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## THE GIS AS «TOOLBOX» TO MANAGE THE PROCESS

The GIS is the best instrument to manage the complexity of the knowledge in a territorial system and the single processes that drive them and their carrying capacity (to be competitive within the sustainability threshold).

The *logical network toolbox* (provisory name of the instrument used into research *Territorial dimensione of the Lisbon/Gothenburg Strategy*), is an easy and intuitive instruments to define and compute regional determinants and policies for a more competitive and sustainable development of Europe.

*Understanding policy-concepts.* – The concept of «territorial competitiveness», as a policy-concept, is a highly abstract concept, and has an elusive meaning. Its better understanding requires to decompose it in determining factors or Determinants (e.g. «Efficient use of resources...») that should be further decomposed in typologies, sectors and categories; the latter ones can, finally, be somehow «explained» by quantitative indicators, build up from indexes or more simple statistical descriptors. While determinants, typologies and sectors are composite elements, categories are, instead, synthetic (i.e. they are explained by quantitative indicators). Too often, for operational reasons quantitative indicators (such as GDP/capita gaps) are used to illustrate policy-concepts (such as economic development) without a systematic in depth analysis of the concept. This is one of the main reasons of misunderstanding between scientists and policy-makers. The next graphic illustrates the network-like structure of concepts of different level of abstraction lying behind a policy-concept such as «territorial competitiveness» (or «territorial cohesion», «sustainable development...»).

*Objective of the toolbox: a policy-support tool.* – The toolbox is a software application that provides for a systematic procedure to define highly abstract concepts (e.g. «sustainable development», «territorial cohesion...») as a combination of more concret concepts and specific statistic indicators (e.g. GDP/capita,

