

### 4.3 INTERNAL PARAMETERS OF THE IC MODULE

The IC Module uses a series of parameters to control how the trips are assigned onto each mode of the network. There are a total of 26 values relative to 13 single concepts which control the simulations of EU transport scenarios. All these values are set up to default values, but can be varied by the user of the IC Module to design customised scenarios.

#### 4.3.1 Costs of Travelling

The cost of travelling with terrestrial modes and air mode has been considered as the sum of the user travel time cost and the price of using the transport infrastructure.

$$Cost = TravelTimeCost + TravelFee$$

##### *Cost of time*

The cost of time is built upon the value of travel time perceived by users. This parameter is segmented among four different major social groups corresponding to different kinds of trip purposes: business trips, private trips, commuting trips and leisure or holidays. The value of travel time is decreasing in this same order, and is a reflex of the willingness of a user to pay for more expensive travel modes when the purpose of its trip is of greater utility.

The considered costs for travel time are specified in Table 4-1.

**Table 4-1 Basic parameters for values of travel time in the IC Module**

Value of travel time (euros / hour)	€ / hour
Business	25.00
Private	10.00
Commuters	10.00
Leisure and holidays	7.50

The parameters presented above represent average EU values and are adjusted according to the GDP per capita in each NUTS3. Being the value of travel time of a traveller a consequence of its wealth level, trips originated in poor regions are assigned with lower values of travel time, representing residents with lower levels of wealth.

The deviation from the central value can be controlled with a dispersion parameter. A value of 0.1 for the dispersion parameter makes the poorest region have a value of time 30% less than the average, and the richest region gets a value of time 30% over the average. The value of time for a given NUTS3 is applied to the trips originating from this NUTS3.

The value of these unitary costs can be varied by the user in the IC Module Multi-modal Parameters Control Panel (see chapter 4.5).

##### *Travel costs to use infrastructure (fees)*

For terrestrial modes, costs of using transport infrastructure are mostly derived from TRANS-TOOLS.

For the road mode, these average costs account for fuel consumption and running costs (mechanics, vehicle deterioration), and for tolls. For rail, they correspond to rail average fares, and mostly account for energy consumption, network maintenance and staff. They have been split into short-distance trips fares (<80km), rail fare for mid-distance trips (80-160km) and rail fare for long-distance trips (>160km).

**Table 4-2 Basic costs for terrestrial networks operation in the IC Module**

Costs of using transport infrastructure	€ / km
Road	0.15
Short-distance rail inter NUTS3	0.09
Mid-distance rail inter NUTS3	0.15
Long-distance rail inter NUTS3	0.20

The parameters presented in Table 4-2 represent average EU values and can be adjusted according to the GDP per capita in each NUTS3. Being the cost of travelling in a specific link directly related to the average level of wealth of the region where it is inscribed, higher costs are assigned on links in the richest regions.

The deviation from the central value can be controlled with a dispersion parameter. A value of 0.1 for the dispersion parameter makes the poorest region have link travel cost 30% less than the average, and the richest region is assigned with link travel cost 30% above the average. The cost of travelling on links within a given NUTS3 is applied to all links contained in this NUTS3.

#### 4.3.2 Costs for Travelling with the Air Mode

Having reviewed the original air network in TRANS-TOOLS, the most important finding is that it cannot be used in a multi-modal model. The connections and costs of the air links work well in TRANS-TOOLS, where the modal shift is calculated prior to assignment onto uni-modal networks. However, when using these links in the multi-modal Interconnect network, where modal split and assignment are calculated in one step, the results were not satisfactory with unreal behaviour in air combinations appearing in the results: the system had a natural trend to keep in the air mode once accessed for the first time, because of the incapacity to introduce penalties in air-air interchanges.

Due to this fundamental difference in the architecture of network composition between TRANS-TOOLS and the IC Module, the TRANS-TOOLS cost scheme is unsuitable for use in the IC Module either. A theoretical price scheme has then been calculated using the existing database as basis.

The cost formulation includes the different time values of three different travel purposes (it is assumed that there are no commuting trips by plane) as well as a specific air fare for each one of these purposes. The fare depends on the distance of the trip and the size of the airport as it is shown below:

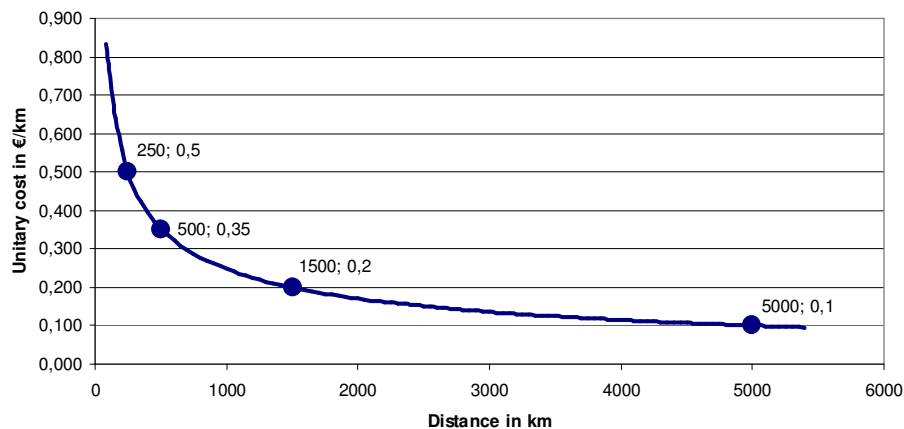
$$Cost = dist \cdot U_{cost} \cdot \alpha$$

Where

$$U_{cost} = f(dist)$$

$$\alpha = f(airport\_pax)$$

The function providing the relationship between cost and distance has been obtained by making a regression from four pairs of values, as shown in Figure 4-3.

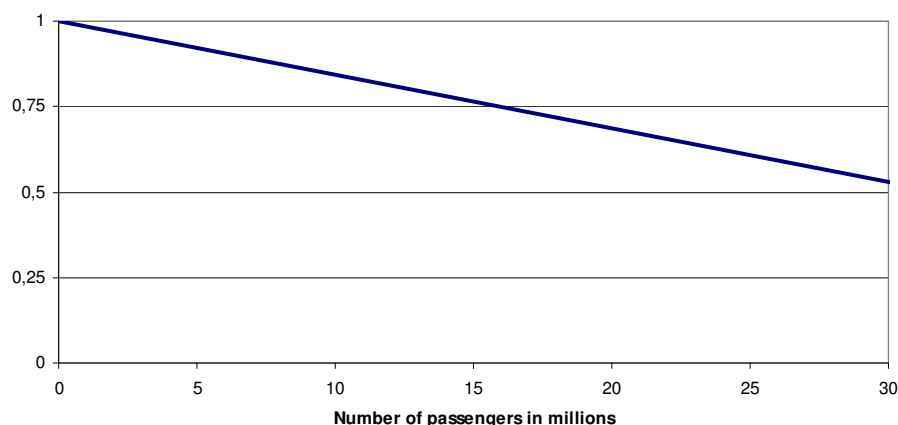


**Figure 4-3 Air mode travel costs: regression of unitary costs against distance**

The formula has been obtained using on-line software for fitting data, which finds the best equation for a given set of parameters and data points<sup>6</sup>. The resulting formula is:

$$U_{cost} = 6.89 \cdot dist^{-0.464} - 0.0313$$

Unitary cost is affected by a coefficient to reflect the fact that scale economies are common in the air transport sector. The coefficient  $\alpha$  takes a minimum value of 0.5 for the airport with the highest annual number of passengers, and a maximum value of 1.0 for the airport with the lowest annual number of passengers. European airports in the IC Module are ranked by their number of passengers and a value between 0.5 and 1.0 is assigned to each one of the linear pattern shown in Figure 4-4.



**Figure 4-4 Air mode travel costs: relation between  $\alpha$  parameter and number of passengers**

The final unitary air fares range from 0.06 €/km up to 0.80 €/km. These values apply to the cost of business air trips, while the private trips have prices half of those of business and holiday trips are one third the price of business:

$$U_{cost} \text{ business} = 2 \cdot U_{cost} \text{ private} = 3 \cdot U_{cost} \text{ holiday}$$

<sup>6</sup> Zunzun.com data fitting on-line software

### 4.3.3 Costs of Using Interconnections

Five unitary costs for interchanges between modes, city-road, city-rail station, road-airport, road-rail station, airport-rail station have been considered. These costs were initially targeted through the analysis of specific transport terminals in Europe, those analysed in case studies included, and adjusted later on in the process of validation of the IC Module. They are expressed in terms of euro per kilometre of the connector.

The resulting costs are shown below.

**Table 4-3 Basic costs for interconnections in the IC Module**

Costs of using interconnections (€ / km)	€ / km
City-road	0.25
City-rail station	0.10
Road-airport	0.15
Road-rail station	0.25
Airport-rail station	0.15

Interconnectivity within the air networks is controlled through penalties when concatenating two air links successively. This is modelled through incorporating the concept of transport services in each link.

Even if the IC Module is able to track interconnections intra-network, that is transitions from a local rail network onto a long-distance rail network – defined as the EU rail core network as presented in the DGTREN TEN-CONNECT study - and from a local road network onto a long-distance road network – defined as the EU road core network as presented in TEN-CONNECT - the model is not able to introduce penalties on those changes. For road networks, that concept is of little use but it could be of more importance for rail networks, constituting a way for further work in the future. In any case, the penalisation magnitude in this case would be much lower than for the air mode as there is considerably less waiting time at rail stations than in airports, and the impact of not incorporating it in the IC Module is expected to be relatively limited.

## 4.4 VALIDATION OF THE IC MODULE RESULTS WITH TRANS-TOOLS

To validate the performance of the IC Module, results obtained from the IC Module are compared to TRANS-TOOLS' original results in an iterative validation process.

Multi-modal parameters have been adjusted in order to obtain results for the IC Module which sufficiently fit those from TRANS-TOOLS.

As mentioned before, the TRANS-TOOLS model is calibrated so that its results sufficiently fit Eurostat statistics. That means that internal parameters in TRANS-TOOLS are set so that results from its modelling process sufficiently fit reality.

As already mentioned in section 2.3.2, the internal parameters of the IC Module – mainly travel costs and interconnectivity costs - have also been adjusted in a process of validation against TRANS-TOOLS results.

With the IC Module validated, the module is ready to test different alternative scenarios, for which the INTERCONNECT Meta-model produces indicators to digest and present results for interconnectivity upgrading impact analysis. This process is reported in INTERCONNECT Deliverable D5.2 *Meta-models for the analysis of interconnectivity*.

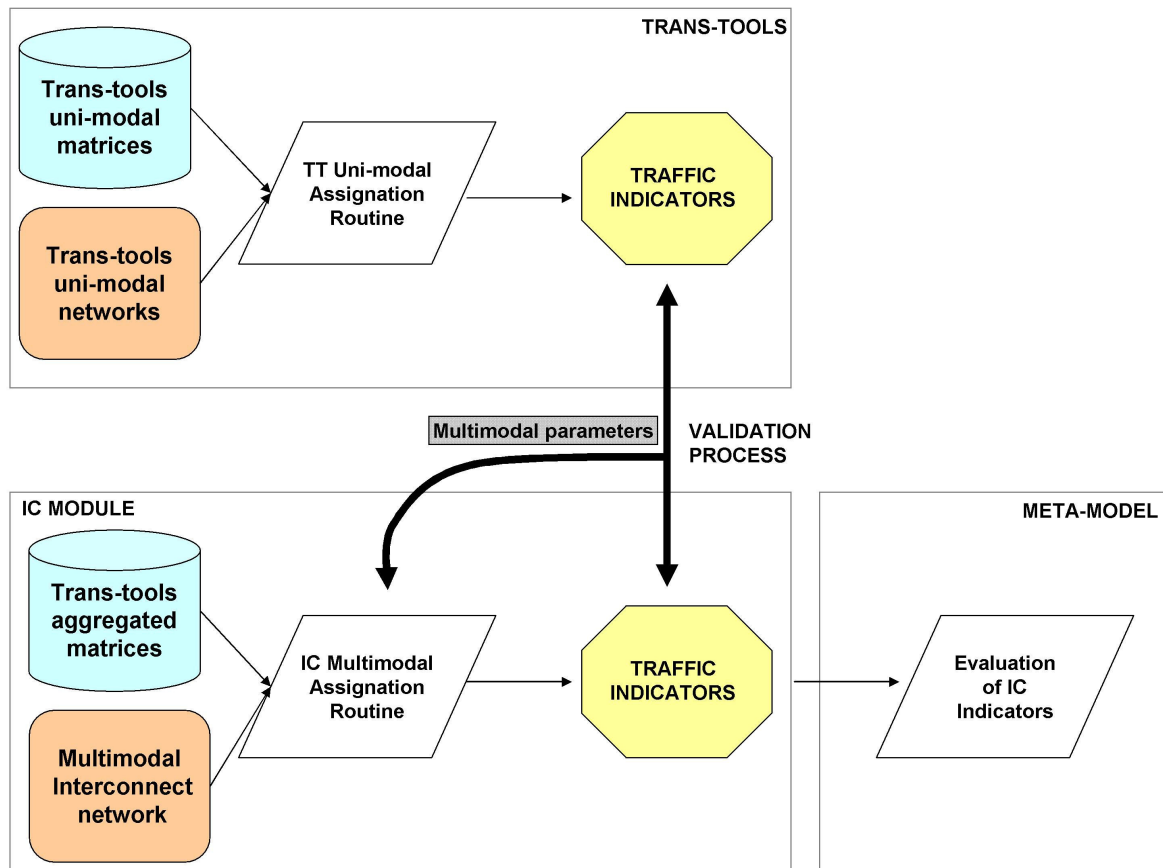


Figure 4-5 IC Module validation process structure

The specific process of validation is as follows.

- First, TRANS-TOOLS OD matrices – one for each transport mode, rail, air, road, and for each trip purpose, business, private, commuter, leisure or holidays - are assigned onto their corresponding uni-modal graphs. With this assignment, traffic indicators are obtained. Traffic volumes are retained for each different transport mode (vehicle-kilometres and passenger-kilometres).
- Secondly, TRANS-TOOLS OD matrices are added for each mode obtaining a set of *TRANS-TOOLS aggregated matrices* containing all trips between NUTS3 pairs – regardless of their travel mode - split by different trip purposes. These *TT aggregated matrices* are assigned onto the IC multi-modal graph, and traffic indicators are obtained. Traffic volumes in Europe in different modes are retained, and it is analysed the intensity of use of each individual travel mode in vehicle-kilometres and passenger-kilometres.
- Obtained volumes of travel for each mode are compared from TRANS-TOOLS resulting indicators and IC Module's.
- This process is repeated iteratively changing the multi-modal parameters of the IC Module – mostly the costs of interconnection - until results of TRANS-TOOLS and IC Module fit sufficiently.

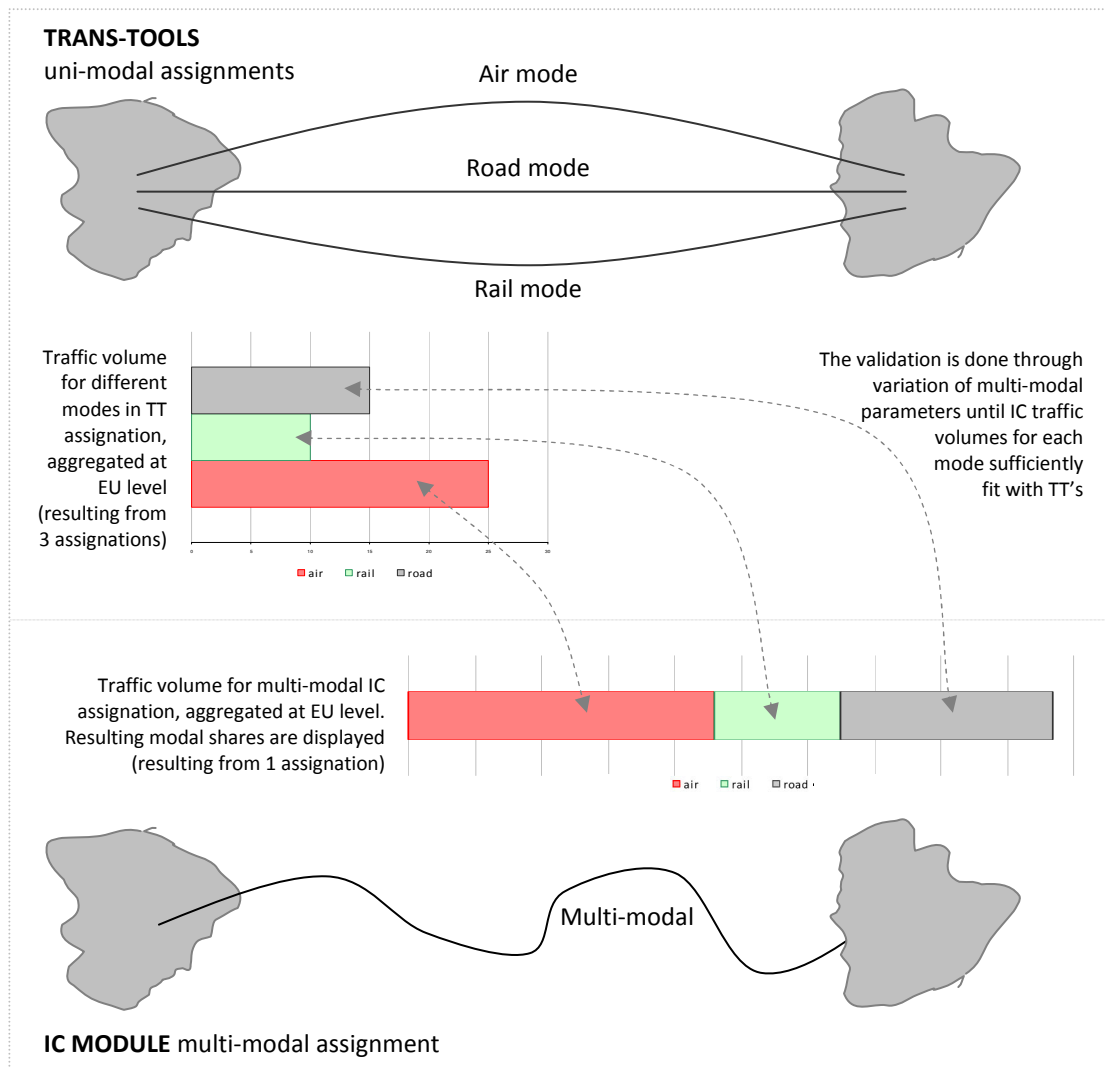


Figure 4-6 IC Module validation criteria

The following figures show the process of validation of the IC Module through successive assignments of TRANS-TOOLS OD matrices onto the INTERCONNECT multi-modal graph, with variations on the multi-modal parameters of the module. A progressive convergence pattern can be tracked along the several assignments until volumes of travelling with different transport modes at EU level obtained from the IC Module sufficiently fit those obtained in TRANS-TOOLS.

Multi-modal parameters being varied are:

- Value of travel time: value perceived by users in euro per hour;
- Travel cost: cost to travel along infrastructure links (rail and road) in euro per kilometre;
- Interconnection cost: cost to travel along an interconnections in euro per kilometre;
- Dispersion parameters: segmented onto three parameters, it alters the distribution of *value of time*, *infrastructure travel cost* and *interconnection travel cost* for the European NUTS3 regions, based on their GDP level (for full reference of this parameter, read chapter 4.3);
- Time penalty for air transfer: penalisation for transferring between two consecutive air links, in minutes.

A full description for each iteration can be found at the end of this report as an Appendix. Finally established parameters after the validation process can be found at the end of this chapter.

