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Inspire policy making by territorial evidence

ESPON TIA Tool Upgrade

Monitoring and Tools

Delivery 5 – Report on the work done in relation to the upgraded version of the TIA tool

Version 10/02/2020

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Information on ESPON and its 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 delivery exists only in an electronic version.

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ESPON TIA Tool Upgrade

Table of contents

List of Figures

List of Tables

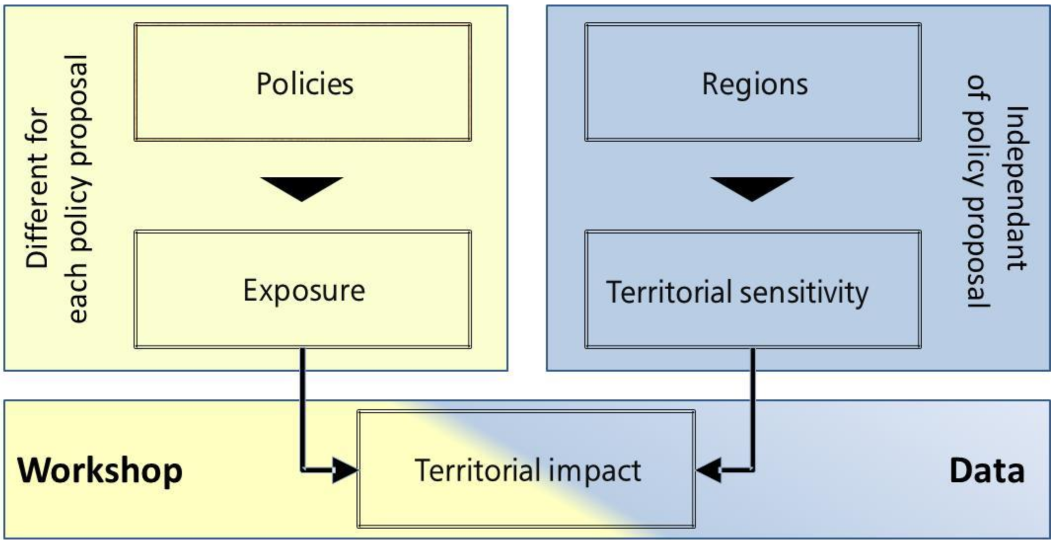
Abbreviations

CB	Cross Border
CoR	Committee of the Regions
DB	Database
DG REGIO	Directorate General for Regional and Urban Policy
ESPON	European Territorial Observatory Network
EU	European Union
EUROSTAT	European Statistical Office
FUA	Functional urban area
GAINS	Greenhouse gas – Air pollution Interactions and Synergies
GDP	Gross Domestic Product
GVA	Gross Value Added
JRC	Joint Research Centre
LUISA	Land-Use based Integrated Sustainability Assessment modelling platform
NO_2	Nitrogen dioxide
NUTS	Nomenclature of Territorial Units for Statistics
RoS	Request of Service
TIA	Territorial Impact Assessment

1 Background of the project

Impact assessments of EU policies from a territorial perspective on a regional level have for a long time been a topic of interest to policymakers especially at the EU, but also on national level. Related to the objective of territorial cohesion stipulated by the Lisbon Treaty, the intent to consider the distribution and extent of impacts already in the ex-ante phase of a policy has led to the development of multiple methodologies with numerous approaches ranging from qualitative, quantitative or a hybrid determination of impacts. One of those methodologies is the "TIA Quick Check" developed in the ESPON ARTS project. It is based on the vulnerability concept, combining the effects of a policy measure (exposure) with the characteristics of a region (territorial sensitivity) in order to calculate territorial impacts (see figure below).

Figure 1.1: Exposure x territorial sensitivity = territorial impact



Source: ÖIR (2015)

Building on this methodology, a first TIA webtool was developed within ESPON as a means of making the calculation of such impacts more user friendly. Especially as the Quick Check is applied in a workshop setting working with hybrid data and expert involvement, it was of high importance, that the relevant steps from determining the likely effects of a policy measure to calculating the impacts and subsequently discussing the maps of impact distribution could be fitted in a timeframe of one day. The first TIA webtool simplified this process substantially and was tested in many practical applications. This process of extensive testing however also led to the identification of a number of possible improvements and wishes from policymakers for further development. Subsequently, in the project at hand, the upgrade of the TIA webtool has been conducted.

The aim of upgrading the tool was threefold:

- Improve the existing functionalities and further increase the user-friendliness of the tool
- Further develop the tool and the methodology by implementing additional functionalities
- Test functionalities in a realistic setting by actually applying them in a TIA workshop

Over the course of the project a number of improvements as requested in the ToR as well as some additional improvements of existing functionalities have been implemented. Eight additional functionalities, which considerably develop tool and methodology forward have been implemented, with one functionality still in development. Finally all functionalities have been tested in a total of 19 TIA workshops, as well as in two trainings conducted in the frame of the current project.

While still some wishes for improvements could not be fitted within the current project, namely the implementation of an electronic voting system or the improvement of the aggregation function, a considerable step forward in the application of the tool on the EU level has been made. Especially the “TIA necessity check” developed as a functionality to assist EU institutions in deciding for a policy proposal if a TIA should be conducted is promising to ensure the continued application of the methodology after the close of the project.

1.1 Structure of the report

As a final report, the document at hands outlines all work that has been done in relation to upgrading the TIA tool. It shall present the technical improvements, the new methods developed, changes to structures and concepts behind specific steps and additional developments surrounding the tool. It is structured in four main sections:

General updates of the previous tool

In this section the general improvements of the tool, e.g. the layout, restructuring of the main tool, update of the administrators module and new types of users introduced are described. The datasets and typologies collected and calculated are presented. Finally, the supporting documents for administrators and moderators are referenced.

Additional functionalities

The major new functionalities for the TIA tool are presented. This includes technical changes to the tool, introduction of new sub-tools for urban- and Cross-border TIA, database links, the new function for aggregating impact as well as the necessity check functionality.

Technical descriptions

In detail descriptions of the normalisation methods, the calculation of cross-border comparative indicators, the aggregation function as well as the FUA-NUTS equivalency calculation are presented. They are supporting an in-depth understanding of advanced functionalities of the tool.

Remaining work

As one request of service which has been made at a late stage of the project is still I the implementation phase, a brief outlook is given.

2 General updates of the previous tool

One of the main actions related to the update of the TIA Tool was the restructuring of the previous tool, making it more intuitive and user friendly. The previous 9 steps have been rearranged and grouped into 4 main steps with their respective sub-steps based on consultation and interviews with the main users from ESPON, DG REGIO and the CoR. The 5th step, aggregation, was added as an additional functionality. Furthermore, the overall layout has been adapted to increase the intuitivity and to fit the needs of different user groups. These user groups can use different functionalities of the tool based on their experience.

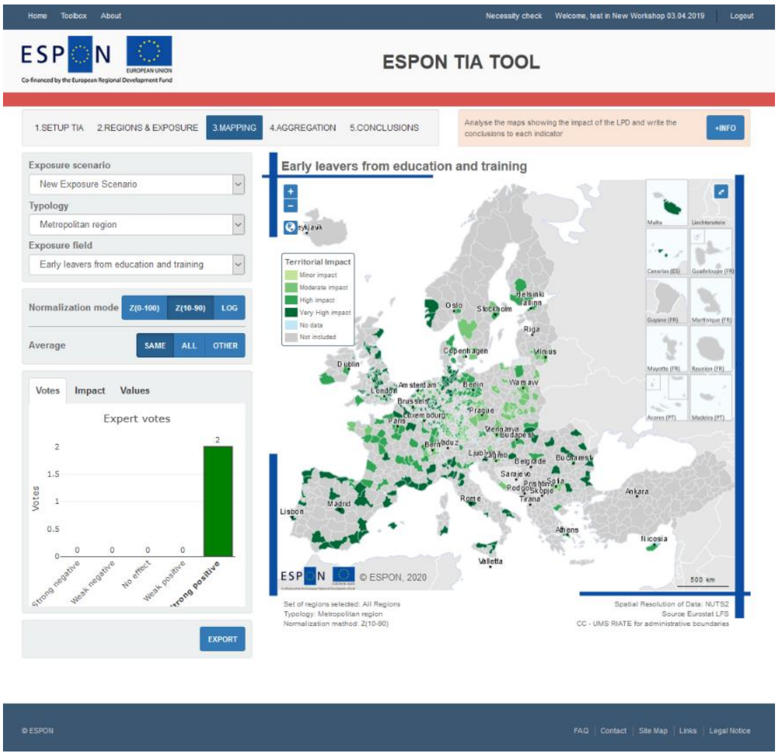
A number of technical updates regarding databases and the format of stored data in the background enable much more sophisticated functionalities, such as user-defined study areas, tailored assessments for Urban Areas or Cross-Border Areas as well as easier upload and update of data.

Finally, the module for administrators has been considerably improved in order to ensure maintenance and update of the tool over a long period.

2.1 Overall appearance of the upgraded tool

The updated version of the ESPON website design was kept in mind when developing the layout of the upgraded TIA tool, for example by integrating some of the elements of the new design so that the TIA tool fits in. The TIATOOL Upgrade “look and feel” uses the new ESPON web style and integrates into the new website as the following figure shows.

Figure 2.1: Layout of the upgraded tool and usage of the new ESPON web-design



Source: ÖIR (2020)

2.2 Users

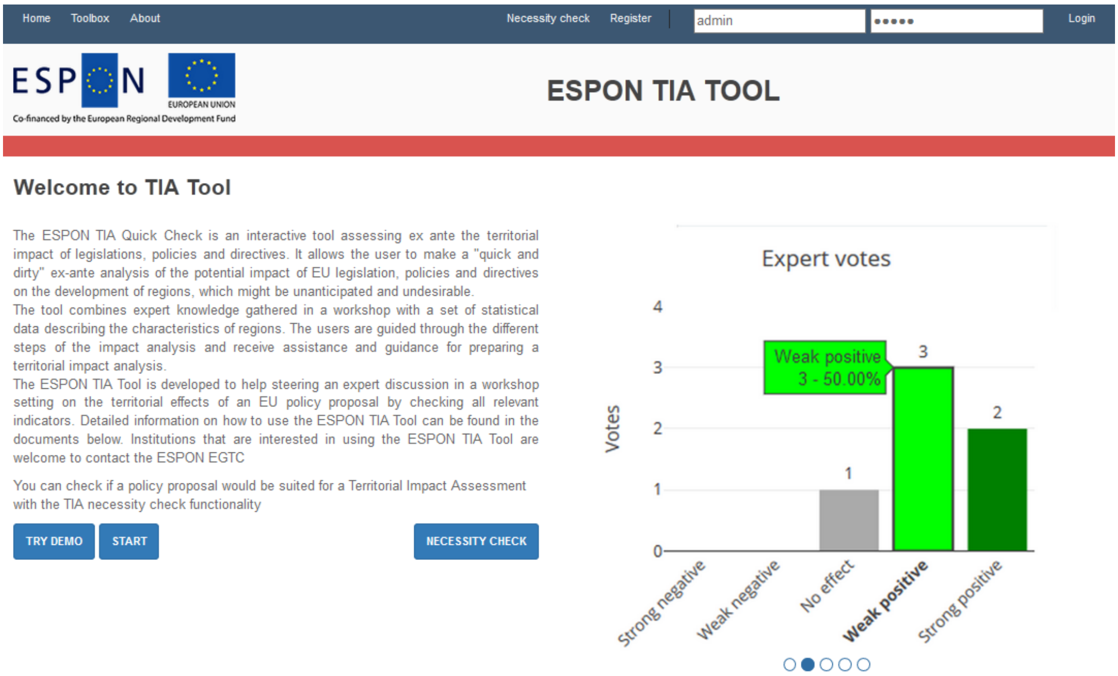
With the accessibility of the tool to different user groups in mind, three general levels of access have been implemented:

- Unregistered users, which can access the demo mode
- Registered users, which can use the full extent of the tool's functionalities, but are still differentiated into sub-groups for users, moderators and trainers
- Administrators

2.2.1 Unregistered users

In order to facilitate easier access to the TIA tool's functionalities, a demo mode has been developed which can show the potential of the tool. However it does not allow for customisation (e.g. of Exposure Fields). It thus can be used as a first glance at the tool's capabilities. For conducting a fully-fledged TIA, registration is still necessary. The demo mode is accessible via a dedicated button on the welcome page.

Figure 2.2: Welcome page with demo mode access



Source: ÖIR (2020)

In the demo mode, a user cannot:

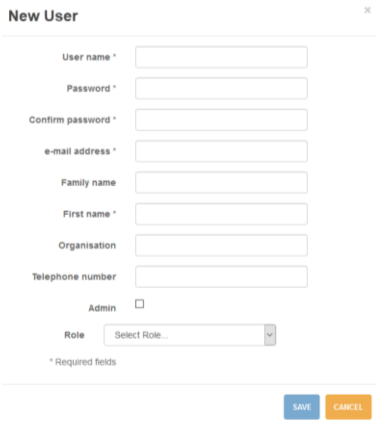
- Upload new indicators
- Create customised sets of regions
- Save workshops
- Download maps without a watermark

This is reserved for registered users. All other functionalities of the tool work in the same way as in the version for registered users.

2.2.2 Registered users

Other than in previous versions of the tool, self-registration of a user is possible and does not require the involvement of an administrator. A “register” button has been implemented on the welcome page of the tool. Some fields of the registration form are mandatory, such as user name, password, email address and first name, while others (such as the organisation and phone number) are optional.

Figure 2.3: Registration form



Source: ÖIR (2020)

This allows for administrators to have an overview about who is using the tool. Furthermore, they are able to assign levels or roles to users as outlined in section 5.1, allowing for a differentiation between users, practitioners, moderators and trainers.

2.2.3 Administrators

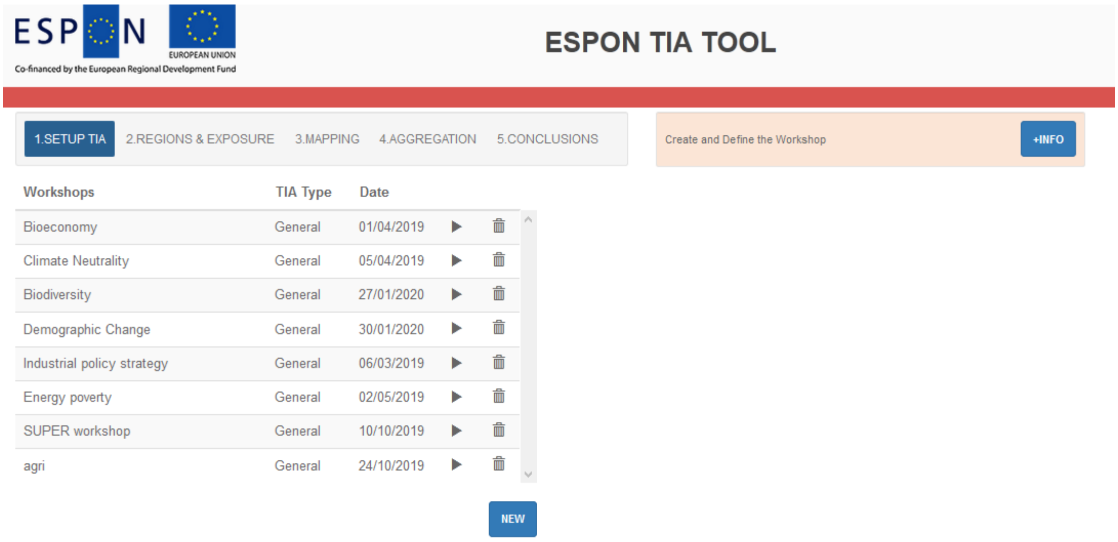
Administrators are the only user group which can make edits to default data, make changes to other users and edit textual content in the tool. Administrator status can only be assigned by another administrator.

2.3 Overall structure of the tool

2.3.1 Step 1: Setup TIA

In this step, the user can create a new workshop or manage existing ones that he or she has created previously. Attention is paid to the information shown on the functionalities the user needs for creating and managing workshops:

Figure 2.4: Step 1, setup page

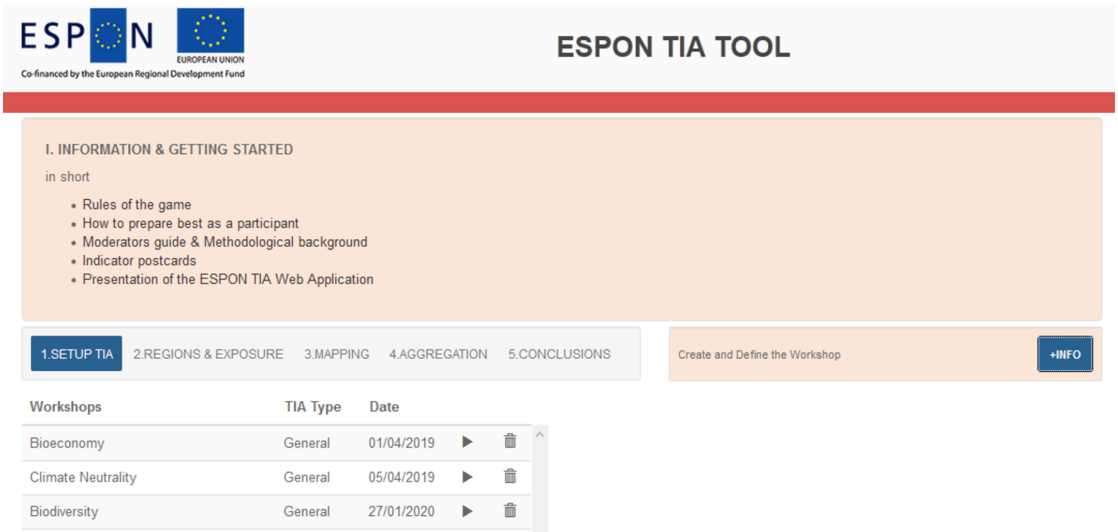


Source: ÖIR (2020)

- On the top-right corner there is a button to create a new workshop
- On the left side of the screen a list of already existing workshops the user has created is shown together with its full title and the creation date
- When selecting a workshop from the list, it can be deleted or opened by clicking on the buttons appearing on the right

Background information to guide the user and especially provide access to information material is available behind a "+Info" button on the right-hand side of the screen (See Figure 2.5).

