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ESPON BSR-TeMo
Territorial Monitoring for the Baltic Sea Region

Scientific Platform and Tools Project 2013/3/9

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Part C | Scientific Report

Volume C5 | Visualisation issues

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This report presents a more detailed overview of the analytical approach to be applied by the project. This Applied Research Project is conducted within the framework of the ESPON 2013 Programme, partly financed by the European Regional Development Fund.

The partnership behind the ESPON Programme consists of the EU Commission and the Member States of the EU27, plus Iceland, Liechtenstein, Norway and Switzerland. Each partner is represented in the ESPON Monitoring Committee.

This report does not necessarily reflect the opinion of the members of the Monitoring Committee.

Information on the ESPON Programme and projects can be found on www.espon.eu

The web site provides the possibility to download and examine the most recent documents produced by finalised and ongoing ESPON projects.

This basic report exists only in an electronic version.

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1 Background

The territorial monitoring system for the Baltic Sea Region entails a strong visual component. Different means of visualization of indicator results and of the demonstration examples are required to illustrate the project output and to provide different views on each indicator and on each type of analyses – the BSR view benchmarked to other regions and the ESPON space as a whole.

Visualization is thus crucial for the success and acceptance of the monitoring system for the Baltic Sea Region. The *Presentation Tool*, as introduced in Volume 3 of the TeMo Scientific Report, relies to a large degree upon illustrations in form of maps and charts.

This Volume of the TeMo Scientific Report introduces the general concept for visualisation and analysis (Chapter 2), including its components and functional requirements, and highlights some of its crucial elements, such as regional subdivision (Chapter 3), map templates (Chapter 4), visualisation concept (Chapter 5) and the integration of alternative spatial units.

The look, functionalities and usage of the *Presentation Tool* as such describes Volume 6 of the TeMo Scientific Report.

2 Concept for Visualisation and Analysis

2.1 General considerations

The *Presentation Tool* is conceptually designed in a way to provide easy access to the different physical outputs of TeMo (Figure 1), illustrating the different kinds of analysis through different ways of implementation.

The monitoring system will focus on three types of ***analyses***, which are the analysis of disparities at one point in time, to look at developments over time (trends) and to benchmark the Baltic Sea Region with other macro regions in Europe by means of four demonstration examples (overall benchmarking, territorial cohesion, cross-border regions, migration; results of these applications are provided in Volume 4 of the Scientific Report).

As ***outputs***, analyses results are documented in maps (i.e. the main form of illustrations in ESPON), diagrams, as well as in tables and as time series graphs.

All these are ***implemented*** as map templates in a GIS (ArcGIS), are laid down in tables and Excel files, and are made available to the user through an easy-to-use local browser application (i.e. the territorial monitoring ***system***), the so-called *Presentation Tool*. The latter is particular designed to enables non-GIS professionals to access the monitoring results through a simple application, which is not bound to any specialized software or by specific operating system requirements. GIS professionals may still, in addition, utilize the ArcGIS map files, together with the underlying GIS database, to perform further analyses or to create their own maps.

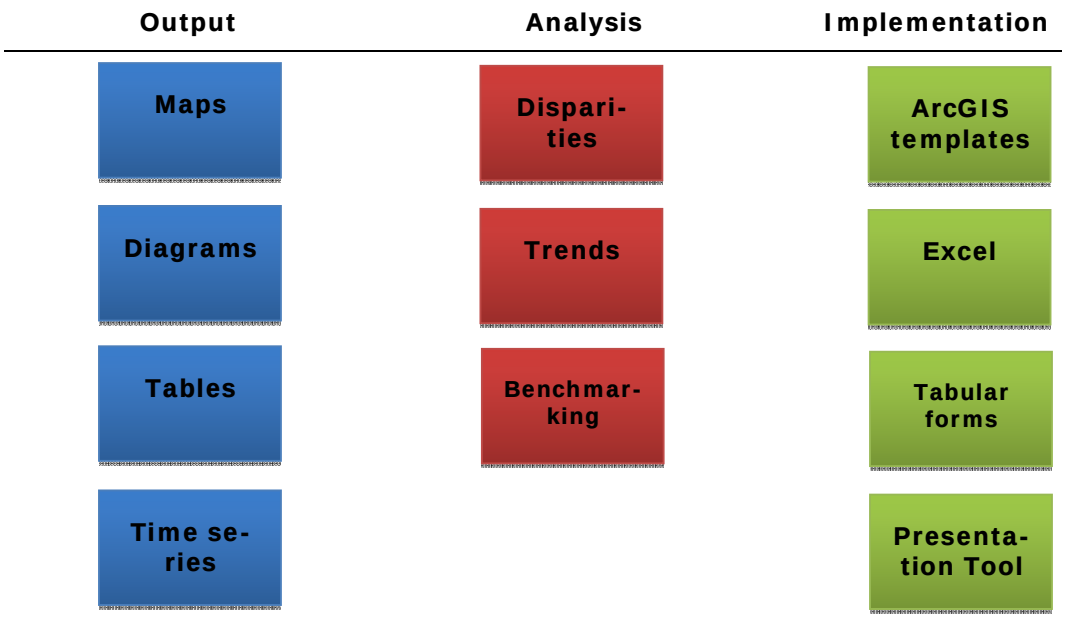

Figure 1. Presentation and visualization framework.

The concept for the visualization framework foresees a flexible framework, where all output, analysis and implementation components tightly integrate with each other. ArcGIS map template files create indicator maps based upon the integrated TeMo GIS database. From ArcGIS, maps can be exported in PNG, AI or SVG file formats into the specifically designed folder structure, from where the *Presentation Tool* loads and illustrates the exported maps, as well as charts and project documentations.

The easy-to-use *Presentation Tool*, the local browser application, not only provides access to the indicator maps, but also grants easy access to the domain and subdomain descriptions, indicator metadata and indicator descriptions, as well as to specific implementation recommendations for each single indicator. All this information can of course also be printed or exported from within the browser application. Figure 2 illustrates the starting page of the browser application.

