference of Territorial Intelligence - caENTI – October 2008 3

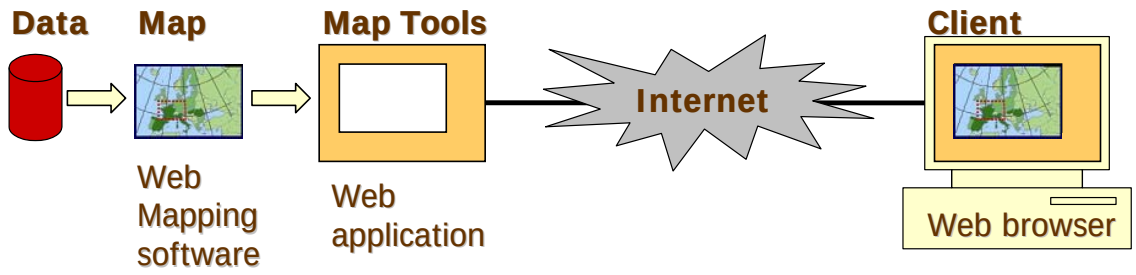


Figure 4: Logical components of Web mapping system.

Interactive map, based on Web Mapping technology, is a very powerful tool. First, it is dynamic tool. End user can interact with it; can "speak" with it to display the map – and also contextual information – that he wants. This is the most important advantage compared to the static, pre-prepared maps that are basically static images. Second, it is highly visual tool, and graphical presentation can outperform normal textual or tabular information. Last but not least, it is very simple to use, only basic computer skills are required for the end user to be able to get all the capabilities.

2.2 Objectives of web mapping of caENTI

Main objective of the Web Mapping within the caENTI framework was to design an Interactive map of Europe for visual representation of selected caENTI indicators. Interactive map has to be built on standard Web Mapping technology (section 1). The work was divided into four subtasks (which follow the conceptual division of Web Mapping system, described within section 1):

- Selection of appropriate software for Web Mapping and for Map Tools (section 3).
- Data: Obtaining and processing the geographical and attribute data to be presented together with its metadata (section 4).
- Map: Preparation of a Map with the selected Web Mapping software (section 5).
- Web application: Preparation of a Web application with the help of selected Map Tools library (section 6).

It has to be stressed that the interactive map has not been completely finished at the stage of writing this paper.

Therefore some items described within the following sections are still in the development phase and might change in the final form.

2.3 Sélection of software

The selection of software has been focused to the so called open source solutions (as opposed to the closed source).
Open source is development methodology, which offers practical accessibility to a product's source (goods and knowledge). In the computer world it is commonly applied to the development of source code for software which is made available for public collaboration, and it is usually released as open-source software. We are convinced that open source solutions are more suitable for scientific and research use, since they are free, they are vendor independent, and since they can be upgraded by additionally developed modules (either by the user or the community). On the other hand, however, more skills are needed on developers' side for the installation and development of the application.

Open source Web Mapping	**Closed (proprietary) software Web Mapping**

	solutions	**solutions**
price	Free	normally 10.000 - 20.000 EUR
installation and use	more skills are needed	relatively easy
own modules	can be added	cannot be added
includes	mapping only	mapping and tools
other	Independent	vendor dependent
examples	Geoserver, UMN MapServer	ArcIMS, MapGuide Enterprise

Table 1: Comparison between open and closed source Web mapping software solutions.

In search for highly standardized solution we followed the recommendation, given by two main non-profit opensource geospatial organizations:

- . The *Open Geospatial Consortium* (OGC): It is a non-profit, international, voluntary consensus standards organization that is leading the development of standards for geospatial content and services, GIS data processing and exchange.

- The *Open Source Geospatial Foundation* (OSGeo): It is a non-profit non-governmental organization whose mission is to support and build the highest-quality open source geospatial software.