Figure 2.5: Step 1, info button



Source: ÖIR (2020)

New or existing workshop

When the “new” button is pressed, or an existing workshop is selected, an additional menu appears on the right-hand side of the screen. Here, the user can fill some fields related to the workshop:

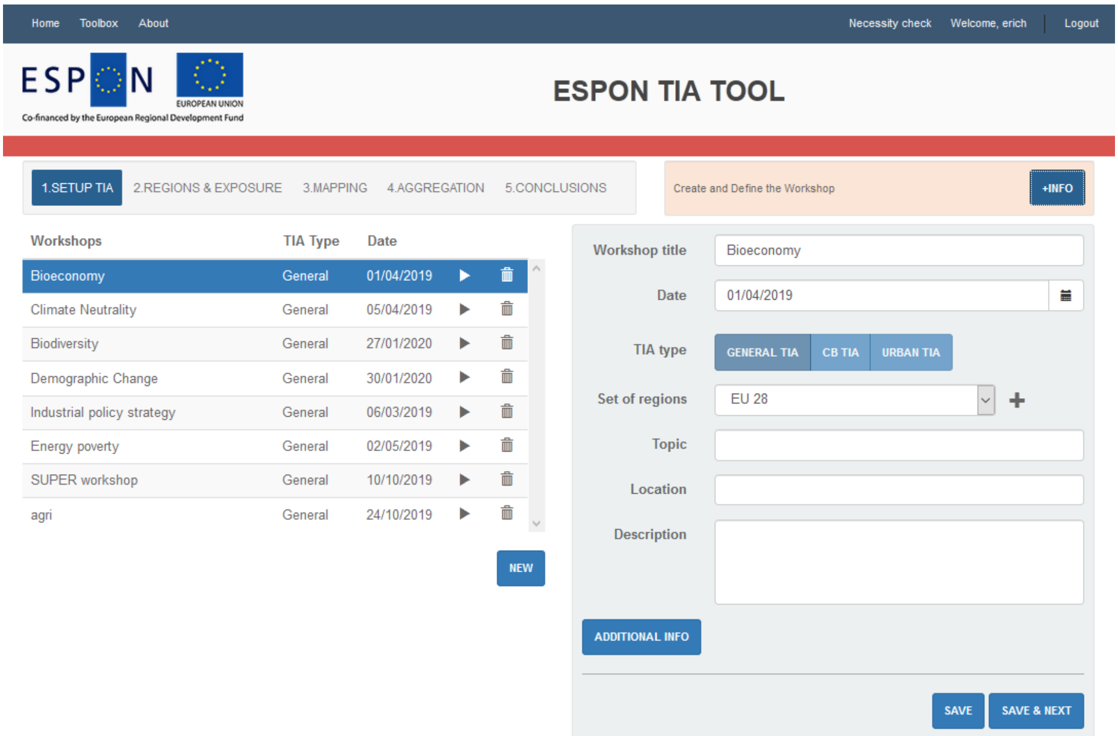
- Workshop Title
- Workshop Date
- Workshop Type: Select between General Mode, Cross-Border Mode or Urban Mode
- Set of regions
- Workshop Topic
- Workshop Location
- Workshop Description

Only Workshop Title, Workshop Date, Workshop Type and Set of Regions are mandatory to fill in.

The Workshop types are one of the main conceptual changes to the TIA tool in comparison to the previous version. The details of the new types of workshops are explained in the section on additional functionalities under sections 3.1 and 3.2.

Furthermore, the button “Additional Info” allows the user to enter information on the number of experts, their name/position, moderators and the workshop agenda.

Figure 2.6: Step 1, management of new or existing workshops



Source: ÖIR (2020)

Delete Workshop

To delete an existing workshop, the user has to select it from the list and push the “trash” button next to it. Confirmation is necessary and asked for.

Edit Workshop

To edit an existing workshop, the user has to select it from the list; the data related to the workshop can then be modified. After that, the button "save" has to be pressed.

Open a Workshop

Once a Workshop has been created and the user wants to move to Step 2, the user can click on the "Save & Next" button or move to Step 2 on the tabs above. Alternatively, a "Save" button is available which will only save the inputs but not proceed to the next step.

If a user just wants to open an existing workshop, a click on the "play" button next to it will directly proceed to step 2.

2.3.2 Step 2: Regions & Exposure

In this step, the user can create a new exposure scenario or select an existing one and define indicators and types of regions to be used in the TIA. The number of exposure scenarios in principle is not limited by the tool, but rather by the practicability of multiple scenarios in a workshop setting. In continuity with step 1 the functions in step 2 are again organised by showing on the left-hand side of the screen the list of existing exposure scenarios and on the right side menus for detailing the selected element (see Figure 2.7).

Figure 2.7: Step 2, management of new or existing exposure scenarios I

Source: ÖIR (2020)

New or existing exposure scenario

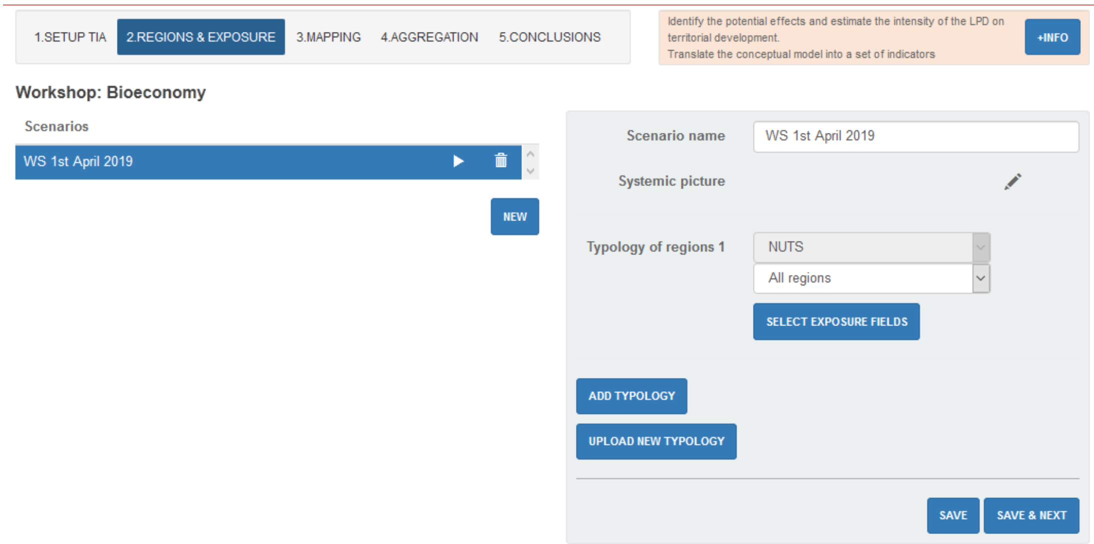
The updated tool is now able to define more than one scenario reflecting different views or different timelines and exposure scenarios. As a prerequisite of comparison of the effects between different types of regions it is necessary to collect the expert judgement on the exposure on different types of regions. This can be done in one session. If the results (potential territorial impacts) of a certain expert judgement on exposure should be compared with other variants of expert judgements (e.g. different exposure for the same sensitivity indicator in case of different policy options of a policy proposal, different short-term or long-term effects or diverging opinions in the group of experts voting on exposure in the TIA workshop), the tool allows for more than one exposure judgement per indicator, creating "exposure scenarios". The moderator can label the scenarios with representative names (e.g. different policy options of a policy proposal), which then can be shown in the new mapping module. This will enable the comparison of exported maps on different scenarios.

The upgraded tool follows a simple flow in step 2, allowing a structured and comprehensible discussion of exposure and possible impacts of different options:

- First, the user creates at least 1 exposure scenario and labels it with a representative name
- Second, the user selects at least 1 regional typology which will serve as a filter for the impact results, focusing only on pre-defined types of regions (or all regions, if desired)
- Third, the user selects at least 1 exposure field/indicator for which the direction and intensity of exposure (expert judgement) will be defined[1]

The different exposure scenarios created will be shown in a list on the left-hand side of the screen, while the menus for modification will be shown on the right-hand side (see Figure 2.8).

Figure 2.8: Step 2, preparation of exposure scenarios II



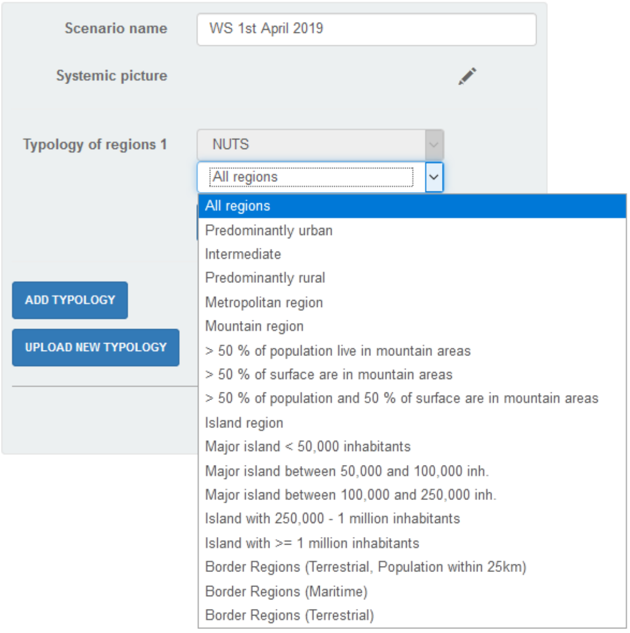
Source: ÖIR (2020)

Select or add regional typology

The TIA tool contains a standard set of regional typologies, from which the user can select. The tool also provides registered users with the option of uploading new typologies (see Figure 2.9). For each exposure scenario, the selection of multiple typologies is possible. This function is especially relevant when e.g. different exposures for Urban/Rural/Intermediate regions are expected.

[1] Which is used by the tool to calculate the impact by combining the exposure value with the pre-defined sensitivity

Figure 2.9: Step 2, management of new or existing regional typologies

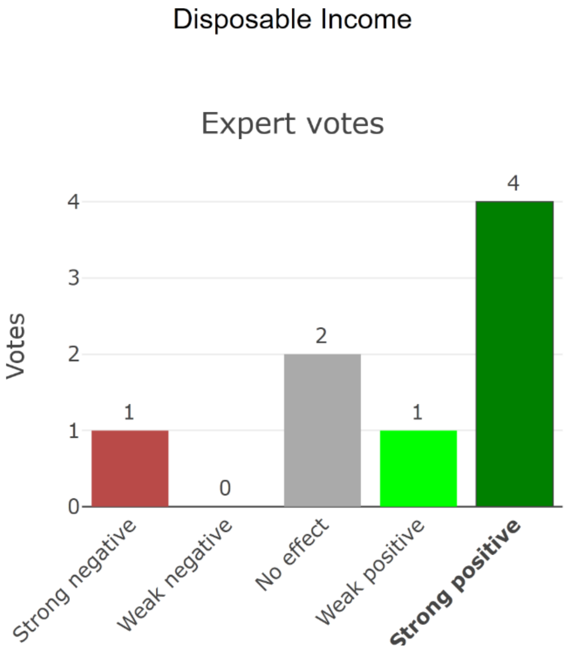


Source: ÖIR (2020)

Selection of exposure fields & exposure voting

A key element of the TIA workshop is the expert judgement of the workshop participants on the direction and intensity of exposure of a policy proposal related to different thematic fields represented by the sensitivity indicators. In the TIA workshops conducted so far, an interactive method of collecting the expert judgement has proven efficient and suitable to capture the opinion of as many experts of the group as possible.

Figure 2.10: Step 2, expert voting results: Definition of direction and intensity of exposure per indicator



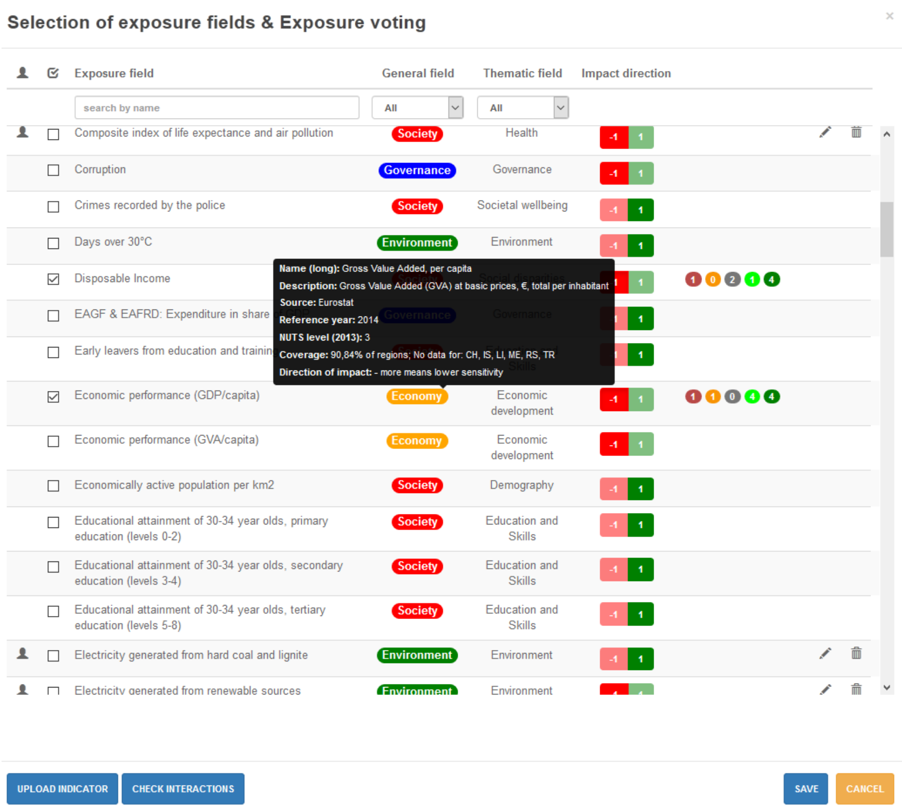
Source: ÖIR (2020)

By conducting a poll with “indicator voting cards”, votes on the 5 categories of direction and intensity of exposure[2] per indicator are collected and later evaluated. The results of the voting are displayed in bar charts, allowing for a comparison e.g. when two categories are voted in equal shares (see Figure 2.10).

The voting procedure will physically be done by the moderators in the workshop session, but the evaluation procedure has been integrated into the tool (see Figure 2.11).

While clicking the “select/modify” button the list of available exposure fields is shown to the user. The exposure fields are arranged by general field (4 quadrants of the systemic picture: economy, society, governance and environment), thematic field (sub-categories of the general fields) and indicator name, to facilitate the selection of indicators. In addition, while placing the mouse cursor over the title of an indicator, information on the indicator appears in a box. Furthermore, a search field was integrated to allow the moderator to find an indicator by entering (parts of) the name.