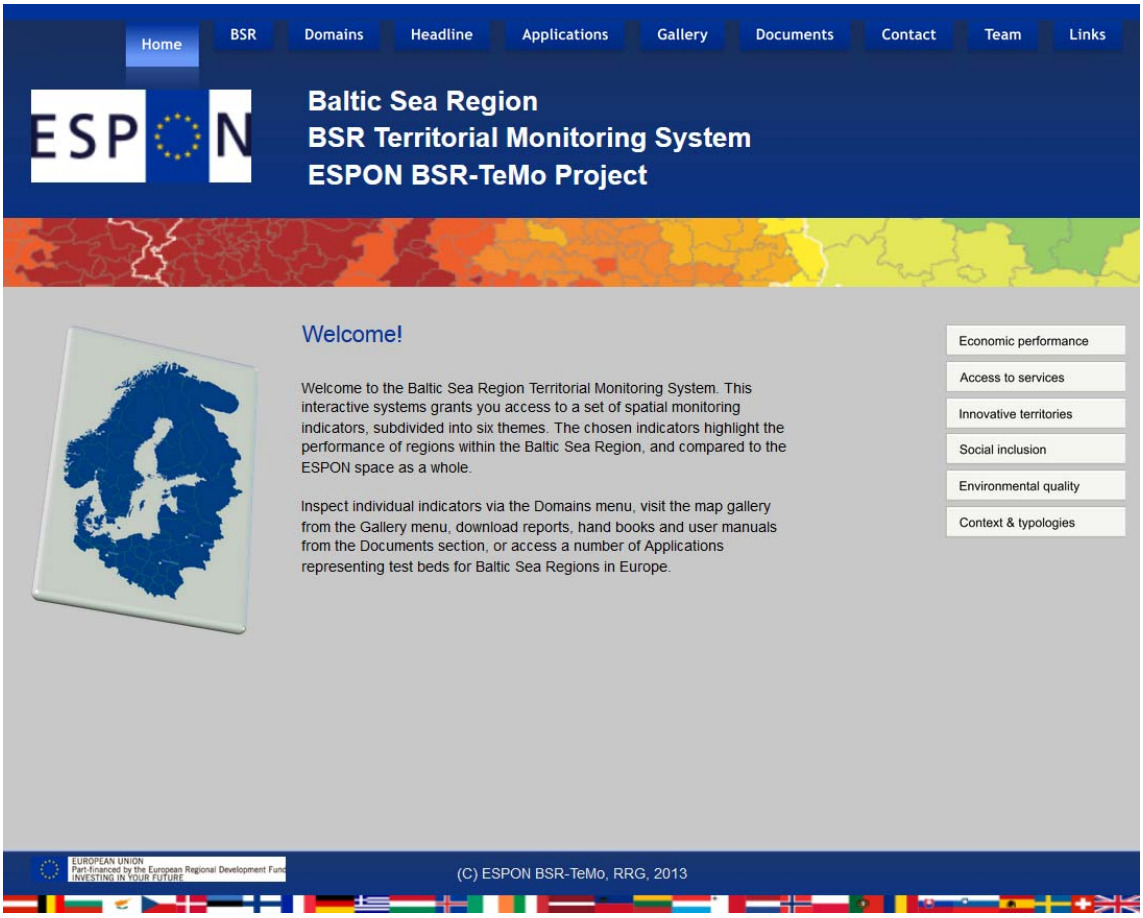

Figure 2. Starting page of the Presentation Tool as Gateway to the Monitoring System.

While a similar concept for the underlying GIS database and folder structure has already been developed in the framework of the ESPON INTERCO project (see Chapter B.2.3 of Final Report of ESPON INTERCO; Dao et al., 2012), the *Presentation Tool* is a new development on top of the INTERCO approach. One of the deficits of the INTERCO approach was that, despite the well-structured database and folder structures, the user still had to know where to look for which kind of information. Thus, he had to navigate through folders and subdirectories in order to obtain the information he is interested in[1]. In TeMo, the *Presentation Tool* is designed in a way that the user is guided by simple hyperlinks and navigation bars, representing the domains and subdomains. In times of widely used web applications, most users are familiar with such browser-based applications, thus no tech-

[1] The ESPON INTERCO Final Report is only of little help for the user in this respect. Even though INTERCO already strived for a standardized indicator presentation, the full indicator description including maps, charts, metadata and descriptive texts required almost 140 pages, which the user has to scroll to find the information he is interested in.

nical objectives should prevent people from using the system. Moreover, the *Presentation Tool* releases the user to know where actually a map file, a table or a document is stored, in order to retrieve the relevant information. Even though far from representing latest state-of-the-art technologies, from a technical point of view, the *Presentation Tool* represents a robust and sound solution tailor-made for politicians to easily interact with the monitoring system.

The Potsdam VASAB Stakeholder assessment (for workshop minutes see Annex 10) clearly showed the need for such a smart application. At the same time, for experienced users, the GIS database and also the Excel files are still available allowing further in-depth analysis.

2.2 Components

Based upon the system description above, in fact the BSR territorial monitoring system for the BSR is composed of different tiers, which are

Tier 1: Techniques
Tier 2: Data and indicators
Tier 3: Analyses
Tier 4: Output
Tier 5: Documentation

each tier subsuming a set of further elements (Figure 3).