Output: IC Module excess/lack of traffic with respect to TRANS-TOOLS

Name of the assignment	Date	Description	Basic Parameters	Comments
1st Assignment Initial setup	08/03/2011	Trans-tools parameters for travel costs and values of travel time. Initial values for interconnection impedance parameters, evaluated according to a basic set of shortest path assignments between representative NUTS-3 pairs.	<p><i>Value of travel time in €/hour:</i> Commuter: 7.5; Business: 15; Private: 10; Leisure: 5</p> <p><i>Travel costs in €/km:</i> Road: 0.1; Rail (short): 0.1; Rail (mid): 0.1; Rail (long): 0.2</p> <p><i>Interconnecting costs in €/km:</i> City-Road: 0.15; City-Rail: 0.15; Air-Road: 0.5; Air-Rail: 0.5;</p> <p><i>Dispersion</i> Time penalty 0.1</p>	<p>Too many users are traveling on road, while rail and air are staying behind. The dysfunction is mostly happening with business travelers, who should apparently use more airplane.</p>
2nd Assignment Altered travel costs for road and rail	09/03/2011	Increase in road and rail mid-distance costs. Adjustments in connection costs to penalise road and benefit rail and air	<p><i>Value of travel time in €/hour:</i> Commuter: 7.5; Business: 15; Private: 10; Leisure: 5</p> <p><i>Travel costs in €/km:</i> Road: 0.15; Rail (short): 0.1; Rail (mid): 0.125; Rail (long): 0.2</p> <p><i>Interconnecting costs in €/km:</i> City-Road: 0.2; City-Rail: 0.15; Air-Road: 0.5; Air-Rail: 0.25;</p> <p><i>Dispersion</i> Time penalty 0.1</p>	<p>Road and rail are now much more adjusted but rail is used too much, mainly by private and holiday trips.</p>
3rd Assignment Minimum dispersion for all variables Dispersion = 0	15/03/2011	Based on "Altered travel costs for road and rail" but decreasing dispersion to a minimum value of 0 in all parameters to see the impact of having no regional variations on the global results	<p><i>Value of travel time in €/hour:</i> Commuter: 7.5; Business: 15; Private: 10; Leisure: 5</p> <p><i>Travel costs in €/km:</i> Road: 0.15; Rail (short): 0.1; Rail (mid): 0.125; Rail (long): 0.2</p> <p><i>Interconnecting costs in €/km:</i> City-Road: 0.2; City-Rail: 0.15; Air-Road: 0.5; Air-Rail: 0.25;</p> <p><i>Dispersion</i> Time penalty 0</p>	<p>A dispersion of 0 makes all prices and costs equal across the different regions. The result is a worse adjustment when compared to the scenario with dispersion 0.1</p>
4th Assignment Maximum dispersion for all variables Dispersion = 1	09/03/2011	Based on "Altered travel costs for road and rail" but increasing dispersion to a maximum value of 1 in all parameters to see the impact of regional variations on the global results	<p><i>Value of travel time in €/hour:</i> Commuter: 7.5; Business: 15; Private: 10; Leisure: 5</p> <p><i>Travel costs in €/km:</i> Road: 0.15; Rail (short): 0.1; Rail (mid): 0.125; Rail (long): 0.2</p> <p><i>Interconnecting costs in €/km:</i> City-Road: 0.2; City-Rail: 0.15; Air-Road: 0.5; Air-Rail: 0.25;</p> <p><i>Dispersion</i> Time penalty 1</p>	<p>A higher dispersion means increasing the differences in prices and costs throughout Europe. The effect is a better fit with the original TransTools results. However, although there is a correct change from road to air, rail mode still has too many trips.</p>
5th Assignment Increased Value of Time	15/03/2011	Increase in Value of Time for the four types of users, with a correction of rail costs	<p><i>Value of travel time in €/hour:</i> Commuter: 10; Business: 20; Private: 12; Leisure: 7.5</p> <p><i>Travel costs in €/km:</i> Road: 0.15; Rail (short): 0.1; Rail (mid): 0.15; Rail (long): 0.2</p> <p><i>Interconnecting costs in €/km:</i> City-Road: 0.2; City-Rail: 0.15; Air-Road: 0.5; Air-Rail: 0.25;</p> <p><i>Dispersion</i> Time penalty 0.1</p>	<p>The increase in Value of Time has resulted in a more accurate fit of TransTools results, with differences by mode under 10%, although these differences are bigger when looking at the trips per travel purpose.</p>
6th Assignment Altered travel costs for rail and air	15/03/2011	Based on the scenario "Increased Value of Time", with slightly higher road and rail costs and cheaper interconnection to air mode. Also a higher dispersion value has been adopted, provided that it seems that higher dispersion gives a better fit to TRANS-TOOLS results.	<p><i>Value of travel time in €/hour:</i> Commuter: 10; Business: 20; Private: 12; Leisure: 7.5</p> <p><i>Travel costs in €/km:</i> Road: 0.155; Rail (short): 0.11; Rail (mid): 0.16; Rail (long): 0.2</p> <p><i>Interconnecting costs in €/km:</i> City-Road: 0.1; City-Rail: 0.1; Air-Road: 0.125; Air-Rail: 0.125;</p> <p><i>Dispersion</i> Time penalty 0.5</p>	<p>The model is highly sensitive to rail cost, and a slight increase has resulted in a big decrease in the use of rail. Air mode has now a good fit when measured globally.</p>

Output: IC Module excess/lack of traffic with respect to TRANS-TOOLS

Name of the assignment	Date	Description	Basic Parameters	Comments
7th Assignment Time penalty for air transfer = 0min	15/03/2011	Based on a mix of the scenarios "Increase in Value of Time" and "Altered travel costs for rail and air", but with an interconnection penalty of 0 minutes for changing between air services.	<p>Value of travel time in €/hour: Commuter: 10; Business: 20; Private: 12; Leisure: 7.5 Travel costs in €/km: Road: 0.165; Rail (short): 0.11; Rail (mid): 0.16; Rail (long): 0.2 Interconnecting costs in €/km: City-Road: 0.2; City-Rail: 0.2; Air-Road: 0.25; Air-Rail: 0.125; Dispersion Time penalty 0</p>	Reducing the penalty waiting time between consecutive planes to 0 results in an enormous increase in plane use, mainly coming from road trips but also some from the rail.
8th Assignment Variation in interconnections and time penalty	16/03/2011	Based on a mix of the scenarios "Altered travel costs for rail and air", with slightly lower cost of road but higher interconnection cost from road to city. Slight reduction of short distance rail cost.	<p>Value of travel time in €/hour: Commuter: 10; Business: 20; Private: 12; Leisure: 7.5 Travel costs in €/km: Road: 0.15; Rail (short): 0.1; Rail (mid): 0.16; Rail (long): 0.2 Interconnecting costs in €/km: City-Road: 0.25; City-Rail: 0.1; Air-Road: 0.125; Air-Rail: 0.125; Dispersion Time penalty 0.5</p>	A reduction of 50% in the time penalty for air services has resulted in a big increase in use of the air mode. This increase comes in part from rail users but also from a great number of road users.
9th Assignment Dispersion = 0.5 (all) Time penalty for air transfer = 60min	21/03/2011	Based on the scenario "Variation in interconnections and time penalty", with slightly lower cost of rail short.	<p>Value of travel time in €/hour: Commuter: 10; Business: 25; Private: 10; Leisure: 7.5 Travel costs in €/km: Road: 0.15; Rail (short): 0.09; Rail (mid): 0.15; Rail (long): 0.2 Interconnecting costs in €/km: City-Road: 0.25; City-Rail: 0.1; Air-Road: 0.125; Air-Rail: 0.125; Dispersion Time penalty 0.5</p>	The slight reduction in rail cost has equilibrated the rail passengers moving them from the road mode. All modes have now less than 10% difference with respect to Transstools.
10th Assignment Dispersion = 0.5 (all) Time penalty for air transfer = 60min	21/03/2011	Based on the scenario "Variation in interconnections and time penalty", with slightly lower cost of rail short and a dispersion parameter of 1.	<p>Value of travel time in €/hour: Commuter: 10; Business: 25; Private: 10; Leisure: 7.5 Travel costs in €/km: Road: 0.15; Rail (short): 0.09; Rail (mid): 0.15; Rail (long): 0.2 Interconnecting costs in €/km: City-Road: 0.25; City-Rail: 0.1; Air-Road: 0.125; Air-Rail: 0.125; Dispersion Time penalty 1</p>	The increase in dispersion factor in this case has the effect of increasing the air trips. Globally the fit has worsened.
11th Assignment Dispersion = 0.5 (all) Time penalty for air transfer = 90min	21/03/2011	Based on the scenario "Variation in interconnections and time penalty", with slightly lower cost of rail short and time penalty of 90 minutes.	<p>Value of travel time in €/hour: Commuter: 10; Business: 25; Private: 10; Leisure: 7.5 Travel costs in €/km: Road: 0.15; Rail (short): 0.09; Rail (mid): 0.15; Rail (long): 0.2 Interconnecting costs in €/km: City-Road: 0.25; City-Rail: 0.1; Air-Road: 0.125; Air-Rail: 0.125; Dispersion Time penalty 0.5</p>	A higher time penalty in connecting flights moves users from air to road and rail, but the rail grows too much.
12th Assignment Dispersion = 1 (all) Time penalty for air transfer = 90min	21/03/2011	Based on the scenario "Variation in interconnections and time penalty", with slightly lower cost of rail short, a dispersion parameter of 1 and a time penalty of 90 minutes.	<p>Value of travel time in €/hour: Commuter: 10; Business: 25; Private: 10; Leisure: 7.5 Travel costs in €/km: Road: 0.15; Rail (short): 0.09; Rail (mid): 0.15; Rail (long): 0.2 Interconnecting costs in €/km: City-Road: 0.25; City-Rail: 0.1; Air-Road: 0.125; Air-Rail: 0.125; Dispersion Time penalty 1</p>	By increasing the dispersion to 1 the fit is better with values under 6%.



Output: IC Module excess/lack of traffic with respect to TRANS-TOOLS			
Name of the assignment	Date	Description	Basic Parameters
<p>13th Assignment</p> <p>Dispersion parameters: for value of time = 1 for cost of infrastructure = 0.5 for cost of interconnection = 0.5 Time penalty for air transfer = 90min</p>	22/03/2011	Based on the scenario "12th assignment", with variations in the dispersion parameters: 1 for VOT, 0.5 for infrastructure costs and interchange costs	<p>Value of travel time in €/hour: Commuter: 10; Business: 25; Private: 10; Leisure: 7.5</p> <p>Travel costs in €/km: Road: 0.15; Rail (short): 0.09; Rail (mid): 0.15; Rail (long): 0.2</p> <p>Interconnecting costs in €/km: City-Road: 0.25; City-Rail: 0.1; Air-Road: 0.125; Air-Rail: 0.125;</p> <p>Dispersion Time penalty Variable 90</p>
<p>14th Assignment</p> <p>Dispersion parameters: for value of time = 1 for cost of infrastructure = 0.5 for cost of interconnection = 0 Time penalty for air transfer = 90min</p>	22/03/2011	Based on the scenario "12th assignment", with variations in the dispersion parameters: 1 for VOT, 0.5 for infrastructure costs and 0 for interchange costs	<p>Value of travel time in €/hour: Commuter: 10; Business: 25; Private: 10; Leisure: 7.5</p> <p>Travel costs in €/km: Road: 0.15; Rail (short): 0.09; Rail (mid): 0.15; Rail (long): 0.2</p> <p>Interconnecting costs in €/km: City-Road: 0.25; City-Rail: 0.1; Air-Road: 0.125; Air-Rail: 0.125;</p> <p>Dispersion Time penalty Variable 90</p>
<p>15th Assignment</p> <p>Dispersion parameters: for value of time = 0.5 for cost of infrastructure = 0.5 for cost of interconnection = 0.5 Time penalty for air transfer = 90min</p>	22/03/2011	Based on the scenario "12th assignment", with variations in the dispersion parameters: 0.5 for VOT, 0.5 for infrastructure costs and 0 for interchange costs	<p>Value of travel time in €/hour: Commuter: 10; Business: 25; Private: 10; Leisure: 7.5</p> <p>Travel costs in €/km: Road: 0.15; Rail (short): 0.09; Rail (mid): 0.15; Rail (long): 0.2</p> <p>Interconnecting costs in €/km: City-Road: 0.25; City-Rail: 0.1; Air-Road: 0.125; Air-Rail: 0.125;</p> <p>Dispersion Time penalty Variable 90</p>
<p>16th Assignment</p> <p>Dispersion parameters: for value of time = 0.5 for cost of infrastructure = 0.1 for cost of interconnection = 0 Time penalty for air transfer = 90min</p>	22/03/2011	Based on the scenario "12th assignment", with variations in the dispersion parameters: 0.5 for VOT, 0.1 for infrastructure costs and 0 for interchange costs	<p>Value of travel time in €/hour: Commuter: 10; Business: 25; Private: 10; Leisure: 7.5</p> <p>Travel costs in €/km: Road: 0.15; Rail (short): 0.09; Rail (mid): 0.15; Rail (long): 0.2</p> <p>Interconnecting costs in €/km: City-Road: 0.25; City-Rail: 0.1; Air-Road: 0.125; Air-Rail: 0.125;</p> <p>Dispersion Time penalty Variable 90</p>
<p>17th Assignment</p> <p>Dispersion parameters: for value of time = 0.75 for cost of infrastructure = 0.75 for cost of interconnection = 0 Time penalty for air transfer = 120min</p>	23/03/2011	Based on the scenario "12th assignment", with variations in the dispersion parameters: 0.75 for VOT, 0.75 for infrastructure costs and 0 for interchange costs	<p>Value of travel time in €/hour: Commuter: 10; Business: 25; Private: 10; Leisure: 7.5</p> <p>Travel costs in €/km: Road: 0.15; Rail (short): 0.09; Rail (mid): 0.15; Rail (long): 0.2</p> <p>Interconnecting costs in €/km: City-Road: 0.25; City-Rail: 0.1; Air-Road: 0.125; Air-Rail: 0.15;</p> <p>Dispersion Time penalty Variable 90</p>
<p>18th Assignment</p> <p>Dispersion parameters: for value of time = 0.75 for cost of infrastructure = 0.75 for cost of interconnection = 0.75 Time penalty for air transfer = 120min</p>	23/03/2011	Based on the scenario "12th assignment", with variations in the dispersion parameters: 0.75 and 120 minutes as air interchange penalty	<p>Value of travel time in €/hour: Commuter: 10; Business: 25; Private: 10; Leisure: 7.5</p> <p>Travel costs in €/km: Road: 0.15; Rail (short): 0.09; Rail (mid): 0.15; Rail (long): 0.2</p> <p>Interconnecting costs in €/km: City-Road: 0.25; City-Rail: 0.1; Air-Road: 0.125; Air-Rail: 0.15;</p> <p>Dispersion Time penalty Variable 120</p>
			Comments
			<p>The choice in dispersion values has clearly favoured the rail mode at expense of both air and road.</p>
			<p>A value of 0 in the dispersion parameter for interchange costs improves the fit to TransTools data, but only marginally.</p>
			<p>The choice of dispersion values in this scenario has a result in a situation similar to that of scenario "Sixth assignment Disp 1 TP 90", but road and rail shifting roles.</p>
			<p>A lower value of dispersion for infrastructure costs results in a high increase of rail trips</p>
			<p>Relatively adjusted, shows an excess of rail</p>
			<p>Air loses too much, and rail increases as a counterpart</p>

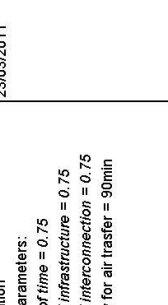
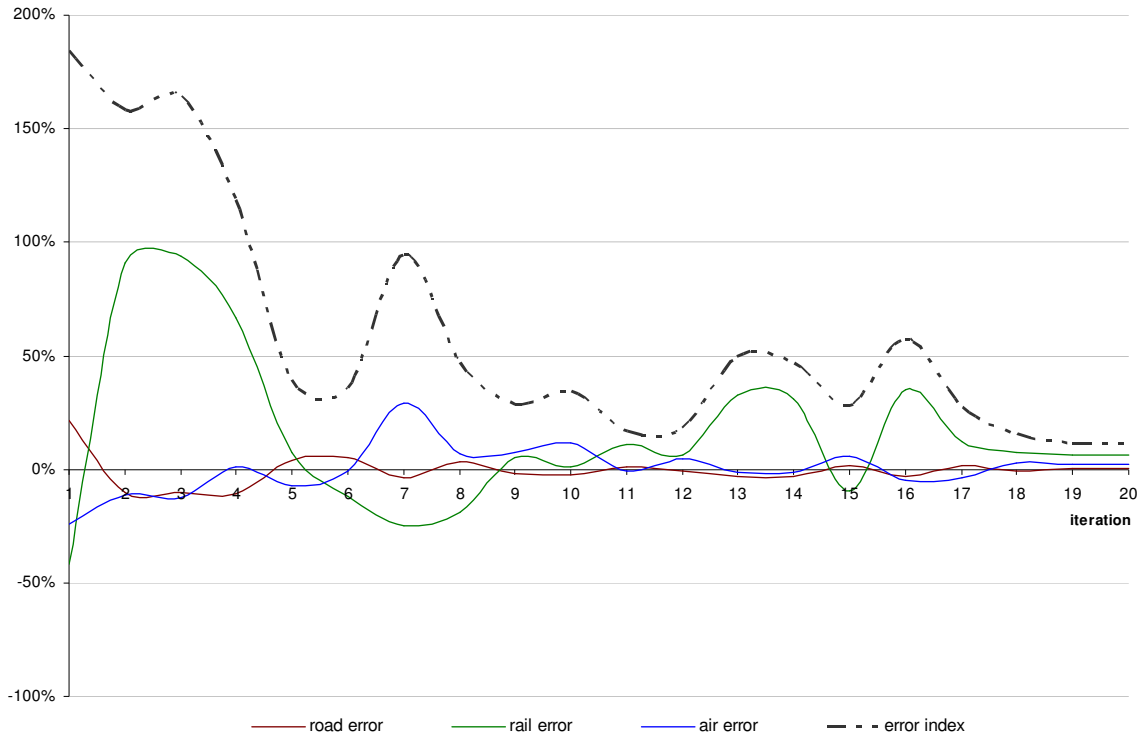
Name of the assignment	Date	Description	Basic Parameters	Output: IC Module excess/lack of traffic with respect to TRANS-TOOLS	Comments
19th Assignment Dispersion parameters: for value of time = 0.75 for cost of infrastructure = 0.75 for cost of interconnection = 0.75 Time penalty for air transfer = 90min	23/03/2011	Based on the scenario "12th assignment", with variations in the dispersion parameters: 0.75	Value of travel time in €/hour: Commuter: 10; Business: 25; Private: 10; Leisure: 7.5 Travel costs in €/km: Road: 0.15; Rail (short): 0.09; Rail (mid): 0.15; Rail (long): 0.2 Interconnecting costs in €/km: City-Road: 0.25; City-Rail: 0.1; Air-Road: 0.15; Air-Rail: 0.15; ; Rail-Road: 0.25 Dispersion Time penalty 0.75 90		Same behaviour as "Assignment 17", fits slightly better

Figure 4-7 IC Module validation process results. iteration after iteration

Figure 4-8 shows the progressive convergence between the IC Module results and TRANS-TOOLS'. The *error index* measures the global performance of the iteration, and is defined as the sum of each of the errors for road, rail and air, in absolute value, and weighted by the modal share of the mode in passenger-kilometres in relation to others. Each of the modal errors is measured as the volume of passenger-kilometres obtained with the IC Module divided by the volume obtained with TRANS-TOOLS'.