Figure 2.11: Step 2, selection of exposure fields & exposure voting



Source: ÖIR (2020)

For each of the selected thematic fields the moderator has to enter the amount of votes given per category of exposure. The number of votes by category are then shown beside each selected indicator. In step 3 (mapping), the tool will then show a bar chart as the result of voting

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[2] strong advantageous (++), weak advantageous (+), neutral/unknown (0), weak disadvantageous (-), strong disadvantageous (--) effect of the policy

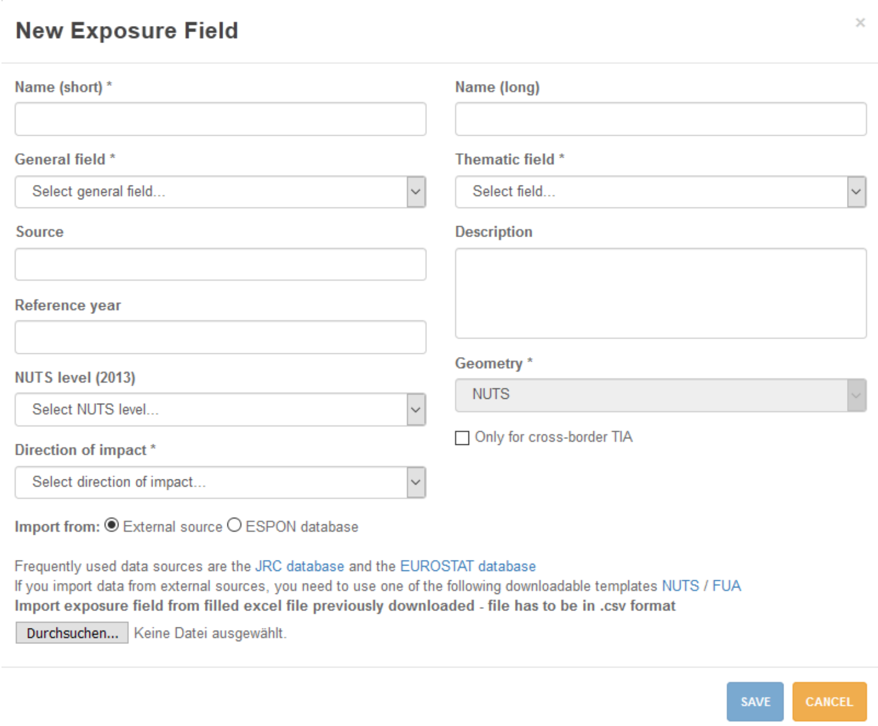
per type of region, indicator and exposure scenario. The voting results (= intensity of exposure) combined with the sensitivity of the regions (database) determine the intensity of impact shown in the maps. By clicking on the different bars representing different voting results, the impact displayed in the map can be changed accordingly (see chapter 2.3.3). This makes the logic behind the calculation of impact more transparent and also allows for the incorporation of different expert opinions in the mapping.

Upload new exposure field/indicator

The "upload indicator" button allows registered users to upload new indicators to the database (see Figure 2.12). A label has to be given to the indicator as well as the affiliation to a general field and a thematic field has to be selected. Statements on source, reference year and description are optional, but highly advised in order to keep a good overview of the data in the database. One of the main technical changes to the tool has been to enable it to store raw data, thus the upload procedure is much simpler than in the previous version of the tool. The user can now upload any indicator in its raw format without having to normalize it beforehand. Additionally, a link to the ESPON Database is provided, allowing for a direct import of indicators and the corresponding metadata.

The tool executes the normalization procedure right before calculating the territorial impacts in step three. As additional feature, different modes of normalization are offered (see chapter 3.5). The direction of impact can be changed by the user as well – however this functionality is not advised to be used in the workshop setting, as it requires in-depth understanding of the methodology of impact calculation, which the participants usually do not have.

Figure 2.12: Step 2, upload new indicator



Source: ÖIR (2020)

Several additional functionalities geared towards more experienced users have been included in the updated tool as well, which are outlined in section 3.

2.3.3 Step 3: Mapping

In this step, the user can visualise in maps and graphs the calculated territorial impact by exposure scenario, indicator and type of region selected.

Figure 2.13: Step 3, mapping, layout and included elements

Source: ÖIR (2020)

Some relevant elements of ESPON corporate identity are included in the ESPON map templates. The final version of the ESPON EU-wide MapKit is used in the TIA tool (see Figure 2.13). This step includes different elements.

Selection of data to be displayed on the map

During step 3 the user has access to drop-down menus on the top-left side of the screen to select the exposure scenario, regional typology and exposure field/indicator to be displayed on the map.

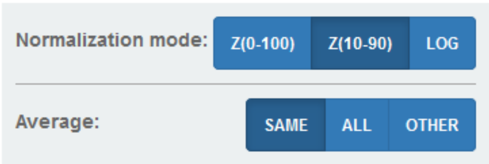
Buttons for data normalization

In addition, the user will be able to access different options for the mode of data normalization (z-normalization, 10-90 quantile z-normalization and log-normalization), which can be found on the left-hand side of the screen. The theoretical background behind the normalization modes is explained in section 4.1.

Buttons for average, map export and conclusions

Below on the left, three buttons are offered to the user. The first one “average” lets the user choose different calculation methods of the distance to average value. As standard option, the distance to the average within the same type of regions will be calculated by the tool and shown on the map. The user can choose two other options; distance to average of all regions or another type of region (i.e. another typology). The calculation of the average however is always done in relation to the selected Set of Regions.

Figure 2.14: Step 3, mapping, option for display of distance to average and normalisation mode



Source: ÖIR (2020)

The “export” button lets the user export the map displayed in different formats (pdf, png for high resolution map, data in .xls or .csv, Votes, and Value distribution as bar charts and impact distribution as pie charts in png or pdf). The map is always exported as shown in the frame, i.e. either zoomed out to the full extent or zoomed in.

Tabs for data visualisation in graphs

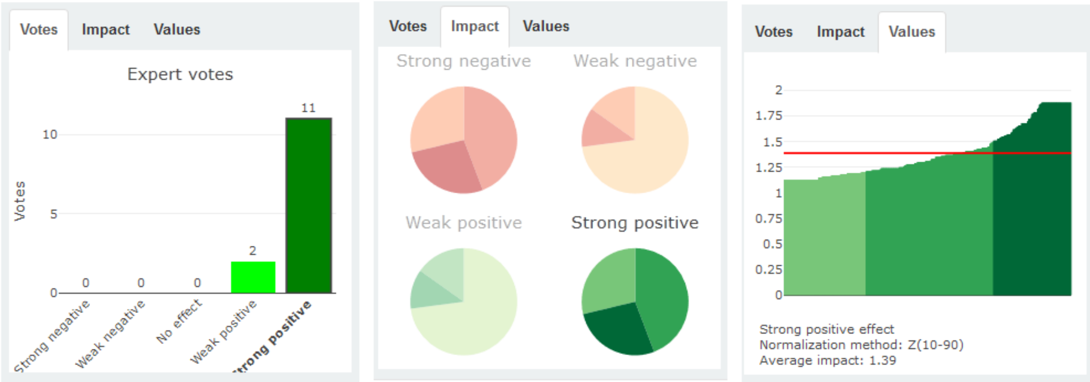
On the left-hand side the user is able to locate three tabs to be selected for the data visualisation in graphs (see Figure 2.13).

The first one, **“votes”,** shows a bar chart representing the exposure voting from step 2. The user can choose to display on the map the different voting results by clicking on the respective bar in the chart.

The tab **“impact”** shows the regional distribution of different strengths of impacts in pie charts. In doing so, the user can get an overall impression of the distribution of territorial impact on the regions and whether there are significant differences between the regions or not. The pie charts can help a moderator of a workshop to identify which maps present the most evident differences and deserve to be discussed and analysed in order to reach meaningful conclusions in the last step of the TIA (production of a report).

The tab **“values”** shows the impact distribution in the value range of all regions and the average impact. This graph can support the interpretation of results, e.g. in case where outliers on either end of the scale determine the impact distribution.

Figure 2.15: Step 3, graphs



Source: ÖIR (2020)

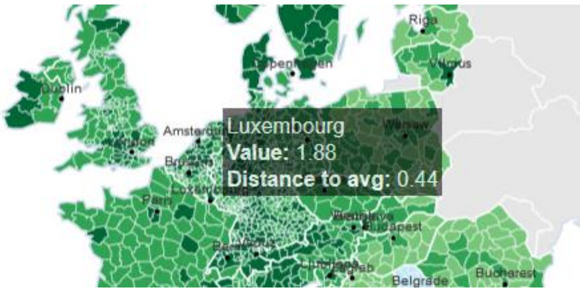
Map display

The map on the right-hand side of the screen shows the potential territorial impact of the selected Set of Regions, exposure scenario, type of region and exposure field/indicator in combination with the exposure voting selected from the bar chart. The map includes buttons for zooming in, zooming out and full extent view. It automatically centres around the regions that are selected to improve usability.

Simple analysis

As a tooltip when moving the mouse over a region, a simple analysis has been integrated in the mapping step to compare the impact on specific regions with the average impact on all regions, same type of regions, or another specific type of regions (based on included typologies). This makes it possible to compare the individual impact on one single region with the average impact on all regions of the same type if focus on some specific regions is necessary.

Figure 2.16: Step 3, simple analysis



Source: ÖIR (2020)

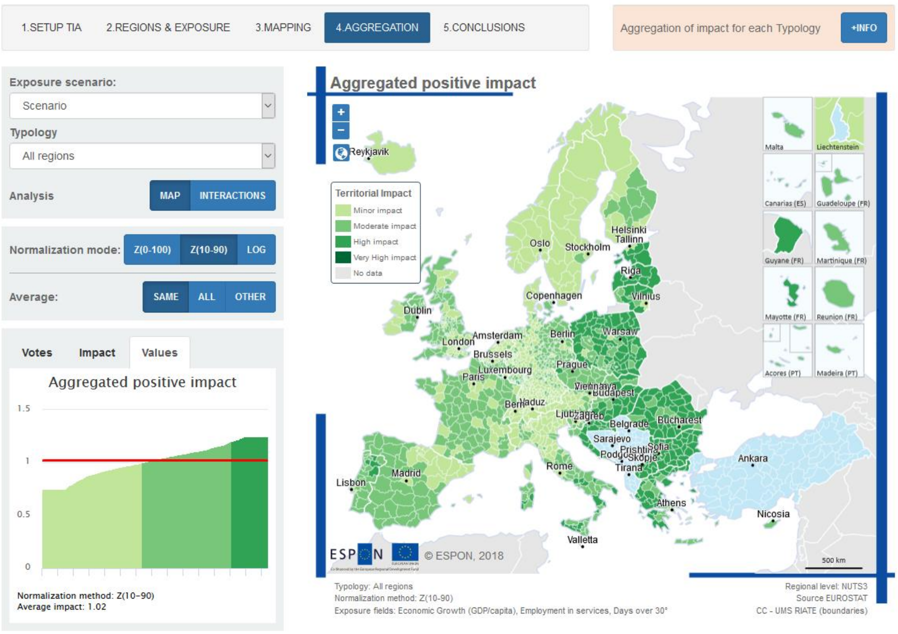
2.3.4 Step 4: Aggregation

As requested for the update of the TIA tool, a functionality to calculate an aggregated impact for a scenario has been implemented. It should allow for gaining an overview over the expected positive and negative impact on regions. Still aggregating impact has trade-offs as it is always connected to a loss of information. It requires clear outlining of the caveats of such a method to the workshop participants, and strict methodological guidance in interpreting the results.

The main issue for such an aggregation calculation is thus to allow for simple results while not hiding the complexity of the impact assessment in terms of multiple fields and judgements. The concrete method applied in the tool is outlined in section 4.2.

The aggregation function now is fully integrated into the workflow of the tool. It follows the same lay-outing and mapping approach as regular TIA maps. Other than for regular maps though, the tooltips shown when moving the mouse over a specific region show a bar chart with the aggregated votes for each indicator to assist in interpretation. Furthermore, a specific way of mapping missing values has been applied as presented in section 3.6.2.

Figure 2.17: Aggregation of impact into the tool



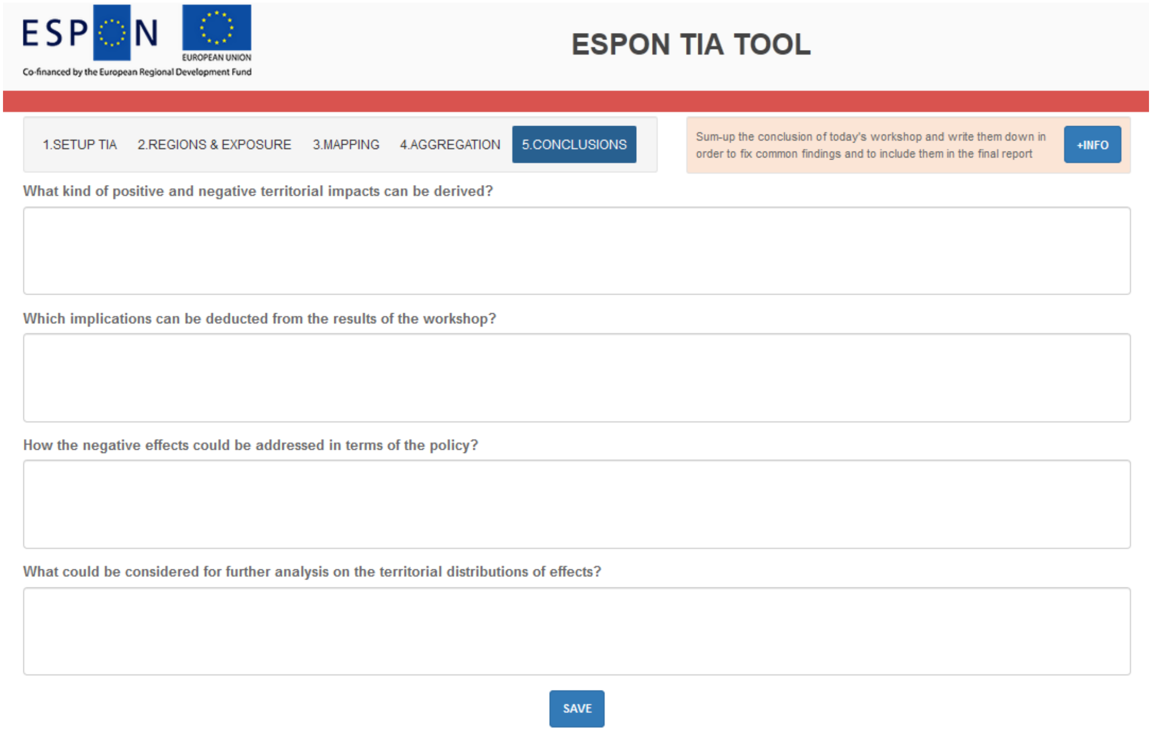
Source: ÖIR (2020)

2.3.5 Step 5: Summary

In the fifth and final step of the tool the user can enter general conclusions of the workshop and record them directly in the tool (see Figure 2.18). The leading questions to consider are:

- What kind of positive and negative territorial impacts can be derived?
- Which implications can be deducted from the results of the workshop?
- How the negative effects could be addressed in terms of the policy?
- What could be considered for further analysis on the territorial distributions of effects?

Figure 2.18: Step 4, conclusions



Source: ÖIR (2020)

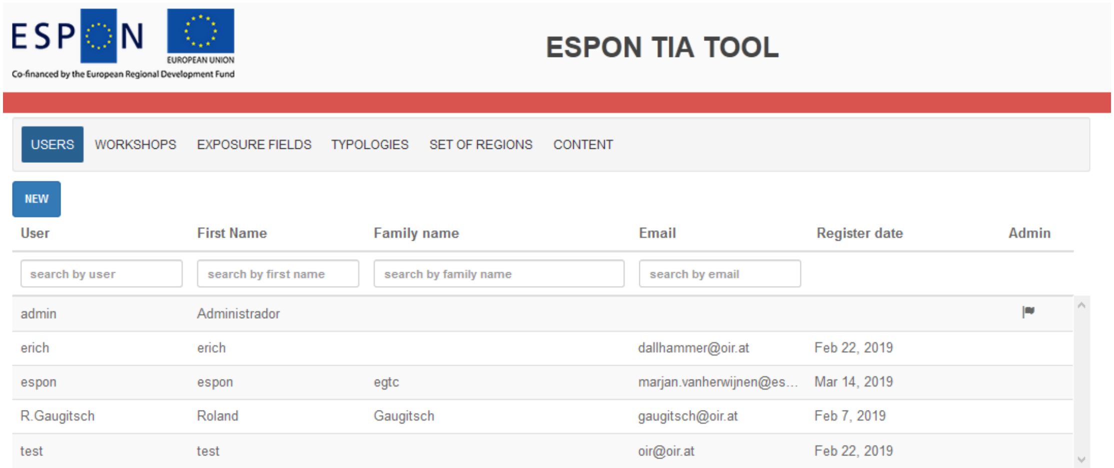
2.4 Redesigned administrator module

The administrator module has been redesigned to allow for easier administration and management of users, workshops, exposure fields/indicators, sets of regions as well as regional typologies and other content in the tool. The administrator module is organized in six tabs, which give the administrator the opportunity to add, edit or delete the different elements mentioned above to the TIA tool database.

In the users administration tab, information on name and status of all registered users is shown alphabetically in a list. Administrator status as well as the different user roles can be assigned to new users or users can be added, edited and deleted.

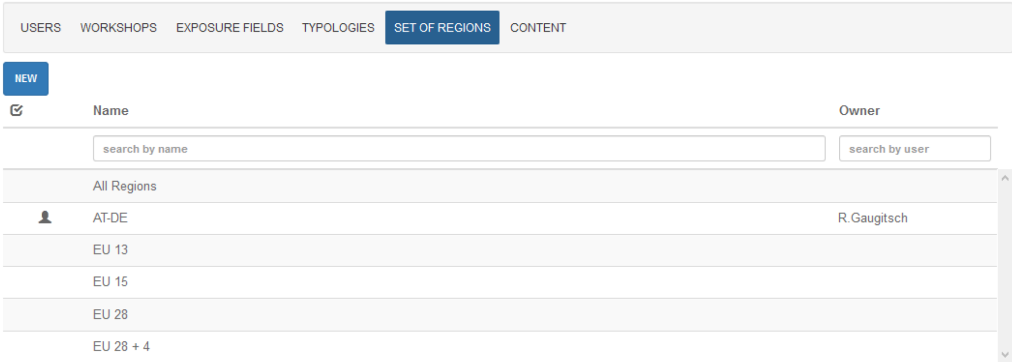
In the workshops tab a list of workshops is shown, which is sorted by date. The workshops can also be opened by the administrators to check the topic, indicators used and maps produced. The exposure fields, typologies and set of regions tabs are similarly structured, allowing for review of all default and user created content as well as editing it. By allowing for edits instead of complete replacements of existing exposure fields, administrators can easily update outdated datasets by uploading the latest values and keeping the metadata, thus reducing the effort necessary.

