1. The unique Greek observatory of transport and spatial impacts

2. **Scope of work**: Systematic over-time monitoring and assessment of the Egnatia motorway’s spatial impacts

3. **Targets**:
   i. support the integrated management of the motorway.
   ii. support of regional development policies and spatial planning.
   iii. information for agencies and citizens.
   iv. contribute to the harmonized assessment of TENs-T impacts on the territorial cohesion of the European area.
Data management and Indicator Monitoring System based on a Geographical Information System (GIS), including statistical and cartographical information on:

- mobility and accessibility,
- economic and social cohesion,
- polycentricity and networking,
- environment quality,

in the impact zone of the Egnatia Motorway and its vertical axes.

- A system of indicators
- A monitoring and information system
SYSTEM OF INDICATORS

• Socio-Economic and Spatial Planning Indicators (19)

• Environmental indicators (9)

• Transportation Indicators (15)
<table>
<thead>
<tr>
<th>SET01</th>
<th>Benefited Population</th>
</tr>
</thead>
<tbody>
<tr>
<td>SET02</td>
<td>Market Size (GDP)</td>
</tr>
<tr>
<td>SET03</td>
<td>Work force</td>
</tr>
<tr>
<td>SET04</td>
<td>Growth and prosperity level (GDP per head)</td>
</tr>
<tr>
<td>SET05</td>
<td>Unemployment rate</td>
</tr>
<tr>
<td>SET06</td>
<td>Accessibility to transport modes</td>
</tr>
<tr>
<td>SET07</td>
<td>Accessibility to industrial areas</td>
</tr>
<tr>
<td>SET08</td>
<td>Accessibility to sites of cultural &amp; tourist interest</td>
</tr>
<tr>
<td>SET09</td>
<td>Population change</td>
</tr>
<tr>
<td>SET10</td>
<td>Urban population changes</td>
</tr>
<tr>
<td>SET11</td>
<td>Hierarchy of urban centers</td>
</tr>
<tr>
<td>SET12</td>
<td>Population Density</td>
</tr>
<tr>
<td>SET13</td>
<td>Composition of production by industry sector (GVA)</td>
</tr>
<tr>
<td>SET14</td>
<td>Composition of employment by industry sector</td>
</tr>
<tr>
<td>SET15</td>
<td>Foreign trade</td>
</tr>
<tr>
<td>SET16</td>
<td>Urban land use changes</td>
</tr>
<tr>
<td>SET17</td>
<td>Industrial and commercial land use changes</td>
</tr>
<tr>
<td>SET18</td>
<td>Real estate changes</td>
</tr>
<tr>
<td>SET19</td>
<td>Business location</td>
</tr>
</tbody>
</table>
### Environmental indicators (9)

<table>
<thead>
<tr>
<th>Indicator</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>ENV01</td>
<td>Population exposed to traffic noise</td>
</tr>
<tr>
<td>ENV02</td>
<td>Air pollution</td>
</tr>
<tr>
<td>ENV03</td>
<td>Cohesion – fragmentation of settlements</td>
</tr>
<tr>
<td>ENV04</td>
<td>Tunnel air quality</td>
</tr>
<tr>
<td>ENV05</td>
<td>Landscape restoration</td>
</tr>
<tr>
<td>ENV06</td>
<td>Fragmentation of natural areas</td>
</tr>
<tr>
<td>ENV07</td>
<td>Land use changes</td>
</tr>
<tr>
<td>ENV08</td>
<td>Proximity to protected areas</td>
</tr>
<tr>
<td>ENV09</td>
<td>Crossings with surface waters</td>
</tr>
<tr>
<td>Code</td>
<td>Description</td>
</tr>
<tr>
<td>-------</td>
<td>-------------------------------------------------------</td>
</tr>
<tr>
<td>TRA01</td>
<td>Traffic volume (AADT)</td>
</tr>
<tr>
<td>TRA02</td>
<td>Traffic composition</td>
</tr>
<tr>
<td>TRA03</td>
<td>Person movements</td>
</tr>
<tr>
<td>TRA04</td>
<td>Travel-time</td>
</tr>
<tr>
<td>TRA05</td>
<td>Time-distance</td>
</tr>
<tr>
<td>TRA06</td>
<td>Freight (transport of goods)</td>
</tr>
<tr>
<td>TRA07</td>
<td>Annual vehicle kilometers</td>
</tr>
<tr>
<td>TRA08</td>
<td>Road safety</td>
</tr>
<tr>
<td>TRA09</td>
<td>Level of service</td>
</tr>
<tr>
<td>TRA10</td>
<td>Road network density</td>
</tr>
<tr>
<td>TRA11</td>
<td>Traffic volume on National Road</td>
</tr>
<tr>
<td>TRA12</td>
<td>Trans-border movements</td>
</tr>
<tr>
<td>TRA13</td>
<td>Intermodal transport</td>
</tr>
<tr>
<td>TRA14</td>
<td>Characteristics of vehicle movements</td>
</tr>
<tr>
<td>TRA15</td>
<td>Passenger journeys by alternative transport modes</td>
</tr>
</tbody>
</table>
**Target:** How Egnatia Motorway affects time-distance