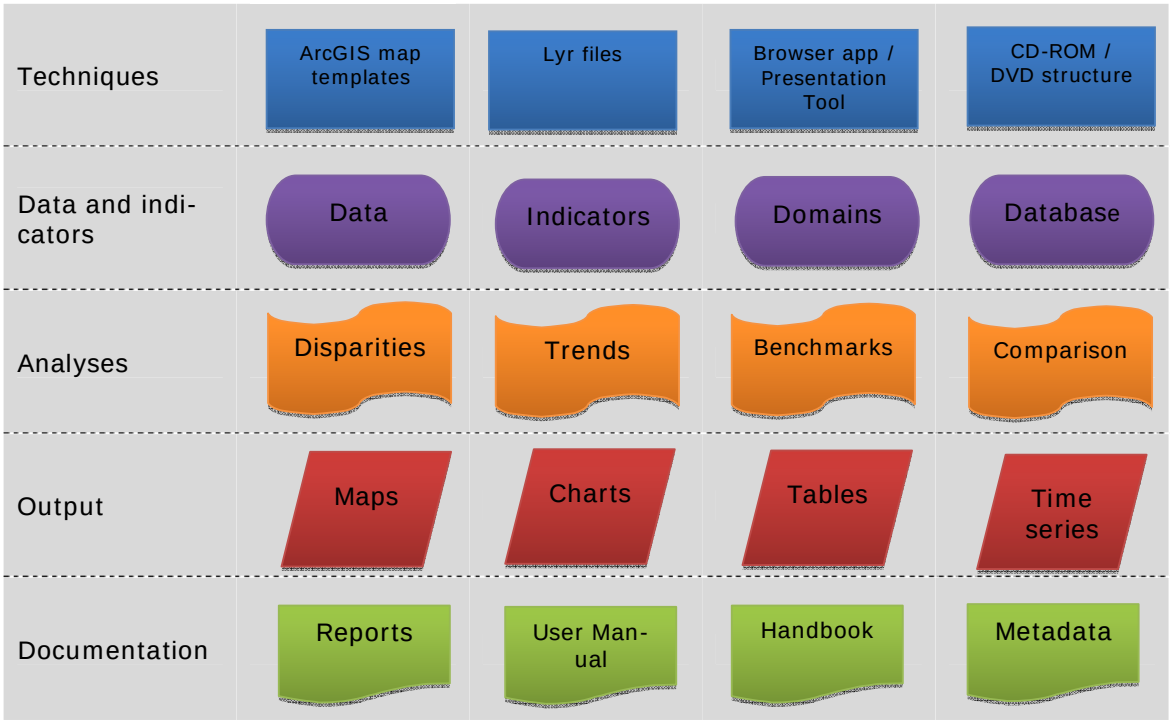

Figure 3. Elements of the territorial monitoring system

As the central output, all these elements of the monitoring system will be available on CD-ROM / DVD, and access to them will be provided through the central browser application – the *Presentation Tool*.

Concerning the ***technological basis*** (tier one), ArcGIS map templates, lyr files, a browser application and a dedicated CD-ROM folder structure are utilized. ***Data and indicators*** are the second tier, composed of statistical data, the defined indicators, organized in a system of domains and sub-domains, and physically implemented in a dedicated database. The third tier, the ***analyses*** tier, builds upon both previous tiers, conducting different types of analysis, such as analyzing disparities, trends, benchmarking and other forms of ESPON-wide comparisons. Results of the analysis tier are communicated through maps, charts, tables and as time series, as system ***output***. Finally, the ***documentation*** tier summarizes and explains the monitoring system in form of reports, user manual, a handbook, technical specifications and indicator metadata.

From Figure 3 it becomes obvious that the monitoring system represents not only an indicator framework, but a dedicated and compatible ***system of techniques, indicators, types of analysis, output***, as well as recommendations as laid down in the project documents.

2.3 Functional Needs of the Monitoring System

In order to be successful and acceptable, the monitoring system for the Baltic Sea Region should fulfil a number of functional needs:

- *Analysis*: focus on simple but yet policy relevant types of analysis. Complicated statistical methods or complicated types of diagrams should be avoided. This concerns the selection, definition and analysis of indicators as such, and concerns the selection of policy-relevant demonstration examples.
- *Analysis*: there is no need to interactively change indicator thresholds or ways of standardizations.
- *Output*: The ESPON standard output (maps, diagrams, tables) is appreciated. All output should be easily accessible through the monitoring system.
- *Map templates*: There is need for two map templates. One specific template focusing on the BSR space, and the standard ESPON map template for the entire ESPON space. The BSR map template should be used to produce high-quality zoom-in maps for the Baltic Sea Region, while the latter one is needed to draw up benchmarking maps, comparing the BSR with other macro regions in Europe or with the ESPON space as a whole.
- *Spatial level*: NUTS-3 has been identified as the main spatial level to work at. Finer spatial levels such as LAU-2 or grid levels were highly appreciated, acknowledging the more experimental character of these levels in terms of data availability and computation efforts. NUTS-2 level or even more aggregated spatial levels will only be accepted in exceptional cases, where current data availability prevents from using more disaggregated approaches.
- *Other geographical references*: Beyond the traditional regional levels, the VASAB stakeholders emphasized need and interest in other geographical references, such as points or hubs (e.g. cities, ports or airports), links (e.g. air, train or maritime connections including frequencies and/or goods and passengers transported), or flows (e.g. o-d-matrices). These types of geographical objects go beyond the classical ESPON type of regional approach, as alternative geographical objects are used as reference. Nonetheless, interesting alternative information could be provided that way.
- *Types of maps*: Following the opinions of the VASAB Committee, the BSR territorial monitoring system should make use of different map types (Figure 4). Besides the standard chloropleth map type, used at regional level, point maps, flow maps and in-

teraction maps were appreciated. More complex map types, such as chart map, were, however, rejected.