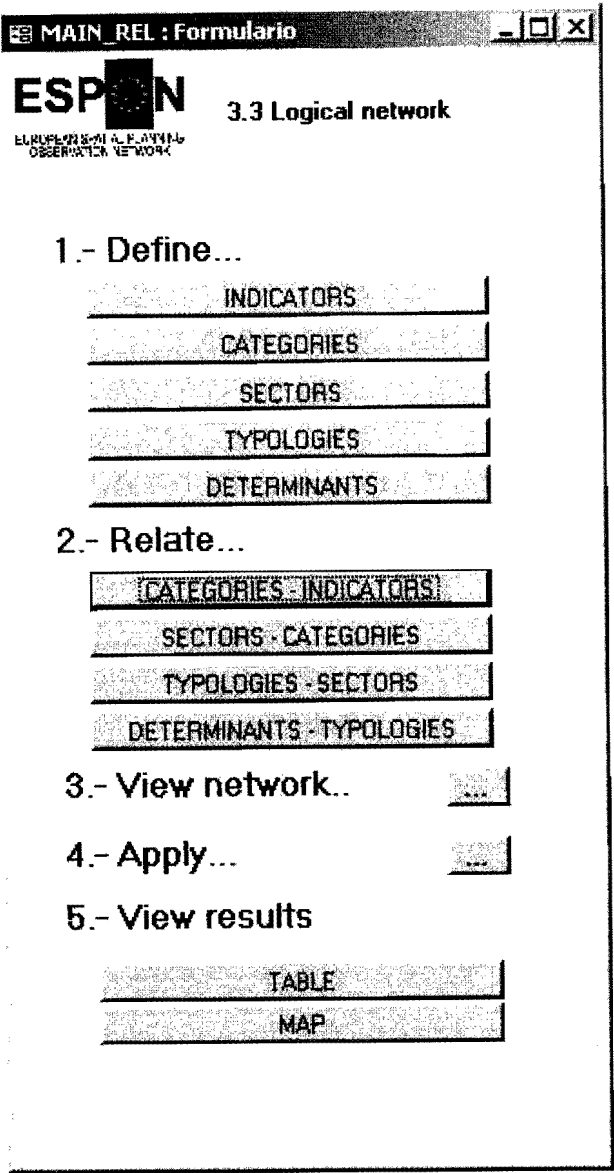


Fig. 1 – The «GIS Toolbox» main interface

| INDICATORS : Formulario                                               |                                     |   |
|-----------------------------------------------------------------------|-------------------------------------|---|
| VARIABLES                                                             | INDICATOR                           |   |
| Accesibilidad potencial en avión, espacio ESPON = 100                 | <input checked="" type="checkbox"/> |   |
| Accesibilidad potencial multimodal, espacio ESPON = 100               | <input checked="" type="checkbox"/> |   |
| Accesibilidad potencial por carretera, espacio ESPON = 100            | <input type="checkbox"/>            |   |
| Altitud media respecto al mar                                         | <input type="checkbox"/>            |   |
| Amenaza potencial regional de terremotos                              | <input type="checkbox"/>            |   |
| Balance migratorio por cada 1.000 habitantes en 1999                  | <input type="checkbox"/>            | - |
| Cambio de la parte de las regiones UE27 + 2 PIB en PPS (en %)         | <input type="checkbox"/>            |   |
| Cambios en el potencial natural de crecimiento                        | <input type="checkbox"/>            |   |
| Cambios en el Potencial Natural de Crecimiento: población entre 20-29 | <input type="checkbox"/>            |   |
| Capacidad de los aeropuertos comerciales (pasajeros/año)              | <input type="checkbox"/>            |   |
| Crecimiento del PIB entre 1995-2000 (en euros y en %)                 | <input type="checkbox"/>            |   |
| DENSIDAD (KWH/KM2) CARRETERAS VEL>85 KWH                              | <input type="checkbox"/>            |   |
| DENSIDAD (KWH/KM2) CARRETERAS VEL>85 KWH                              | <input type="checkbox"/>            |   |
| Densidad de carreteras                                                | <input type="checkbox"/>            |   |
| Densidad de empleados (por km2)                                       | <input type="checkbox"/>            |   |
| Densidad de población (hab/km2) 2000                                  | <input type="checkbox"/>            |   |
| Densidad de población 1999 (hab/km2)                                  | <input type="checkbox"/>            |   |
| Dentistas por 100.000 hab. 2002                                       | <input type="checkbox"/>            |   |
| Dentistas por 100.000 hab. 2001                                       | <input type="checkbox"/>            |   |
| Dentistas por 100.000 hab. 2003                                       | <input type="checkbox"/>            |   |
| Desarrollo del desempleo entre 1998 y 2001 (en %)                     | <input type="checkbox"/>            |   |
| Desembolso en Investigación y Desarrollo, todos los sectores instituc | <input type="checkbox"/>            |   |
| Desempleados por debajo de los 25 años / 1.000 habitantes 15-25 añ    | <input type="checkbox"/>            |   |
| Distancia a la capital del estado (en km)                             | <input type="checkbox"/>            |   |
| Distancia a Maastrich (en km)                                         | <input type="checkbox"/>            |   |
| Doctores per 100.000 habitantes 2003                                  | <input type="checkbox"/>            |   |
| Doctores por 100.000 habitantes 2001                                  | <input type="checkbox"/>            |   |
| Doctores por 100.000 habitantes 2002                                  | <input type="checkbox"/>            |   |
| Empleados en agricultura (en%) 2001                                   | <input checked="" type="checkbox"/> |   |

Fig. 2 – Example of Indicators List

number of firms with Internet access, CO<sub>2</sub> emissions...) and calculate them for preselected territorial units (e.g. European regions).

The predefined conceptual levels are the following ones: Indicators (e.g. Population with tertiary education); Categories (e.g. «Human capital»); Sectors (e.g. «Innovative human capital»); Statistical Typologies (e.g. «Knowledge innovation structures»); Territorial Determinants (e.g. «Innovation and research capability»).

The Territorial Determinant aims to integrate the most policy-relevant information in relation to each region to support a policy decision-making process; therefore, «Policies» are included as the most abstract concepts (e.g. «Progressive reduction of Structural Funds»). Depending on the relative values of the Territorial Determinants, specific policies may be suggested. because of that, *the toolbox can be considered as a policy-support tool that helps policy-analysts to make explicit and communicate more effectively their reasoning.*

The figure consists of four vertically stacked screenshots of a software interface, each displaying a table with two columns: 'Id' and 'DESCR'. The tables are titled 'categorias', 'sectores', 'tipologias', and 'determinants' respectively.