OGC is responsible – among other well known standards (GML, KML ...) – also for a very important standard for delivery of maps across the Internet. This standard is called *Web Map Service* interface standard (WMS). WMS provides a simple HTTP interface for requesting geo-registered map images from one or more distributed geospatial databases. A WMS request defines the geographic layer(s) and area of interest to be processed. The response to the request is one or more map images (returned as JPEG, PNG, etc.) that can be displayed in a browser application.

OGC specifies also Styled Layer Descriptor (SLD), XML-based coding scheme for describing the appearance of map layers. A typical use of SLDs is to instruct a WMS of how to render a specific layer.

In section 1 it was stated that on conceptual level map is distinct from the data which composes the map. Also, the tools for exploring the map are distinct from the map itself. This concept is followed by the standards and software that are developed by OGC and OSGeo, respectively. Therefore, following proposals from OGC and OSGeo, we had to find two separate software modules to build the Interactive map for caENTI. Among the tested products (GeoServer, MapBender, MapServer, OpenLayers and Open Source MapGuide) the following two products were selected:

- for the Web Mapping software: *GeoServer*

- . for the Tools software: *OpenLayers*

GeoServer (currently in stable version 1.6.4.) is the most standards compliant open-source Web Mapping server. It is built upon the GeoTools Java code library for geographical data and OGC specifications. GeoServer runs on all major operating systems and will work with almost any Web server. It allows publishing of geospatial data in the form of maps using the OGC's standard WMS (version 1.1.1) and also publishing of actual data, supporting OGC Web Feature Server (1.0 and 1.1), and OGC Web Coverage Server (1.0) specifications. GeoServer reads a variety of data formats, including Shapefiles, PostGIS, Oracle Spatial, ArcSDE, DB2, MySQL, GeoTIFF, GTOPO30 (some of them can be edited via the WFS-T). Through the standard protocols it produces KML, GML, Shapefile, GeoRSS, Portable Document Format, GeoJSON, JPEG, GIF, SVG, PNG and more. As far as the speed of map delivery is concerned GeoServer (from version 1.6 on) is said to become very comparable with its older and more known competitor UMN MapServer.

OpenLayers (current in stable version 2.6) is an open source JavaScript library for displaying map data in web browsers. It provides an API for building rich web-based geographic applications. It enables easy incorporation of maps from a variety of sources into same application. It has support for OGC WMS layers, navigation, icons, markers, overview map, and layer selection.

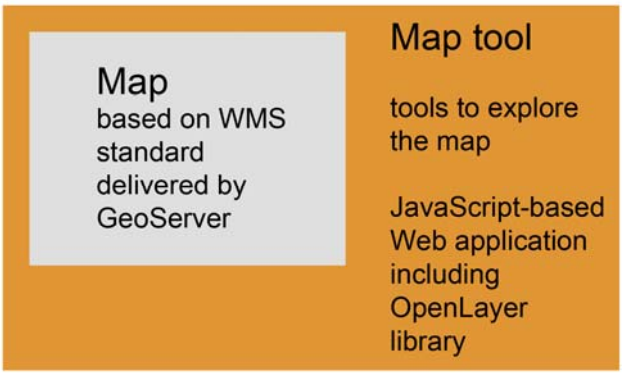


Figure 5: Schema of selected software.

2.4 Data préparation

Spatial data is essential for successful application of any GIS system in general and Web Mapping application in particular. The important data issues are of quantitative (contextual richness, completeness) and qualitative (accuracy, categorisation, data formats, methods of obtaining data, metadata) nature. Partners of the caENTI framework were well aware of this since they have prepared a large set of data. The collected data is from different sources, thus of different quality and completeness.

2.4.1 The NUTS standard

The Nomenclature of Territorial Units for Statistics, (NUTS; for the French *nomenclature d'unités territoriales statistiques*) is a code standard for referencing the administrative divisions of countries for statistical purposes. The purpose is to have a single code for each administrative division, and to identify each administrative level. The standard was developed by European Union and thus covers only the member states of the EU in detail. At the moment, Eurostat establishes NUTS codes for the 10 countries that joined the EU in 2004, but they can be changed in the future. The NUTS divisions do not necessarily correspond to administrative divisions within the country. The different levels are determined by minimum and maximum thresholds for the average size of regions, like in table 2.