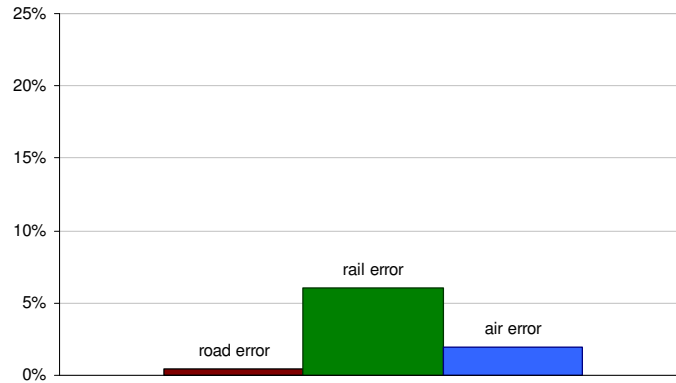


**Figure 4-8 IC Module results' convergence to TRANS-TOOLS' along iterative validation**

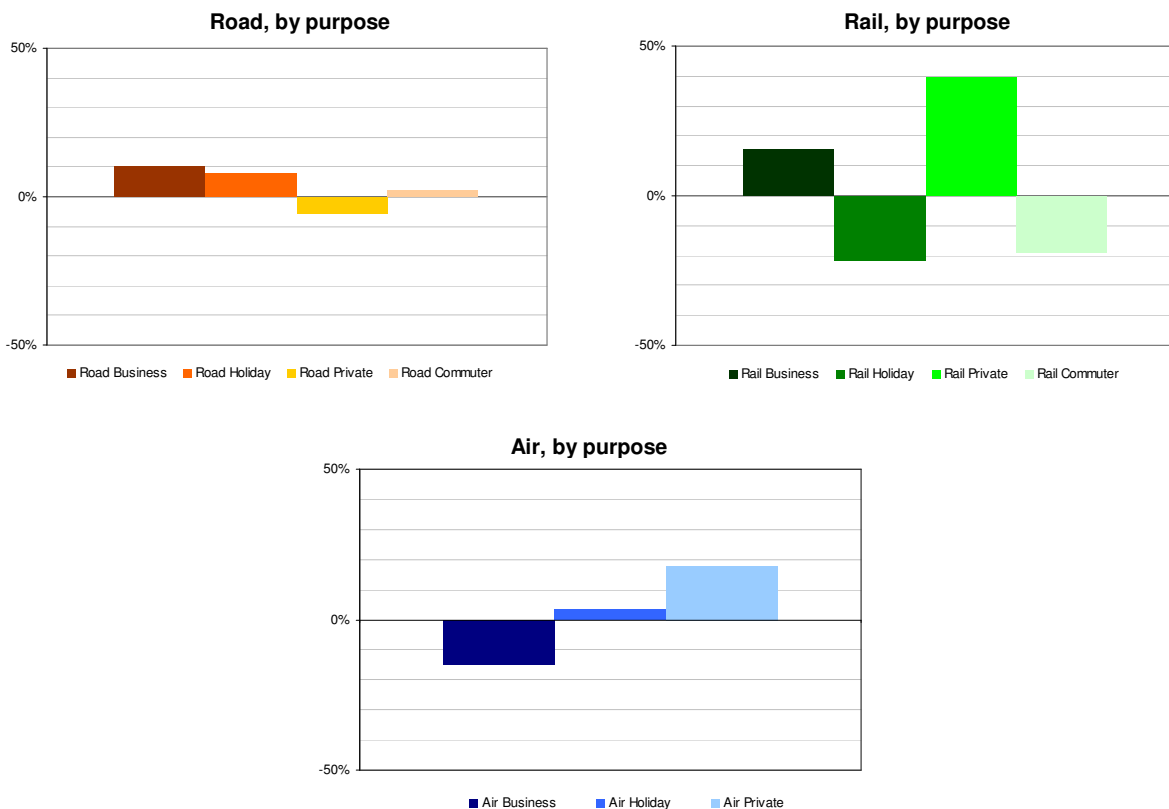
**Table 4-4 Errors between IC Module results and TRANS-TOOLS'**

Iteration	road error	rail error	air error	error index
1	21%	-42%	-25%	184%
2	-10%	91%	-11%	158%
3	-10%	94%	-13%	164%
4	-11%	67%	1%	118%
5	4%	8%	-7%	39%
6	5%	-12%	-1%	36%
7	-4%	-25%	29%	94%
8	3%	-19%	7%	47%
9	-2%	5%	7%	28%
10	-3%	1%	12%	34%
11	1%	11%	-1%	17%
12	-1%	6%	5%	18%
13	-3%	33%	-2%	50%
14	-3%	31%	-2%	47%
15	2%	-9%	6%	28%
16	-3%	35%	-5%	57%
17	2%	12%	-4%	27%
18	-1%	8%	3%	15%
19	0%	6%	2%	12%
20	0%	6%	2%	12%

The final iteration gave sufficiently adjusted results between IC Module and TRANS-TOOLS with the error in the road mode lower than 0.5%, in the rail mode around 6% and in the air mode around 2%; these results are considered satisfactory, as the road mode, representing 73% of all kilometres travelled in Europe, has a very low error, while the rail mode with the 6% error represents only around 3% of total traffic. The analysis by different trips purposes shows that for the road mode, the error laid below  $\pm 10\%$  for all trip purposes and below  $\pm 15\%$  for the air mode, while the rail mode gave more distant values (but it is also the one with a lower modal share in passenger-kilometres)."



**Figure 4-9 Error levels between IC Module results and TRANS-TOOLS' after validation**



**Figure 4-10 Error levels for different trip purposes after validation**

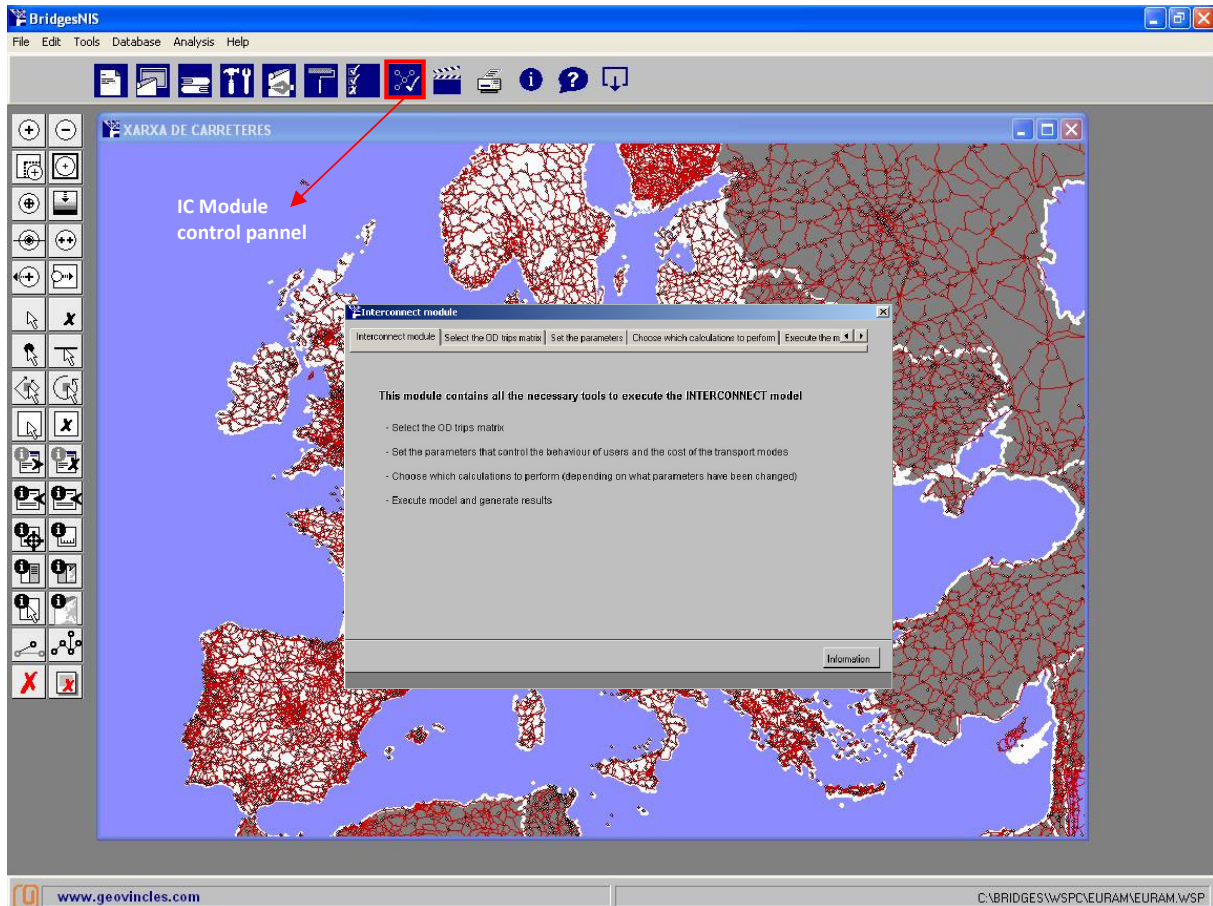
The main parameters of this final iteration, taken as basic multi-modality parameters of the IC Module, are the following:

**Table 4-5 Adopted values for IC Module multi-modal parameters after validation process**

<b>Parameter</b>	<b>Value</b>
Value of travel time	
<i>Business</i>	25 €/h
<i>Private</i>	10 €/h
<i>Commuters</i>	10 €/h
<i>Holiday</i>	7.5 €/h
Travel Costs	
<i>Road</i>	0.15 €/km
<i>Short-distance rail</i>	0.09 €/km
<i>Medium-distance rail</i>	0.15 €/km
<i>Long-distance rail</i>	0.2 €/km
Interconnecting costs	
<i>City-road connector</i>	0.25 €/km
<i>City-r connector:</i>	0.1 €/km
<i>Airport-road connector</i>	0.15 €/km
<i>Airport-train connector</i>	0.15 €/km
<i>Train-road connector</i>	0.25 €/km
Dispersion of <i>value of travel time</i>	0.75
Dispersion of <i>travel cost in infrastructure</i>	0.75
Dispersion of <i>travel cost in interconnections</i>	0.75
Time Penalty for interconnecting at airports	90min

#### 4.5 HOW TO USE THE IC MODULE

In the following an explanation of the IC Module's main functionalities is provided. For additional reference of the working of the Module, see Appendix 3.



**Figure 4-11 IC Module: general view**

The main control panel of the IC Module contains all the necessary links to available tools and parameter configuration screens to fully execute the INTERCONNECT module. These tools are:

- Selection of the OD trip matrix to be assigned to the INTERCONNECT graph. The TRANS-TOOLS 2005 matrix is available by default.
- Configuration of multi-modal parameters determining travel behaviour, including value of travel time, operative costs on infrastructure and interconnections, and dispersion parameters.
- Selection of the set of calculations to be performed on the INTERCONNECT graph with the selected OD matrix. One or more can be selected: business, private, commuter and holiday trips.
- Execution of the module. The apply button launches the calculations with all selected parameters and configurations, and returns the selected output results. The window shows the progress of the calculation.

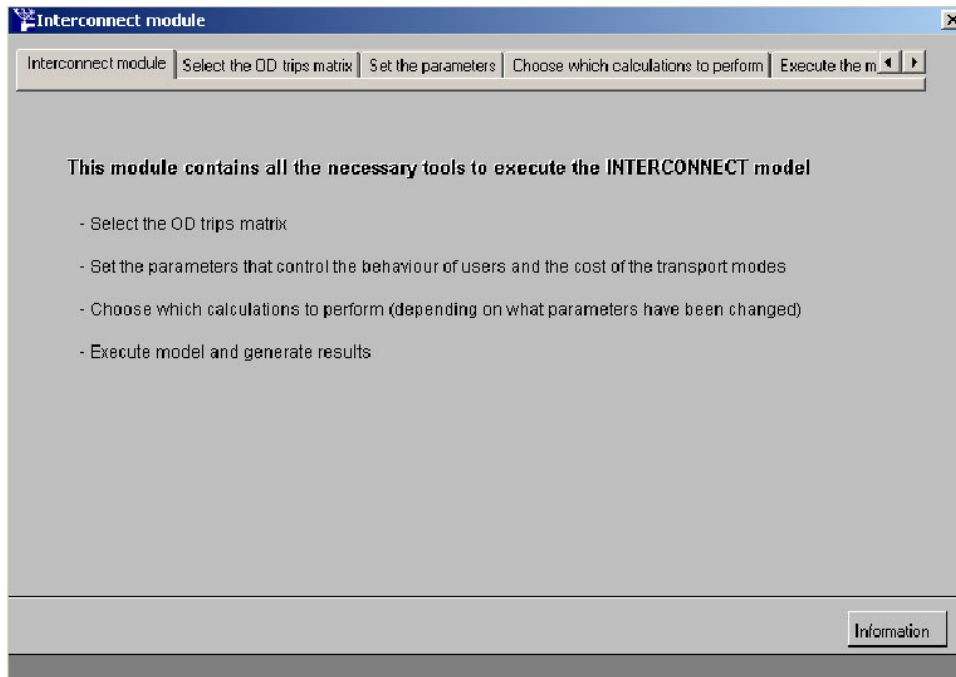


Figure 4-12 IC Module: welcome screen

The next sections provide a brief description of each of the IC Module tabs allowing setting up the IC calculations and the outputs to be obtained.

#### *OD Trip matrix selection control panel*

The *OD Trip Matrix Selection* control panel allows the user to choose from the dropdown list which OD matrix will be used for the model calculations. The TRANS-TOOLS 2005 OD matrix is used by default.

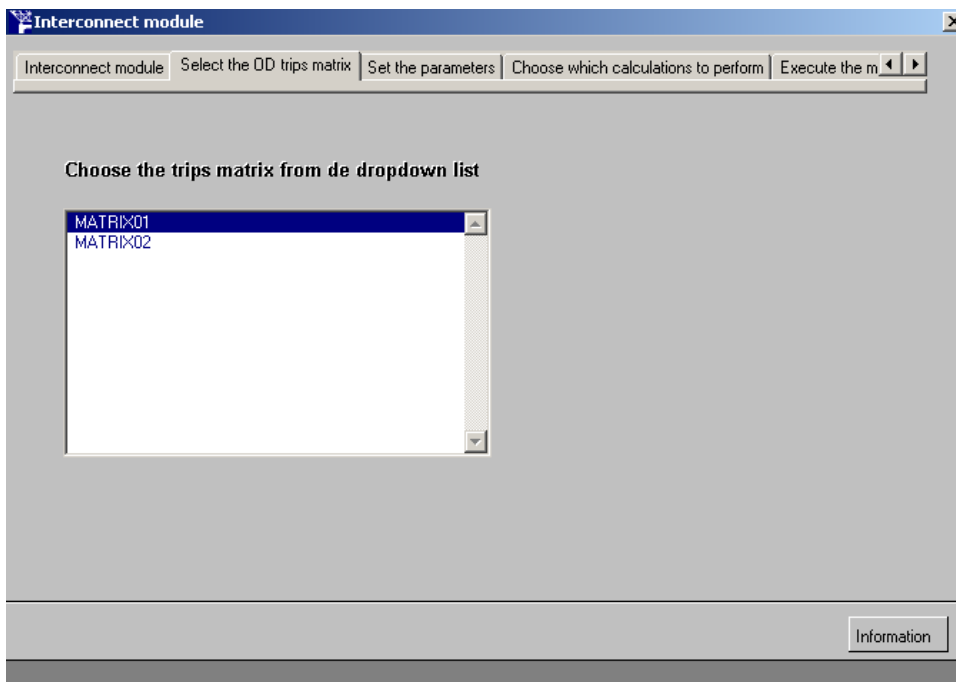
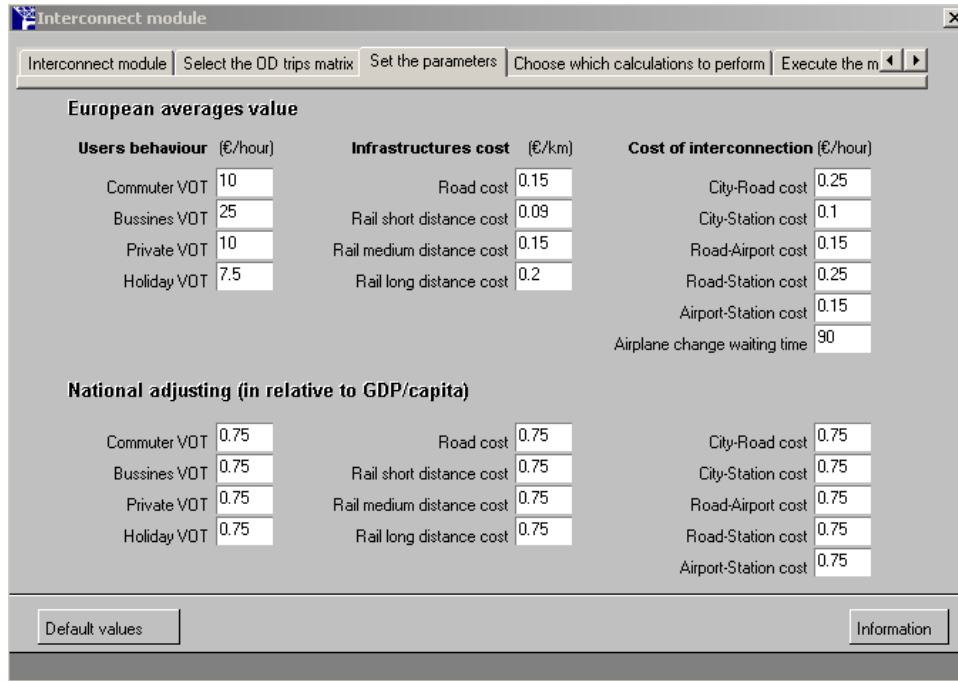


Figure 4-13 IC Module: OD Trip matrix selection control panel

*Multi-modal parameters control panel*

The *Multi-modal parameters control panel* tab allows setting up all key parameters determining the travel behaviour of users onto the IC multi-modal graph. These parameters include the different values of user's travel time, the operative costs and prices for different transport modes and the costs for connector travelling. It also includes the possibility to configure dispersion parameters.



**Figure 4-14 IC Module: multi-modal parameters control panel**

The upper left column corresponds to the configuration of average EU value of travel time. The parameters are introduced for the four different trip purposes. Costs are expressed in euro per hour. The Module applies adjustment factors to represent differentials in travel time values among different Member States depending on their level of wealth with higher value for trips originating in wealthier NUTS3. These factors are controlled through the dispersion coefficients in the bottom left column, ranging from 0 (no dispersion) to 1 (maximum dispersion).

The upper central column corresponds to the configuration of travel costs along transport infrastructure. Costs are expressed in euro per kilometre. The upper right column corresponds to the configuration of travel costs along connectors. These parameters correspond to the costs of interconnection, and are in general higher than travelling costs along infrastructure. The reason for this is that perceived costs for users when interconnecting are much higher than when actually travelling, due to increased inconveniences. The module applies again adjustment factors to represent differentials in travel cost among different Member States depending on their level of wealth, again controlled through the dispersion coefficients.

*Computation selection control panel*

The *Computation selection control panel* allows the user to choose which calculations will be performed for the selected OD Trip matrix and the chosen multi-modal parameter configurations. One or more can be selected.

The available options on the tab are the computation of trips separately for the four different travel purposes.





**Figure 4-15 IC Module: computation selection control panel**

#### *Execution control panel*

The Execution *control panel* allows the user to accept all configurations and run the simulation with the IC Module.

Running times can vary from 4 to 6 hours for a complete simulation, depending on the computer being used<sup>7</sup>. If not all trip purposes are selected, computation times are lower.

The progress window shows how far is done in the total calculation. First, the queries and the NSD files are loaded (it will increase the *Attributes* indicator). Afterwards, the assignment is computed. The number of total *steps* to be run is 1. The number of total *processes* is 1446, corresponding to the number of NUTS3 in Europe and neighbouring States.

Once computation is finished, traffic assignment maps can be examined with the IC Module, but most interconnectivity indicators need to be computed with the INTERCONNECT meta-model. Running times for the meta-modal process on indicator processing may take an additional 4 hours. For full reference on the meta-model functioning, see INTERCONNECT deliverable D5.2 *Meta-models for the analysis of interconnectivity*.

<sup>7</sup> 4 hours are needed on an Intel XEOM 2.5GHz Quadcore PC with 4GB RAM.