| Id | DESCR                                  |
|----|----------------------------------------|
| 1  | Virtual Population                     |
| 2  | Virtual Firms                          |
| 3  | Virtual Institutions                   |
| 4  | Education structures                   |
| 5  | R & D infrastructures                  |
| 6  | Level of telecommunication development |
| 7  | Human capital (structure)              |
| 8  | Human capital (education)              |
| 0  |                                        |

| Id | DESCR                         |
|----|-------------------------------|
| 1  | Virtual shareholders          |
| 2  | Virtual stakeholders          |
| 3  | Knowledge creation education  |
| 4  | Knowledge creation facilities |
| 5  | Innovative Human Capital      |
| 0  |                               |

| Id | DESCR                           |
|----|---------------------------------|
| 1  | Virtual society                 |
| 2  | Knowledge Innovative Structures |
| 0  |                                 |

| Id | DESCR                 |
|----|-----------------------|
| 1  | Innovation & Research |
| 0  |                       |

Fig. 3 – Example of Categories, Sectors and Typologies

*Development of the toolbox.* – The design of the toolbox and the theory behind has been developed by the University of Rome at Vergara, also responsible for testing and using it within the ESPON 3.3 project, and the software implementation by MCRIT (Barcelona).

The toolbox uses as a reference data ESPON regional statistical indicators, aggregates them according to the network-like conceptual structures to be defined by the user, and provides as a result relative values of each region from the simple indicators up to the highest more abstract concept.

*Software platform.* The software platform selected to implement the toolbox has been Visual Basic on Microsoft ACCESS. The toolbox uses Geomedia Viewer, a royalties-free desktop mapping application by Intergraph, to display results graphically, and it can be easily linked to any other standard Desktop mapping or GIS application such as Mapinfo or Arview.

*Rule of aggregation.* The regional values for logical objects (from Indicators to Determinants) are categorized in four *classes* (A, B, C, D).

The aggregation rules between classes across levels are defined qualitatively.

The qualitative aggregation is made successively *pair to pair*, starting by the one with less relative importance.

Fig. 4  
Example of  
Procedure for  
Calculating the  
Determinant

The figure displays three screenshots of a software interface used for calculating determinants. Each screenshot shows a window with two main panels: a left panel for selecting objects and a right panel for displaying their values. The windows are titled 'Categories', 'Sectors', and 'Typologies'.

**Categories Window:**

| Categories                      | Indicators                                       |
|---------------------------------|--------------------------------------------------|
| Virtual Population              | Accumulated potential in each region ESPON = 100 |
| Virtual Infrastructure          | Accumulated potential in each region ESPON = 100 |
| Education structure             | SUPERFICIE / SUPERFICIE ESTAD                    |
| R & D infrastructure            | Superficie Agricola UG / Superficie total 1999   |
| Level of innovation development | Superficie en agricultura total 2001             |
| Human capital (education)       |                                                  |

**Sectors Window:**

| Sectors                       | Determinants                    |
|-------------------------------|---------------------------------|
| Virtual Infrastructure        | Virtual Population              |
| Knowledge creation education  | Virtual Infrastructure          |
| Knowledge creation facilities | Education structure             |
| Innovative Human Capital      | R & D infrastructure            |
|                               | Level of innovation development |

**Typologies Window:**

| Typologies                    | Sectors                       |
|-------------------------------|-------------------------------|
| Virtual Infrastructure        | Virtual Infrastructure        |
| Knowledge creation education  | Knowledge creation education  |
| Knowledge creation facilities | Knowledge creation facilities |
| Innovative Human Capital      | Innovative Human Capital      |

There is a *table of qualitative addition* that translates pair of values into single ones (e.g. A+A=A, A+B=A, A+C=B, etc.)

The table is unique, and is applied to all levels.

The user of the toolbox, concerning the aggregation process, can only modify the table of qualitative aggregation.

**Main interface.** The main interface is organised according to the five successive steps needed: *a)* logic objects included in each level (Indicators, Categories, Sectors, Statistical Typologies, Determinants and Policies); *b)* logic relations between objects (e.g. which Indicators form each Category, which Categories form each Sector, which Sectors each Typology and which Typologies each Determinant); *c)* define Computation rules (to categorize quantitative indicators in qualitative groups, to aggregate values across levels, to aggregate determinants, to derive policy recommendations from determinants); *d)* application of rules to obtain all values for all regions; *e)* view results, as a table (integrating all value for all regions) and as a regional map (using Geomedia Viewer).