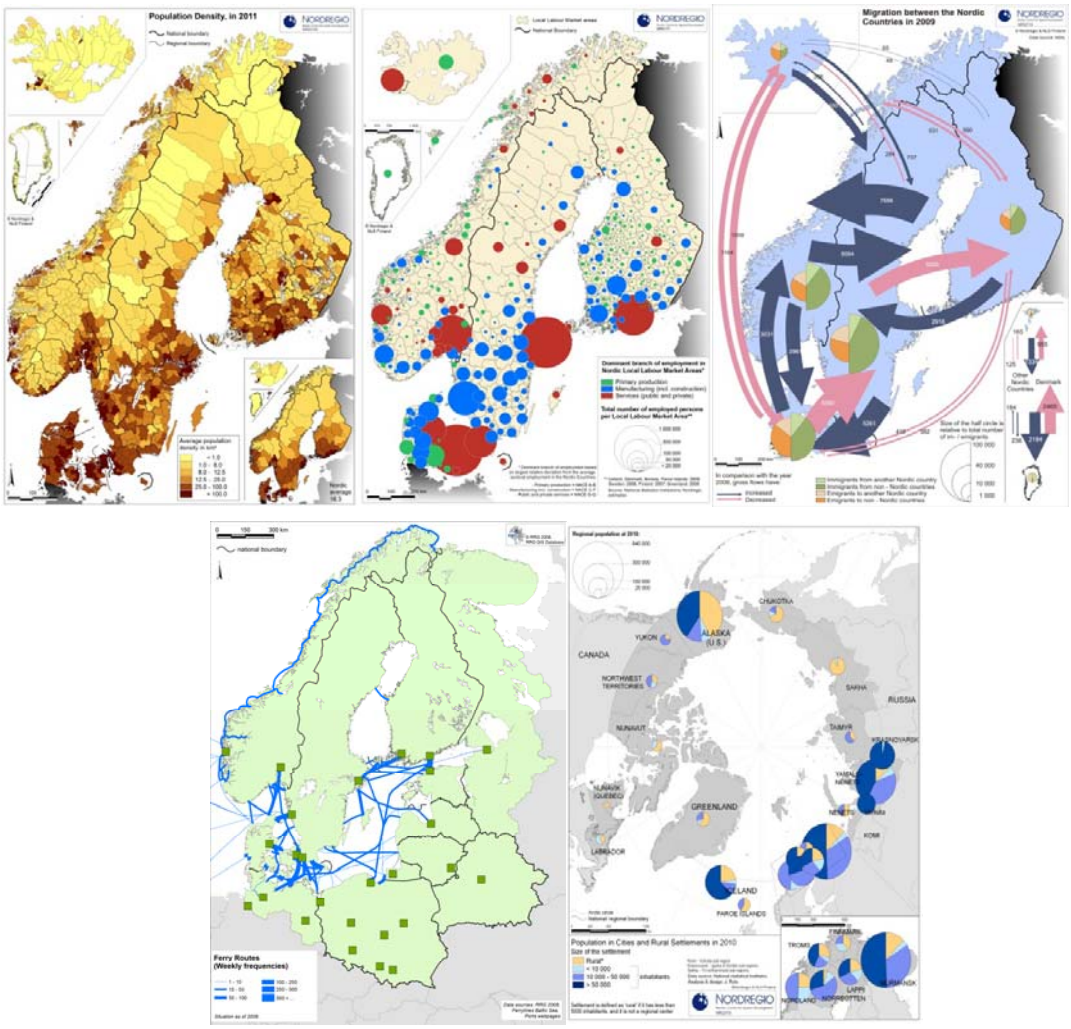

Figure 4. Examples of different map types: Chloropleth map (top, left), point map (top, middle), flows map (top right), interaction map (bottom left), chart map (bottom right).

- *Standardized presentation*: The indicator presentation through the *Presentation Tool* should be done in a standardized manner, i.e. each indicator should be presented in the same way as all other indicators, striving for a harmonized presentation, where the user finds himself easy, and finds all information at the same place, regardless which indicator he is looking at.

3 Regional Subdivision of the Area

NUTS-3 and NUTS-2 levels are identified as the main geographical scales to work at in ESPON TeMo. Following is a comparison of these NUTS levels for the countries concerned (Table 1), as well as an illustration of the regional boundaries (Figure 5).

Even though there is already a newer NUTS 2010 classification available from Eurostat, the NUTS 2006 system will still be used (Eurostat, 2007) since all the data provided by Eurostat, representing one of the main data sources, still refers to this classification.

Table 1: NUTS3 and NUTS2 levels in the Baltic Sea Region.

Country	NUTS2		NUTS3	
Belarus	Oblasts	7	Rayons (sNUTS4)	118 (130**)
Denmark	Regioner	5	Landsdeler	11
Estonia	Country	1	Groups of Maakond	5
Finland	Suuralueet / Storomraden	5	Maakunnat / Landskap	20
Germany *	Regierungsbezirke	8	Kreise / kreisfreie Städte	66
Latvia	Country	1	Regioni	6
Lithuania	Country	1	Apskritys	10
Norway	Regions	7	Fylker	19
Poland	Województwa	16	Podregiony	66
Russia *	Oblasts	7	Rayons (sNUTS4)	123***
Sweden	Riksomraden	8	Län	21

** Only those entities located in the BSR.*

*** Including towns of oblast subordinance (urban locality with the population of not less than 50,000 people; it has its own body of self-government). Belarus officially has 118 rayons, but there are separate statistics for towns of oblast subordinance.*

**** On the level sNUTS4 Russian statistic includes rayons and municipality districts.*

Apparently there are huge differences in the number of regions between the BSR countries, both at NUTS-2 and NUTS-3 level. While at NUTS-2 level the three Baltic States are not further subdivided, Germany, Sweden and Poland have 8, 8 and 16 NUTS-2 regions, just to mention the extremes. At NUTS-3 level, the number of entities is even more significant, ranging from 5 regions for Estonia up to 66 for Germany and Poland. By way of consequence, the average size of the regions differs accordingly.

This basic drawback of the current NUTS classification cannot be amended by ESPON TeMo, since many datasets are provided based upon this classification. Therefore, the project will attempt to find additional data at LAU-2 or raster level; if not for all BSR countries, LAU-2 or raster data may be exemplified for a subset of them. One of the main advantages of using regular raster systems[2], for instance, would be to get rid of the distortions caused by the different sizes and different numbers of NUTS entities.

For some indicators, based upon modelling approaches (i.e. accessibility indicators or environmental indicators) data for spatial entities below NUTS-3 level are rather easy to compile (if one has access to model output), for other indicators national or regional statistical offices have to be contacted.

[2] I.e. raster systems where each raster cell is of same size.