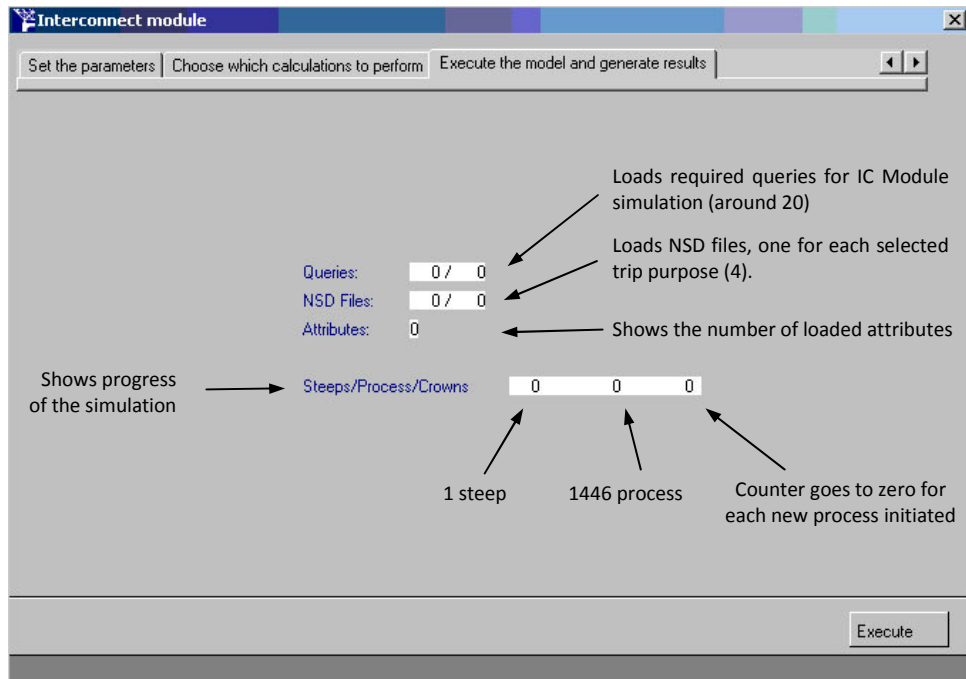


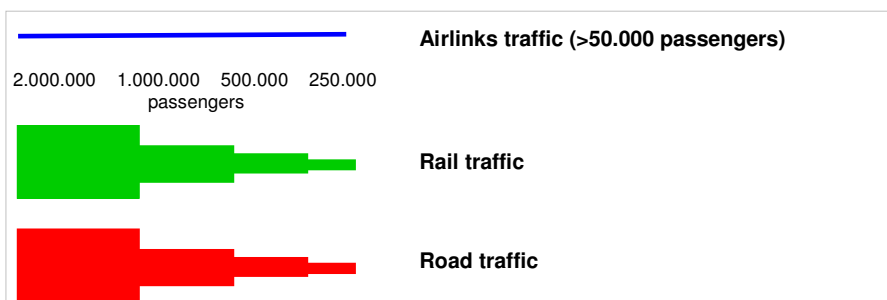
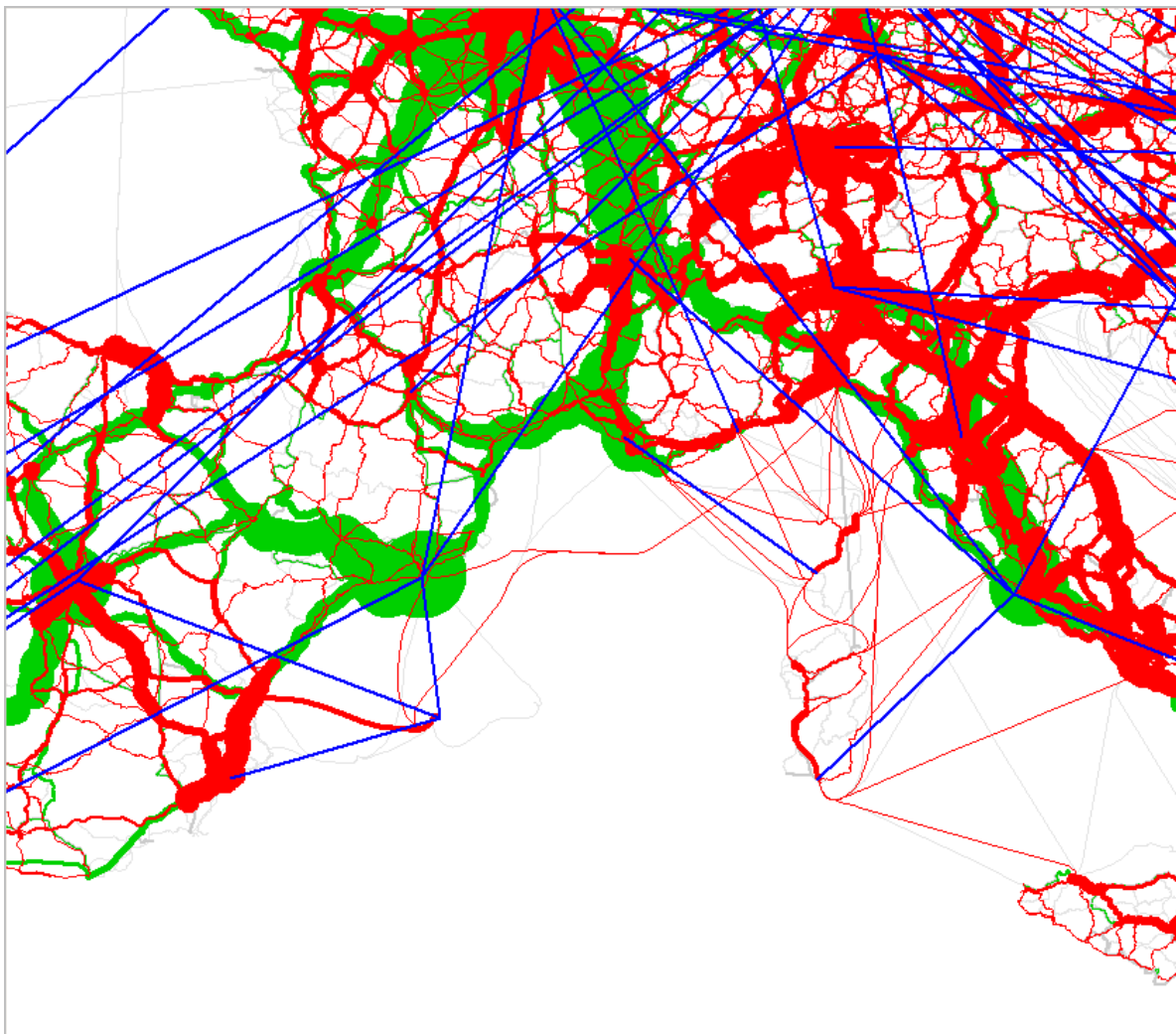
Figure 4-16 IC Module: execution control panel

## 5 RESULTS

### 5.1 MULTI-MODAL ASSIGNMENT EXAMPLES

Next, a collection of figures portraying the assignment of traffic in TRANS-TOOLS OD matrices for all NUTS3 pairs in Europe onto the INTERCONNECT multi-modal graph are provided. For an extended gallery of IC Module assignment results, see Appendix 1.

In Figure 5-1 to Figure 5-4 traffic in the road network is shown in red, traffic in the rail network in green and traffic in the air network in blue. Different assignments have been done for different trip purposes: business trips, personal trips, commuting trips and holiday and leisure trips. For a NUTS3 to NUTS3 relation, traffic is assigned in an *all-or-nothing* basis.



**Figure 5-1 Traffic assignment example for business trips in the Mediterranean arch**

In Figure 5-1 above, it can be observed that business travellers in Western Europe tend to use the rail mode for preferential ODs such as Barcelona-Madrid, or Lyon-Paris. Figure 5-2 below shows that private purpose trips (visiting relatives or friends, or other personal purposes) tend to use fewer airplane segments than business travellers, revealing their lower value of time.

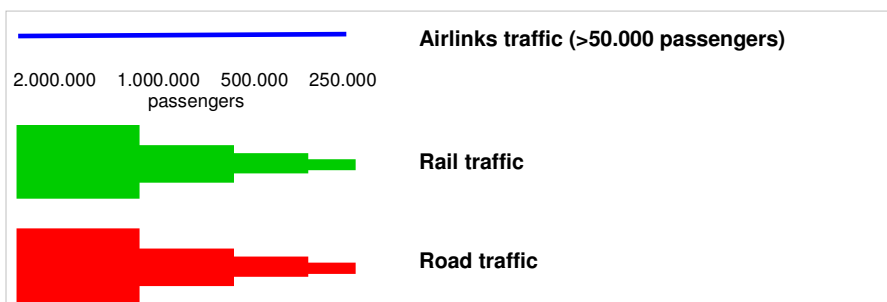
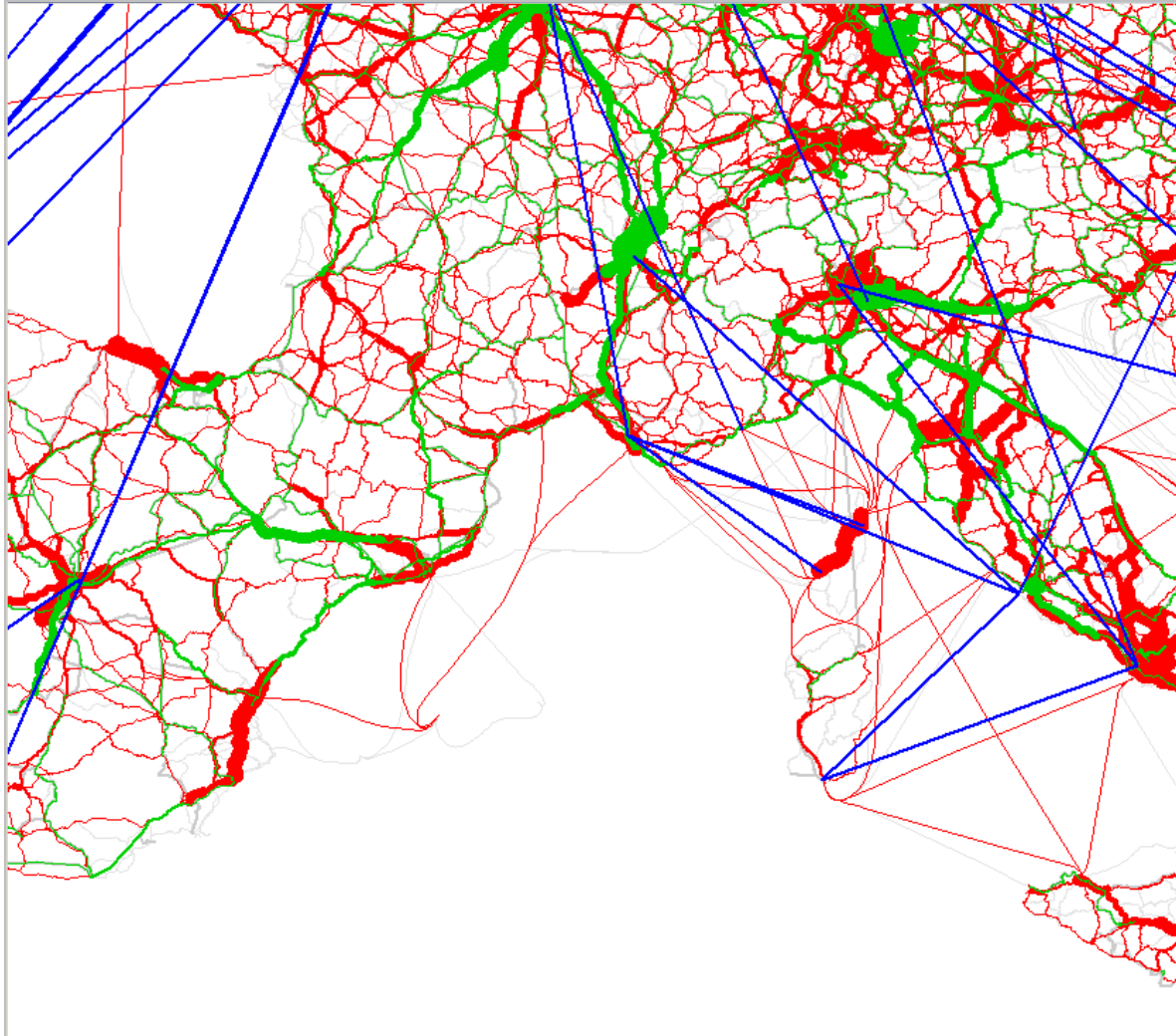
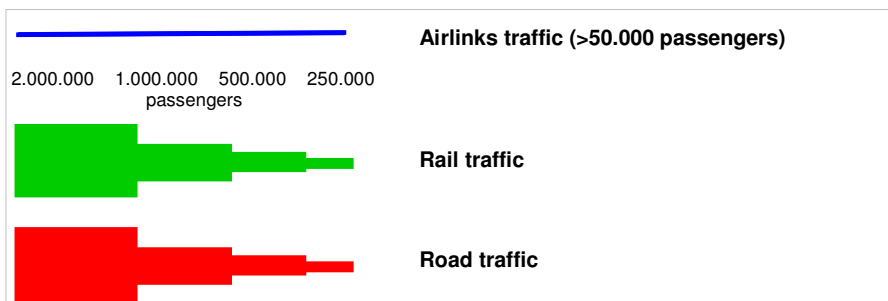
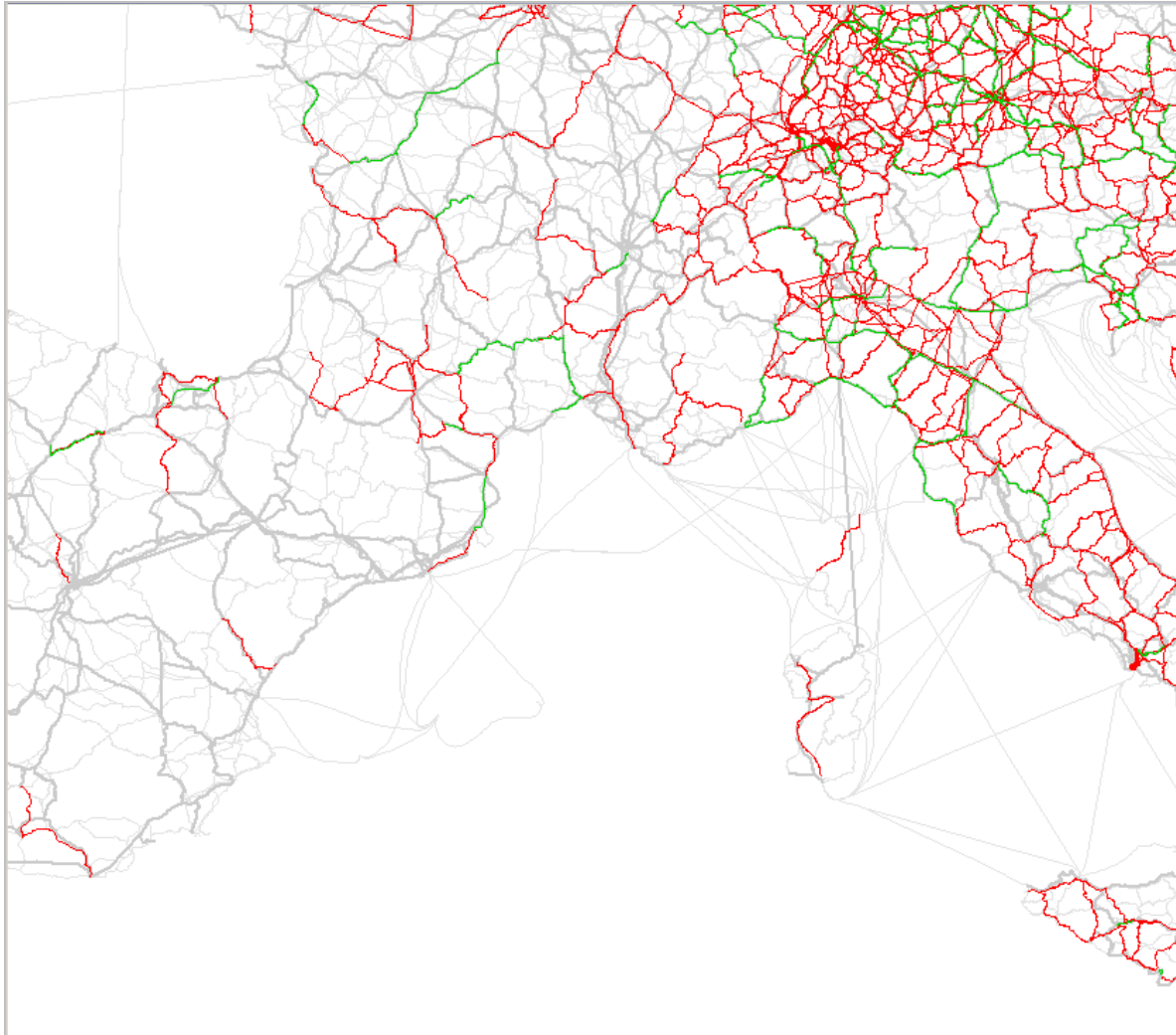


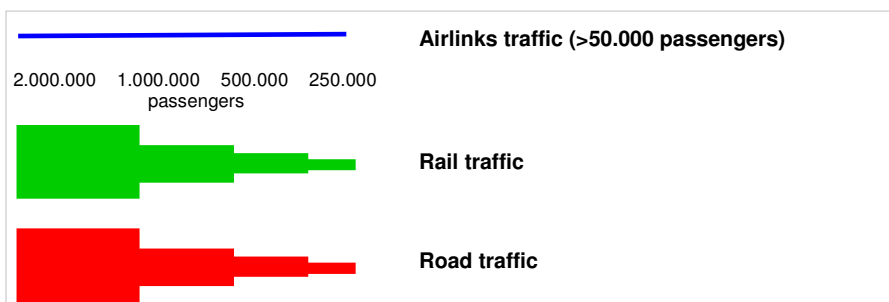
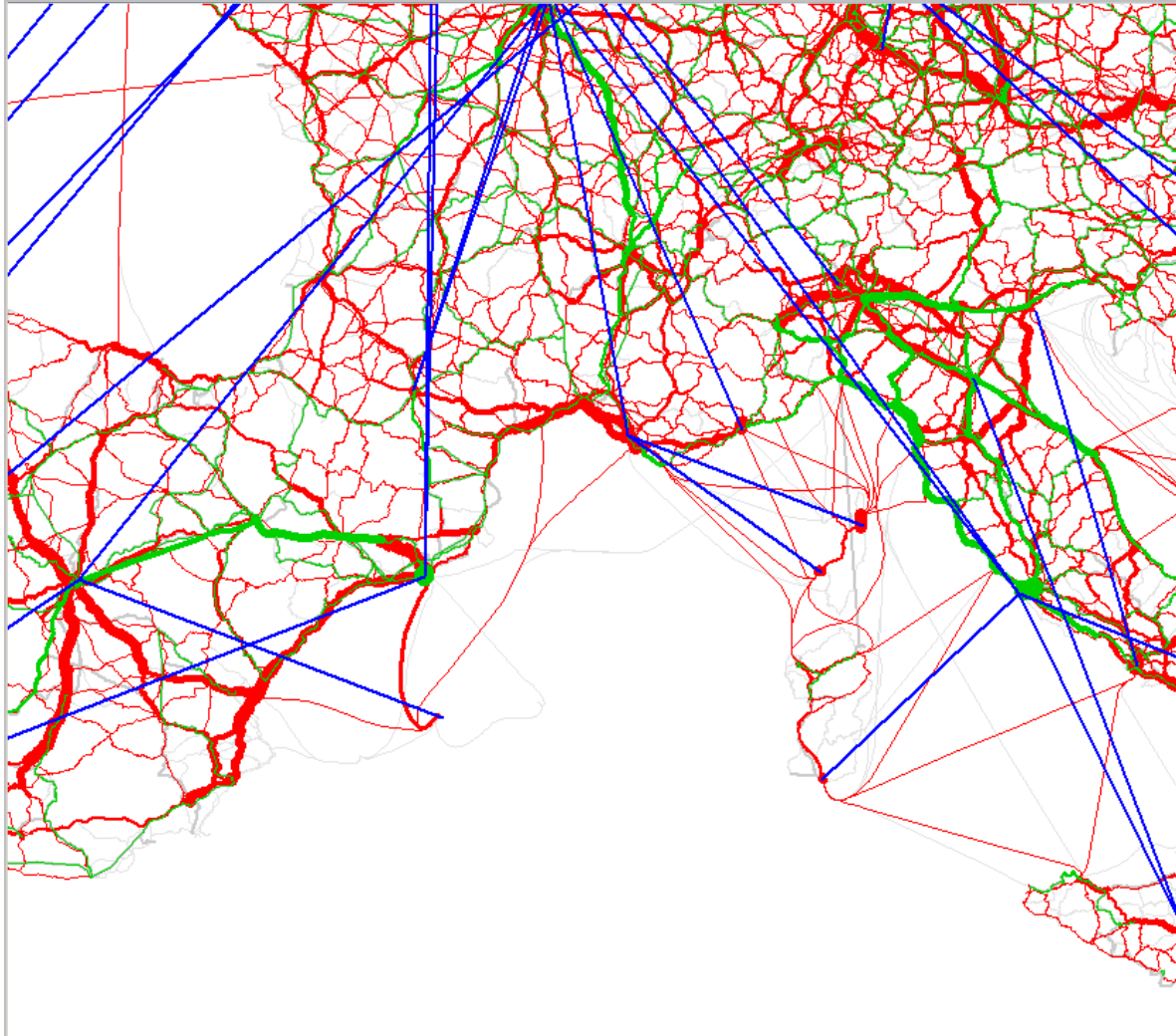
Figure 5-2 Traffic assignment example for private trips in the Mediterranean arch

Commuter trips are most important in regions where NUTS3 are smaller, like in Germany or Italy. Figure 5-3 shows that for France or Spain, where NUTS3 are larger, very few commuter trips exist between different NUTS3. Only some traffic can be tracked around big metropolitan areas, such as trips between Barcelona and the surrounding NUTS3 (Girona at the north and Tarragona at the south). Traffic levels are much lower in any case than for any other trip purpose considered.



**Figure 5-3 Traffic assignment example for commuters trips in the Mediterranean arch**

Holiday trips tend to use the road mode for mid-distance trips, like within the Iberian peninsula (e.g. most relations from Madrid to the costal areas), as value of time for holiday travel is much lower than for other trip purposes (Figure 5-4). The air mode is chosen for the very long distance, for instance, between Northern Europe and the Mediterranean seaside.



**Figure 5-4 Traffic assignment example for holiday trips in the Mediterranean arch**

## 5.2 WAYS FOR FUTURE IMPROVEMENT

Possible future improvements in the IC Module and IC multi-modal graph for more accurate simulation are as follows:

- Testing a stochastic user equilibrium algorithm to allocate trips among reasonable multi-modal chains between ODs. This new way would overcome the limitations of an *all-or-nothing* assignment routine, representing a more accurate image of reality.
- Even if the IC Module is able to track interconnections intra-network, that is transitions from a local rail network onto a long-distance rail network – defined as the EU rail core network as presented in the DGTREN TEN-CONNECT study - and from a local road network onto a long-distance road network – defined as the EU road core network as presented in TEN-CONNECT - the model is not able to introduce penalties for those changes. To be able to penalise transfers intra-network for the rail mode, a service scheme should be put in place, like in the case of air services or ferry services.
- All airports in the TRANS-TOOLS graph are represented as nodes. There has been an attempt in INTERCONNECT to increase the resolution of the modelling process in airports by creating nodes for each of the airport terminals, allowing with that to analyse internal interconnections at airports. Airports in Europe with more than one terminal and significant transit times between them were located, new nodes were created in the geographic position of the terminals, and connectors were established between them. However, due to the lack of information regarding flight arrival/departure split among terminals, this task was finally abandoned, but could represent a way for further improvement of the graph.
- Connectors between different transport networks are generated automatically, maximum one between each city or transport terminal and a nearby transport network. Connectors are created only when their lengths lies above a certain threshold. This procedure implies a substantial simplification of reality, because when automating the process of creation of connectors, these are created in all those situations where conditions in reality are sufficient to allow a connection, which is when networks exist and are close enough to each other. However, in reality the connection may or may not exist. To limit the impact of this, a review of the largest transport terminals in Europe was undertaken to correct maladjustments, but a complete review of all transport terminals could unveil maladjustments in medium and small transport terminals.
- The IC Module has considered differences in travel behaviour and travel volumes resulting from different trip purposes (business, private, commuter and holidays). Differences in travel behaviour resulting from different niche users like elderly or youths have not been considered in the IC Module due to lack of data availability, but could be stated as a possible way of improvement in the future.