Figure 2.19: User management in the administrators module



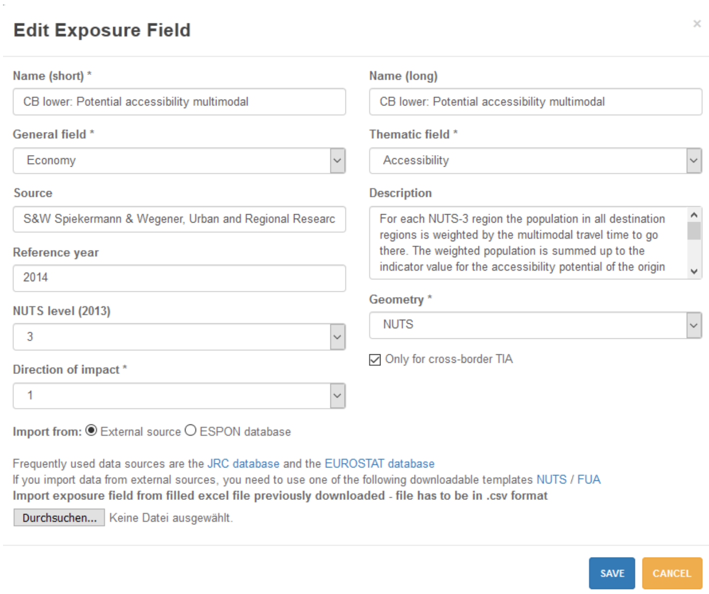
Source: ÖIR (2020)

Figure 2.20: Sets of regions in the administrators module



Source: ÖIR (2020)

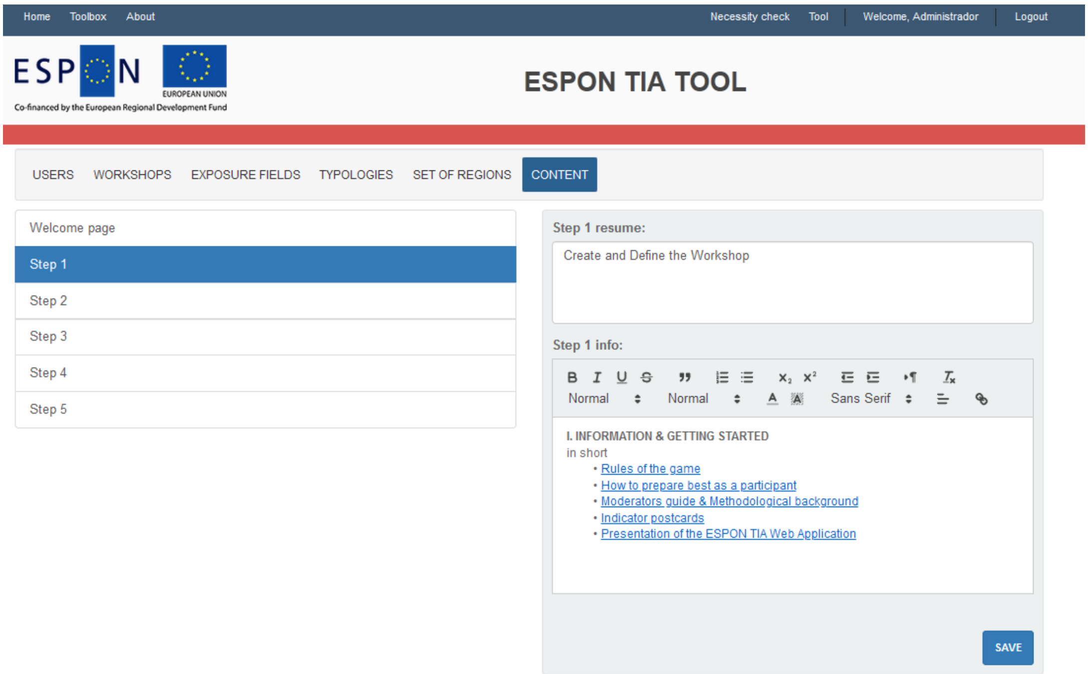
Figure 2.21: Editing exposure fields in the administrators module



Source: ÖIR (2020)

Finally, an easy solution to updating the tools description and content when necessary has been developed. The content tab allows for administrators to make changes to descriptions and informational texts via a standard html text editor. Thus also upload and linking to new guidance material developed in the future is possible

Figure 2.22: Content editor in the administrators module



Source: ÖIR (2020)

2.5 Datasets gathered and integrated into the TIA tool

Starting with a base set of indicators which consisted mainly of an update of existing ones from the previous tool, the number of standard indicators over the course of the project has been considerably expanded. For the implementation of the workshops, over 130 Indicators have been researched, around 1/3 of which was integrated as standard indicators into the tool. The indicators which were not kept as standard were excluded in most cases due to their too narrow scope fitting only a very specific topic. Table 2.1 provides an overview of standard indicators in the tool.

Table 2.1: Datasets updated and integrated

Thematic field	**Indicator**	**Source**	**Ref year**
Accessibility	Potential accessibility by air	S&W Spiekermann & Wegener, Urban and Regional Research	2014
	Potential accessibility by rail	S&W Spiekermann & Wegener, Urban and Regional Research	2014
	Potential accessibility by road	S&W Spiekermann & Wegener, Urban and Regional Research	2014
	Potential accessibility multimodal	S&W Spiekermann & Wegener, Urban and Regional Research	2014
Climate	Days over 30°C	E-OBS	1995

Thematic field	Indicator	Source	Ref year
Demography	Average age of population	Eurostat	2017
	Economically active population	EUROSTAT	2016
	Old age dependency ratio	EUROSTAT	2015
Economic Development	Economic growth (GDP/capita)	Eurostat	2014
	Economic performance (GVA/capita)	EUROSTAT	2014
	Employment in industry (secondary sector)	Eurostat SBS/ÖIR calculation	2015
	Entrepreneurship (share of private enterprises)	Eurostat LFS	2014
	GVA in industry (secondary sector)	Eurostat/ÖIR calculation	2015
	Total overnight stays per thousand inhabitants	Eurostat	2015
Education and Skills	Early leavers from education and training	EUROSTAT	2015
	Early leavers from education and training	Eurostat LFS	avg. 2011-15
	Educational attainment of 30-34 year olds, primary education (levels 0-2)	EUROSTAT	2016
	Educational attainment of 30-34 year olds, secondary education (levels 3-4)	EUROSTAT	2016
	Educational attainment of 30-34 year olds, tertiary education (levels 5-8)	EUROSTAT	2016
	Number of students in tertiary education	EUROSTAT	2012
	Quality of public education	Charron, Nicholas, Lewis Dijkstra and Victor Lapuente (European Quality of Government Index), ESPON M4D, ÖIR calculation	2013
	Share of pupils in Youth Education system	EUROSTAT, ÖIR calculation	avg. 2014/15
Employment	Employment in agriculture, forestry and fishing	Eurostat ESA 2010, ÖIR Calculation	2013
	Employment in industry and construction	Eurostat ESA 2010, ÖIR Calculation	2013
	Employment in services	Eurostat ESA 2010, ÖIR Calculation	2013
	Employment in Tourism	Eurostat, DG REGIO	2018
	Share of full-time employments	EUROSTAT, ÖIR Calculation	avg. 2014-16
	Share of part-time employments	EUROSTAT, ÖIR Calculation	avg. 2014-16
Environment	Emissions of CO_2 per capita (tonnes)	JRC, GAINS model	2020
	Emissions of NO_x per capita (kilotonnes)	JRC, GAINS model	2020
	Land cover: Share of Water areas	Eurostat, LUCAS Land Use and Cover Area frame Survey	2012
	Municipal waste generated	EUROSTAT	2013
	Municipal waste generated	Eurostat – pilot project data	2013
	Solar energy potential	ESPON LOCATE	2012
	Specific transport parameters	EUROSTAT	2013
	Structural Green Infrastructures	JRC, LUISA	2020
	Urban population exposed to PM10 concentrations	Urban population exposed to PM10 concentrations	2020

Thematic field	Indicator	Source	Ref year
	Urban wastewater	EEA, DG Regio 6th Cohesion Report	2010
	Water Consumption	JRC, water use model	2020
	Wind energy potential	ESPON LOCATE	2012
Governance	Corruption	DG Regio Regional Competitiveness Index 2016[3]	2013
	EAGF + EAFRD: Expenditure in share of GDP	DG Agri, ÖIR calculation	avg. 2004-08
	ERDF & CF: Expenditure in share of GDP	WIIW, Ismeri Europa, ÖIR calculation	2014
	Impartiality of government services	DG Regio Regional Competitiveness Index 2016	2013
	Quality and accountability of government services	DG Regio Regional Competitiveness Index 2016	2013
	Quality of law enforcement	Charron, Nicholas, Lewis Dijkstra and Victor Lapuente (European Quality of Government Index), ESPON M4D, ÖIR calculation	2013
	Trust in the legal system	EU-SILC ad-hoc Quality of Life module (publisher: SPI 2016)	2013
	Trust in the political system	EU-SILC ad-hoc Quality of Life module (publisher: SPI 2016)	2013
Health	Birth rate	EUROSTAT, ÖIR Calculation	avg. 2014-15
	Life expectancy at birth	Eurostat	2015
	Quality of the public health care system	Charron, Nicholas, Lewis Dijkstra and Victor Lapuente (European Quality of Government Index), ESPON M4D, ÖIR calculation	2013
	Total fertility rate	EUROSTAT, ÖIR Calculation	avg. 2014-15
Infrastructure	Regional ICT infrastructure	EUROSTAT	2015
	Regional transport infrastructure: motorways	EUROSTAT	2014
	Regional transport infrastructure: navigable canals	EUROSTAT	2014
	Regional transport infrastructure: navigable rivers	EUROSTAT	2014
	Regional transport infrastructure: total railway lines	EUROSTAT	2014
Innovation	Employment in technology and knowledge-intensive sectors	Eurostat LFS	2015
	Employment in technology and knowledge-intensive sectors	Eurostat LFS	2015
	Patent applications/Mio inhabitants	Eurostat	2012
	Patent applications/Mio inhabitants	Eurostat	2012
	Share of R&D personnel and researchers	EUROSTAT	2013
Land use and conservation	Hectare of green infrastructure per capita	JRC, LUISA	2020
	Land cover: Share of agricultural areas	Eurostat, LUCAS Land Use and Cover Area frame Survey	2012

[3] http://ec.europa.eu/regional_policy/en/information/maps/regional_competitiveness/

Thematic field	Indicator	Source	Ref year
	Land cover: Share of Woodland, Shrubland and Wetland	Eurostat, LUCAS Land Use and Cover Area frame Survey	2012
	Land use: Share of agriculture	Eurostat, LUCAS Land Use and Cover Area frame Survey	2012
	Land use: Share of heavy environmental impact	EUROSTAT, LUCAS	2012
	Land use: Share of irrigated land	EUROSTAT	2013
	Protected areas (NATURA 2000)	EEA, DG REGIO	2012
	Relative size of built-up areas	JRC	2012
Natural Hazards	Capacity of ecoystems to avoid soil erosion	JRC, LUISA	2020
	Probability of forest fire hazard	ESPON 1.3.1., GTK	1997 – 2003
	Soil erosion by water	JRC	2010
	Soil erosion by water	JRC, LUISA	2020
	Soil retention	JRC, LUISA	2020
Regional economy	GDP loss due to cross-border obstacles	Politecnico di Milano	2017
Social disparities	Disposable Income	Eurostat	2014
	Early leavers from education and training	Eurostat LFS	avg. 11-15
	Female employment ratio	Eurostat	2016
	Female employment ratio	Eurostat, ÖIR calculation	2016
	Gender balance employment	Eurostat/DG Regio RCI 2016	2014
	Net Migration	Eurostat	2015
	People at risk of poverty or social exclusion	Eurostat	2015
	Unemployment rate	Eurostat LFS	2014
Societal wellbeing	Crimes recorded by the police	EUROSTAT	2010
	Hospital beds per hundred thousand inhabitants	EUROSTAT	2014

Source: ÖIR (2020)

Datasets gathered for Urban TIA

For Urban TIA, as outlined in section 3.2.2 all NUTS based datasets can be used as well. However the core specifity of the Urban TIA module is the addition of data based on Functional Urban Areas. A number of highly specialised datasets is available at this level, of which a quality and relevance check for TIA standard indicators has been conducted. The result is the number of indicators for FUAs listed in Table 2.2 which has been integrated into the TIA tool.

Table 2.2: Datasets integrated for URBAN TIA at FUA level

Thematic Field	Indicator	Source	Ref. year
Accessibility	Average travel distances	JRC, LUISA	2010
	Potential accessibility by transport infrastructure	JRC, LUISA	2020 (projection)
Demography	Old age dependency ratio	Eurostat, ÖIR calculation	2016
	Population density	JRC, LUISA	2020 (projection)
	Population weighted density	JRC, LUISA	2020 (projection)

Thematic Field	Indicator	Source	Ref. year
	Urbanisation level	JRC, LUISA	2010-2030
	Young age dependency ratio	Eurostat, ÖIR calculation	2016
Environ-ment	Concentration of NO_2	JRC, LUISA	2020 (projection)
	Concentration of PM10	JRC, LUISA	2020 (projection)
	Recreational areas	JRC, LUISA	2020 (projection)
	Removal capacity of NO_2	JRC, LUISA	2020 (projection)
	Removal capacity of PM10	JRC, LUISA	2020 (projection)
Health	Crude birth rate	Eurostat	2015
Infrastruc-ture	Length of local roads per inhabitant	JRC TSEA and DG REGIO (based on data from TomTom, EUROSTAT and NSIs)	2014
	Road safety	Eurostat, DG REGIO	2014
	Urban form efficiency	JRC, LUISA	2011
Land use and conser-vation	Annual land take per inhabitant	JRC, LUISA	2010-2030
	Built-up areas per inhabitant	JRC (European Settlement Map ESM 2016), Eurostat (GEOSTAT 2011 grid), DG REGIO	2011
	Hectare of green infrastructure per capita	JRC, LUISA	2020 (projection)
	Share of green infrastructure	JRC, LUISA	2020 (projection)
Natural Haz-ards	Urban Flood Risk	JRC, LUISA	2020 (projection)
Social dis-parities	Unemployment rate	Eurostat	2015

Source: ÖIR (2020)

Datasets calculated for Cross-Border-TIA

As outlined in section 3.2.1, the core element of the Cross-Border-TIA module is the introduction of comparative indicators we have calculated as a basis for standard indicators. Other than stock indicators provided e.g. by Eurostat, these have to be specifically calculated and require an in-depth understanding of the methodology. Their actual application is strongly connected to the individual approaches of a CB TIA, thus only a small set of standard indicators was calculated.

Table 2.3: New CB Indicators integrated

Thematic Field	Indicator	Source	Ref. year
Accessibility	CB lower: Potential accessibility multimodal	S&W Spiekermann & Wegener, Urban and Regional Research, AC-CSCEN_PotAcc_2001-2014_Index, ÖIR calculation	2014
Economic Development	GDP loss due to cross-border obstacles	Politecnico di Milano (publisher: European Commission)	2017
Environment	CB product: Protected areas (NATURA 2000)	EEA, DG REGIO, ÖIR calculation	2012
Governance	CB difference: Quality and accountability of government services	DG Regio RCI 2016 on University of Gothenburg, European Quality of Institutions Index, ÖIR calculation	2013

Thematic Field	Indicator	Source	Ref. year
Governance	CB lower: Quality and accountability of government services	DG Regio RCI 2016 on University of Gothenburg, European Quality of Institutions Index, ÖIR calculation	2013
Health	CB difference: Hospital beds	Eurostat, ÖIR calculation	2014

Source: ÖIR (2020)

2.6 Typologies gathered and integrated into the TIA tool

A number of typologies was integrated into the tool as a basis for most TIA workshops. With the update to the TIA tool, the integration of "fuzzy" typologies has been implemented. Instead of standard typologies, which are determined on a binary basis, i.e. either a region belongs to a typology ("1") or it does not ("0"), fuzzy typologies allow for a differentiated picture. A region is assigned a value between 0 and 1 based on a specific property (e.g. the share of the population that is living within a 25km corridor from the border), a coefficient which is applied before the impact calculation and thus can reduce the strength of calculated impacts for a specific region.

Some specialised typologies, especially fuzzy ones have been used for TIA workshops but have not been selected as standard. The following table presents the typologies now integrated into the tool.