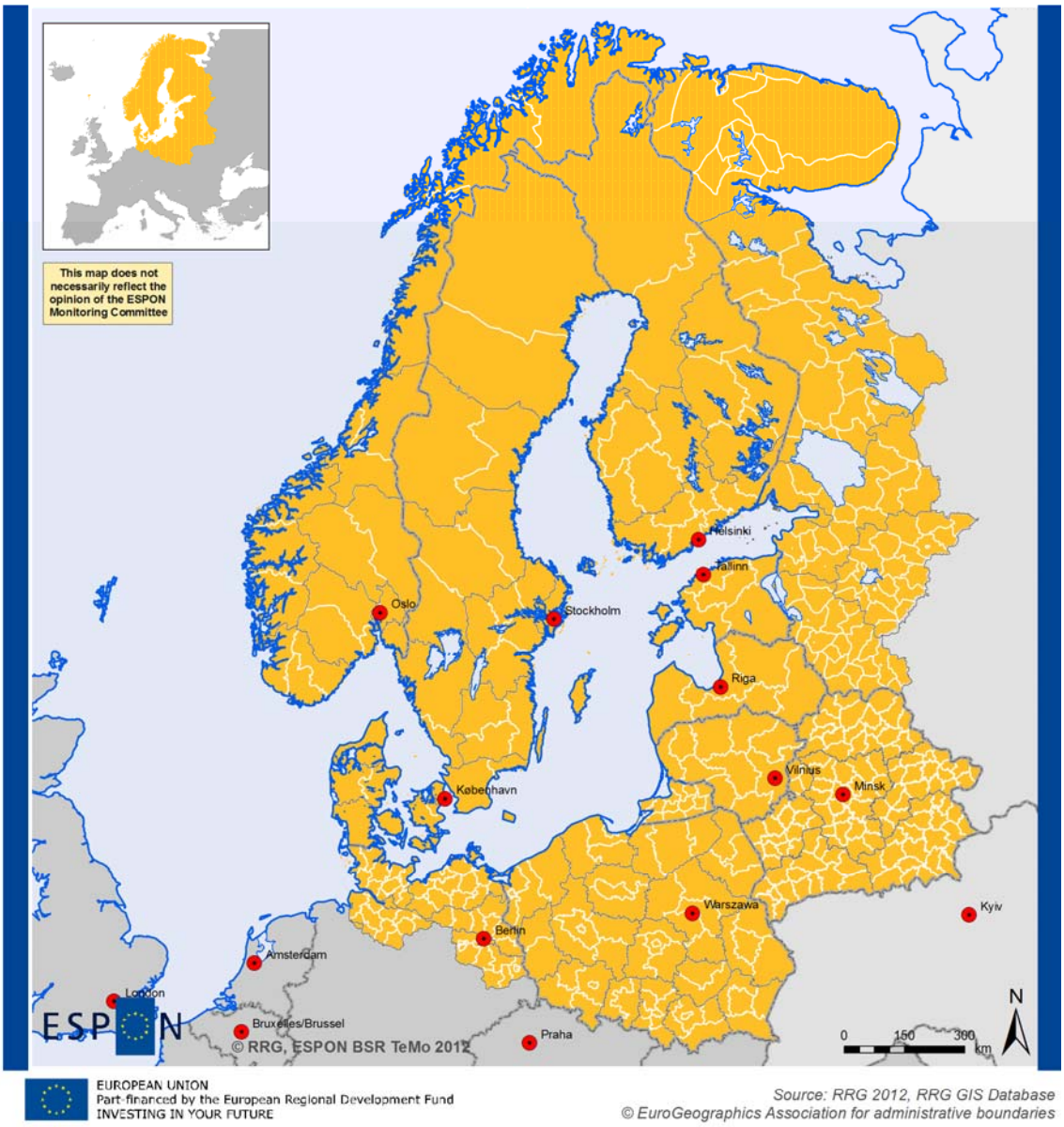

Figure 5. NUTS-3 and NUTS-2 levels in the Baltic Sea Region.

4 Map Templates

As with all ESPON projects, TeMo uses map templates to generate its maps in a standardized map layout. Since TeMo specifically deals with the Baltic Sea Region, it was decided to develop a new standard map template zooming into the BSR, the so-called *Standard BSR Map* (BSR mapkit), while preserving as much as possible the standard ESPON map layout.

4.1 Standard BSR Map

The justification for this new template is that all maps produced for this monitoring system should highlight the specificities, trends and spatial patterns within the Baltic Sea Region as best as possible, i.e. the map scale and map extent should be adjusted to this area.

The new map template follows the general ESPON map guidelines to ensure harmonized map layouts. Figure 6 illustrates the new *Standard BSR Map* template of TeMo, highlighting the study area and its adjacent regions.

Obviously, the main map fits to the outline of the BSR region. Adjacent areas are shown as well, from Russia in the East to the UK in the West, plus neighboring regions to the south. The additional overview map highlights the BSR territory in the overall ESPON space context.

One of the advantages of this focused map template is that, as the spatial extent is adjusted to the outline of the BSR, higher spatial details can be shown. For instance, indicators at LAU-2 or raster level can be illustrated much clearer compared to Europe-wide map extents.

Apart from this new map template, the ESPON TeMo project needed to work on the GIS input layers in two different aspects:

- ***Generalization level***: The standard ESPON shapefiles provided by the ESPON Database project were highly generalized. This generalization was introduced with the view to produce clear and easy-to-read maps. What works well for the cartography, entails certain drawbacks when attempting to use these layers for spatial analysis. Through the generalization overlay procedures in the GIS will return unreasonable results, for instance when spatial objects plunge 'into the sea' or when spatial objects 'move' over country boundaries. Therefore, for GIS analyses, the project team sought for alternative input layers of administrative boundaries with higher resolution.
- ***Seamless layers***: So far, the standard ESPON shapefiles provided by the ESPON Database project did not include regional boundaries for Belarus and Russia. Also, regions of the candidate countries and of Turkey were only provided as separate shapefiles. Again, this is not useful for GIS analyses, and causes extra work in the cartography. Thus, the task for ESPON TeMo was to generate seamless layers of administrative boundaries (NUTS3, NUTS2 and NUTS0) for the study area.

As a result of these activities, the TeMo GIS Database now includes new administrative boundary layers called **ZONES_TEMO_NUTS0**, **ZONES_TEMO_NUTS1**, **ZONES_TEMO_NUTS2** and **ZONES_TEMO_NUTS3**, including boundaries for Russia and Belarus, as well as representing seamless layers for the entire space.