Level	Minimum	Maximum
NUTS 1	3 million	7 million
NUTS 2	800 000	3 million
NUTS 3	150 000	800 000

Table 2: Thresholds for individual NUTS levels.

A NUTS code begins with a two-letter code referencing the country, which is identical to the ISO 3166-1 alpha-2 code (except UK instead of GB for the United Kingdom). Then, each level adds one number as in table 3.

Country	NUTS 0	NUTS 1	NUTS 2	NUTS 3	LAU 1	LAU 2
Belgium	BE	BE1	BE11	BE111	-	BE11100001
France	FR	FR1	FR11	FR111	-	FR11100001
Hungary	HU	HU1	HU11	HU111	HU11101	HU111010001
Spain	ES	ES1	ES11	ES111	-	ES11100001

Table 3: Coding of different NUTS/LAU levels.

Each numbering starts with 1, as 0 is used for the upper level. In case the subdivision has more than 9 entities, capital letters are used to continue the numbering.
There are four levels of NUTS defined, with two levels of local administrative units (LAU) below. Before July 2003, LAU1 was called NUTS4, and LAU2 was NUTS5, later the terms NUTS4 and NUTS5 were officially abolished by regulation, although they are sometimes still in use. For each country, the number of levels depends on its size. LAUs are established by Eurostat and not by European Union.

2.4.2 Attribute data

Through the caENTI a vast number of socio-economic indicators for all European Union countries were obtained for different levels of detail. For the Interactive map, it was decided to limit the levels of details as well as number of presented indicators. The levels of details to

be presented are: NUTS0, NUTS1, NUTS2, NUTS3, and LAU2 (only for 4 pilot countries: Belgium, France, Hungary, Spain). As far as the indicators is concerned, in the initial implementation of Interactive map only 6 of them were selected:

- Total population
- Density of population
- Active population
- Unemployment rate
- Net income available for household
- Average size of household

The indicator data for levels NUTSx were collected by the members of caENTI project team. The obtained indicator data differs in considerably in several parameters. It differs in year of validity of data. In a lot of cases we lack indicator data for some spatial units and/or for some levels NUTSx/LAU2 – in such case the corresponding indicator cannot be followed completely throughout the complete EU and/or all levels of detail. In the table 5 already processed data is highlighted in green. Please note that the table shows the situation in the December 2009.

	Level of details				
Indicator	NUTS0	NUTS1	NUTS2	NUTS3	LAU2*
Total population [persons]	EU+	EU+	EU+	EU+	Belgium Hungary (few units)
Density of population [/km2]	EU+	EU+	EU+	EU+	Belgium
Active population [%]	EU+	EU+	EU+	EU+	
Unemployment rate [%]	EU+	EU+	EU+	EU+	Belgium Hungary (few units)
Net income available for household [EUR]	EU, total for spatial unit	EU, total for spatial unit	EU, total for spatial unit		Belgium (few units)
Average size of household [persons]	EU (few units)				Belgium (few units)

Table 4: Obtained and processed indicator data (marked with green).

2.4.3 Vector data and cartographic specification

Geographical vector database was obtained from EuroGeographics. We obtained data for different level of detail:

NUTS1 to NUTS3 and USE1 to USE6. All data were reprojected to the selected projection (see below) and exported to shapefile format. Shapefile, although being native format of ESRI

and its ArcGIS software (and thus being propriety), is probably the most widespread format for spatial vector data. Shapefile groups spatial data, attributes and projection information together in such a way that no mistake is possible with the correlation between them.

The entire vector database, obtained in WGS 84, was reprojected to the selected projection, which is Lambert Conform Conic (LCC) on datum ETRS 89. The LCC projection was selected for several reasons. First it gives balanced representation of all European countries as far as surface area is concerned, giving minimal distortion also on Scandinavia and Great Britain. Datum ETRS 89 was selected to comply European datum recommendations.