Table 2.4: Typologies updated and integrated

Regional Typology Name	Definition	Ref. year	NUTS Level (2013)
All regions	All regions	2016	3
Predominantly urban	The typology is applied to NUTS level 3 regions of the European Union (EU) to Statistical Regions level 3 of the EFTA and Candidate countries; A similar typology is applied by the OECD to Territorial Level 3 (TL3) regions of its member countries. It is a based on the share of the regional population living in rural grid cells (in other words the rural population) and urban clusters. Based on the share of the rural population the regions are then classified into the following three groups: predominantly urban region: the rural population accounts for less than 20% of the total population; intermediate region: the rural population accounts for a share between 20% and 50% of the total population; predominantly rural region: the rural population accounts for 50% or more of the total population.	2011	3
Intermediate		2011	3
Predominantly rural		2011	3
Metropolitan region	The NUTS-3-based typology of metro regions contains groupings of NUTS-3 regions used as approximations of the main metropolitan areas.	2011	3
Mountain region	A typology of NUTS3 regions based on mountain areas (areas defined in the DG REGIO study on mountain areas)	2016	3
> 50% of population live in mountain areas		2016	3
> 50% of surface are in mountain areas		2016	3

Regional Typology Name	Definition	Ref. year	NUTS Level (2013)
> 50% of population and 50% of surface are in mountain areas		2016	3
Island region	A typology of NUTS3 regions entirely composed of islands	2016	3
Major island < 50,000 inhabitants		2016	3
Major island between 50,000 and 100,000 inh.		2016	3
Major island between 100,000 and 250,000 inh.		2016	3
Island with 250,000 – 1 million inhabitants		2016	3
Island with >= 1 million inhabitants		2016	3
Urban Areas	Fuzzy: share of population in urban areas	2016	3
Rural Areas	Fuzzy: share of population in rural areas	2016	3
Mountainous Regions	Fuzzy: share of population in mountain areas	2016	3
Mountainous Regions	Fuzzy: share of surface covered by mountain areas	2016	3
Border Regions (Maritime)	DG Regio defined maritime border regions	2016	3
Border Regions (Terrestrial)	DG Regio defined terrestrial border regions	2016	3
Border Regions	Fuzzy: Share of population within 25km	2016	3

Source: ÖIR (2020)

2.7 Final version of the guidance documents for moderators

The moderators guide has received some updates regarding the indicators added to the tool, as well as some minor updates based on the tools functionalities. The final version is annexed as a separate document to this report.

2.8 Final version of the guidance documents for administrators

The administrators guidance has been reviewed and the changes requested following Delivery 4 have been included. Furthermore, the latest changes to the tool, especially the User Roles have been added and explained in the guidance. The final version is annexed as a separate document to this report.

3 Additional functionalities

Several additional functionalities, going beyond the simple updating/upgrading of existing functionalities in the tool have been implemented in the frame of the project.

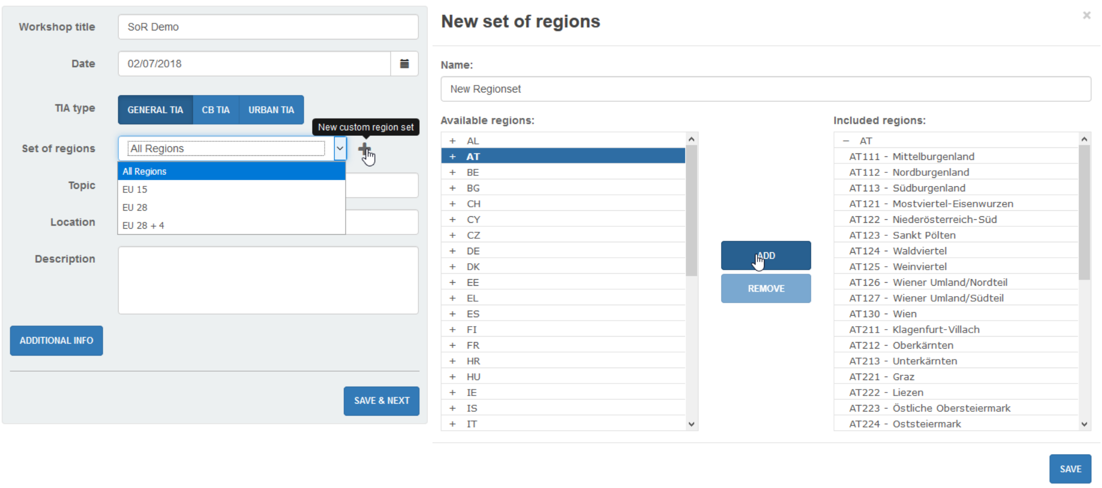
3.1 Focus on a set of regions

The request frequently made by users related to an option to limit the geographic extent of the assessment more tailored than possible with a typology only, thus allowing for a combination of a typology (i.e. Urban Regions) with a set of regions (e.g. the Central Europe Area). Consequently, such a possibility was integrated fully functional with all three sub-modules, all normalisation modes etc.

3.1.1 Selecting and defining a set of regions

In the set-up of any type of TIA the moderator is provided with an interface where a pre-defined set of regions can be selected (default or user-defined). A new set of regions can also be created and user-defined sets of regions can be edited by the help of a simple interface that lists all regions available and those included in two side-by side lists. Figure 3.1 shows the selection of the set of regions considered with the set-up of a TIA and the creation of a new set of regions in the editor.

Figure 3.1: Selecting and defining a set of regions

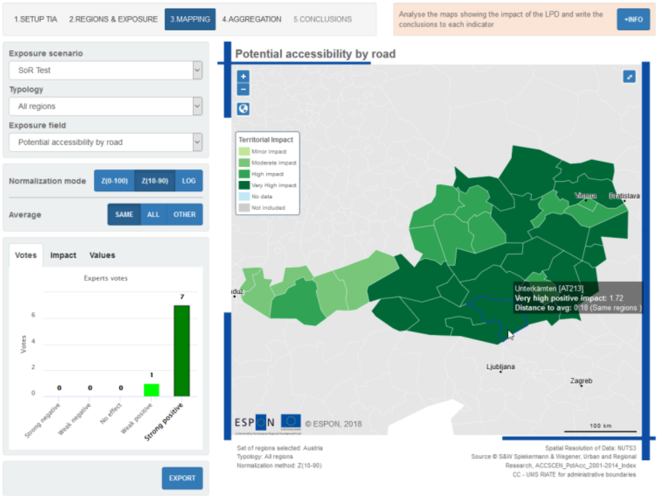


Source: ÖIR (2020)

3.1.2 Calculation and mapping

The selected set of regions is then applied with all calculations, including “Interactions between Indicators”, calculation of distances to average, the calculation of regional exposure and mapping as well as aggregated impact. Figure 3.2 shows an example for a map of a TIA focussed on a set of regions comprising all regions in Austria.

Figure 3.2: Mapping of a TIA based on a set of regions



Source: ÖIR (2020)

For the Urban TIA which allows for FUA as a different base geometry along with NUTS based regional boundaries, equivalence between FUAs and NUTS was defined. The methodology applied allows for the use of the same sets of regions with both geometries.

3.2 Sub-tools for Cross-Border TIA and Urban TIA

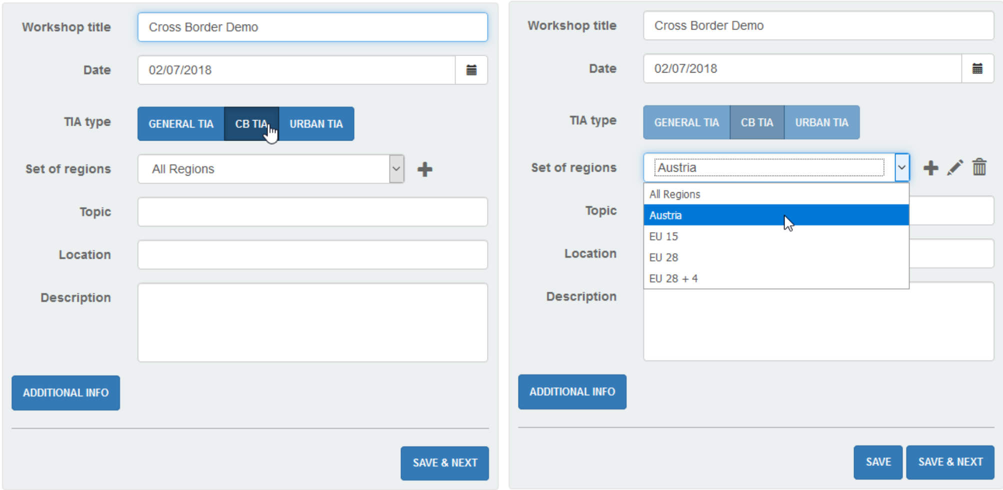
In order to allow for a more focused analysis on specific types of regions, going beyond what the typology function already implemented in the tool can offer, two sub-tools covering Cross-Border Regions and Urban Regions have been implemented into the tool. For the CB-TIA new types of indicators have been included, which represent sensitivity values not only in relation to a single regions properties, but in relation to a regions properties in connection with its neighbouring regions. For the Urban TIA, a new geometry, “Functional Urban Areas” has been included to allow for using new datasets and to enable analyses on one entire urban area instead of its individual sub-regions on NUTS3 level.

The decision which TIA sub-tool should be applied has to be made in the first step of the tool as outlined in section 2.3.1.

3.2.1 Cross-Border TIA

The Cross-Border TIA tool and methodology has been tested and applied in two Cross-Border TIA workshops (on a legislative proposal regarding Cross-Border Commitment and on the European Labour Authority). Figure 3.3 shows the set-up of a Cross-Border TIA. As shown it has also been extended to be interlinked with the “Focus on set of Regions” feature to allow for a CB-TIA only for a specific set of regions.

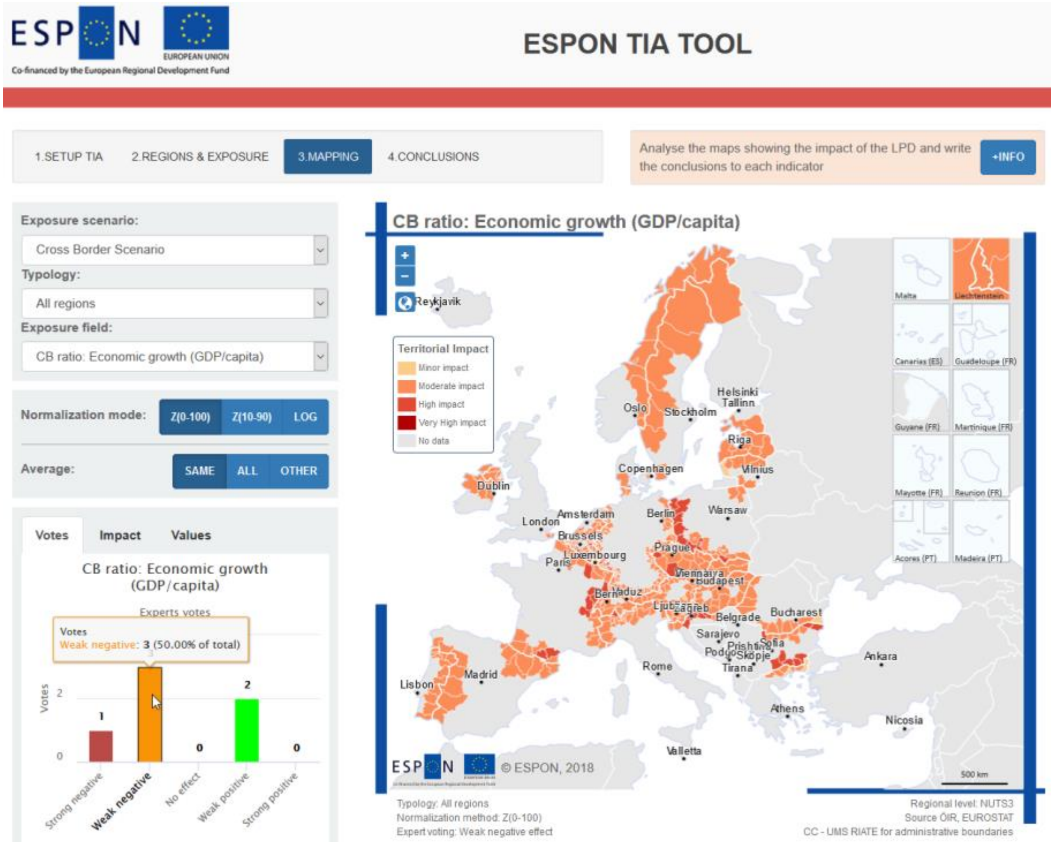
Figure 3.3: Set-up of a Cross-Border TIA



Source: ÖIR (2020)

Figure 3.4 shows an example for the resulting map of a Cross-Border TIA for the EU.

Figure 3.4: Example for a Cross-Border TIA map



Source: ÖIR (2020)

CB-indicators

While the simple focus of the tool on CB areas in principle could be achieved by a typology or selecting a set of regions as well, the main element of the CB TIA module are the specific cross-border indicators. Sensitivity of a region in a regular TIA is always based on a regions own properties, which especially in the case of regions at national borders can be a narrow view. In those areas, some defining properties are always linked to a regions relation with its neighbours, i.e. the susceptibility towards a specific policy/action differs not only depending on the region but also on its surroundings. To accurately depict those relations in a TIA setting, specific types of indicators, CB-indicators, which depict a regions sensitivity based on a region and its relation to the neighbouring regions have been developed. The sensitivity in these cases can be e.g. determined by the equilibrium or the differences between regional properties such as GDP, tourism numbers etc. A technical outline of the method applied is presented in section 4.3.

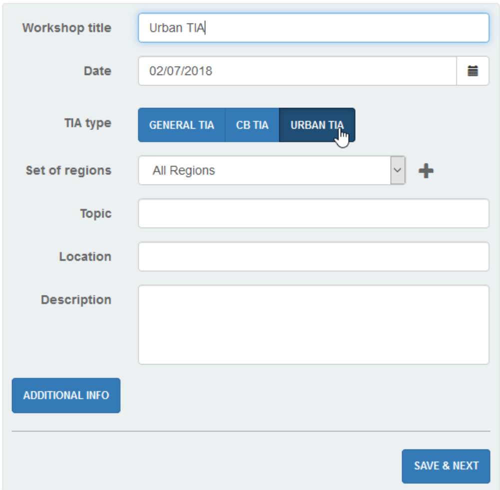
3.2.2 Urban TIA

Urban TIA as a new form of TIA has been integrated into the tool. The functionality has already been tested and successfully applied a workshop setting. At the core of the Urban TIA is a different geometry than with the “General” and “Cross-Border” TIA. Whereas these TIAs are conducted by considering regions represented by NUTS 3 borders, the Urban TIA allows to consider Functional Urban Areas (FUA) as defined by Eurostat, if needed in parallel with NUTS3 regions.

Focus on a set of regions

As to be seen in the set-up screen for the Urban TIA (s. Figure 3.5) the Urban TIA has also been interlinked with the “Focus on set of Regions” feature to allow for an Urban TIA only for a specific set of regions.

Figure 3.5: Urban TIA set-up

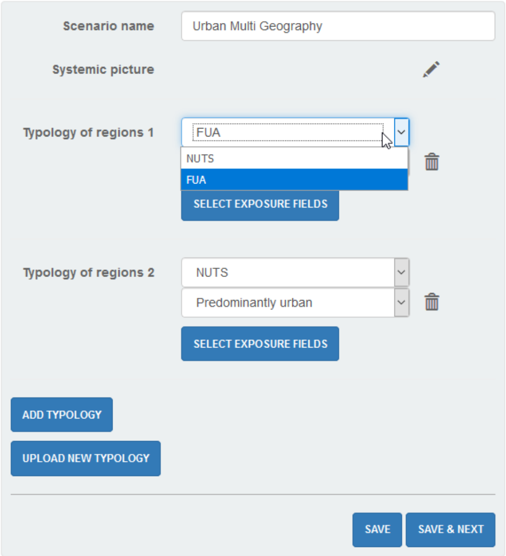


Source: ÖIR (2020)

Multi-Geometry TIA

Furthermore the Urban TIA does not only allow for a different geometry (FUA) than the “General” and the “Cross-Border” TIA, it allows for both geometries within a single TIA. This has been integrated mainly to still allow to use the extensive amount of indicator data available at NUTS 3 level within the tool or beyond to fill possible data gaps at the FUA level.