## 6 REFERENCES

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Petersen M.S., Enei R., Hansen C.O., Larrea E., Biosca O., Sessa C., Timms P.M., Ulled A. (2009): Report on Transport Scenarios with a 20 and 40 year Horizon, Final report of TRANSvisions, Funded by DG TREN, Copenhagen, Denmark.

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## **APPENDIX 1 - RESULTS**

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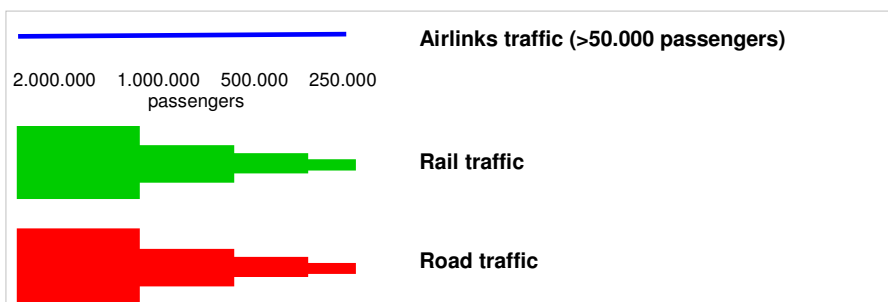
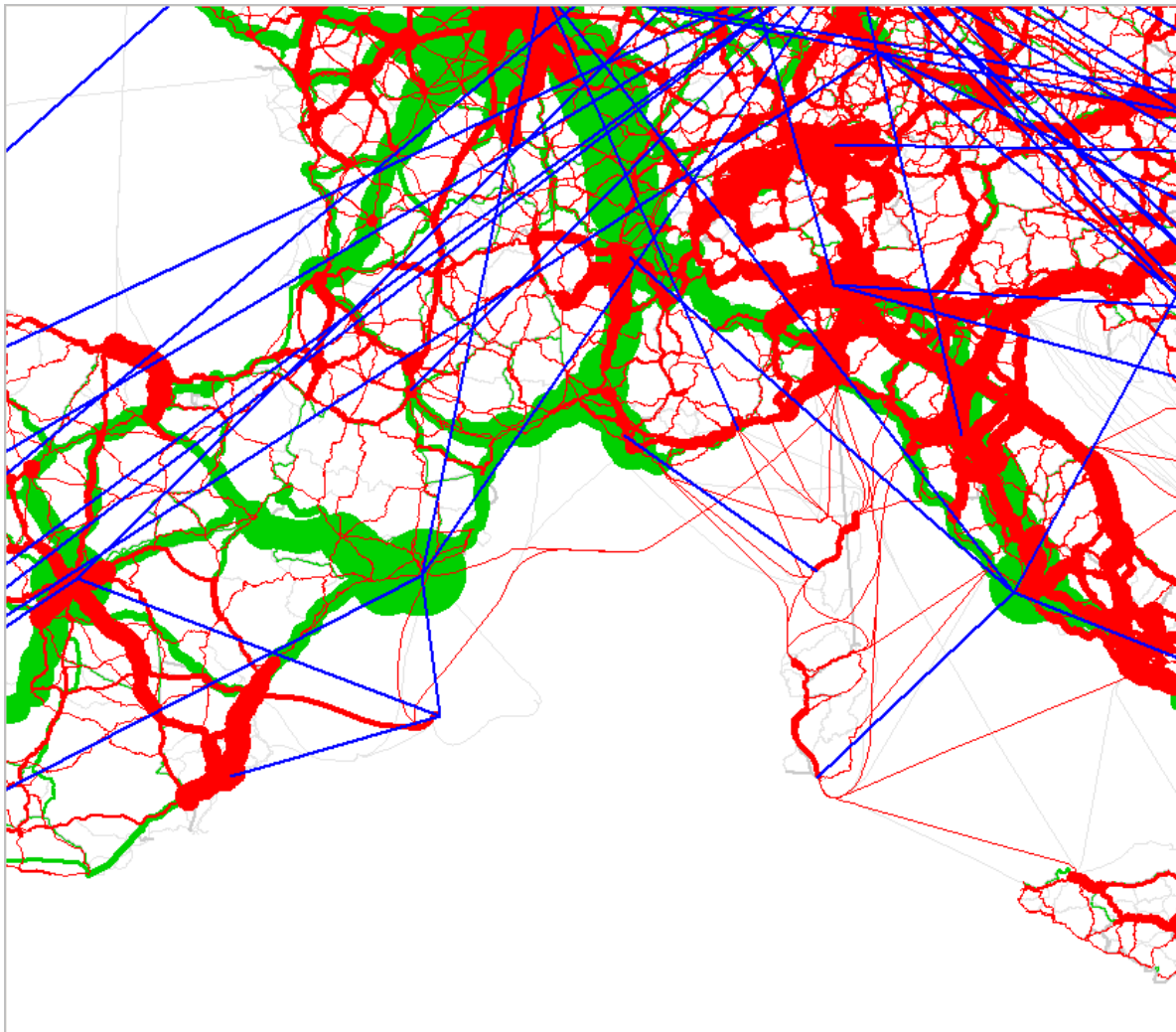
### **MULTI-MODAL GRAPH ASSIGNMENTS**

Next, a collection of figures portraying the assignment of traffic in TRANS-TOOLS OD matrices for all NUTS3 pairs in Europe onto the INTERCONNECT multi-modal graph are provided.

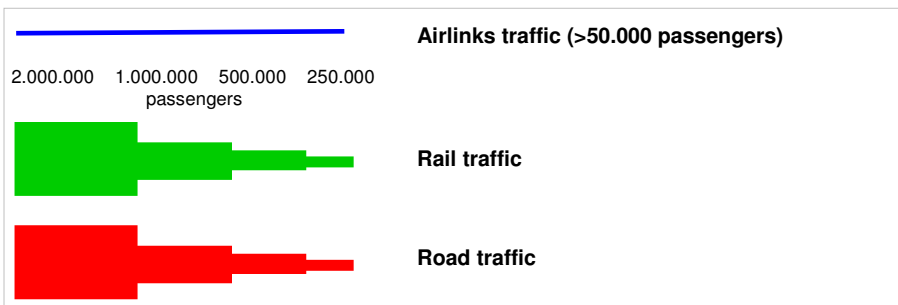
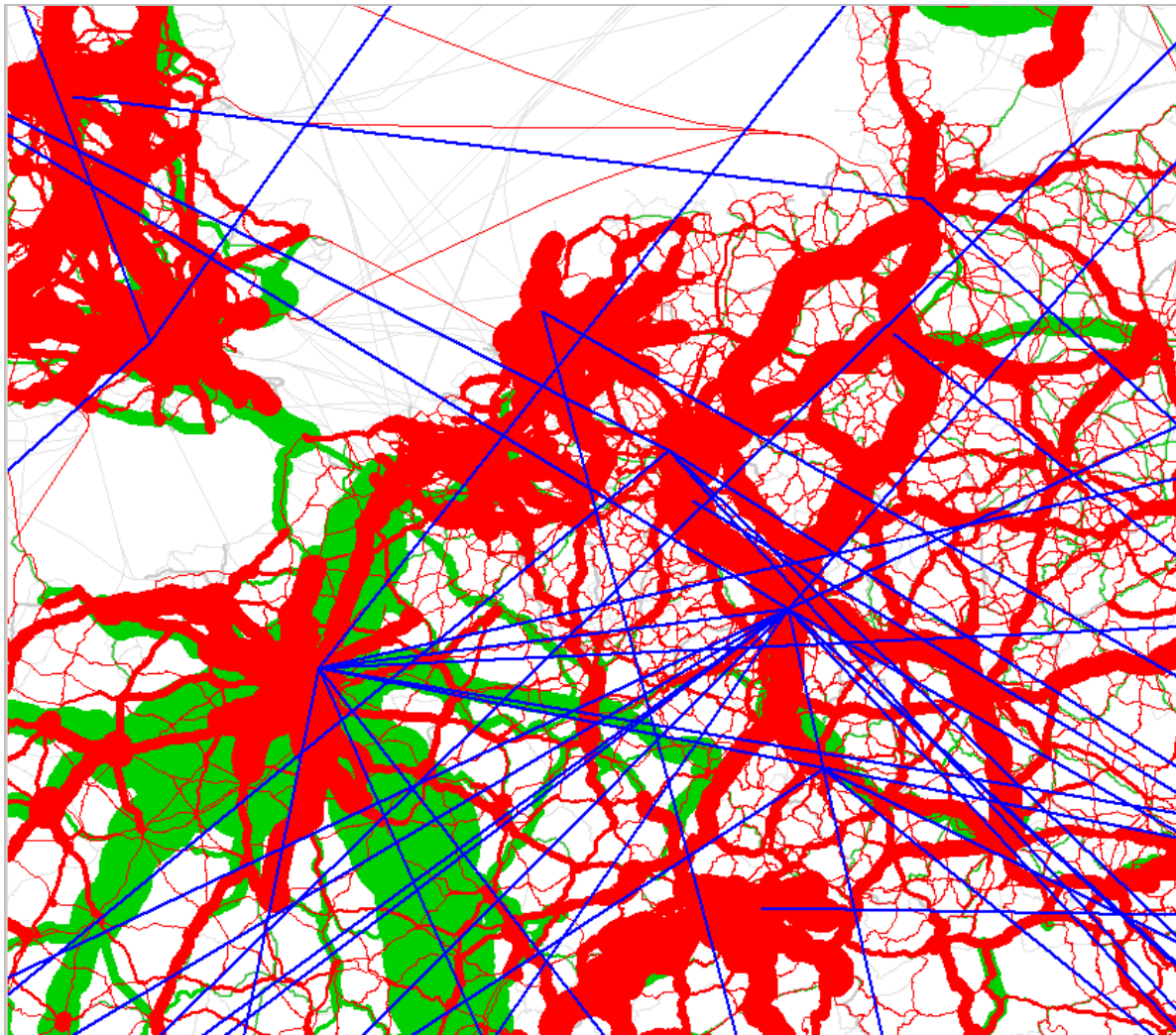
In red, traffic in the road network; in green traffic in the rail network; in blue traffic in the air network.

Different assignments have been done for different trip purposes: business trips, personal trips, commuting trips and holiday and leisure trips.

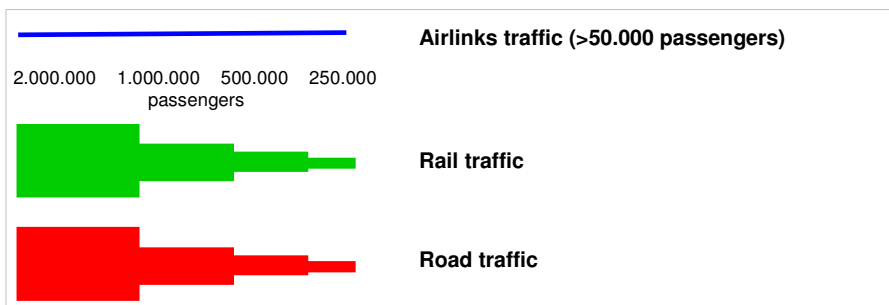
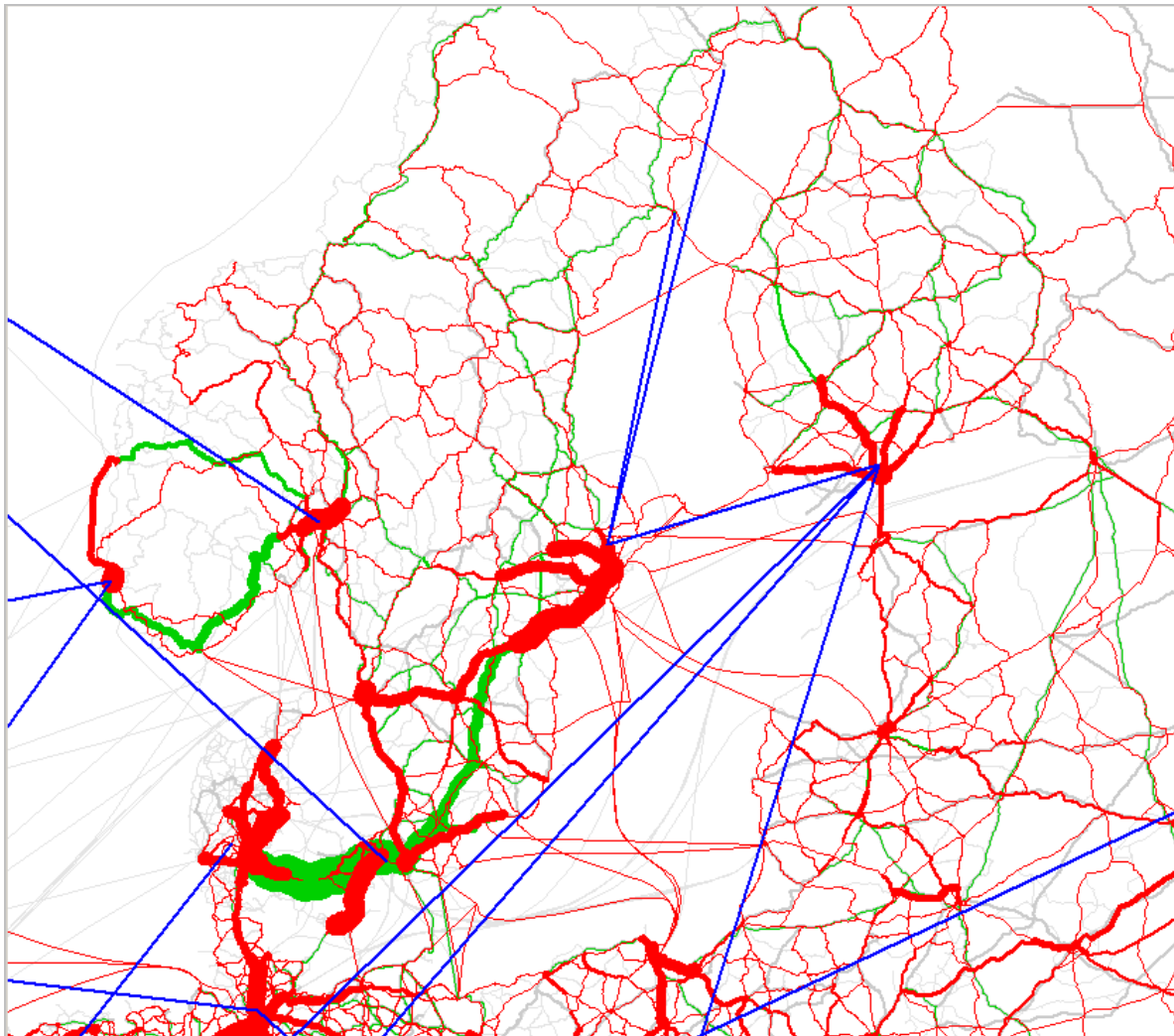
*Business traffic assigned in the INTERCONNECT multi-modal graph*



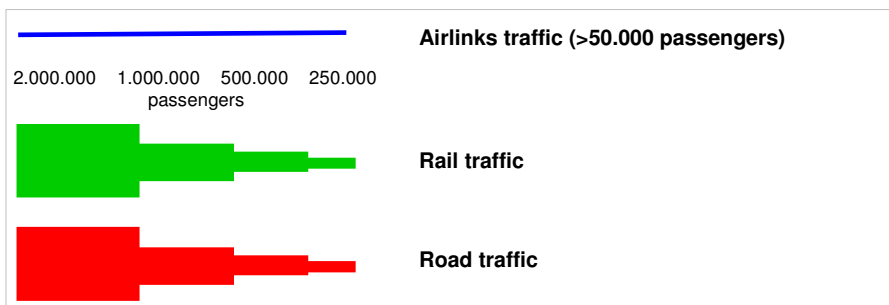
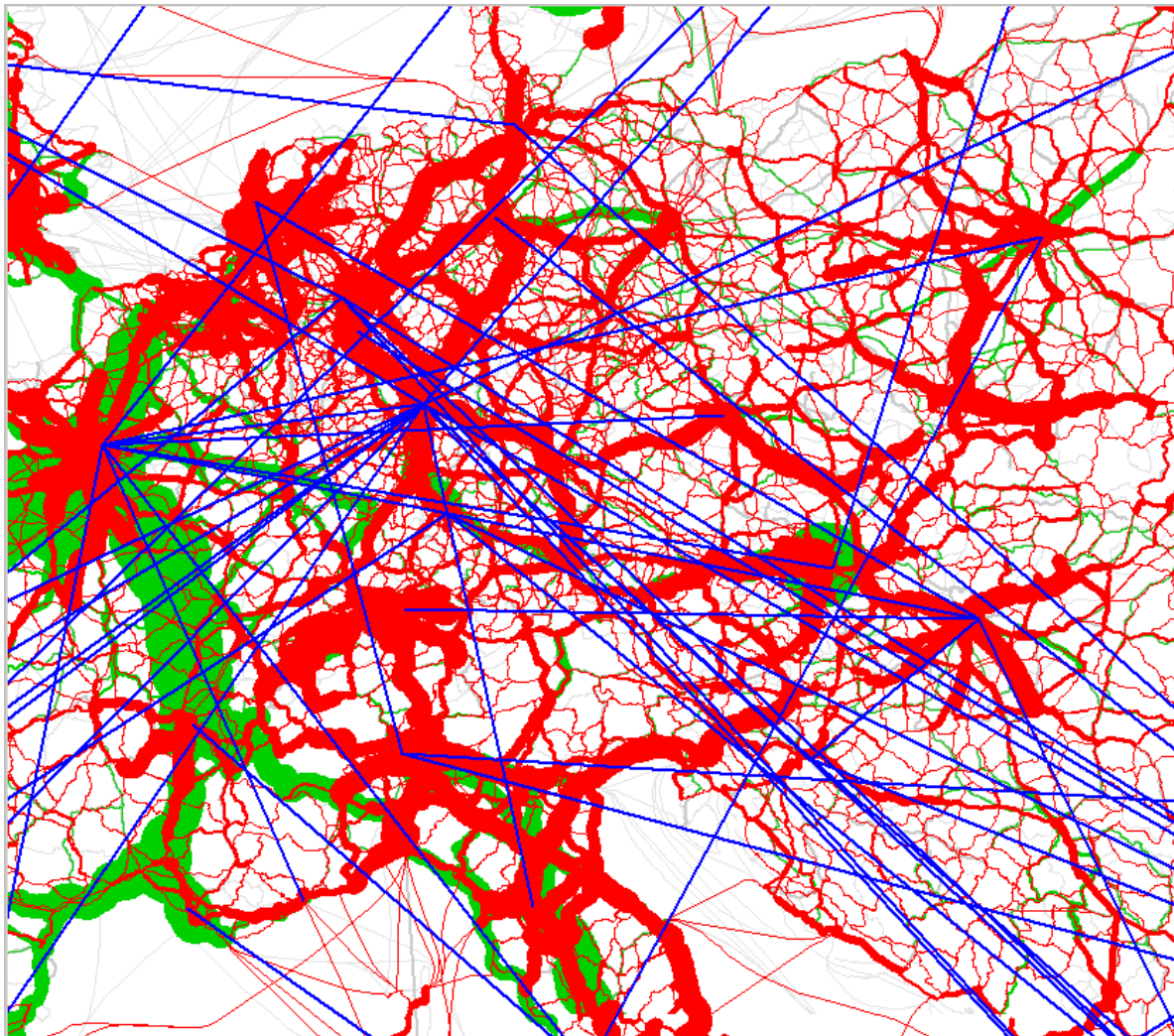
(source: Interconnect, based on TRANS-TOOLS 2005 databases)  
**Traffic assignment for business trips in the Mediterranean arch**