2.4.4 Combined data

Geographical vector data and indicator data were linked with the identification key being the NUTS code (see section 4.1). As a final result we had:

- shapefiles for whole Europe with 6 indicators as table attributes for NUTS levels 0, 1, 2 and 3, respectively.

- 4 shapefiles with 4 indicators as table attributes for level LAU2 for pilot study areas in Belgium, France, Hungary and Spain, respectively.

2.4.5 Metadata

Metadata is data about data. It is of extreme importance, since it gives qualitative parameters of the data itself. As any map, also interactive map should deliver basic metadata about the data that are presented on the map.

2.5 Map design

The preparation and design of the map was done in the selected Web Mapping software GeoServer. The final look however is configured later within the Web application (see section 6). To design the map the following steps were taken:

- . installation and configuring of the GeoServer,

- pre-processing and reprojecting of the data (described within section 4),

- uploading of the data to the GeoServer, and

- rendering of data-layers by implementing OGC's XML-based coding scheme Styled Layer Descriptor (SLD).

When those steps were taken, the GeoServer was ready to accept the HTTP request according to WMS standards. As a response GeoServer returns a layer (as a part of a map), either layer's legend or layer's feature information. For every available combination of indicator and NUTSx/LAU2 level a separate layer was prepared.

2.6 Web application

Web application combines the Map with needed visual and contextual tools for exploring the Map. For the mapping tools implementation the open source library OpenLayers was selected. Since OpenLayers is a JavaScript library, JavaScript was naturally selected to be main design language of the web application. To build the web application the following steps were taken:

- graphical design of the web-page,
- composition of the Map from WMS layers from GeoServer using the WMS requests GetMap, GetLegend and getFeatureInfo,
- implement needed tools from the OpenLayers library, and
- design and implement proprietary tools if they are not available within the OpenLayers library.

Implemented OpenLayers tools are (all OpenLayers tools a graphical design was changed from the default one):

- Different zoom and pan tools: These are tools to change the geographical area that is shown on the map by changing the scale of the map (zoom-tools) and by moving the map (pan-tools). The following tools were implemented: Zoom Slider, Zoom In, Zoom Previous, Zoom Next, Zoom to Full Extent; Pan Arrows, Pan Hand.
- Current scale and current cursor position on the map (x, y) in selected projection (see section 4.3.), given in 'meters'.
- Overview map: small map in which rectangle shows the extent that is presented on the main map
- Identify tool: displays attribute data (indicators) of all layers of the clicked point on the map

Implemented proprietary tools:

- Selection of indicator and level of details NUTSx/LAU2 to be presented on the map. The legend corresponding to the indicator is also displayed.

- Zoom to country: tool that enables direct zoom to each EU country.