Figure 3.6: Multi-Geometry Urban TIA



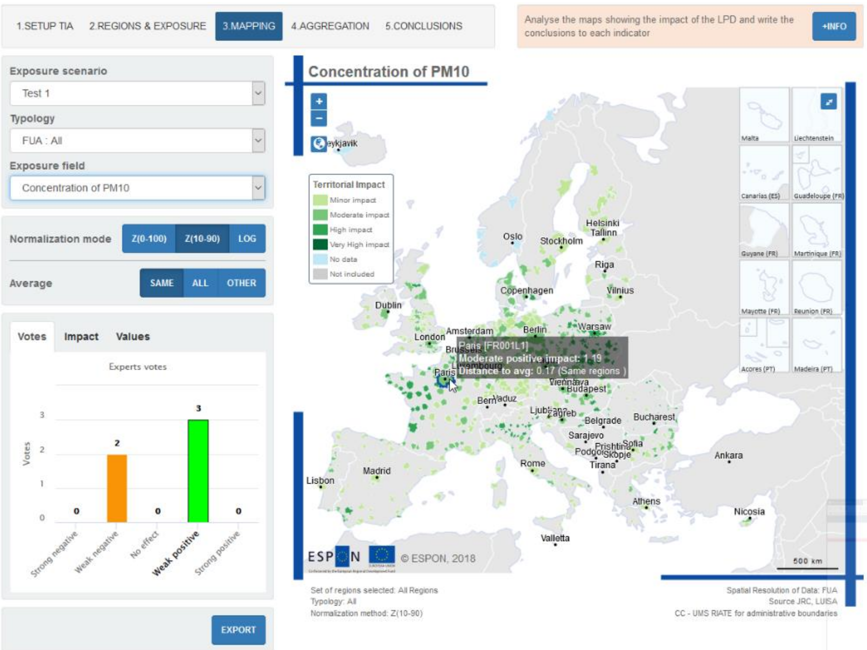
Source: ÖIR (2020)

Figure 3.6 shows the set-up of such a multi-geometry Urban TIA. For every typology included in the TIA a geometry (either FUA or NUTS) can be chosen and along with these respective typologies can be selected. For an Urban TIA using FUAs a typology focussing on urban areas (e.g. Eurostat's "Predominantly Urban" typology) is commonly advised. The calculation of equivalence between NUTS and FUA geometry is presented in section 4.4.

Mapping

The resulting maps and charts look similar to those for the General and CB TIA. The Urban TIA maps for typologies based on a FUA geometry differ in that they show data on a base map with FUA boundaries as to be seen in Figure 3.7.

Figure 3.7: Urban TIA map



Source: ÖIR (2020)

3.3 Interactions between Indicators

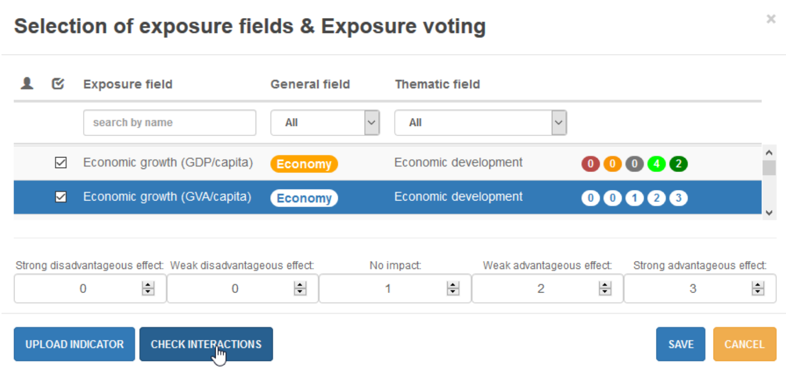
Having tested two methods for calculating interactions between indicators, namely cluster analysis and linear regression, the project team decided to implement the linear regression method as it is easier to communicate to a more general audience and easier to integrate into the tool in a flexible way.

Figure 3.8: Interactions between indicators

Source: ÖIR (2020)

Here a matrix shows the similarity between indicators over all regions considered. The calculation explicitly considers the “Focus on set of regions” as well as the chosen typology. Thus similarity measures allow to understand the similarity in terms of territorial impact between indicators for the specific analysis at hand. To allow for an easy way to comprehend the extensive data, it is presented in a matrix where similarity values as well as colours representing these values are shown. Figure 3.8 shows an example of such a matrix.

Figure 3.9: Exposure field selection with interactions check

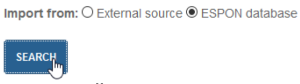


Source: ÖIR (2020)

3.4 Link to the ESPON Database

When creating or updating an exposure field in the admin or in a workshop, a direct import of data from the ESPON database via the API instead of uploading a file has been implemented. Figure 3.10 shows how to start the import.

Figure 3.10: Importing data from the ESPON database

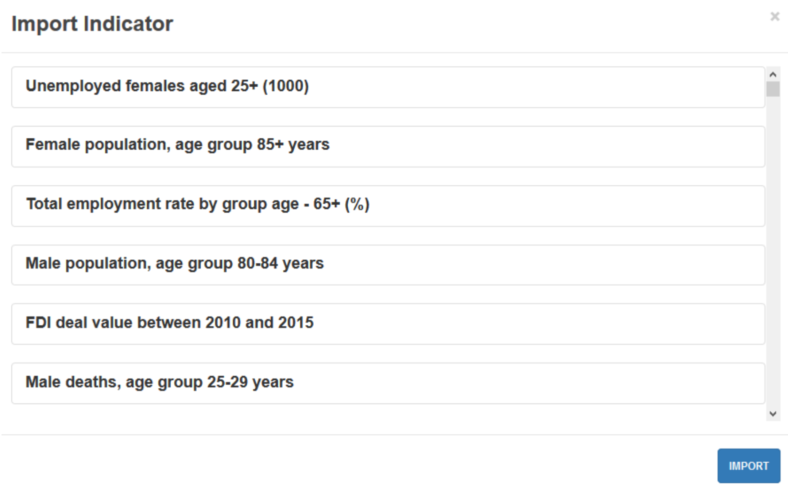


Source: ÖIR (2020)

Then a list of available datasets is provided as to be seen in Figure 3.11. Some tweaks to the import function have been made to increase usability:

- Filters have been added to make the search for indicators on specific topics easier
- A search field has been added for the same purpose
- If multiple years are available in the ESPON DB, the indicator can be imported for each year separately
- Metadata is imported to the extent it is provided by the ESPON DB
- A warning has been added, when data from a NUTS version different from the one the Tool uses is imported. The import will still work, however the user is made aware, that he might experience some data gaps due to changed NUTS codes.

Figure 3.11: ESPON database datasets list



Source: ÖIR (2020)

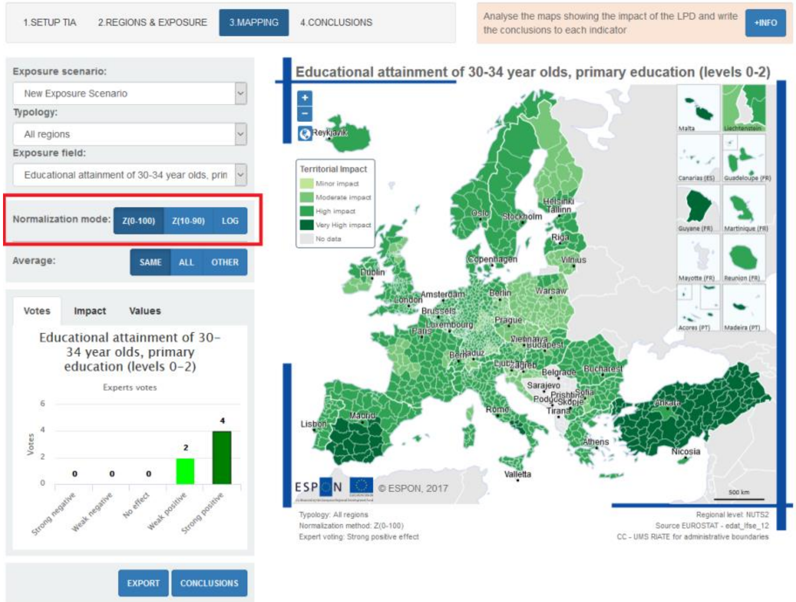
3.5 Normalization modes

Three additional normalization modes have been implemented in the TIA tool, which are the following:

- z(0-100%)
- z(10-90%)
- log

The user can select a normalization mode in step 3 via one of the buttons. The chosen normalization mode translates directly into the mapping of impacts. The "normalization mode" button is located above the average button in step 3 of the TIA tool. The selected "normalization mode" button is marked dark blue, like in the case of "average" button (see the screenshot below-normalization mode button is marked in red).

Figure 3.12.Location of the normalization mode button.



Source: ÖIR (2020)

For all normalization methods normalization proceeds in four steps:

(1) Apply direction of impact and typology
(2) Remove cases excluded from the typology
(3) Filter and rescale values
(4) Map values to the sensitivity range

For all normalization modes steps 1,2, and 4 are the same. In the first step all indicator values are multiplied with the direction of impact (-1 or 1) and the typology is applied. Second, all cases where the typology does not classify the region (i.e. Null-values) or the region is not included (i.e. 0-values) are removed. Third, the filtering and rescaling is applied. This step differs for the three normalization modes. Finally the indicator data is mapped to the sensitivity value range [0.75;1.25]. The lower bound of 0.75 depicts the lowest and 1.25 the highest sensitivity value for the indicator.

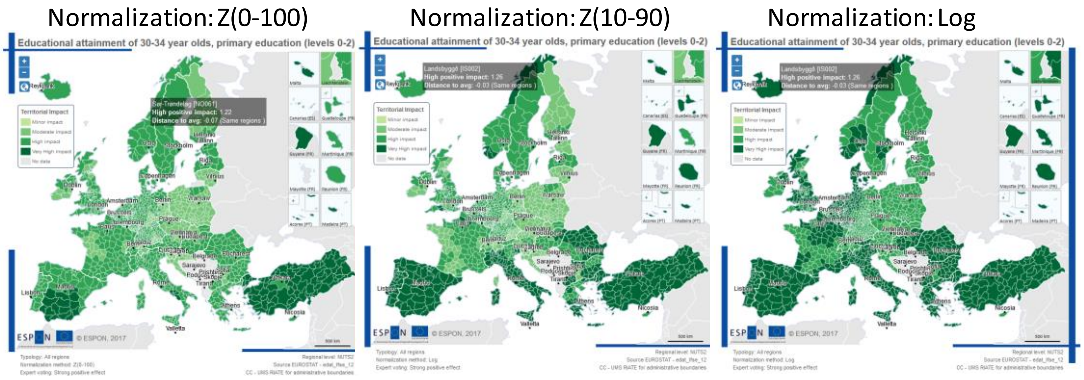
For the z(0-100) normalization no filtering or rescaling is applied. It offers the possibility to visualise all data, irrespective of outliers which may compress the scale for most of the values.

For the z(10-90) normalization the values are bounded to the 10% and 90% quantile of the values. Thus outliers are replaced with the q10 or q90 values. It allows for a reliable view on the relevant differences for the vast majority (80%) of the regions.

The log-normalisation first replaces all 0 values are replaced with 0.0001 (or -0.0001 if the direction if impact is negative). Then the values are logarithmized. Logarithmizing values allows for a more fine grained look at values when they are skewed to the left, i.e. there are many small values and few large values. This may be useful e.g. with degrees of urbanization or similar indicators depicting spatial concentration.

A short guidance on the difference between different normalization modes as well as when to use them is included in the guidance for moderators. The screenshots in Figure 3.13 present an impact assessment for the same exposure field using different normalization modes.

Figure 3.13: Impact presentation using different normalisation modes



Source: ÖIR (2020)

3.6 Aggregated impact

The aggregation functionality allows the user to get an overview on possible aggregated impacts for each typology selected within a scenario. While possible issues and misleading conclusions of adding up exposures are to be considered as such, a functionality always comes with big caveats, the principle idea of presenting aggregated impact can – depending on the selection of indicators and careful interpretation – produce meaningful results.

One of the core issues with regard to the practical usability is that adding up different exposure values for the various regions creates an overall tendency to average values all over the territory. This tendency to the middle is a common problem with combined indicators and can be dealt with in two ways: either carefully selecting the respective indicators to add up in advance to avoid this (as has e.g. been done with the EU SPI indicators) or by readjusting the overall variance after the addition.

We cannot anticipate the data that will be added up we decided to readjust the overall variance after the addition. So, after the weighted aggregated positive or negative exposure values have been calculated for all regions included in the typology the same normalization process that is done with the regular exposure calculation is re-applied to ensure the aggregated exposure values to be in the range of 0.75 to 1.25.

Finally, to still consider the average votes on positive or negative impact for the aggregated impact the average positive or negative voting weight is calculated and multiplied with the normalized positive or negative aggregated impact.

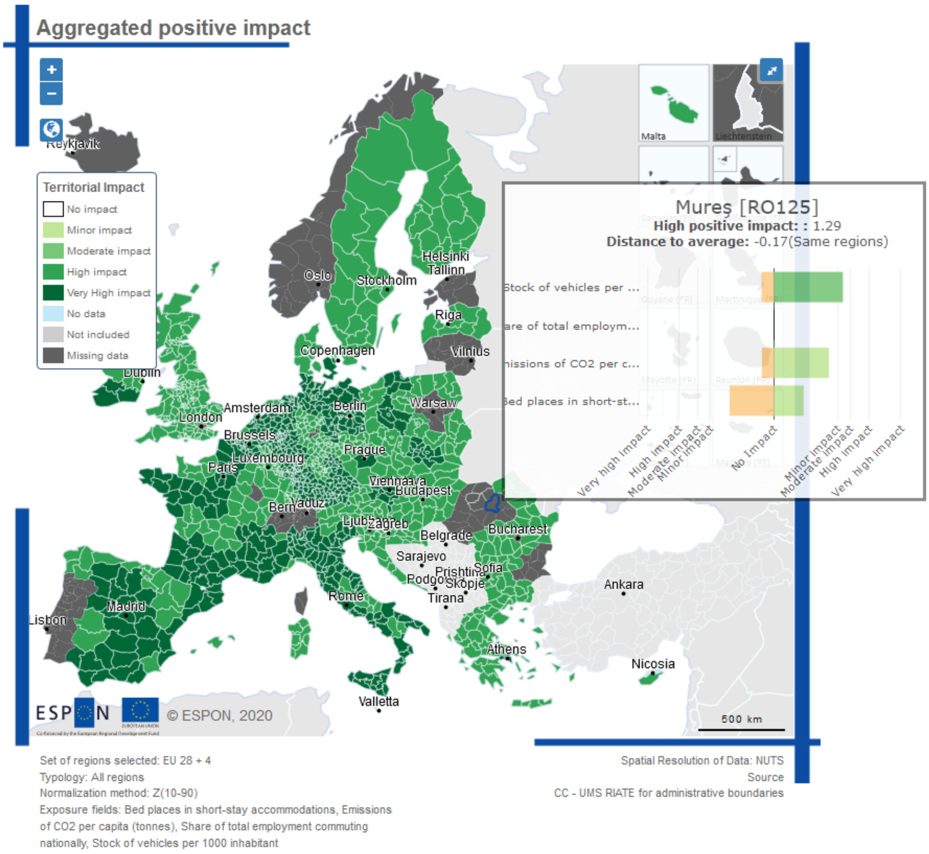
3.6.1 Average Votes

The voting chart for the aggregated impact does not show votes in the single voting categories but instead shows average voting weights for all exposure fields included with the current typology. This allows understanding the overall contribution of an exposure field to the aggregated exposure.

3.6.2 Mapping

Mapping of aggregated impacts generally follows the same lines as the mapping of exposure. The map kit and the symbology are mostly the same. One special case is how missing values are dealt with. While for such regions the aggregated impact still could be calculated, it was not based on the same indicators as for other regions which were not missing data in some of the indicators – the resulting impact value and thus mapped colour therefore was not comparable. This issue was solved by displaying every region that would have missing data for any single indicator in solid grey, making it clear at a glance that this region could not be included in the interpretation. The tooltip as shown in the figure will still depict the individual indicators as bar charts allowing for interpretation for single regions. Indicators with missing data are listed but do not show a bar.

Figure 3.14: Aggregation mode



Source: ÖIR (2020)

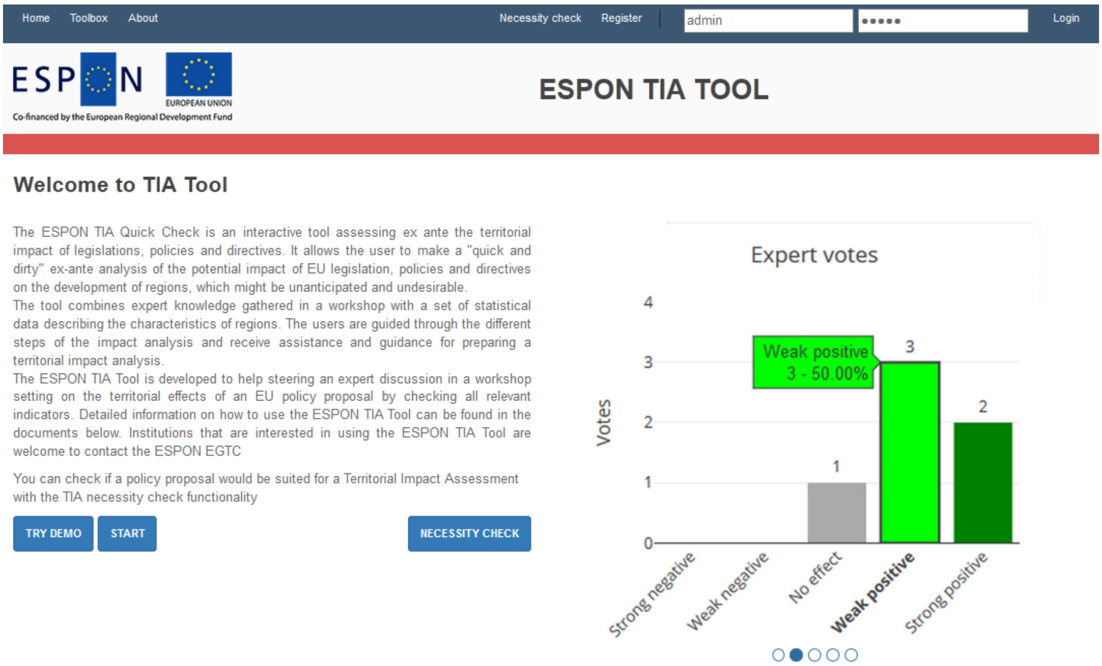
3.6.3 Exposure components chart

On mouse-over on the aggregation map a mouse-over is presented showing the single exposure fields and how the single exposures contribute to the overall aggregated exposure. This allows to see the specific characteristics of a region and how its aggregated impact value is to be understood.