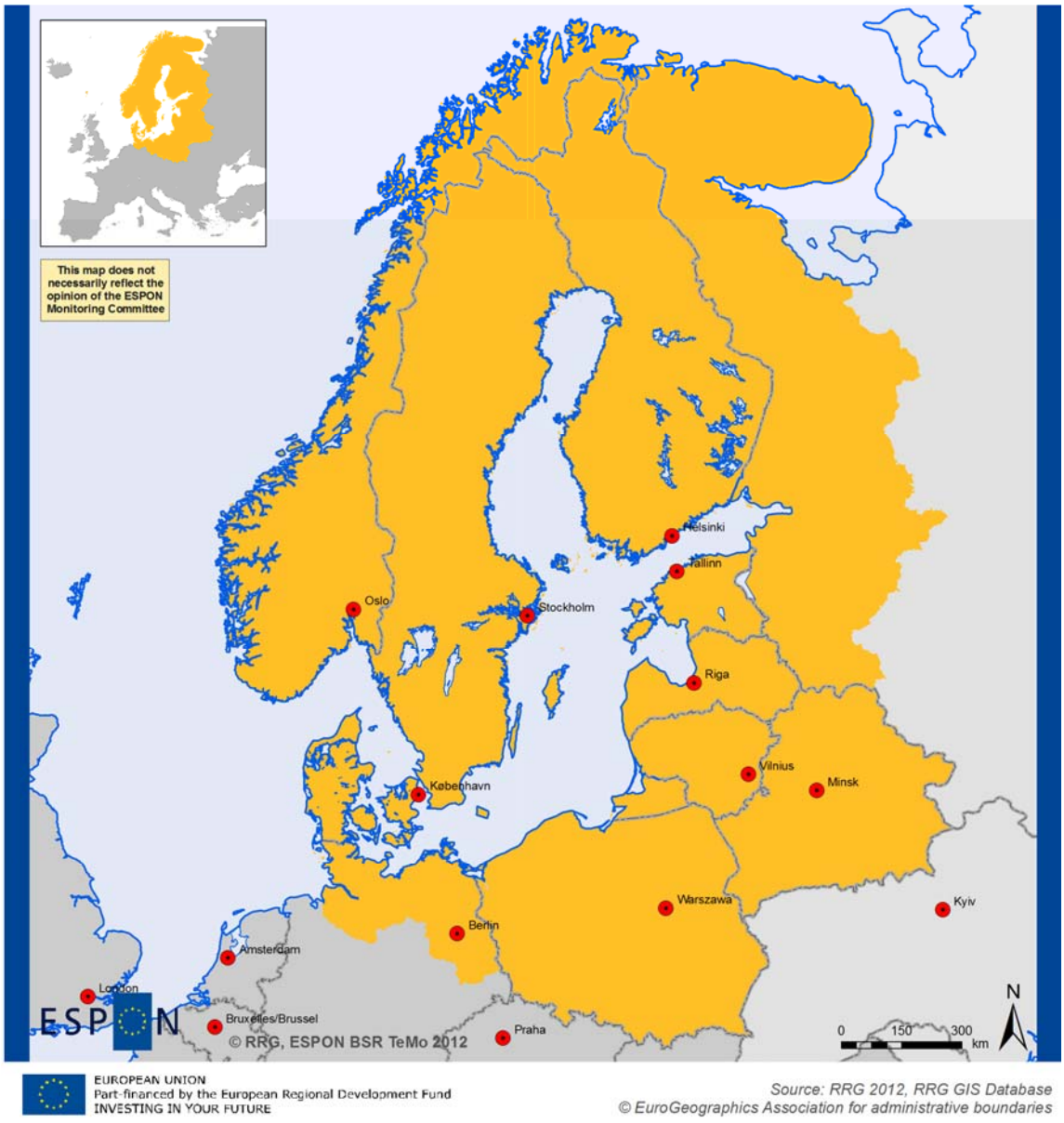

Figure 6. Map template for Baltic Sea Region.

4.2 ESPON Space Map

The benchmarking and comparison maps illustrating the entire ESPON space, however, will be based upon the latest standard ESPOM Space map kit as provided by the ESPON Database Project.

5 Visualisation Concept

The monitoring system basically consists of two parts, a “simple” indicator part, and another “advanced module” dealing with four applications. Both parts require specific attention when it comes to the presentation of results, both in the report and in the *Presentation Tool*.

5.1 Simple Indicators

The main part of the monitoring system is the analysis of the indicators. Every indicator is presented and analyzed in a standardized way. The indicator presentation basically consists of three parts (Figure 7)

(i) the textual part,
(ii) data part, and the
(iii) visual part (maps).

Figure 7. Standardized indicator presentation.

Part 1, the textual parts, covers indicator definition, indicator importance, indicator findings, recommendations for the implementation, as well as the metadata (Figure 8). Part 2, the data part, covers basic statistics at national level (minima, maxima, mean, coefficient of variation), as well as access to the indicator numbers in tabular format. Part 3, the visual part, comprises the indicator maps. Three standard maps are defined for each indicator, which are the BSR map for the latest available year, the ESPON space map for the latest available year, and a difference maps for the BSR.

As far as data availability allows, additional maps are produced. These may be maps for alternative years, to represent a time series, or specialized maps illustrating border discontinuities. In consequence, the number of maps produced for each indicator varies, subject to data availability.

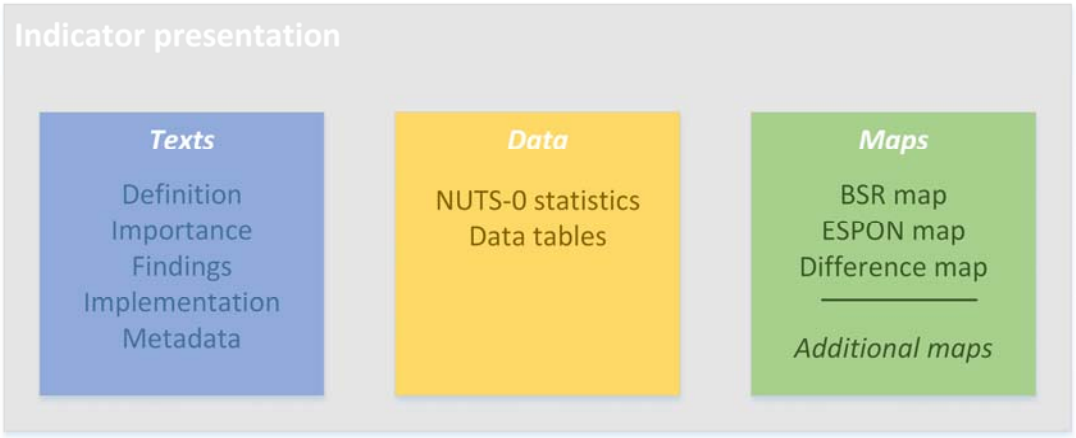

Figure 8. Standardized indicator presentation - details.

The *Presentation Tool* implements these standard elements, as Figure 9 shows.