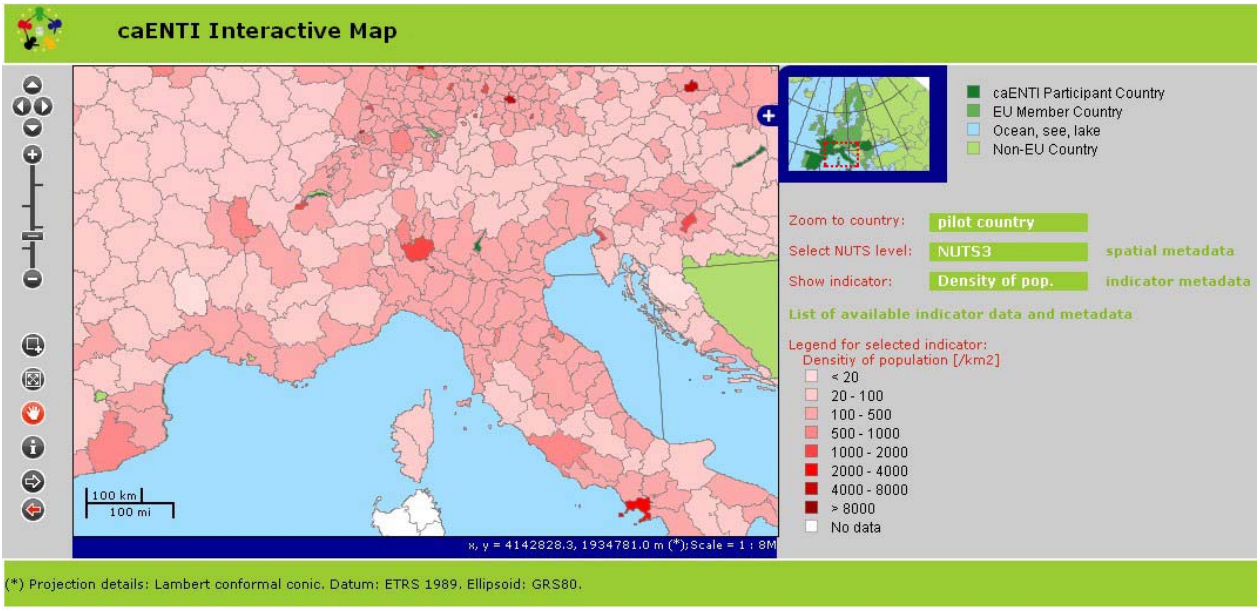


Figure 6: One of the development phases of Web application. Map is delivered by Web mapping software GeoServer, tools are written in JavaScript.

2.7 Conclusion

In its final form the Interactive map of caENTI enable visual presentation of 6 selected socio-economic indicators for EU countries in different levels of detail from NUTS0 to LAU2. The proposed solution is based on the open source Web mapping technology; the selected software tools are GeoServer (for Web mapping) and JavaScriptbased library OpenLayers (for Map tools). The caENTI Web mapping portal is simple to use and the end user will need just standard compliant web browser and only basic computer skills will be required.

It can be said that Interactive map has a potential to become very powerful tool for technical teams of the caENTI member groups and the whole European community to get appropriate visual and contextual information, thus it can become very important aid for analysis and research.

3. METADATA

Volumes of data treated by the system of representation of territorial information are considerable: it is a question of distributing data of 27 countries for many indicators. Potentially, taking into account the administrative levels, that represents a number of several million of data. The preceding studies (CAENTI, 2008) showed in addition that the sources of the indicators are numerous, and that the conditions of obtaining are particularly diversified.

In this context, several arguments are in favor of the collection and the aggregation of metadata describing at the same time the data themselves, and the indicators. Firstly, the end users must be able to analyze the data by knowing the methods of calculating of the indicators, the year of the data, their source, etc. In the second place, the metadata are useful within the framework of the updates and the various automatic treatments being able to be carried out on the database.

The research undertaken within the framework of program CAENTI (DAMY *and al.*, 2008) aims to harmonize the metadata and to adapt them to the geographical data and the indicators. The research undertaken in this direction is based on Dublin Core and the ISO standards. Work led to a proposal of grid for the metadata, which was successfully tested on European and national indicators, like on geographical files.

The results of this research led within the WP6I framework are published in the Deliverable 60, “Specifications for a Territorial System of Information”.

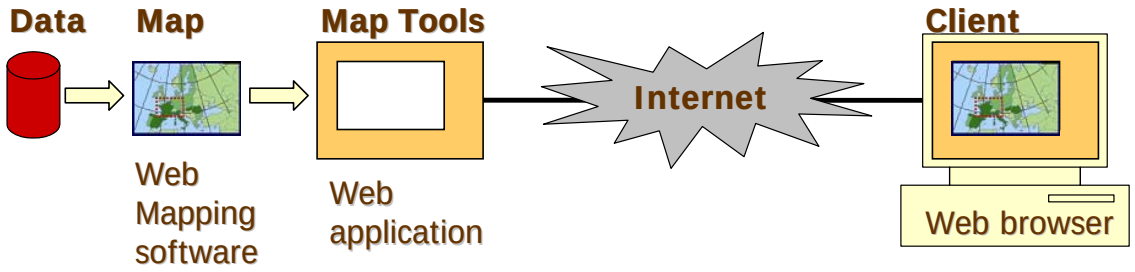
4. GUIDE D'UTILISATION DU WEB MAPPING

TOOLS: INTERACTIVE MAP FOR CAENTI

Peter Pehani, Krištof Oštir (ZRC SAZU, Slovenia), Marion Landre (University of Franche-Comté, MSHE Ledoux, France)