**Calculation:**

- A point feature class is created corresponding to the province centres.

- Using a VISUM software model, a time-distance matrix is created, from zone to zone, before Egnatia Motorway construction and with Egnatia Motorway fully operational.

- A point for the calculation of time-distance is chosen and its zone identified.

- For the selected zone and to the other zones, the difference before and after the Egnatia Motorway construction is noted and entered into the time-distance matrix.

- The point feature class layer is linked with the time-distance matrix.

- Calculation of isochrone curves. (Spatial Analyst -> Interpolate to Raster -> Inverse Distance Weighted)

**Input data:**

- Time-distance matrix, from province to province, before and after the completion of Egnatia Motorway

- National Road Network before construction of Egnatia Motorway

- National Road Network after completion of Egnatia Motorway
**Target:** How Egnatia Motorway affects time-distance

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- Calculation of isochrone curves. (Spatial Analyst -> Interpolate to Raster -> Inverse Distance Weighted)

**Input data**:

- Time-distance matrix, from province to province, before and after the completion of Egnatia Motorway
- National Road Network before construction of Egnatia Motorway
- National Road Network after completion of Egnatia Motorway
**Target:** Study of road network infrastructure development

**Calculation:**
- Road network classification
- Linking with prefectures-regions population data
- Calculation of total road network length by category
- Ratio of total network length to the prefecture/region total area or total population

**Input data:**
- Line layer of road network before and after Egnatia Motorway construction
- Polygon Layers of Prefectures and Regions
- Prefecture & Regions permanent population
ENV07: LAND USE CHANGES

**Row data**: «Pilot study of land uses and values in selected urban areas around 3 interchanges of the Egnatia motorway”, Contractor: Division of Cadastral, Photogrammetry and Cartography, Department of Topography, Aristole University of Thessaloniki, Greece.

**Target**: investigation of changes in the direct impact zone of Egnatia motorway in terms of land uses, land values, and business location, 1998-2007 in the following areas:
1. Zone 5x5 Km around Ioannina I/C (Ioannina city, west section of the motorway)
2. Zone 5x5 Km from Efkarpia I/C (K4) to Ionía I/C (K2) (outer Thessaloniki city area, central section of the motorway).
3. Zone 5x5 Km around the East Komotini I/C (Komotini city, east section of the motorway)

**Landuse changes**: Changes from cultivated to non-cultivated landuse as a result of expected pressures in specific areas along the motorway axis (especially near settlements, industrial areas etc.) and more specifically, rate of change of

(a) cultivated land into urban land,
(b) natural areas into urban land and
(c) natural areas into cultivated land.
ENV07 indicator: Land use changes

THESSALONIKI I/C
SPOT: 088/268

IKONOS-2
Panchromatic & multispectral
SPOT and IKONOS samples for classification

part of the classified SPOT & IKONOS images, respectively
Sample of the SPOT image and its equivalent IKONOS image sample, showing areas with no landuse changes, during the 1998-2007 period.

Sample of the IKONOS image, showing landuse changes during the 1998-2007 period.
ENV07 indicator: Land use changes


LEGEND
- Egnatia Motorway Interchanges
- Egnatia Motorway
- Municipal Divisions
- Study Area Zone

Pilot study of urban landuse & values changes in specific urban areas of the Egnatia Motorway impact zone


Scientific Project Team
Petros Nikolakis, Director
APOILOS GRATITAS, Performa
EVANGELIA BAILA, M. Sc., Urban & Regional Planning
ATHANASSIOULI, M. Sc., Cartography & Spatial Data Management
KRISTINA STAMOGLU, M. Sc., Geomatics

Thessaloniki
October 2007
ENV07 indicator: Land use changes

Thematic Map: Land use classification in base year (1998)