The main indicator page already provides the indicator definition, indicator importance, and the findings, together with the main indicator map, illustrating the BSR.

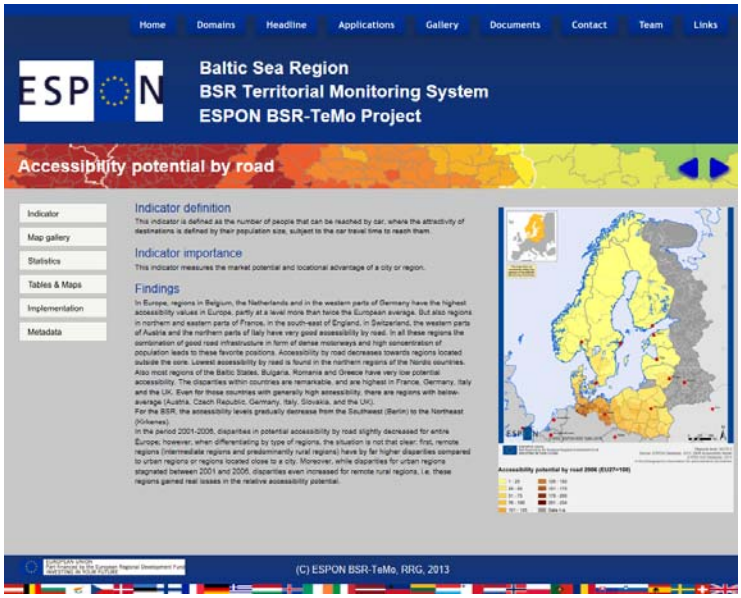

Figure 9. Indicator page in the Presentation Tool.

The navigation bar at the left hand side allows switching to implementation and metadata tabs (text), switching to the tables&maps or statistics tab (data), or allows switching to the map gallery, where all maps generated under one indicator are presented (maps).

This type of indicator presentation is not only available in the software, the *Presentation Tool*, but it is also followed in Volume 3 of the Scientific Report, where each indicator is described by using the same structure.

5.2 Integration of Alternative Spatial Units

How are alternative spatial units, such as LAU-2, raster, labour market areas, and others, integrated into this standardized analysis system?

One of the big advantages of the *Presentation Tool* is that the indicator map gallery may host a great number of maps. Unlike ESPON paper reports, where in practical terms there is a page limit so that not dozens of indicator maps can be presented, the software allows to add as many maps into the system as required.

So, if data for LAU-2 or raster levels, or for any other spatial entity are available, these maps are added to the map gallery of that indicator, where the user can inspect them. In addition, the findings sections also reference these maps. Finally, from the tables&maps tab, these maps can also be downloaded, so as the standard indicator maps. Figure 10 exemplifies a map gallery page by using the indicator accessibility potential by road, where LAU-2 and raster level maps for the three Baltic States are added to the standard BSR and ESPON maps.

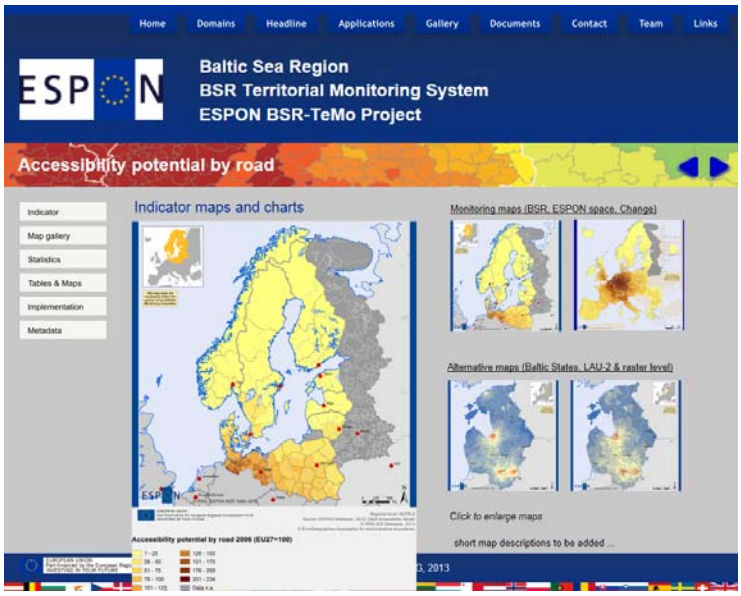

Figure 10. Indicator map gallery with alternative maps.

5.3 Advanced module

While the simple indicator part of the monitoring system analyses individual indicators, the advanced module is dedicated for cross-sectoral, cross-indicator analyses, by relating different indicators with each other, and by producing advanced indicators through statistical procedures (such as GINI coefficients etc.).

Initially, TeMo develops the following four demonstration examples under the advanced module:

- Overall benchmarking of the BSR with other macro regions in Europe
- Territorial cohesion (cross-cutting issue)
- Cross-border regions (geographical scope)
- Migration (thematic scope)

More modules can be added to the system as needed at any point in time.

Similar to the simple indicator presentation, the demonstration examples are presented in a standardized way, despite their different characteristics, based upon texts and illustrations (Figure 11).

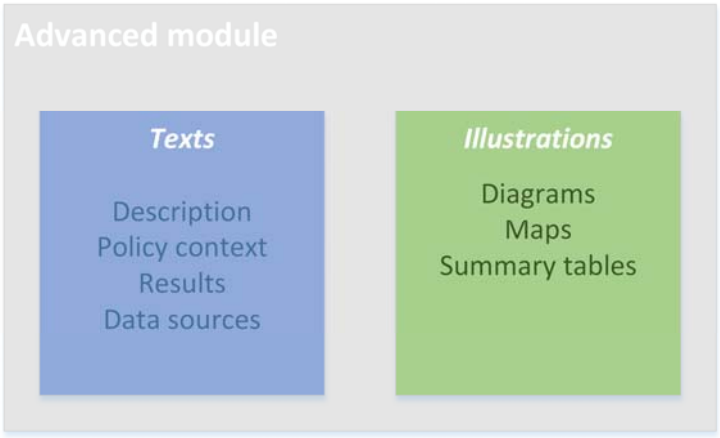

Figure 11. Standardized advanced module presentation.