**Use of the application.** The use of the application is extremely easy. The user has to click one by one successively the list of buttons in the main interface and fill in the tables. Then click the RUN button and see the results as

Results: Table

| id | NUTS2 | NAME                                     | Determinant | Typology | Sector | Category | Indicator |
|----|-------|------------------------------------------|-------------|----------|--------|----------|-----------|
| 1  | AT11  | BURGENLAND                               | b           | a        | b      | a        | b         |
| 2  | AT12  | NIEDEROESTERREICH                        | c           | b        | d      | c        | c         |
| 3  | AT13  | WIEN                                     | d           | d        | a      | a        | c         |
| 4  | AT21  | KÄRNTEN                                  | c           | b        | c      | d        | c         |
| 5  | AT22  | STEIERMARK                               | c           | b        | b      | c        | d         |
| 6  | AT31  | OBEROESTERREICH                          | a           | c        | b      | b        | a         |
| 7  | AT32  | SALZBURG                                 | d           | a        | d      | a        | d         |
| 8  | AT33  | TIROL                                    | b           | c        | a      | d        | c         |
| 9  | AT34  | VORARLBERG                               | c           | c        | a      | a        | d         |
| 10 | BE1   | REG. BRUXELLES-CAP./BRUSSELS HF.DST.GEW. | d           | c        | c      | c        | c         |
| 11 | BE21  | ANTWERPEN                                | b           | b        | b      | d        | a         |
| 12 | BE22  | LIMBURG (B)                              | a           | d        | b      | c        | c         |
| 13 | BE23  | OOST-VLAANDEREN                          | a           | b        | c      | d        | b         |
| 14 | BE24  | VLAAMS BRABANT                           | a           | a        | b      | b        | a         |
| 15 | BE25  | WEST-VLAANDEREN                          | d           | b        | b      | b        | a         |
| 16 | BE31  | BRABANT WALLON                           | a           | d        | b      | c        | c         |
| 17 | BE32  | HAINAUT                                  | b           | a        | a      | b        | c         |
| 18 | BE33  | LIEGE                                    | b           | d        | c      | b        | c         |
| 19 | BE34  | LUXEMBOURG (B)                           | b           | d        | b      | a        | b         |
| 20 | BE35  | NAMUR                                    | a           | b        | a      | c        | a         |
| 21 | BG01  | SEVEROIZTOCHEN (NORTH-WEST)              | a           | c        | b      | b        | d         |
| 22 | BG02  | SEVEREN TSENTRALEN (NORTH CENTRAL)       | b           | a        | b      | d        | b         |
| 23 | BG03  | SEVEROZAPADEN (NORTH-EAST)               | a           | b        | c      | d        | b         |
| 24 | BG04  | YUGOIZTOCHEN (NORTH-EAST)                | a           | b        | d      | b        | b         |
| 25 | BG05  | YUZHEN TSENTRALEN (SOUTH CENTRAL)        | b           | a        | a      | b        | b         |
| 26 | BG06  | YUGOZAPADEN (SOUTH-EAST)                 | c           | d        | b      | c        | c         |
| 27 | CH01  | REGION L-EMMENTHE                        | b           | b        | a      | d        | b         |
| 28 | CH02  | ESPACE MITTELLAND                        | a           | d        | d      | d        | b         |
| 29 | CH03  | SUSSE DU NORD-EST                        | a           | d        | a      | d        | c         |
| 30 | CH04  | ZÜRICH                                   | b           | d        | d      | a        | b         |

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Fig. 5 – Example of Regional Values at Different Levels

a table and the map (using the Geomedia viewer included in the CDROM, or importing the ACCESS table in any other standard Desktop mapping).

In the following figures (2-6), it is decrypted the first part of the 3.3 project GIS actions and results and its easy use to calculate the ex ante capability to be competitive in sustainability.

The *structure* of the GIS is, first of all, carried out as a function of a wider territorial system than the one analyzed, taking into account the possible geoeconomic differences, that will contribute to the definition of the *capability*, as a function of the degree of *vulnerability* and *status quo*. *Vulnerability* is meant as the capacity to contain or not a pressure exercised by the exterior onto a macro-system, of which the responses are unknown *a priori*, and *status quo* is meant as the values and modes of response suggested by the behaviour of the indicators (micro vision).

Also the *territorial extension* of the study area (*domain of the impacts*) is a character that is capable to modify the organization and «depth» of the results derived by the application of an informative system, but only if the possibility of creating a European regional GIS is disregarded.