Interactive map for caENTI is a dynamic tool for presentation of selected socio-economic indicators of European Union countries. Interactive map is fairly simple to use. On user's side web browser is needed, and only basic computer skills are required.

Architecture of the solution is based on Web Mapping technology. The architecture is quite complex, however on conceptual level four basic components can be found (see *Figure 1*). The caENTI solution is based on Mapping server GeoServer, web application is designed on



scripting technologies ASP and JavaScript library OpenLayers.

Figure 1: Logical components of Web mapping system.

Data

Through the caENTI a vast number of socio-economic indicators for all European Union countries were obtained for different levels of detail. However for the Interactive map, it was decided to limit the levels of details as well as number of presented indicators. The levels of details that are presented are from NUTS0 to NUTS3 and LAU2 (only for 4 pilot countries: Belgium, France, Hungary and Spain). In the initial implementation of the Interactive map only 6 selected indicators are presented. Table 1 shows which indicator data are available for different level of details (available data are in green; yellow text denotes work in progress)

	Level of details				
Indicator	NUTS0	NUTS1	NUTS2	NUTS3	LAU2*
Total population [persons]	EU+	EU+	EU+	EU+	Belgium Hungary (few units)
Density of population [/km2]	EU+	EU+	EU+	EU+	Belgium
Active population [%]	EU+	EU+	EU+	EU+	

Unemployment rate [%]	EU+	EU+	EU+	EU+	Belgium Hungary (few units)
Net income available for household [EUR]	EU, total for spatial unit	EU, total for spatial unit	EU, total for spatial unit		Belgium (few units)
Average size of household [persons]	EU (few units)				Belgium (few units)

*Table 1: Available indicator data (*Note: LAU2 indicator data for France and Spain will be available soon).*

Table implies that in some cases indicator data are missing for some spatial units and/or for some levels NUTSx/LAU2. In such case the corresponding indicator cannot be followed completely throughout the complete EU and/or all levels of detail.

Metadata

Metadata is data about data. It is of extreme importance, since it gives qualitative parameters of the data itself. For the caENTI the set of metadata was proposed, grounded on propositions of standard ISO 19115 and Dublin Core. Interactive map delivers metadata about the indicator data as well as about spatial data (see *Table 2*).

	Level of details				
Indicator	NUTS0	NUTS1	NUTS2	NUTS3	LAU2
Spatial data	EU+	EU+	EU+	EU+	Belgium
Total population					Belgium
Density of population	EU+	EU+	EU+	EU+	Belgium
Active population					
Unemployment rate					Belgium
Net income available for household					Belgium
Average size of household					Belgium

Table 2: Available metadata.

Instructions for use

User opens a map in the web browser. The basic components of the working window are (see *Figure 2*):
(1) *the Map*: shows the thematic map of selected indicator in the selected level of detail. In the status bar below the Map one can find the scale and the current mouse coordinates (in the Lambert Conform Conic projection on ETRS89, given in meters).
(2) *the Overview Map*: the small map of EU; red dashed rectangle shows the current extent of the main Map (1)

(3) *the Toolbox* with different tools to zoom, pan and identify
(4) *the User-tools panel* including tools to select the combination of indicator and level of detail to be presented, metadata service, legend, aso.