LEGEND
- Natural Areas
- Agricultural Land
- Urban Land
- Egnatia Motorway Interchanges
- Egnatia Motorway
- Municipal Divisions
- Study Area Zone

PILOT STUDY OF URBAN LANDUSE & VALUES CHANGES IN SPECIFIC URBAN AREAS OF THE EGNATIA MOTORWAY IMPACT ZONE


Ortho-Image SPOT Spatial Resolution 70m
Capture Date: 01 July 1998

DATA SOURCE: PILOT STUDY OF URBAN LANDUSE & VALUES CHANGES. November 2007
FILE: IMAGES.INDICATORS.EVN07.2006.IMAGE unlock.egnatiaindicators.ENVI_M_07_012006.DIR

EGNATIA ODOS OBSERVATORY

DATE: 05/02/2006

DATA SOURCE: PILOT STUDY OF URBAN LANDUSE & VALUES CHANGES. November 2007
FILE: IMAGES.INDICATORS.EVN07.2006.IMAGE unlock.egnatiaindicators.ENVI_M_07_012006.DIR
ENV07 indicator: Land use changes

LEGEND
- Natural Areas
- Agricultural Land
- Urban Land
- Egnatia Motorway

PILOT STUDY OF URBAN LANDUSE & VALUES CHANGES IN SPECIFIC URBAN AREAS OF THE EGNATIA MOTORWAY IMPACT ZONE


Ortho-Image IKONOS
Spatial Resolution 1m
Capture Date: 25 July 2006
**Target:** Calculation of benefited population and its changes inside the Egnatia Motorway impact zone

**Step 1:** Reference points definition (Impact Zone II)
SET01 indicator: Benefited population

Setup of Road Network Topology
Distances of up to 50 km along the national road network (daily trips)

SET01 indicator: Benefited population

Setup of Road Network Topology
Road Network at a 50 km range around the local reference point

SET01 indicator: Benefited population
Selection of municipal districts intersected by the 50 km range - road network around the local reference centre

SET01 indicator: Benefited population
Sum of population and population changes in selected municipal districts
Repeat of the same procedure for all the reference centres in impact zone II.
### POTENTIAL BENEFITED POPULATION, 2001
*(in 50 km distance from Prefecture Seats in Impact Zone II)*

<table>
<thead>
<tr>
<th>City</th>
<th>Permanent Benefited Population</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Igoumenitsa</td>
<td>53,773</td>
<td>2%</td>
</tr>
<tr>
<td>2 Ioannina</td>
<td>162,189</td>
<td>6%</td>
</tr>
<tr>
<td>3 Grevena</td>
<td>119,065</td>
<td>4%</td>
</tr>
<tr>
<td>4 Kozani</td>
<td>208,050</td>
<td>8%</td>
</tr>
<tr>
<td>5 Veria</td>
<td>436,061</td>
<td>16%</td>
</tr>
<tr>
<td>6 Thessaloniki</td>
<td>1,257,267</td>
<td>46%</td>
</tr>
<tr>
<td>7 Serres</td>
<td>210,104</td>
<td>8%</td>
</tr>
<tr>
<td>8 Kavala</td>
<td>283,394</td>
<td>10%</td>
</tr>
<tr>
<td>9 Xanthi</td>
<td>261,049</td>
<td>10%</td>
</tr>
<tr>
<td>10 Komotini</td>
<td>226,199</td>
<td>8%</td>
</tr>
<tr>
<td>11 Alexandroupoli</td>
<td>142,591</td>
<td>5%</td>
</tr>
</tbody>
</table>

**Total of benefited population for 50 km (no overlaps)**: 2,729,837

**Total of Impact Zone II**: 2,319,052

**Total of Impact Zone IV**: 3,894,511

Data Source:
Greek National Statistics Agency, 2001
Re-estimation of the indicator with Region Capitals (impact zone IV) in a distance of 150 km along the road network.