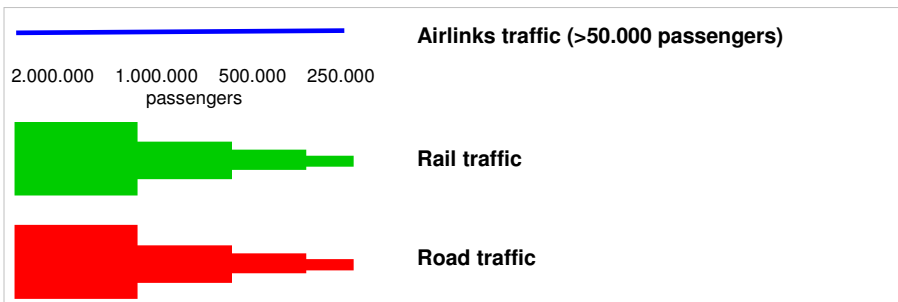
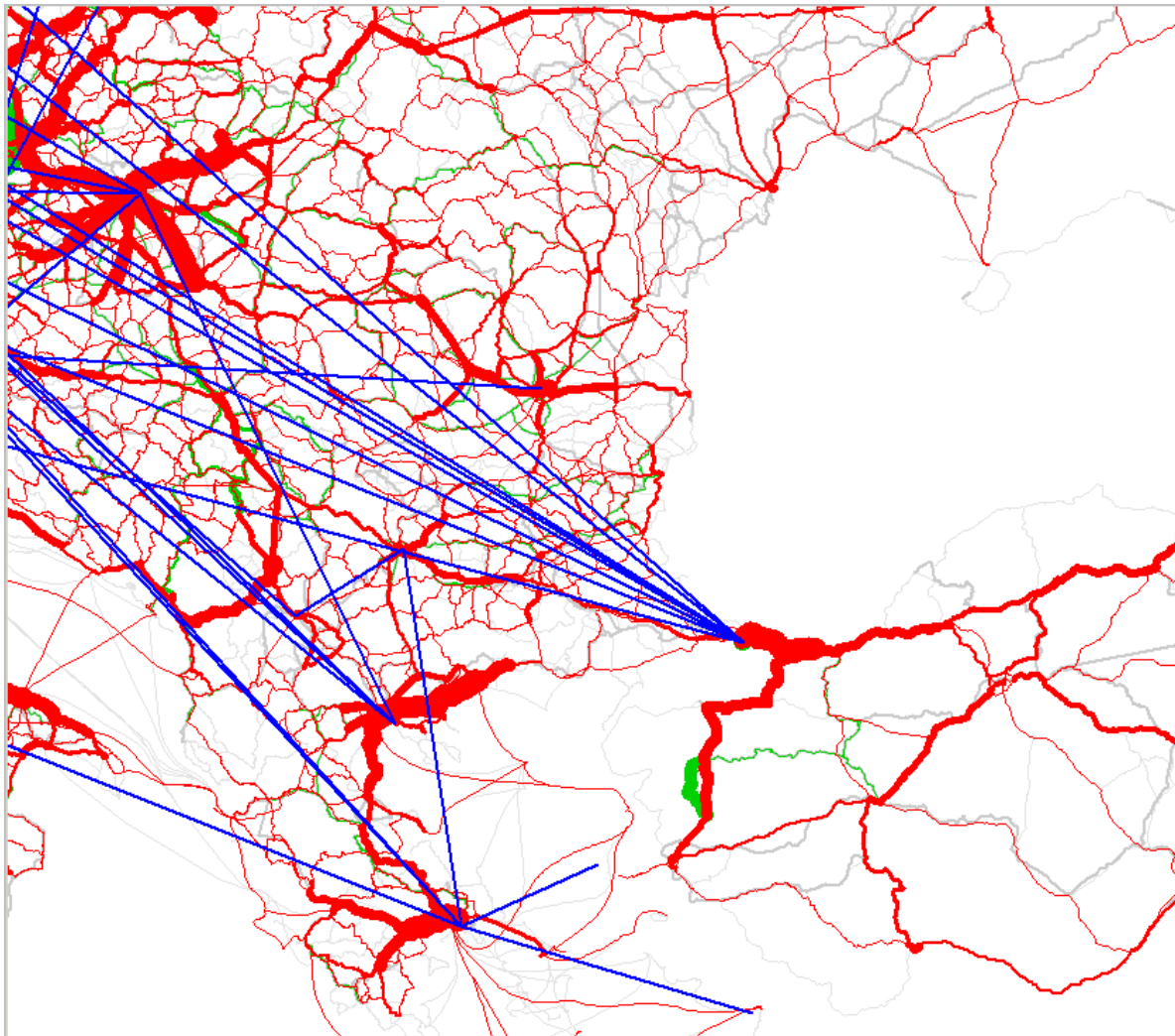
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**Traffic assignment for business trips London-Paris-Benelux**



(source: Interconnect, based on TRANS-TOOLS 2005 databases)  
**Traffic assignment for business trips in the Baltic Region**

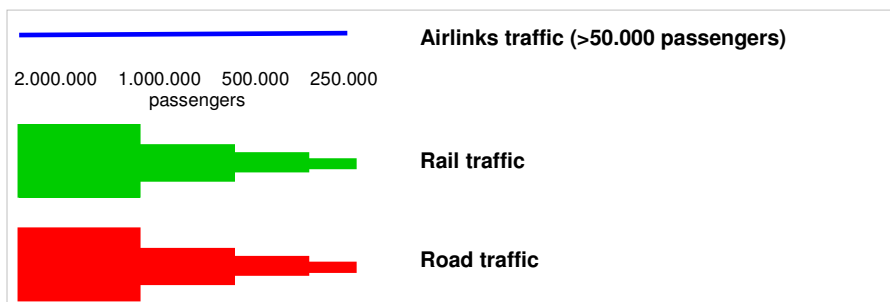
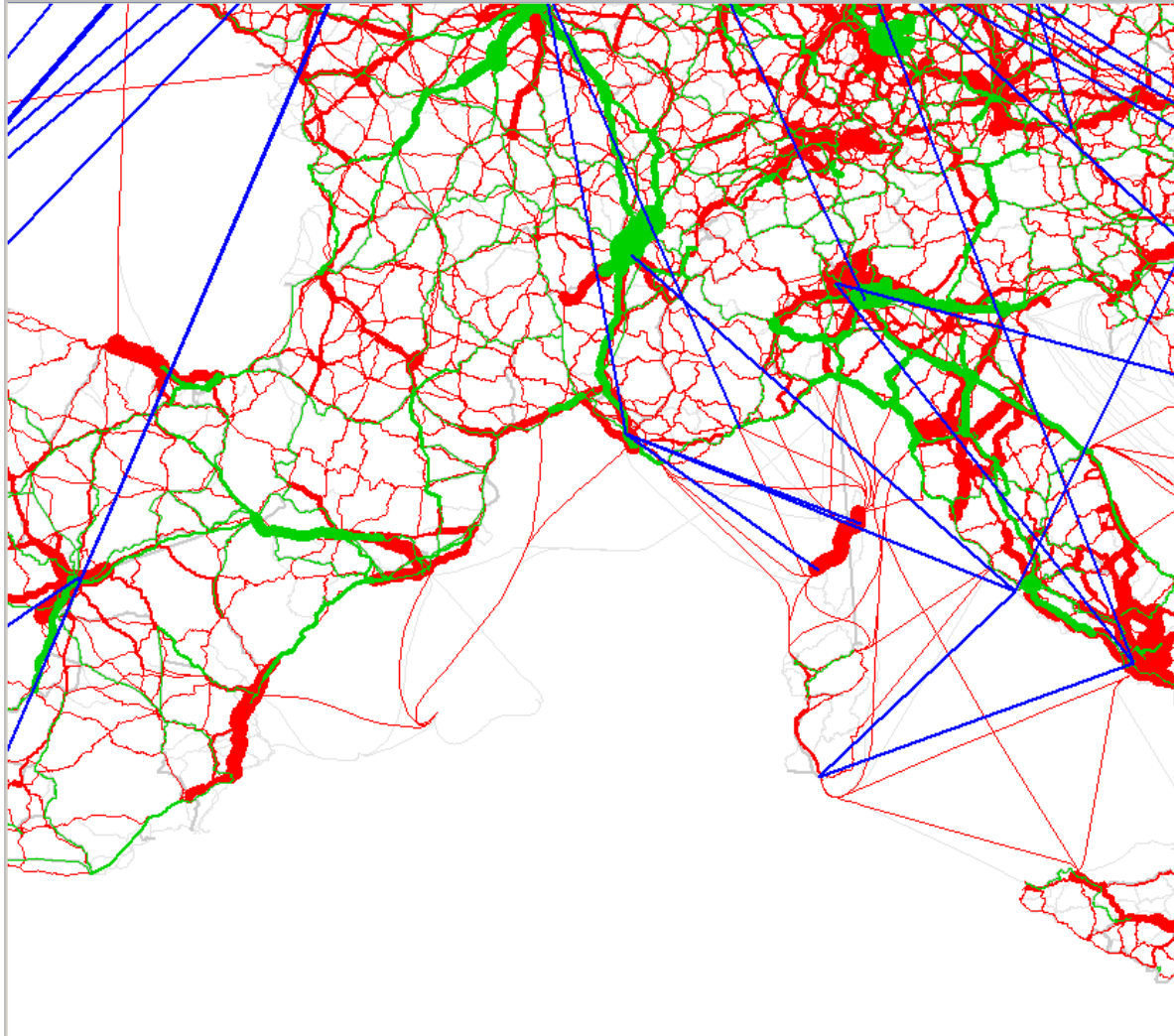


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**Traffic assignment for business trips in Central Europe**

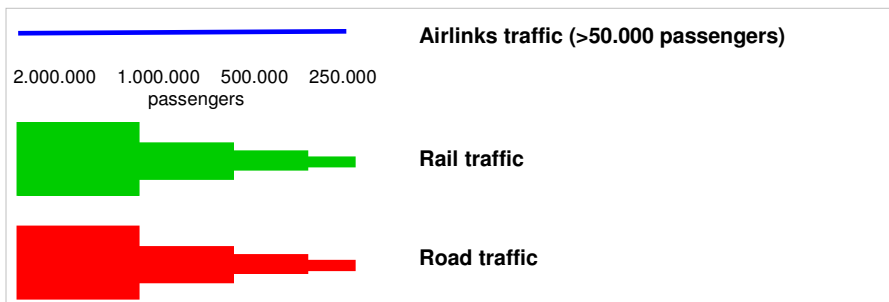
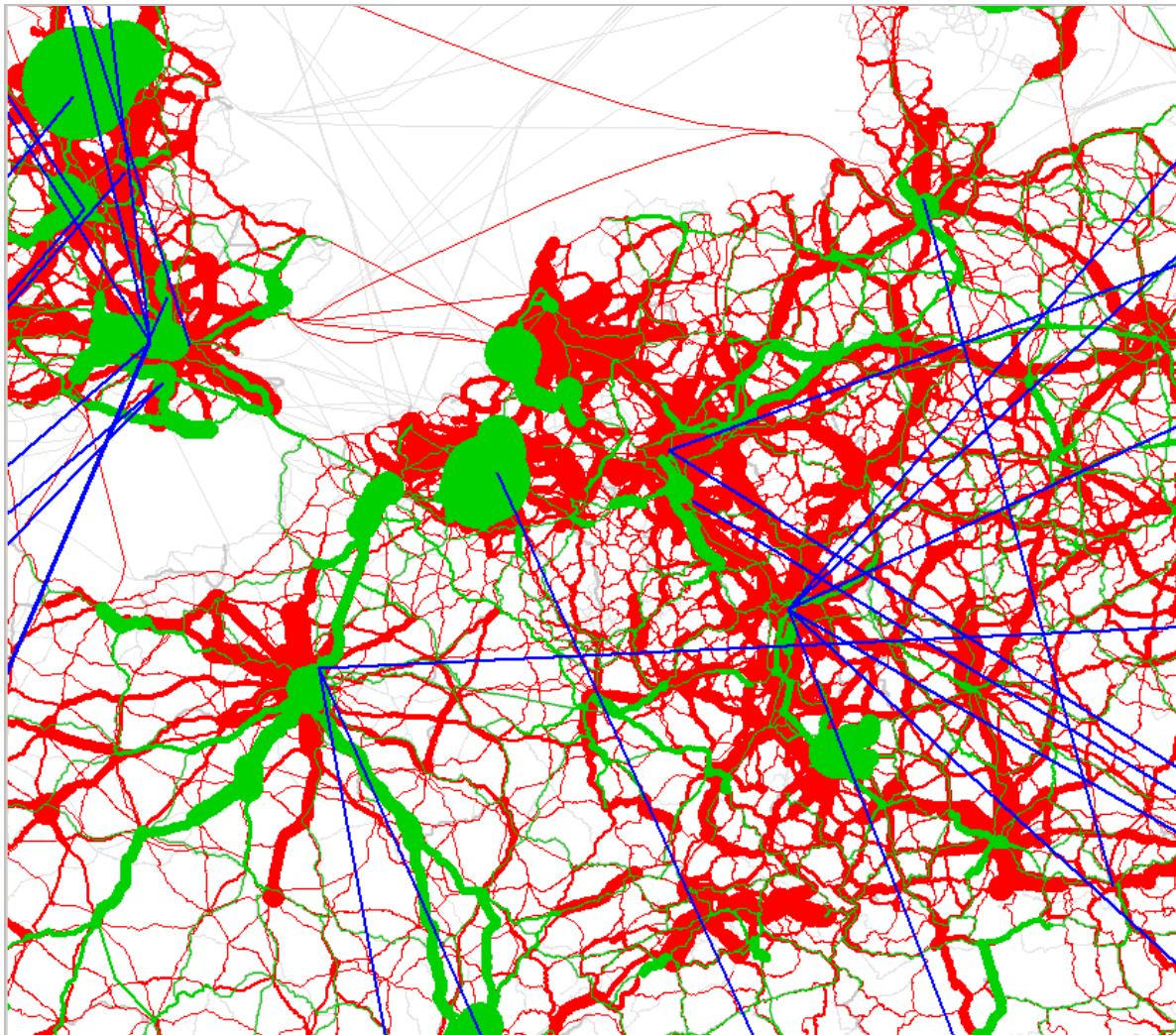


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**Traffic assignment for business trips in the Aegean and Black Sea**

*Private traffic assigned in the INTERCONNECT multi-modal graph*

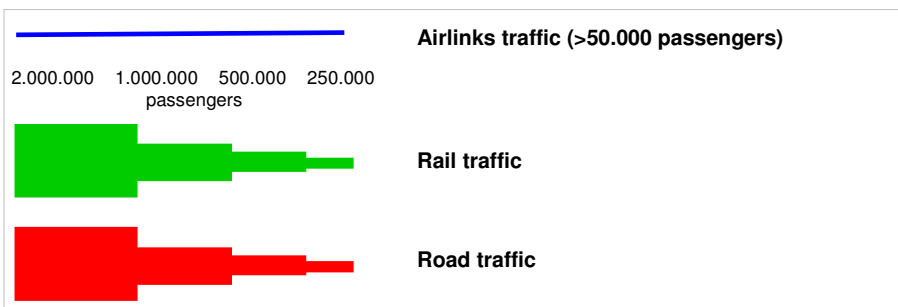
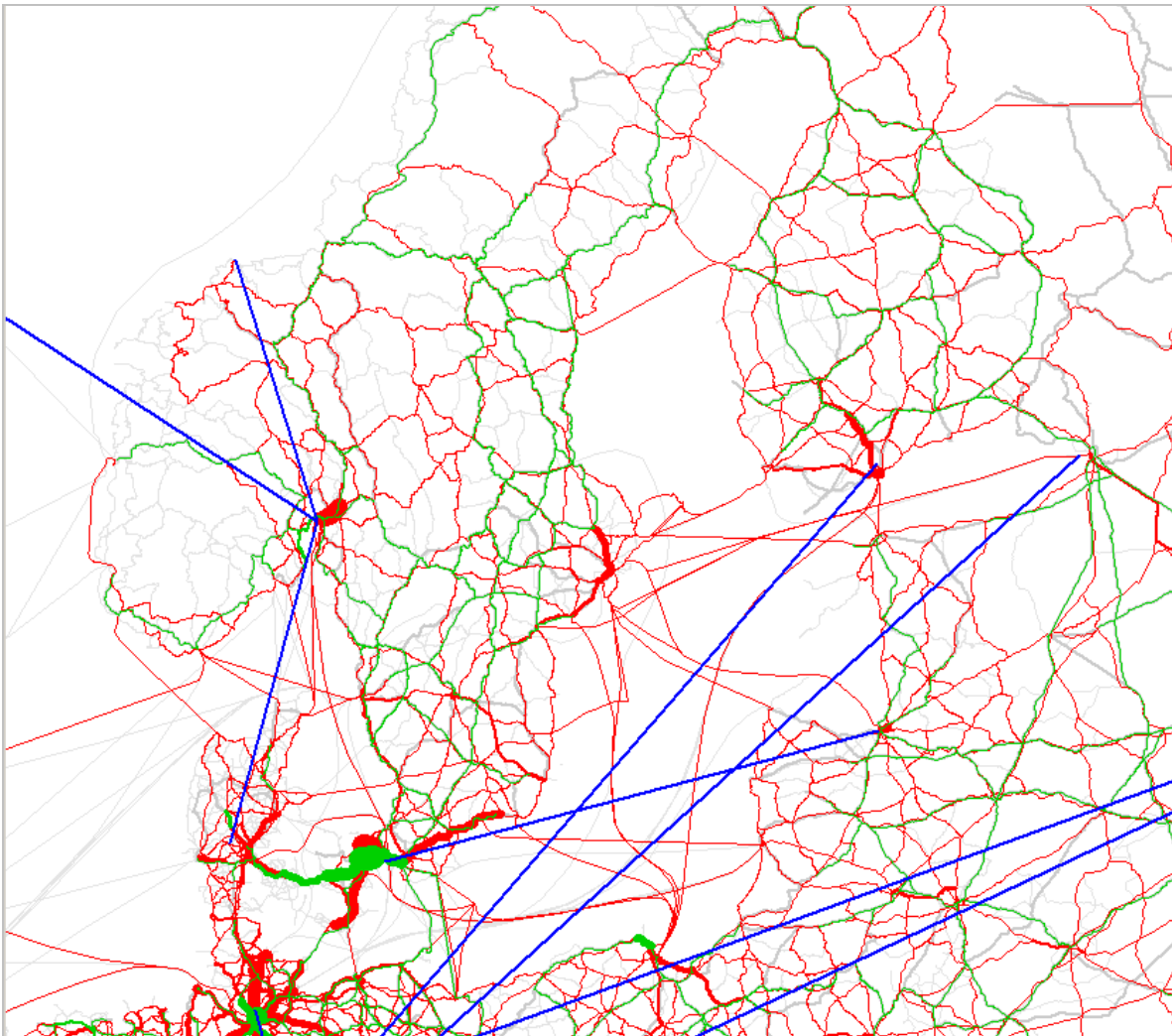


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**Traffic assignment for private trips in the Mediterranean arch**