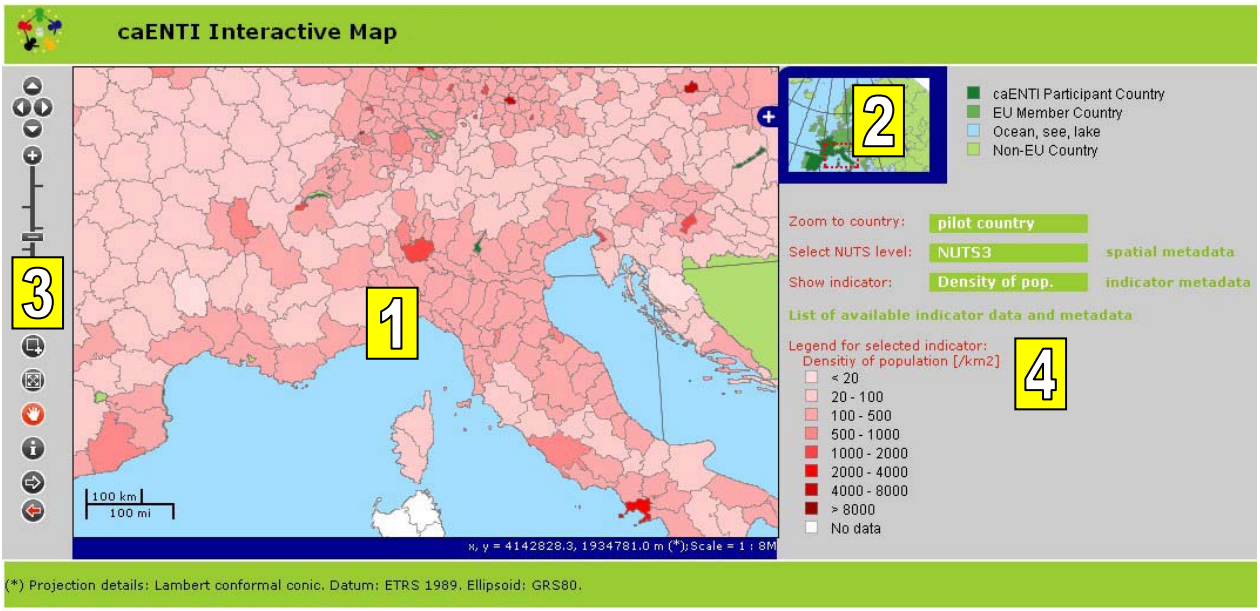


Figure 2: Components of the working window of the Interactive Map for caENTI.

Selection of the content that is presented on the map:

Within the main Map (1) different thematic maps can be shown. The thematic presents the selected indicator in the selected level of detail (NUTSx/LAU2). Tools for selection of indicator and level are located within User-tools panel (4). Theoretically any combination of indicator and level is possible, however all data are not available at the moment.

Select NUTS level: NUTS level

Select the level of details by changing the value of the "Select NUTS level" drop-down menu. Map is automatically redrawn into the selected level. There is no default value for this level, so level has to be selected to draw the first thematic map.

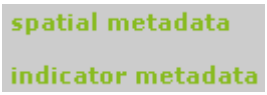
Show indicator: Density of pop.

Select the indicator by changing the value of the "Show indicator" drop-down menu. Map is automatically redrawn to show the selected indicator, legend is automatically replaced to one corresponding to the selected indicator. Default value is "Density of population".

List of available indicator data and metadata

By clicking the "List of available indicator data and metadata" button all available combinations of level

of detail and indicator data are presented in a separate window. There are tables given for indicator data and metadata, respectively.



Show the metadata of the spatial data and indicator data by clicking the "spatial metadata" and "indicator metadata", respectively. Metadata are shown in separate window. Note: List of available metadata is accessible under the "List of available indicator data and metadata" button.

Tools to change the view/scale and to identify

Tools to change the map extent are located within the Toolbox (3), with the exception to Zoom to Country tool, which is located in the User-tools panel (4).

Pan Arrows: click to corresponding arrow to move across the Map up, down, left and right.