3.7 TIA necessity check

Within the ordinary legislative procedure of the EU, impact assessments are a standard element, however so far only the Environmental, Societal and Economic Assessments are compulsory. While territorial impacts are referenced in the Better Regulation Guidelines and Toolbox (namely Tool #33), a frequently asked question at TIA workshops was how a decision or judgement should be made if a TIA was actually necessary or useful for a specific policy proposal. Against this background, a functionality was developed, which should assist e.g. Commission desk officers in this decision – the “TIA necessity check”.

Figure 3.15: Welcome page with necessity check access

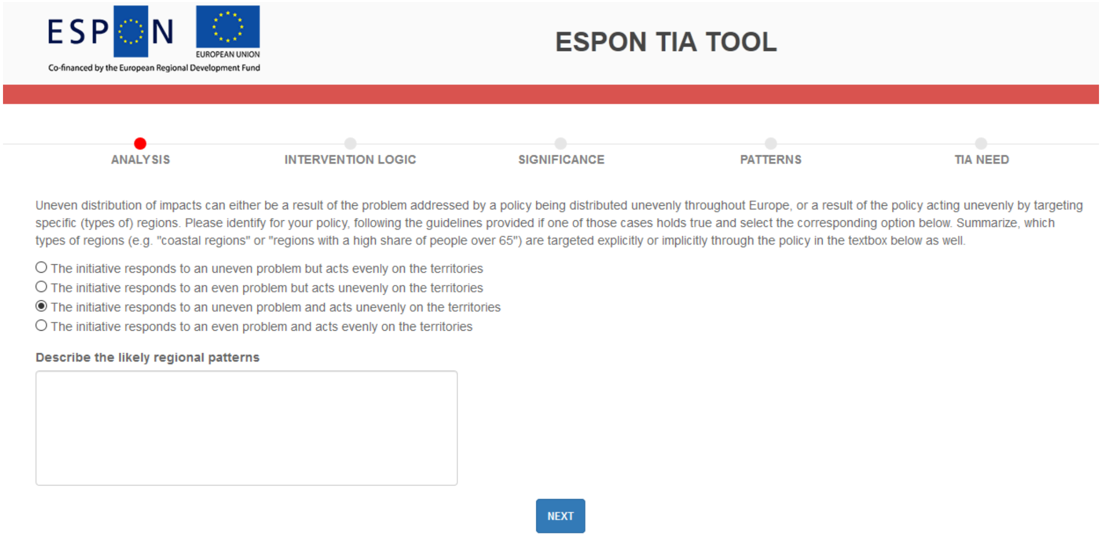


Source: ÖIR (2020)

The check consists of a decision tree oriented along 5 steps, which mirror closely the general steps necessary for deciding if an Impact Assessment is necessary as they are outlined in the Better Regulation Toolbox. The aim is, to put as little additional burden on a desk officer as possible, which is achieved by integrating the necessity check with the other checks done in the inception impact assessment phase. The decision tree is provided both in electronic as well as in paper form, with an additional handbook to provide guidance on how the individual steps should be approached. The handbook however is optional, both in the electronic version as well as in the paper version, relevant brief guidance is included, thus it should be possible to navigate through the decision tree intuitively.

The necessity check online version can be accessed through the welcome page of the TIA tool as shown in Figure 3.15. No registration is necessary to use all functions of the necessity check, in order to encourage the use. The user is guided through the identification of targeted regions by an initiative and identification of primarily impacted thematic fields as the better regulation toolbox defines them.

Figure 3.16: First step of the necessity check



Source: ÖIR (2020)

Figure 3.17: Identification of likely significant impacts

Source: ÖIR (2020)

After selecting those fields likely impacted and identifying the significance of impacts, the user has to outline resulting patterns of affected regions. A subsequent comparison of those patterns with the initially targeted regions will reveal, if there are likely to require an in-detail territorial impact assessment.

The necessity check functionality based on this will provide a suggestion if a full TIA should be conducted or not. The online version furthermore is able to provide some phrases and modular texts based on the inputs of the user. These modular texts can be used as a basis for a desk officer to justify if a TIA is necessary or not in the inception impact assessment.

4 Technical descriptions

4.1 Different methods for data normalization

As a standard, the tool used z-normalisation for standardising the sensitivity indicators. This type of normalisation uses the min-max procedure and is therefore very dependent on the data distribution and existence of outliers. The minimum score observed for all regions is subtracted from the respective transformed score, which is then divided by the difference between the maximum and minimum scores observed for all regions. The maximum normalised score is set equal to 1.25 and the minimum normalised score is set equal to 0.75. Basically, normalized sensitivity indicators represent coefficients that can increase (if greater than 1) or decrease (if lower than 1) each policy proposal's impact on a specific field.

For this step the following definitions are needed:

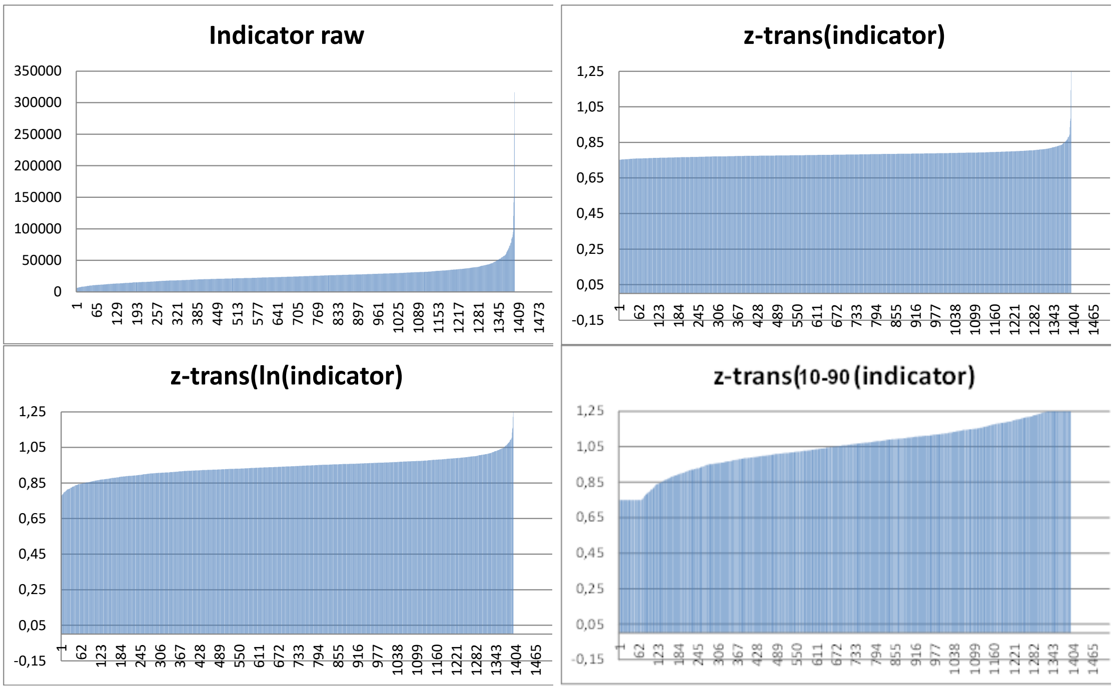
- $Xnorm_i$ is the normalized value of the sensitivity indicator for impact field i
- X_i is the original value of the sensitivity indicator for impact field i
- $Xmin_i$ the minimum original value of the sensitivity indicator for impact field i
- $Xmax_i$ the maximum original value of the sensitivity indicator for impact field i

Then, normalization follows this formula:

- $Xnorm_i = 0,75+((1.25-0.75)*((X_i – Xmin_i)/(Xmax_i – Xmin_i)))$

Some indicators can have asymmetrical or skewed data distributions (where most regions show low performance levels and a few regions show exceptionally high performance levels), which after z-normalization leads to a reduction of differences in the primary data and to maps showing only minor differences of the calculated impact.

Figure 4.1: Example: Distribution of raw data, z-normalized data and logarithmized z-normalized data and z-normalized data using 5-95% quantiles (Indicator: GDP/capita)



Source: ÖIR (2020)

In order to get more differentiated pictures, it was proposed to additionally integrate a function for log-normalisation. Here, raw data in the database will first be logarithmized and then normalized with the same formula as above. An additional normalization method was integrated in in the new TIA tool, which uses z-normalization based on the 10% and 90% quantile. This method leads to the minimisation of the impact of outliers on the distribution of normalized data.

Figure 4.1 shows a comparison of the three normalization methods presented above.

- The example of the indicator GDP/capita shows the asymmetrical distribution of raw data, which is characterized by very high GDP/capita values in cities (graph on the top left of the figure).
- With the standard z-normalization method, the majority of values is situated around the average, while only a few regions (cities, outliers) show high values (graph on the top right of the figure). In combination with the exposure weighting, the calculated impact values will only show significant impacts for the outlier values, while the majority of regions will show no impacts.
- The log normalization described above slightly increases the differences between values and therefore leads to a more balanced distribution (graph on the bottom left of the figure).
- The normalization based on the 10-90 quantiles leads to an even better distribution in terms of differentiation of impacts (graph on the bottom right of the figure). The values below the 10% quantile are automatically assigned to the lowest standardized values (0.75), the values above the 90% quantile are automatically assigned to the highest standardized values (1.25).

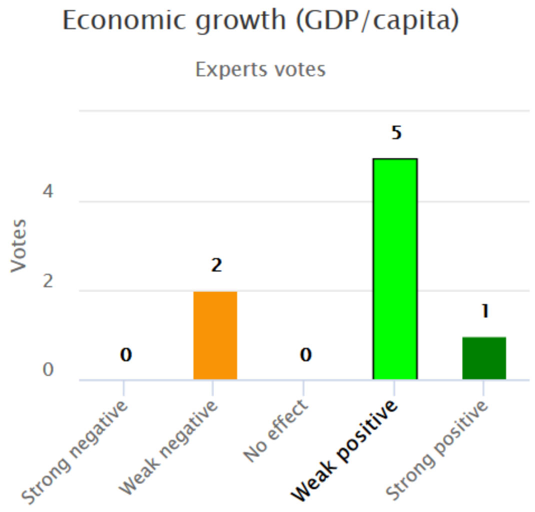
Two or more different types of normalisation will allow users to get the feeling that the TIA tool does not calculate a prognosis of impacts but rather scenarios. The different manifestations of territorial impacts offer more room for analysis of results.

4.2 Methodology for “impact aggregation”

Sensitivity values and the resulting impact scores if decided for a strong negative, weak negative, weak positive or strong positive exposure cannot be added without any further consideration.

First, positive and negative impact scores cannot be added as the concept of sensitivity does not imply that positive impacts may compensate for positive impact in comparable terms. If there is contradicting impact in different fields, this just indicates that there is a more complex impact at different levels and thus a higher level of uncertainty which way the overall impact may play out in total for a certain region. Contradictions in direction of impact must not be lost in aggregation. Therefore aggregation will be separate for positive and negative impact scores.

Figure 4.2: Example for differing and contradicting expert's judgments on exposure



Source: ÖIR (2020)

Second, differing or even contradicting expert judgements and votes must be considered in a way that allows all participants to relate to the aggregated impact and identify their contribution to the results. Figure 4.2 exemplifies on such a case. Contradicting votes on exposure also demand for the separation of the resulting impact scores. Thus, a single exposure field may result in a negative as well as a positive contribution to aggregated impact. Overall differences in judgements on the level of exposure can be considered by weighting the positive or negative contribution of the territorial impact score by the relative share of votes.

To do so an average positive and negative exposure is calculated:

$$\bar{e}_{i,r}^{+} = \frac{\sum e_{v,i}^{+}}{\mathrm{v}_i};\ \bar{e}_{i,r}^{-} = \frac{\sum e_{v,i}^{-}}{v_i}$$

$\bar{e}_{i,r}^{+}, \bar{e}_{i,r}^{-}$ ... $positive/negative\ average\ exposure\ of\ an\ indicator\ for\ the\ region\ r$

$e_{v,i}^{+}, e_{v,i}^{-}$ ... $positive$
$/negative\ numeric\ exposure\ values\ for\ vote\ v\ for\ indicator\ i, e\ \epsilon\{-1.5, -1, 0, 1, 1.5\}$

v_i ... $number\ of\ votes\ for\ indicator$

Next these separate positive and negative exposures allow calculating territorial impacts scores:

$$i_{i,r}^{+} = \bar{e}_{i,r}^{+} * s_{i.r};\ i_{i,r}^{-} = \bar{e}_{i,r}^{-} * s_{i.r}$$

$i_{i,r}^{+}, i_{i,r}^{-}$ ... $positive/negative\ aggregate\ impact\ score\ of\ an\ indicator\ for\ the\ region\ r$

$s_{i.r}$ ... $normalized\ regional\ sensitivity\ of\ an\ indicator\ for\ the\ region\ r, s\ \epsilon\ [0.75; 1.25]$

Finally these scores can be aggregated for a region. Here two more issues have to be dealt with: First, for some regions there may be missing data for certain indicators. Hence there will be no sensitivity values and consequently no impact scores for those indicators for certain regions. If we aggregate only those regions where all indicators are provided data gaps may multiply giving a very sparse result. Thus, it is proposed to calculate a weighted average of those values where there is data available and indicate otherwise that there is a gap. As an additional functionality, it may be helpful to be able to exclude such areas from the results to avoid confusion. Second, within a scenario there may be different typologies that cover different regions to a different extent. To avoid any concerns with this, we propose to only aggregate results within a single scenario and typology.

Consequently the aggregate impact of a region are calculated by summing up those impact scores available and dividing them by the total number of indicators to give aggregated positive and negative impact scores:

$$a_r^+ = \frac{\sum i_{i,r}^+}{s}; a_r^- = \frac{\sum i_{i,r}^-}{s}$$

a_r^+, a_r^- ... *positive/negative aggregate impact score of the region r*

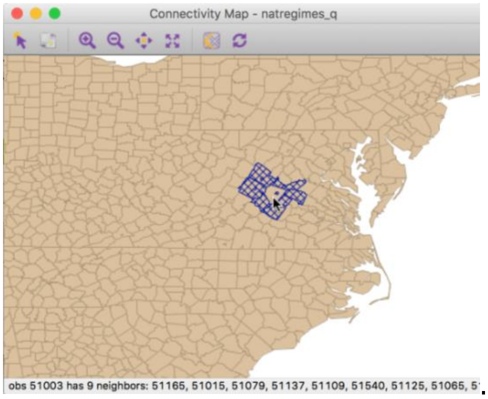
$i_{i,r}^+, i_{i,r}^-$ ... *positive/negative impact score of an indicator for the region r* (*missing values excluded*)

s ... *number of indicators*

4.3 Comparative cross-border indicators

One of the main issues with calculating comparative cross-border indicators is, like with any kind of comparison of data between regions, defining which regions are considered to be neighbours to be compared

Figure 4.3: Example of a rook contiguity (1st order)



Source: Anselin (2017)[4]

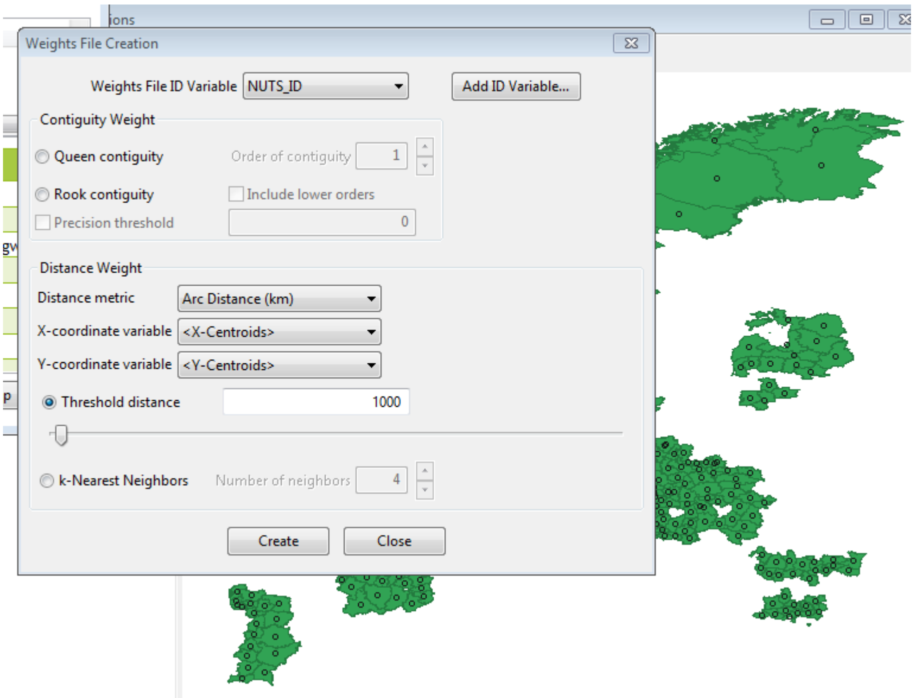
For CB regions there seems to be no dataset that actually defines what are the neighbouring regions across the border and thus which regions are to be related and compared across the border. We discussed several approaches to easily define and calculate such a network or matrix comprising the relationships. One was to only consider regions which share a common border as to be neighbouring regions (rook contiguity, Figure 4.3 depicts an example) or those

[4] Anselin, L. (2017) Contiguity-Based Spatial Weights – https://geodacenter.github.io/workbook/4a_contig_weights/lab4a.html

which have a shared border of a region where there is a shared border (rook contiguity of the 2nd order).