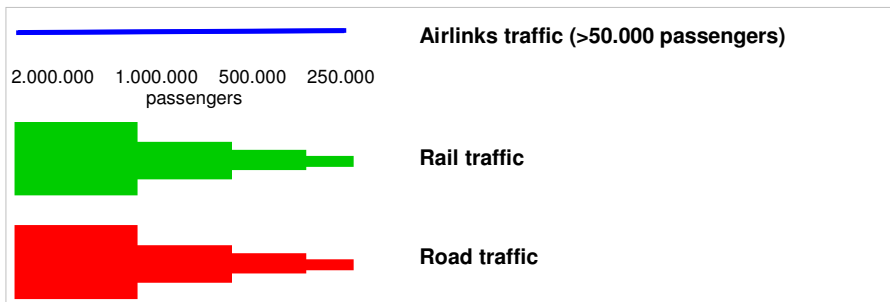
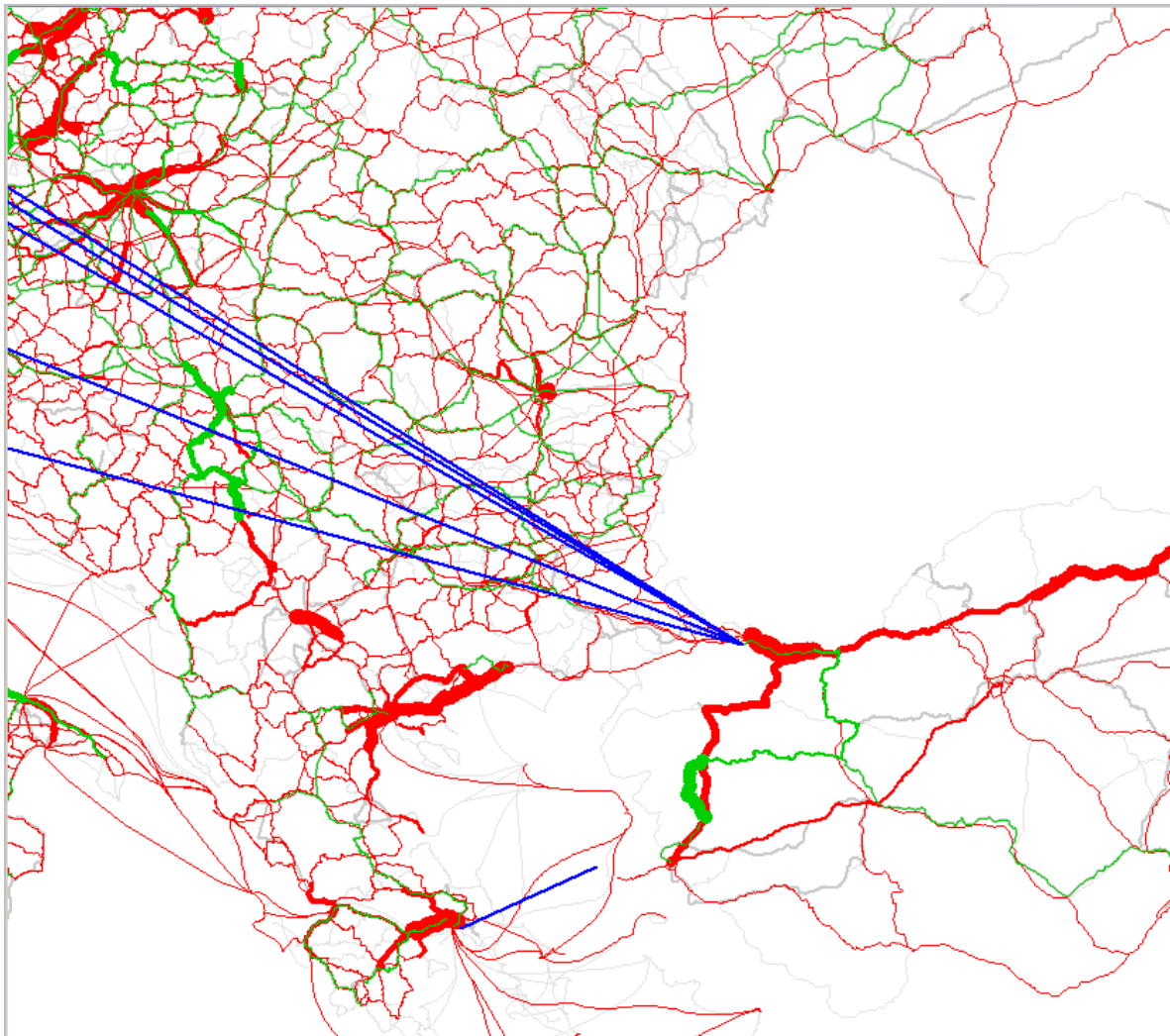


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**Traffic assignment for private trips London-Paris-Benelux**

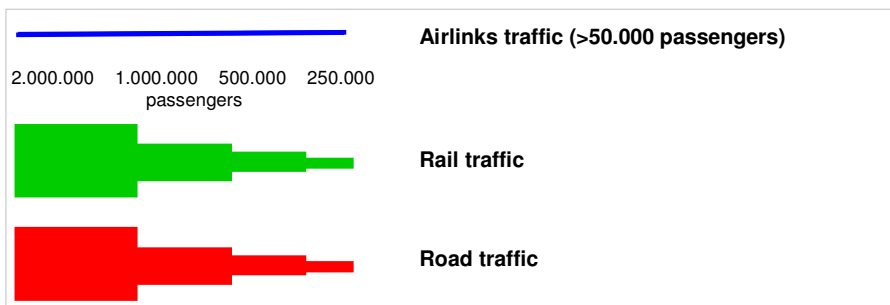
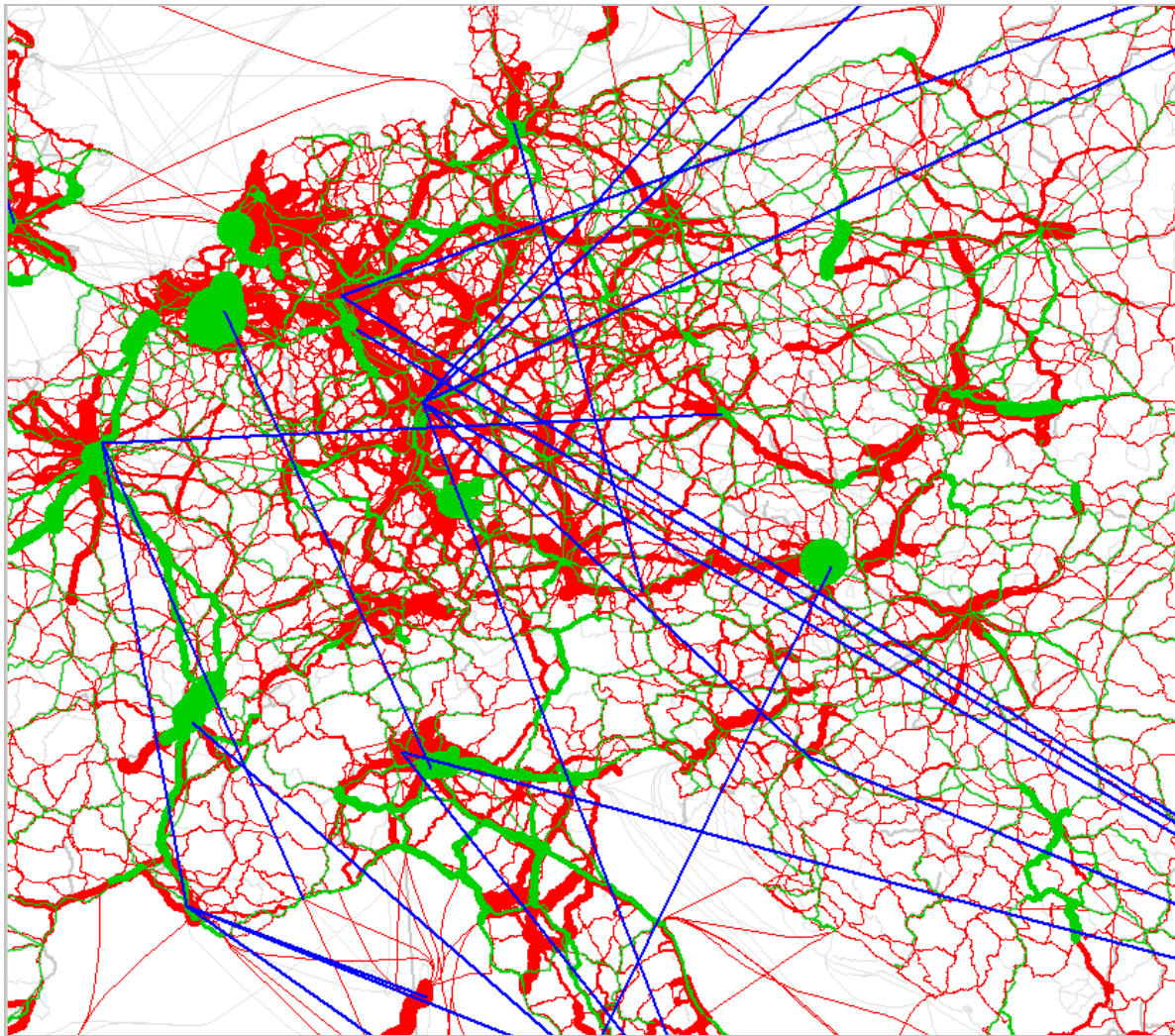




(source: Interconnect, based on TRANS-TOOLS 2005 databases)  
**Traffic assignment for private trips in the Baltic Region**

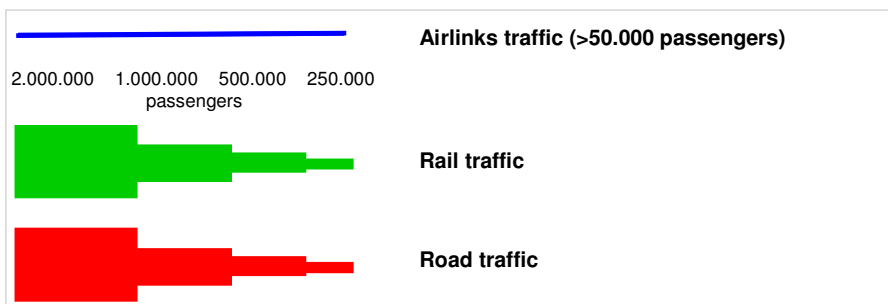
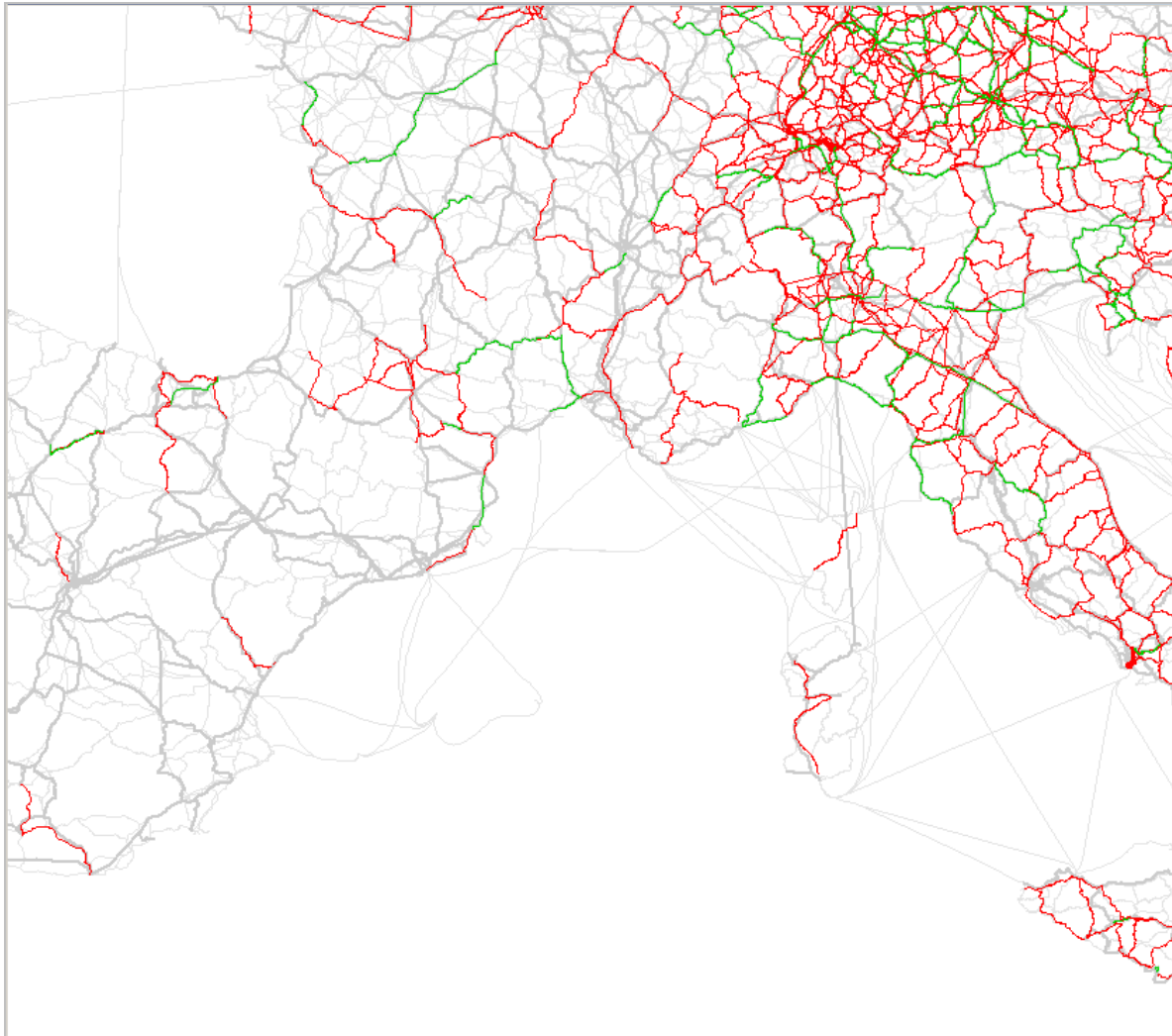


(source: Interconnect, based on TRANS-TOOLS 2005 databases)  
**Traffic assignment for private trips in the Aegean and Black Sea**

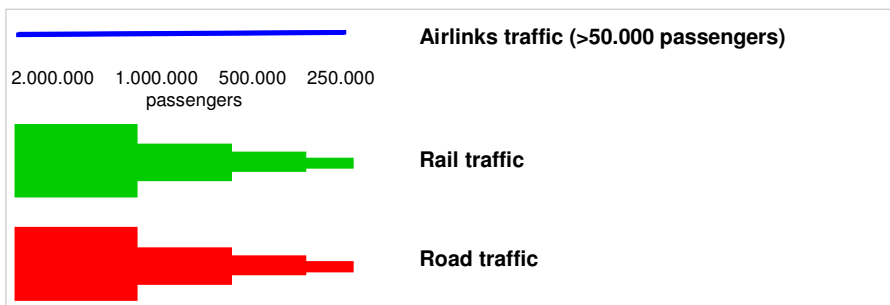
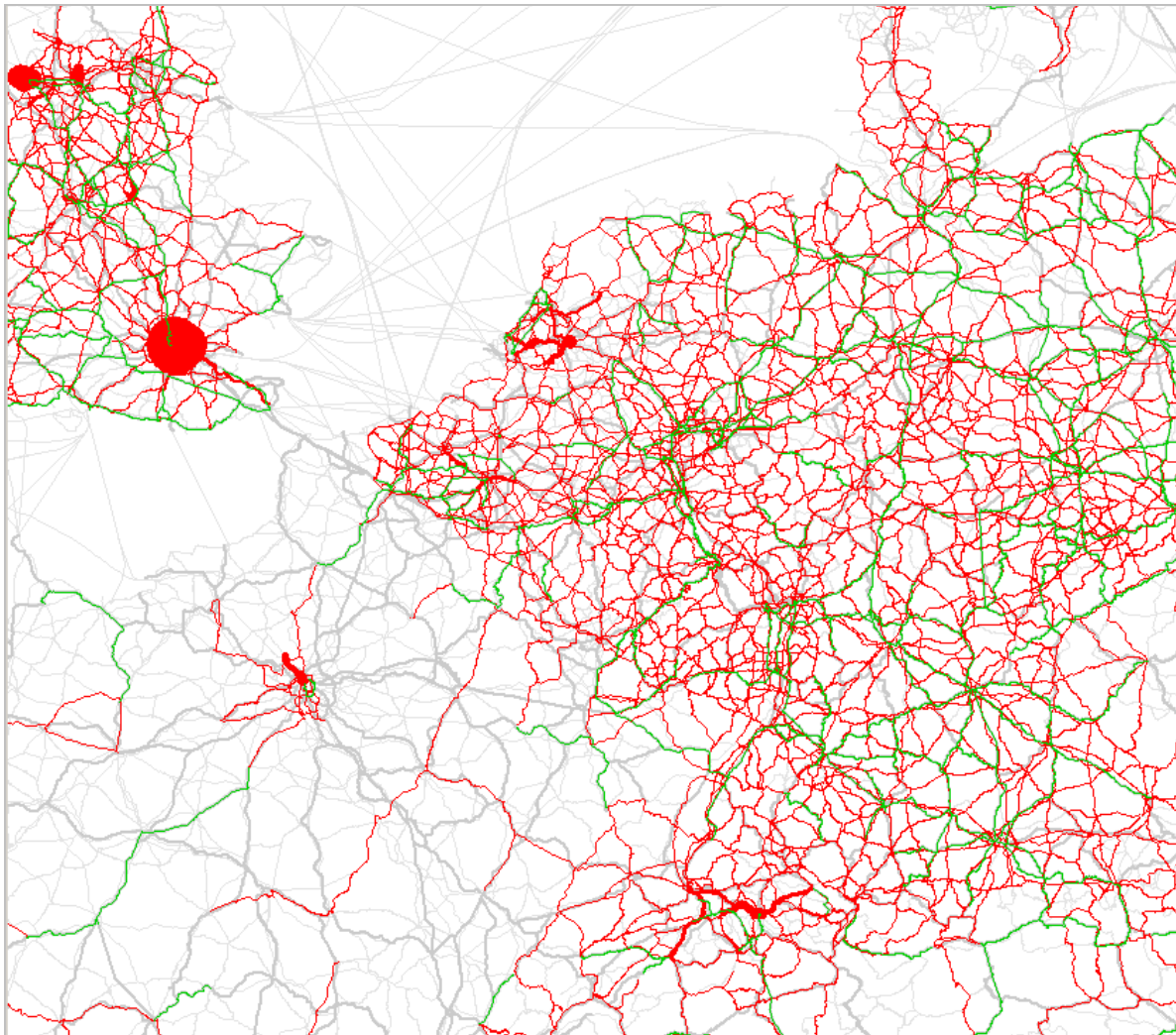


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**Traffic assignment for private trips in Central Europe**

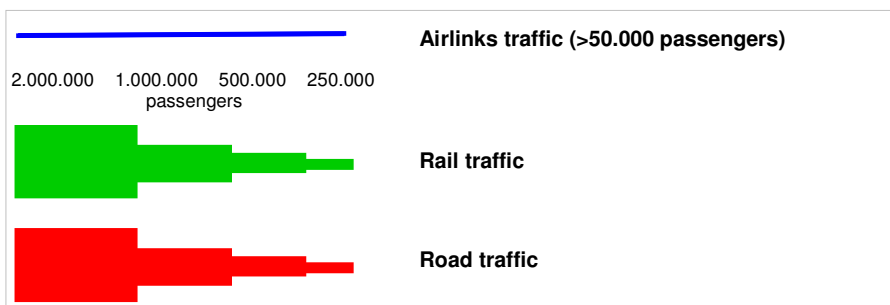
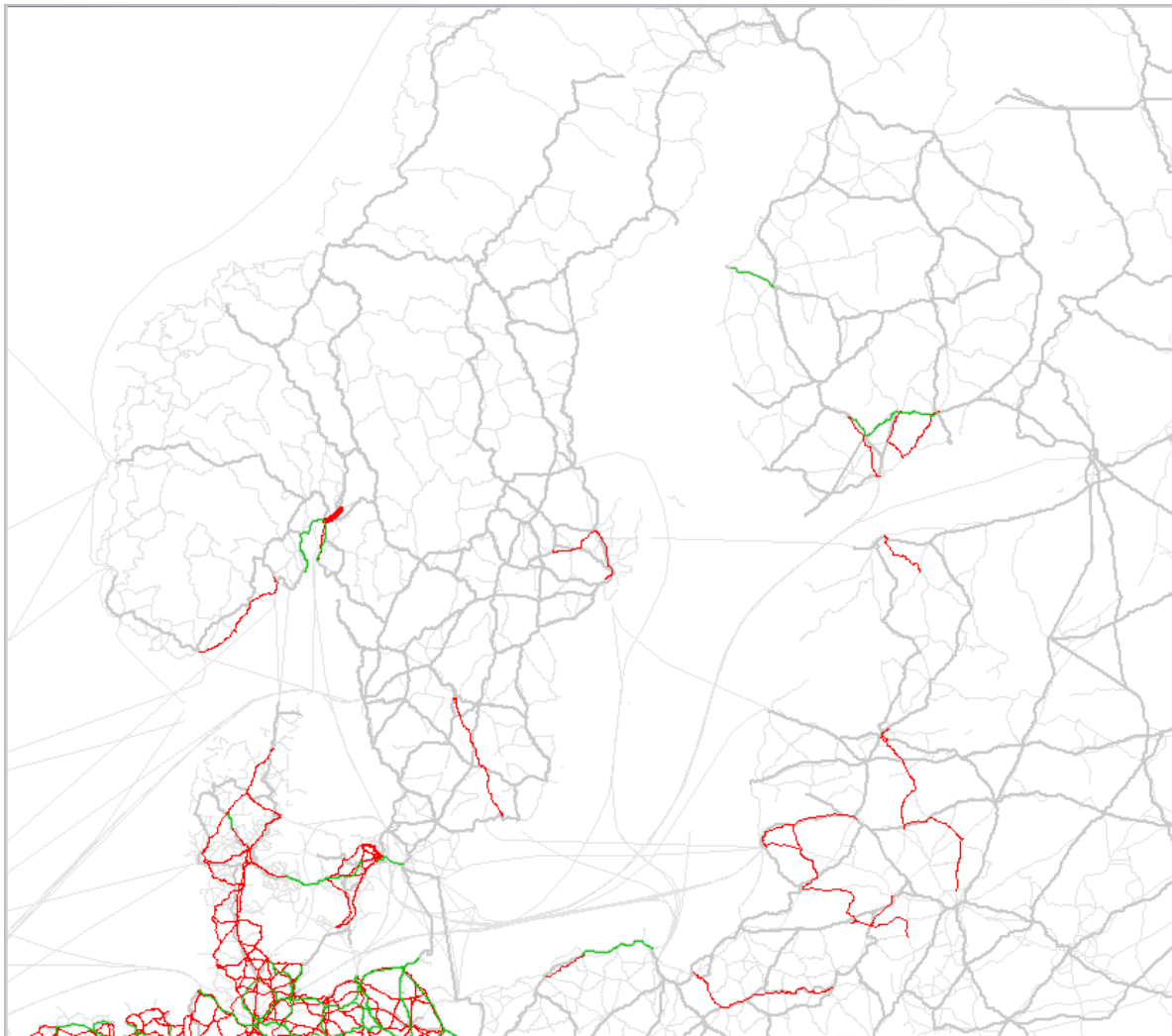
Commuter traffic assigned in the INTERCONNECT multi-modal graph