Zoom Slider: click plus sign and minus sign to zoom in and zoom out respectively; or click-and-drag the slider.

Prepare PDF Document/Print: click the tool to prepare a PDF document, which can be then viewed and/or saved. Note: some of browsers enable viewing and saving (e.g. Mozilla Firefox), other only saving (e.g. MS Internet Explorer).

Zoom In: select the tool, than draw the target extent by click-and-drag. Note: this is a mode-tool*.

Zoom to Full Extent: press the tool to get the initial extent.

Pan: select the tool and move across the Map by click-and-drag. Note: this is a mode-tool*.

Identify: select the tool, than click point on the Map. All indicator data of all NUTSx/LAU2 levels of the clicked point are presented in a separate window. Note: this is a mode-tool*.

Zoom Next: press the tool to get the following extent Note: Tool is available only after using the Zoom Previous tool.

Zoom Previous: press the tool to get previous extent.

Zoom to Country: on the drop-down menu select the country to zoom to it. Currently only zooming to pilot countries is implemented. Note: This tool is located in the User-tools panel (4).

*Mode-tool is a tool that remains active until you select another mode-tool. It remains active also if you are using some other (non-mode) tool meanwhile. Mode-tools are: Zoom In, Pan and Identify.

5. CONCLUSION

The realization of a European gate of indicators as component of the cognitive process of the territories requires a particularly important basic work. After a selection of the indicators represented on the basis of guide adapted to the method CATALYSE, the relative questions to obtaining the data and the metadata emerged. They highlighted the need for collecting both data simultaneously to inform the end user as well as possible.

The collection of information was also particularly instructive to show the availability and the cost of acquisition of geographical information or indicators. The disparities of information spread shown during the research also show the difficulties encountered by the actors to obtain abundant and relevant territorial information. The centralization of the information and its standardization seem to be an essential prerequisite for the processes of the territory knowledge, efficient and accessible for the various actors.

In parallel, the future developments of the cartographic tool will probably make it possible to permit to introduce their own contextual data meeting their needs specifically: in this case, if the data are actually provided by the end user, the shapefiles will have to be provided by the owner of the platform.

The use of an interactive cartographic interface based on technologies of *Web mapping* makes it possible to exploit with relevance the elements implemented before and to widely diffuse near users, whom are sometimes not accustomed with the methods of cartography essential for the comprehension of the territories. The existence of a functional prototype based on real and territorialized data tends to confirm the feasibility of one gate on a European scale, realizing substantial improvements on the level of the accessibility of the data. The work undertaken by the caENTI project allows making recommendations at the European Union to improve the territorial information spreading and to increase the effectiveness of the local actions.

The work initiated within the caENTI framework allowed as starting a theoretical approach (WP4i) in collaboration with the local actors, as implementing the recommendations made in an operational pilot tool (web mapping) for territorial actors. Nevertheless, many identified problems cannot be solved in the technical tools improvement, but in the good practices regulation and diffusion, in order to increase the efficency of public action.

It is important to notice that a significant part of the problems faced during the data gathering should be solved by implementing the elements inscribed in the directive “establishing an Infrastructure for Spatial Information in the European Community” INSPIRE (2007/2/EC). It is already being implemented in public and paragovernmental administrations, under the

responsibility of the Member States, following the emission of regulation (EC) n°1205/2008 of the European Commission about the application modalities of the concerned directive, voted on December, 3rd 2008.

We recommend to create and gratuitously provide a presentation tool of the statistic data under a mapping shape for public authorities, paragovernmental organizatons and associations that work to improve life environment and people accompaniment, at the European Union scale. The fact the tool is free should allow the associations that have few budget being able to evalutate as the territories problems and dynamics, as their policies results. The European nature if the tool meets the analyses imperative transnationality, especially for all the territories located on the margin of the members States.

If it is not possible to provide all the data for free, it is necessary to guarantee a maximum accessibility to the data lined to people state within the sustainable development framework. This necessity is accompanied by the harmonisation of the territorial indicators calculation.

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