The issue with using a contiguity approach is seas and oceans. As there are regions that are considered to be cross border regions but have no direct link to a land of a foreign region across their border, such as in the southwest of England, this approach is non-applicable in such cases. Thus we refrained from such a complex approach and decided to consider just the centroid distance and define a cut-off point beyond which regions would not be considered anymore. Figure 4.4 shows the centroids and the settings applied in GeoDa.

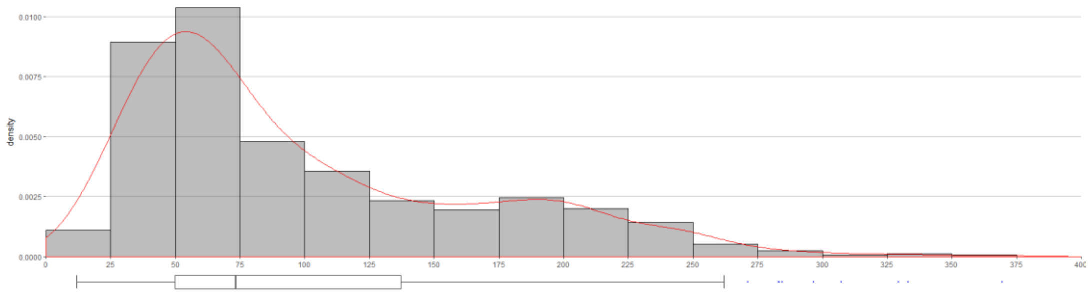
Figure 4.4: Calculation of centroid distances



Source: ÖIR (2020)

Closest CB neighbours may be quite far away. Figure 4.5 shows the distribution of distances to the closest neighbour.

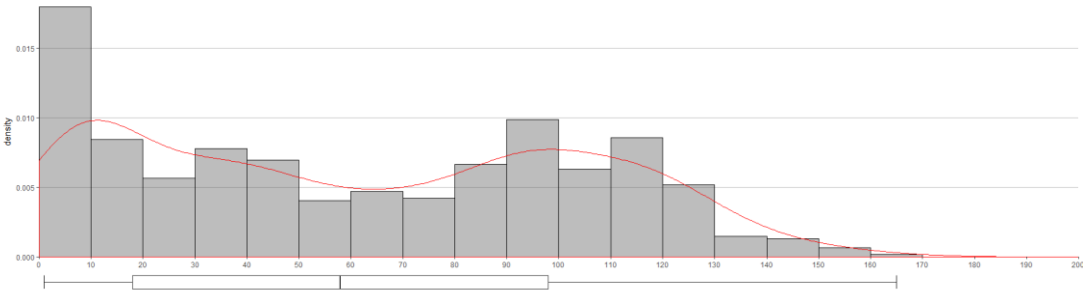
Figure 4.5: Distance to the closest CB neighbour



Source: ÖIR (2020)

By analysing the number of neighbours for all regions within a certain distance, we decided to apply a cut-off of 400 km arc-distance, where regions still had at least one CB region in another country within reach. Figure 4.6 shows the resulting distribution of the number of those CB neighbours over the CB regions.

Figure 4.6: Number of CB neighbours for CB regions within 400km

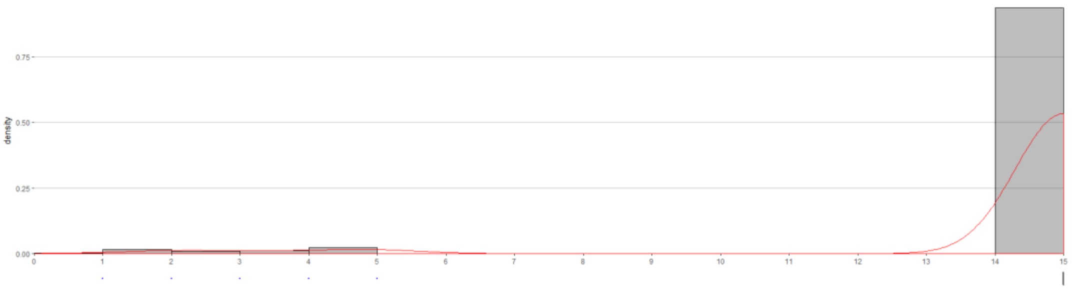


Source: ÖIR (2020)

Filtering of considered neighbours

There are up to 165 neighbours *within 400km*. To allow for more concise results in such dense regions with many close neighbours, we decided to limit the neighbours considered to those *5 which are closest* (s. Figure 4.7).

Figure 4.7: Number of CB neighbours for CB regions within 400km (limited to 5)



Source: ÖIR (2020)

With the calculated distances we calculate weights for the neighbouring CB regions to compare to as follows:

$$w_n = \frac{1}{\mathrm{d}_n}$$

$w_n \ldots spatial\ weight\ of\ the\ neighbour$

$d_n \ldots distance\ to\ the\ neighbour$

This finally allows calculating a synthetic indicator that shows the value of an indicator in comparison to the weighted average within the neighbouring CB region. These calculations are based on a comparison of the “home” value and a weighted average value for the neighbouring regions. The value for the neighbouring region is calculated as follows:

$$i_{\bar{n}} = {\sum i_n * w_n}\Big/{\sum w_n}$$

$i_{\bar{n}}$ ... $weighted\ average\ neighbourhood\ indicator\ value$

w_n ... $spatial\ weight\ of\ the\ neighbour$

$\sum w_n$ ... $sum\ of\ weights\ for\ neighbours\ (cases\ with\ missing\ indicator\ data\ excluded)$

i_n ... $indicator\ value\ of\ the\ neighbour\ (missing\ cases\ excluded)$

Different approaches to this calculation may be taken. The following gives an overview over those calculations:

Cross border difference

Here the relative difference between two regions is calculated. The hypothesis for such indicators is that any difference counts proportionally and thus increases the sensitivity. This may e.g. be a case where some form of trade benefits both sides.

$$j_{dr} = \frac{|\mathrm{i}_r - \mathrm{i}_{\bar{n}}|}{\mathrm{i}_r}$$

j_{dr} ... $difference\ indicator\ for\ the\ region$

i_r ... $indicator\ value\ of\ the\ region$

$i_{\bar{n}}$ ... $weighted\ average\ neighbourhood\ indicator\ value$

Cross Border lower

Here the value of the regions is compared to the neighbours’ values proportionally. Sensitivity is higher with higher relative distance to the neighbours. The hypothesis of such an indicator is “levelling up”, a region is more sensitive if the neighbours are higher on an indicator value than the region itself and the more the more this is the case. This may e.g. be a case where a region that is falling behind may profit from a region that is in front. If the regions value is higher than the neighbouring regions there is no sensitivity, as along the hypothesis behind a “CB-lower” indicator it is not possible for such a region to profit from neighbours which are all scoring “below” the region in question.

$$j_{lr} = \begin{Bmatrix} \frac{\mathrm{i}_r}{\mathrm{i}_{\bar{n}}} * -1 & if\ \mathrm{i}_r < \mathrm{i}_{\bar{n}} \\ NA & else \end{Bmatrix}$$

j_{lr} ... $lower\ indicator\ for\ the\ region$

i_r ... $indicator\ value\ of\ the\ region$

$i_{\bar{n}}$ ... $weighted\ average\ neighbourhood\ indicator\ value$

Cross Border higher

Here the value of the regions is compared to the neighbours’ values proportionally. Sensitivity is higher with higher relative distance to the neighbours. The hypothesis of such an indicator is “levelling down”, a regions is more sensitive if the neighbours are lower on an indicator value than the region itself and the more the more this is the case. This may e.g. be a case where a region that is having higher indicator values (e.g. on unemployment) may profit from neighbouring regions that have lower values. If the regions value is lower than the neighbouring regions there is no sensitivity as along the hypothesis behind a “CB-higher” indicator it is not possible for such a region to profit from neighbours which are all scoring “higher” than the region in question..

$$j_{hr} = \begin{Bmatrix} \frac{\mathrm{i}_r}{\mathrm{i}_{\bar{n}}} & if\ \mathrm{i}_r > \mathrm{i}_{\bar{n}} \\ NA & else \end{Bmatrix}$$

j_{hr} ... $higher\ indicator\ for\ the\ region$

i_r ... $indicator\ value\ of\ the\ region$

$i_{\bar{n}}$ ... $weighted\ average\ neighbourhood\ indicator\ value$

Cross Border product

Here the product of the regions is calculated. Thus the more indicator values on both sides are high the more sensitive the region is. The hypothesis of such an indicator is a situation where a joint high level is necessary, e.g. when cooperation is only reasonable with both regions being highly affected.

$$j_{pr} = \mathrm{i}_r * \mathrm{i}_{\bar{n}}$$

j_{pr} ... $product\ indicator\ for\ the\ region$

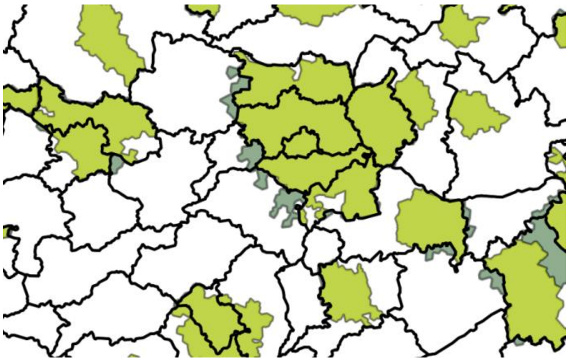
i_r ... $indicator\ value\ of\ the\ region$

$i_{\bar{n}}$ ... $weighted\ average\ neighbourhood\ indicator\ value$

4.4 Equivalence between FUA and NUTS regions

Allowing for the selection of a set of regions in a multi-geometry TIA calls for a possibility to provide an equivalence for the selection between the two geometries. For reasons of simplicity and compatibility the selection of a set of regions for the Urban TIA is based on the same sets as for all other TIAs and it is thus based on NUTS regions.

Figure 4.8: Example for the overlaps between NUTS and FUA regions



Source: ÖIR (2020)

After selecting a set of specific NUTS regions one then needs to know which FUA regions are to be included based on that selection. As no complete and matching data for this was to be found we calculated the equivalence based on geometry data provided by Eurostat (NUTS 2013 1:3 Million[5]) and ESPON (FUA) in ETRS-LAEA.

For a NUTS region all FUA regions are included where at least 25% of the NUTS region overlap with the FUA region or at least 25% of the FUA region overlap with the NUTS region. So all relevant FUAs for a NUTS region should be considered. Figure 4.8 shows an example for these overlaps within the Centrope region. Here all FUA regions shown in light green are considered to be a part of the overlapping NUTS regions whereas those in dark green are discarded as they do not meet any of the 25% thresholds.

[5] s. http://ec.europa.eu/eurostat/web/gisco/geodata/reference-data/administrative-units-statistical-units/nuts

5 Work for finalising outstanding RoS

One more additional functionality, which was requested at a late stage of the project will be finalised only after the delivery of the final report. This functionality is split in a conceptual part (section 5.1) and a technical part (section 5.2)

5.1 TIA Curriculum

The steady interest in application of the TIA tool both from the EU institutions but as well from the national level has been met with the possibility of conducting workshops and of short training sessions both in the scope of the current project as well as within some Transnational Outreach activities. Nonetheless, interest has been expressed by several institutions and persons to get a more thorough insight into TIA methodologies and the Quick Check in particular.

On this basis, to promote high-quality territorial impact assessments and to enable people to run the TIA tool with the necessary background knowledge, a curriculum is in the stage of being developed. The course concept will include both theoretical and practical lessons, including participation in staged and actual TIA workshops with the TIA tool. It will consist of the following modules:

- EU legislative process and TIA theory
- Overview of the ordinary legislative procedure
- Overview of different TIA methodologies available
- Necessity check for legislative proposals

- Workshop conceptualisation
- Policy analysis
- Spatial data and indicators
- Workshop concept setup

- Workshop Setting
- Moderation skills
- Systemic picture theory
- Expert involvement

- Tool handling
- Computer lab
- Practical use of the tool

- Practical exercises – simulated workshop

By successfully completing the courses, a user can achieve different user levels/roles. Certification as a Moderator for example will require the completion of all theoretical and practical modules and the co-moderation of at least two workshops.

The four user levels implemented will be users, practitioners, moderators and trainers.

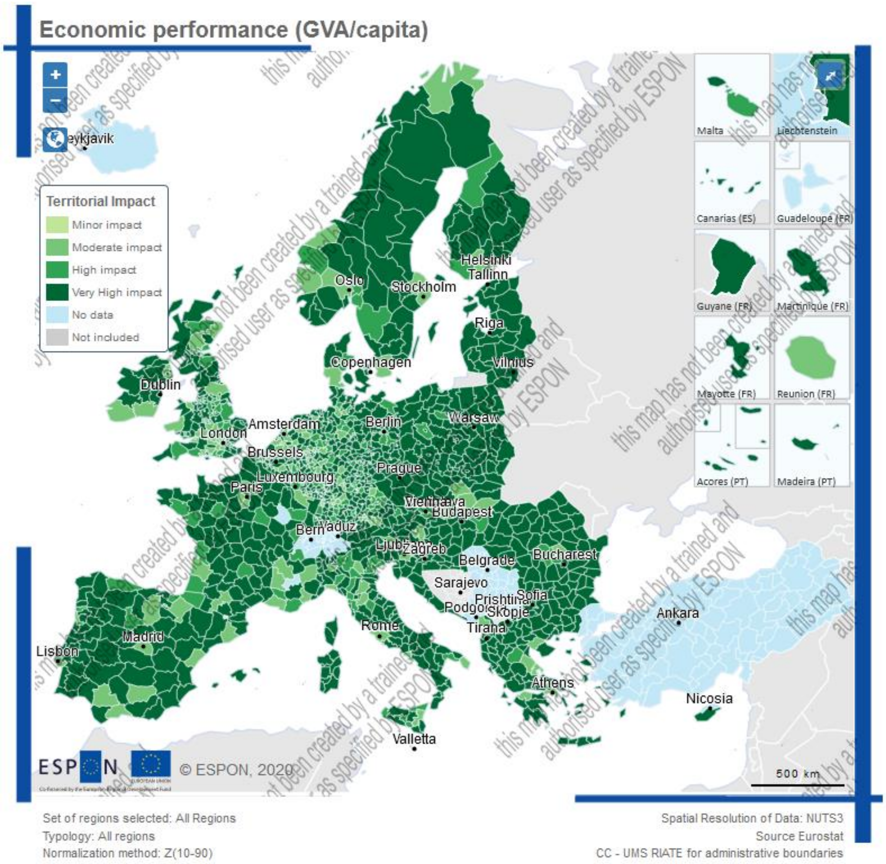
- User: a person who has registered an account for the ESPON TIA Tool and who has participated in at least one workshop or training
- Practitioner: a user who has completed all 4 modules of the curriculum
- Moderator: a practitioner who has also co-moderated at least 2 workshops

Trainer: a moderator who has moderated at least 5 workshopsWhile all users have access to all functionalities of the tool, as outlined in section 5.2 users below the level of moderator will only be able to export maps from the tool with a watermark. Apart from that the levels of users serve as an differentiation indicating the experience and thus the eligibility for certain tasks such as moderating a workshop on their own or proficiently training other persons in the use of the TIA tool.

5.2 Watermarks

Linked to the development of a TIA curriculum and the levels of users envisaged, a functionality will be implemented which displays a watermark over maps shown in the tool and exported from it. This watermark should safeguard, that no un-trained person can use the outputs of the TIA tool for official impact assessments. The preliminary function is shown in Figure 5.1 The watermark will only be removed for persons which have been assigned the level of "moderator" or "trainer" after fulfilling the requirements outlined in section 5.1.

Figure 5.1: Preliminary Watermark



Source: ÖIR (2020)

6 List of Annexes

The following documents are delivered as a separate attachment:

- guidance document for moderators
- guidance document for administrators
- source code of all software developed in relation to the ESPON TIA Tool
- PowerPoint presentation, made up of the main components of the ESPON TIA Tool

ESPON 2020 – More information

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