Texts refer to the description of the module, its policy context, the results, and to data sources. Illustrations mainly refer to a series of diagrams, individual specific maps, as well as summary tables. This concept id implemented in the application section of the *Presentation Tool* accordingly (Figure 12).

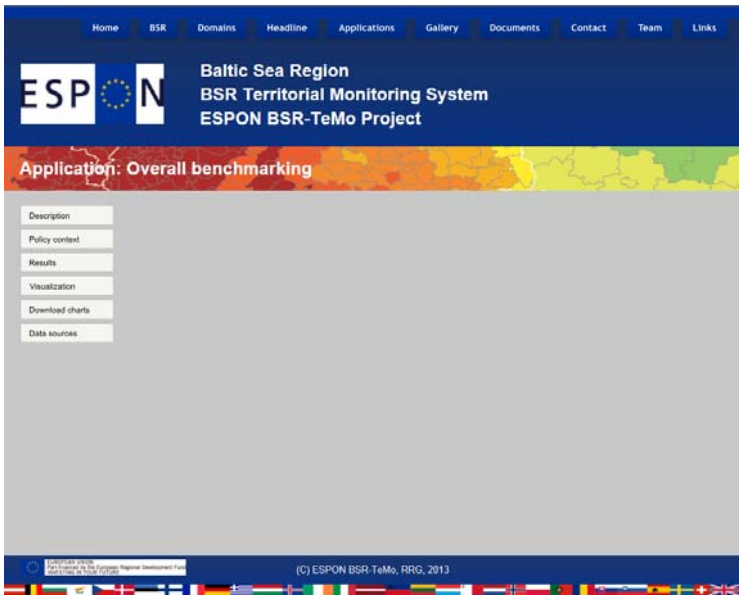

Figure 12. Advanced module page.

Unlike the simple indicator presentation, where visualization mostly relies on maps, visualization in the advanced module focusses on diagrams, complemented by selected tables and maps. Diagrams comprise bar and line charts, box and scatter plots, and summary tables (Figure 13). In the Presentation Tool, all these charts are accompanied with brief texts describing the main findings (Figure 14 for an example). The number and actual type of charts differs for each application, representing their different characteristics and policy relevance.

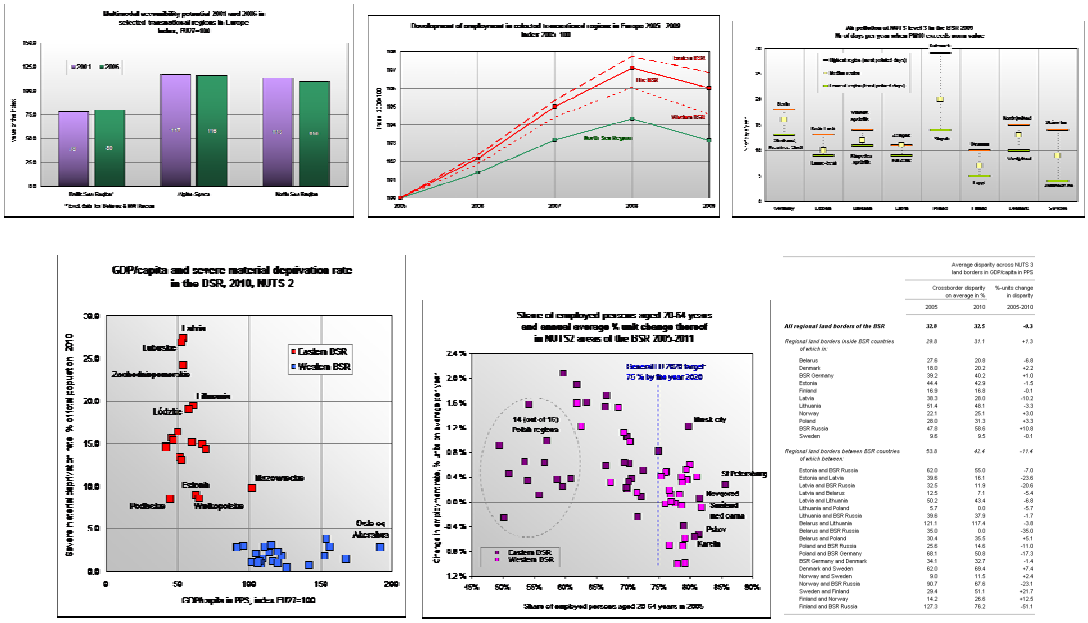

Figure 13. Examples of diagrams in the advanced module.

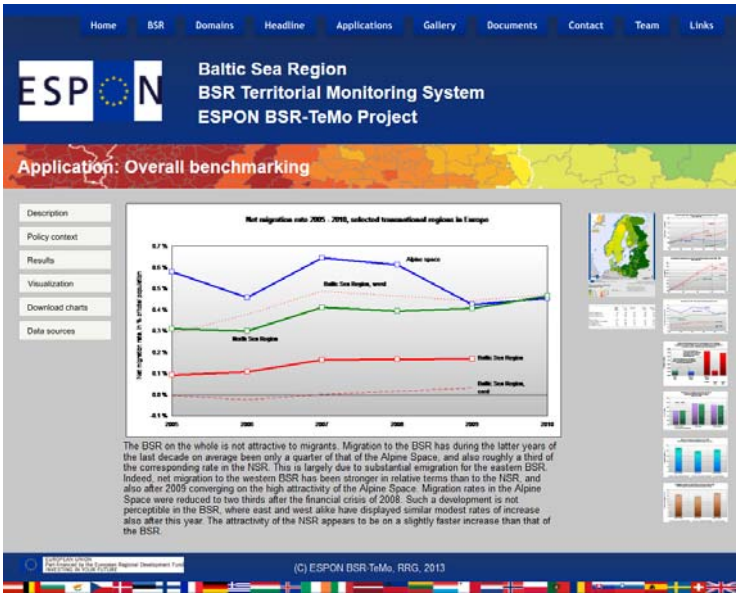

Figure 14. Charts and descriptions in the advanced modules.

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The ESPON 2013 Programme is part-financed by the European Regional Development Fund, the EU Member States and the Partner States Iceland, Liechtenstein, Norway and Switzerland. It shall support policy development in relation to the aim of territorial cohesion and a harmonious development of the European territory.

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