<table>
<thead>
<tr>
<th>City</th>
<th>Permanent Benefited Population</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ioannina</td>
<td>429,880</td>
<td>12%</td>
</tr>
<tr>
<td>Kozani</td>
<td>2,202,174</td>
<td>60%</td>
</tr>
<tr>
<td>Thessaloniki</td>
<td>2,305,540</td>
<td>63%</td>
</tr>
<tr>
<td>Komotini</td>
<td>535,233</td>
<td>15%</td>
</tr>
<tr>
<td>Larissa</td>
<td>1,634,805</td>
<td>45%</td>
</tr>
</tbody>
</table>

Total of benefited population for 150 km (no overlaps): 3,653,115

Total of Impact Zone IV: 3,894,511

Data Source: Greek National Statistics Agency, 2001
**Target:** Effects of Egnatia Odos into natural areas cohesion

**Input data:**
- Land-use layer (CORINE Land Cover)
- Road Network before Egnatia Odos construction
- Road Network with Egnatia Odos fully operational

**Calculation:**
(European Environmental Agency (EEA):
Anthropogenic fragmentation of potential semi-natural and natural areas
http://ec.europa.eu/agriculture/publi/landscape/ch5.htm

- Land-use classification into four main categories:
  - Urban Areas (Pressure)
  - Cultivated Areas (Pressure)
  - Natural Areas
  - Water Areas
- Transform into 250m GRID
- Road Network merge
- Calculation of «adjacent cells cohesion/proximity»

\[
\frac{\text{Total of connected Cells} \times \text{General Polygon Sum} \times 16^2}{\text{Total Sum of Cells} \times \text{General Cell Sum}}
\]
ENV06 indicator: Fragmentation of natural areas

Total of connected Cells * General Polygon Sum * 16^2
indicator = -----------------------------------------------
General Cell Sum^2

Note: Pixel size is equal to 250 m, therefore 1 km² corresponds to 4x250x250m, or 16 pixels

<table>
<thead>
<tr>
<th>Indicator</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt; 0.01</td>
<td>minimum</td>
</tr>
<tr>
<td>0.01 - 0.1</td>
<td>small</td>
</tr>
<tr>
<td>0.1 - 1</td>
<td>middle</td>
</tr>
<tr>
<td>1 - 10</td>
<td>average</td>
</tr>
<tr>
<td>10 - 100</td>
<td>strong</td>
</tr>
<tr>
<td>&gt; 100</td>
<td>Very strong</td>
</tr>
</tbody>
</table>

Model source: DG AGRI, EUROSTAT, ISPRA, EEA, From Land Cover to Landscape Diversity in the European Union, 2000
Indicator Calculation Automation
ENV09 indicator: Crossings with surface waters
ENV09 indicator: Crossings with surface waters
Indicator Calculation Automation

ENV08 indicator: Proximity to protected areas
Egnatia Odos A.E. Observatory – Hardware Setup

Observatory Unit
- GIS Workstations
- Laptop
- PC 1
- PC 2

IT Unit
- Main server

Department of Environment
- PC/GIS workstation

Traffic & Telematics Department
- PC/GIS workstation

Ioannina (Western Region) Regional Office
- PC/GIS workstation
ArcGIS (floating licenses) ArcInfo – ArcEditor - ArcView

user 1  user 2  user 3  user 4  ...  user n

ArcIMS Server (Internet Map Server)

Tier 2
ArcSDE

Tier 3
Data bases & file servers

Database (Oracle)  Main File Server  Geodatabase

intranet (Egnatia Odos A.E.)

internet
Observatory use of ArcGIS

- Spatial data infrastructure
- Indicators calculations
- Spatial impacts analysis and assessment

- Spatial Data storing and processing
- Descriptive data setup
- Linking descriptive data with spatial data
- Thematic map production

- Automation of Indicator calculation process
  - Automation in descriptive data output.
  - Automation in thematic map production.
Egnatia Odos A.E. Observatory

http://www.egnatia.eu

http://observatory.egnatia.gr

Monitoring the developmental, spatial, environmental and transport impacts of the construction and operation of the axis.

The Egnatia Motorway is a Trans-European Transport Network (TEN-T) priority project. It represents a major investment in the transportation infrastructure of Northern Greece, assisting the development of the region specifically and SE Europe in general.

Both the importance and the way of the investment necessitate the promotion of actions supplementary to construction that would multiply the benefits and mitigate the impacts from operation.

EGNATIA ODOS S.A. established the Egnatia Motorway Observatory in order (i) to support the integrated management of the motorway, (ii) to contribute to the utilization of the project in the cohesion and development of Northern Greece and the greater area of SE Europe, and (iii) to participate in the harmonized assessment of impacts of the Trans-European Transport Networks on the cohesion of the European area.

The English version of this website is under development, any inconvenience.


The Observatory is funded by the Operational Programme "Kosmidis Axes: Ports and Urban Development" (E.U. European Regional Development Funds).