Another issue is the *duration* of the monitoring: a plan can have effects in

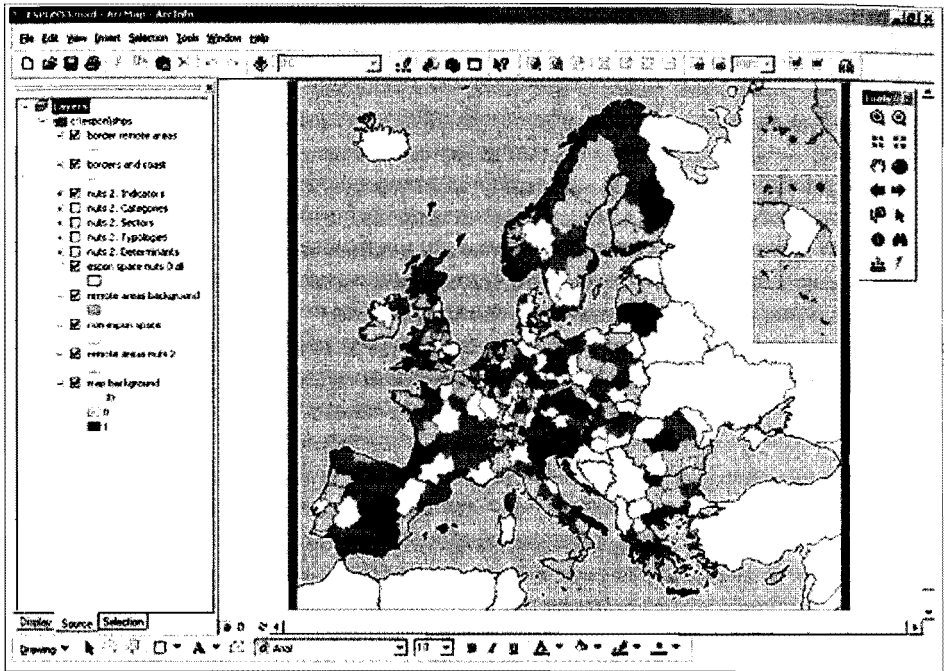


Fig. 6 – Example of Indicator Map

the short, medium and long term, from which derives the necessity of creating a continuous updating architecture of the system itself.

Therefore, the objective that must be pursued is the constitution of a *general informative system* that, by covering the whole territory of the EU, constructs the technical scenario onto which is based the objective assessment of the indicators, contemplating and classifying also those indicators that are not directly involved by the Lisbon-Gothenburg strategy.

The L/G GIS besides being a guarantee of the validity of the data, has also structured in a way that allows the updating, control and, especially, the management of the data, as to be integrated with the whole field of research and planning of the territory.

Even the «simple» geographic or economic analysis, today, uses informative systems to explain complex realities of which the environment is a part. In the 3.3 project *Geographic Information System* (GIS), the field of the research varies according to the objectives, reaching a level of detail that, at the moment, it is relating the individual impacting action to the impacted indicator (*receptor*), by the SEA or TIA of the STeM Approach.

## REFERENCES

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- PREZIOSO M., *STEM Approach. Towards a Common and Cohesive European Policy*, in P. BOSCAINO (a cura di), *Presente e futuro dello Schema di Sviluppo dello Spazio Europeo. Atti della Conferenza internazionale*, Città di Castello, Alinea, 2005 (a), pp. 79-92.
- PREZIOSO M. (a cura di), *Territorial Dimension of Lisbon-Gothenburg Strategy*, ESPON 3.3 Project, Luxemburg, 2005 (b) ([http://www.espon.lu/online/documentation/projects/cross\\_thematic/2209](http://www.espon.lu/online/documentation/projects/cross_thematic/2209)).

IL GIS COME STRUMENTO DI GESTIONE DEL PROCESSO. – Il GIS è il migliore strumento di organizzazione e gestione della conoscenza complessa in un sistema spaziale e territoriale e dei singoli processi che ne determinano le capacità di essere competitivi in sostenibilità. L'articolo presenta una prima sintesi del progetto GIS predisposto per la gestione della conoscenza complessa nell'ambito del progetto di ricerca *La dimensione territoriale della Strategia Lisbona/Göteborg*. Pensato come uno strumento facile e accessibile (anche intuitivamente), il GIS è stato progettato per rispondere ai parametri dell'approccio metodologico utilizzato dal progetto. Esso è finalizzato all'applicazione della valutazione ambientale e territoriale strategica a sostegno di scelte politiche e programmatica per lo sviluppo endogeno regionale competitivo e sostenibile.

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