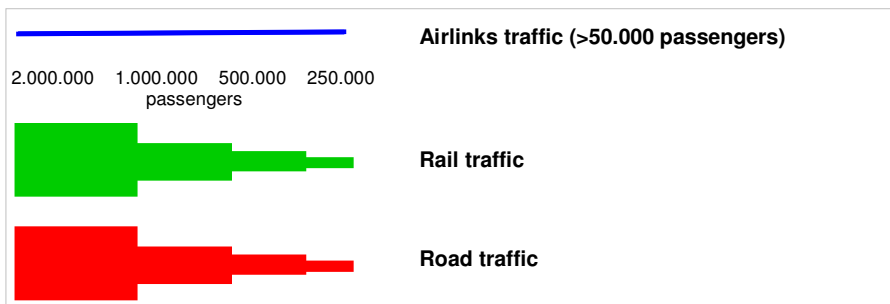
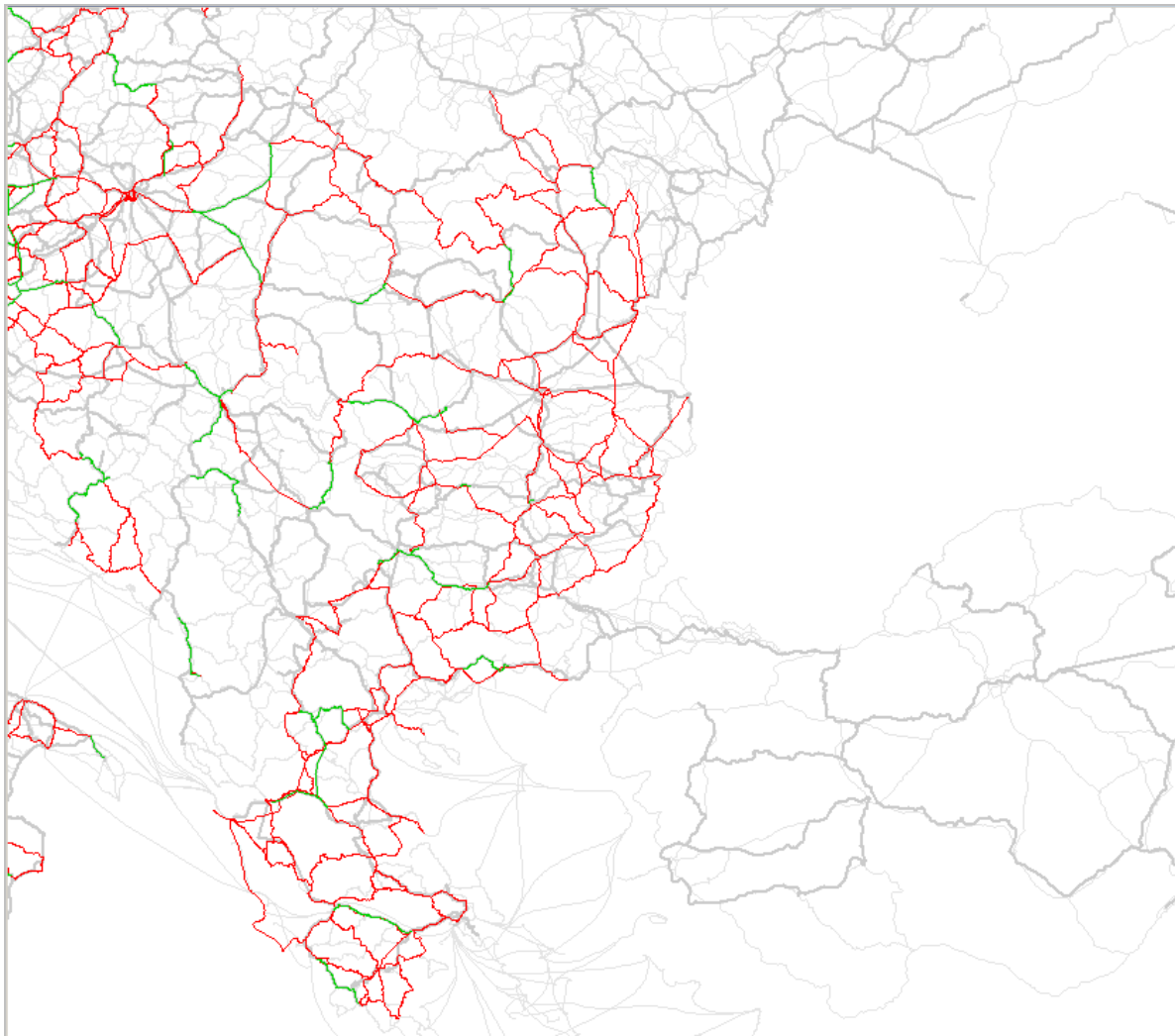
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**Traffic assignment for commuters trips in the Mediterranean arch**



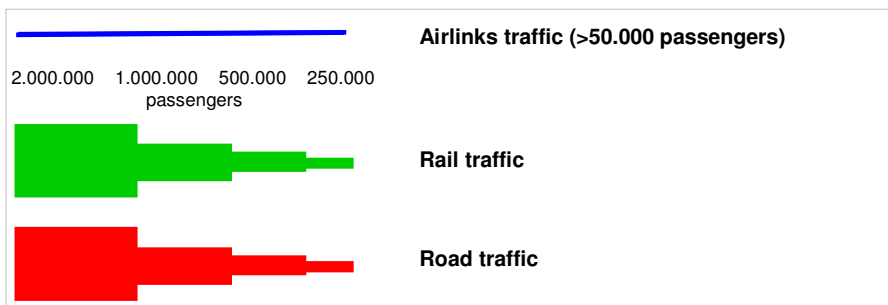
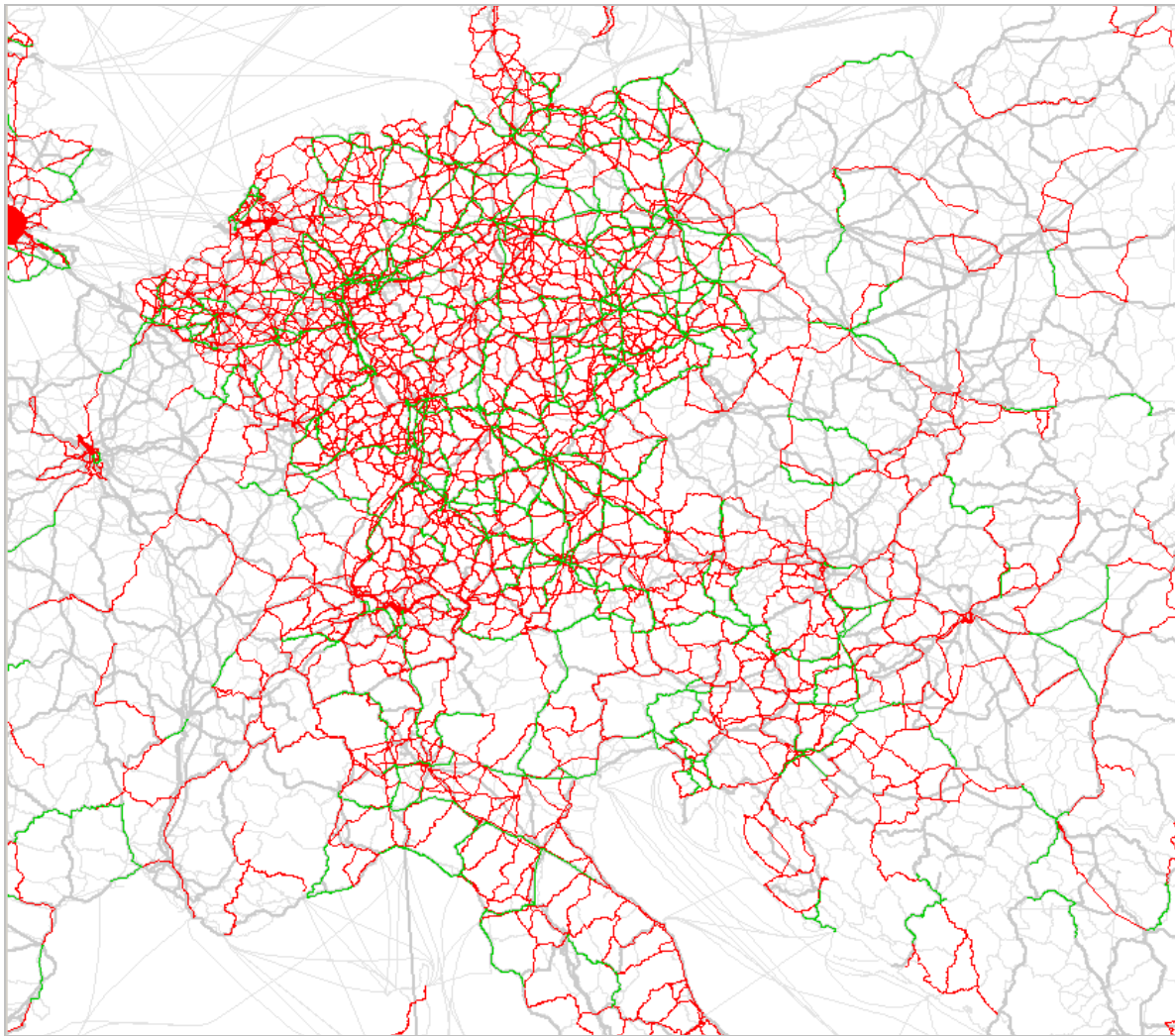
(source: Interconnect, based on TRANS-TOOLS 2005 databases)  
**Traffic assignment for commuters trips London-Paris-Benelux**



(source: Interconnect, based on TRANS-TOOLS 2005 databases)  
**Traffic assignment for commuters trips in the Baltic Region**



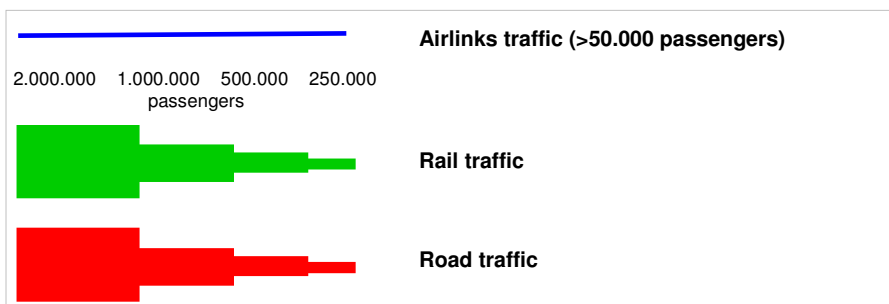
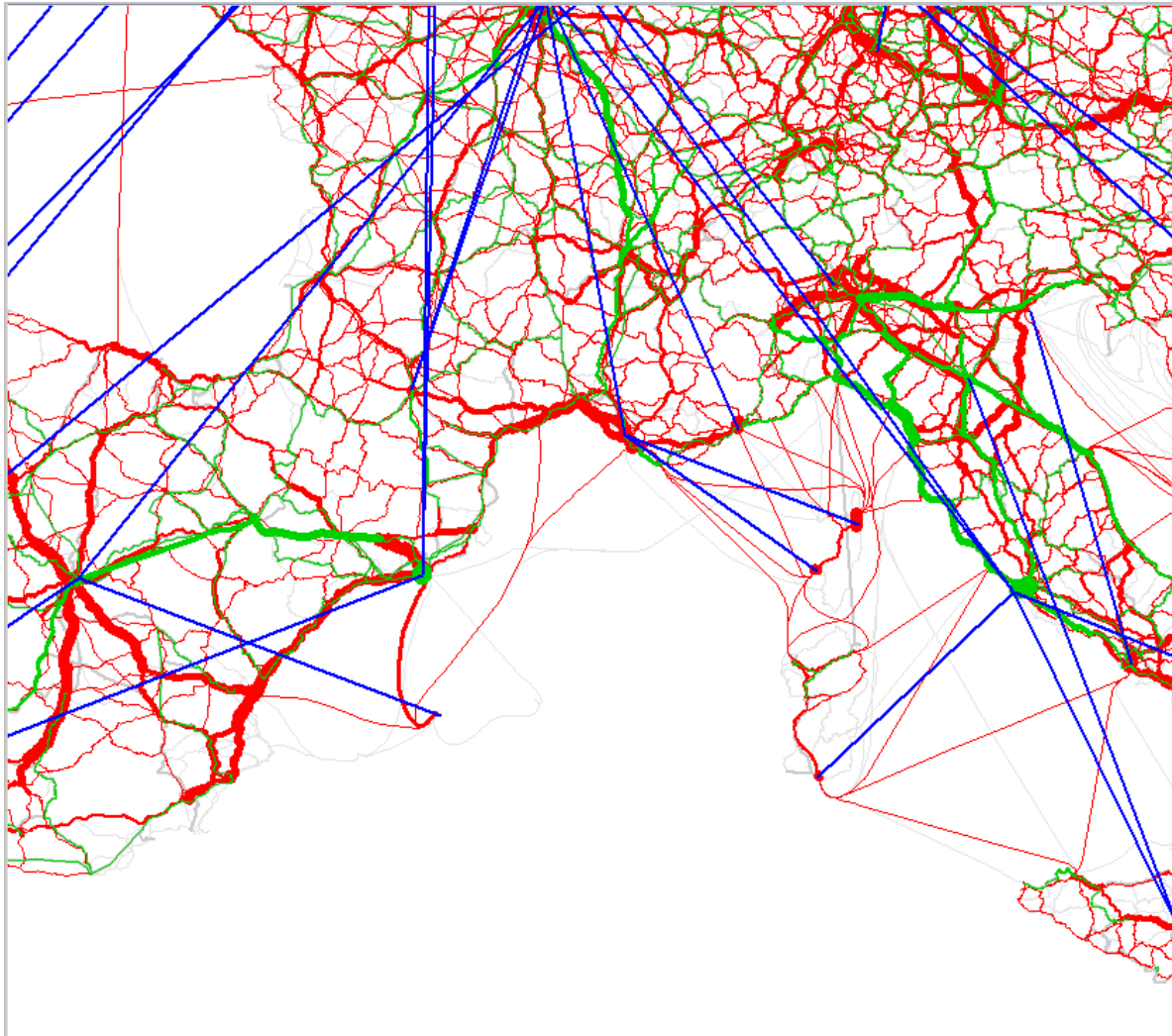
(source: Interconnect, based on TRANS-TOOLS 2005 databases)  
**Traffic assignment for commuters trips in the Aegean and Black Sea**



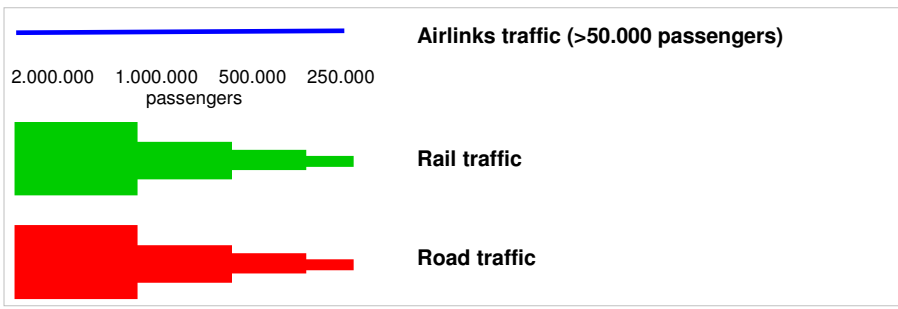
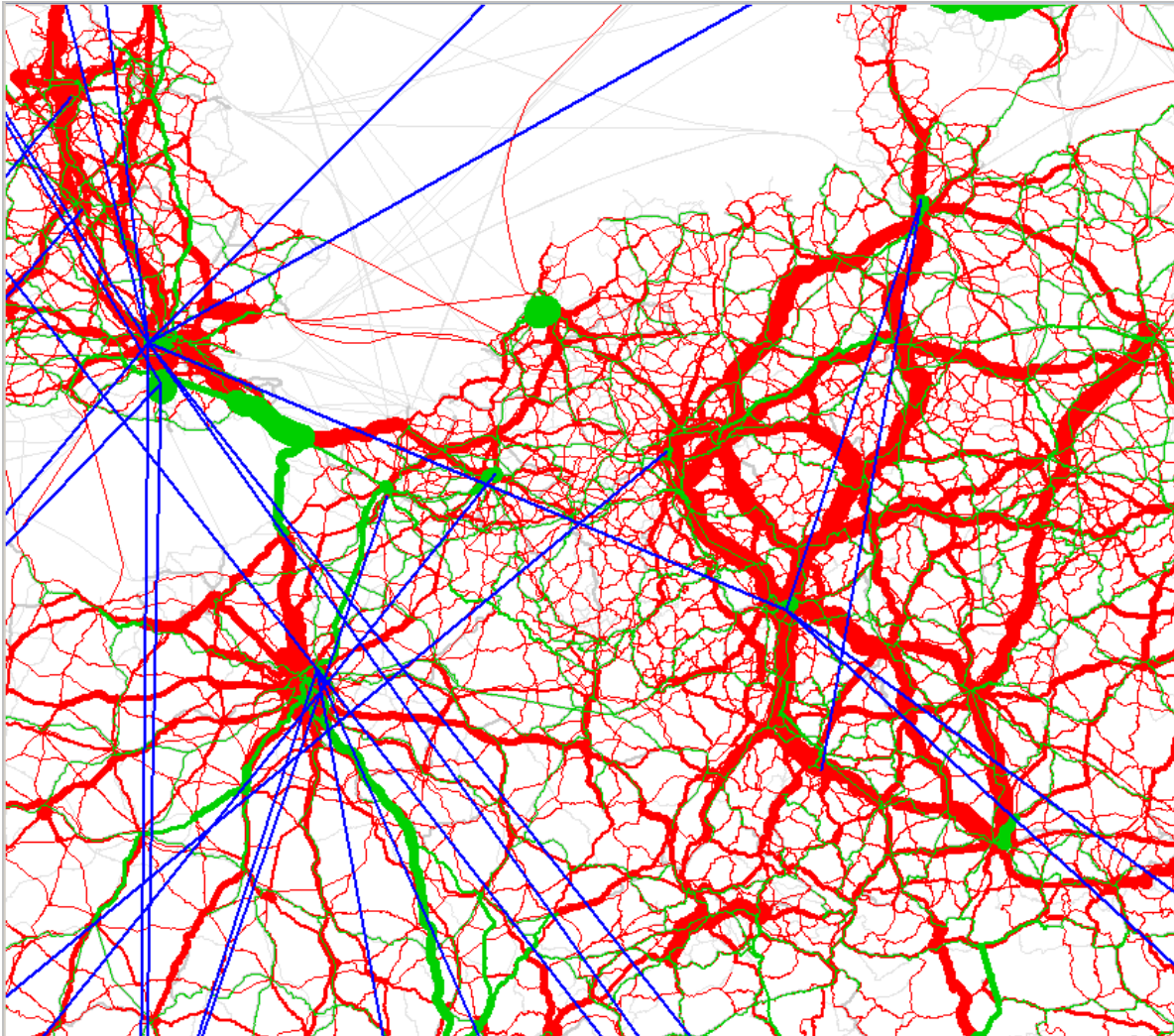
(source: Interconnect, based on TRANS-TOOLS 2005 databases)  
**Traffic assignment for commuters trips in Central Europe**



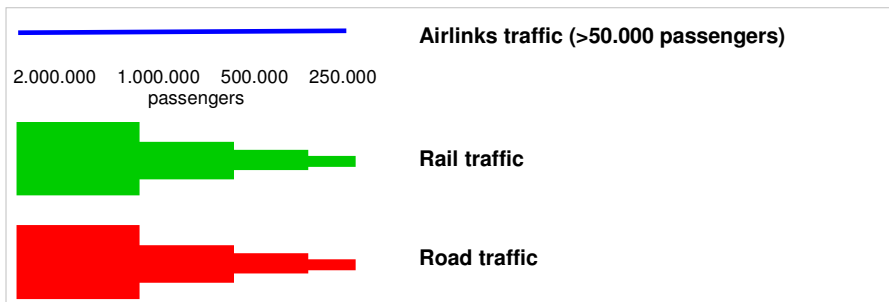
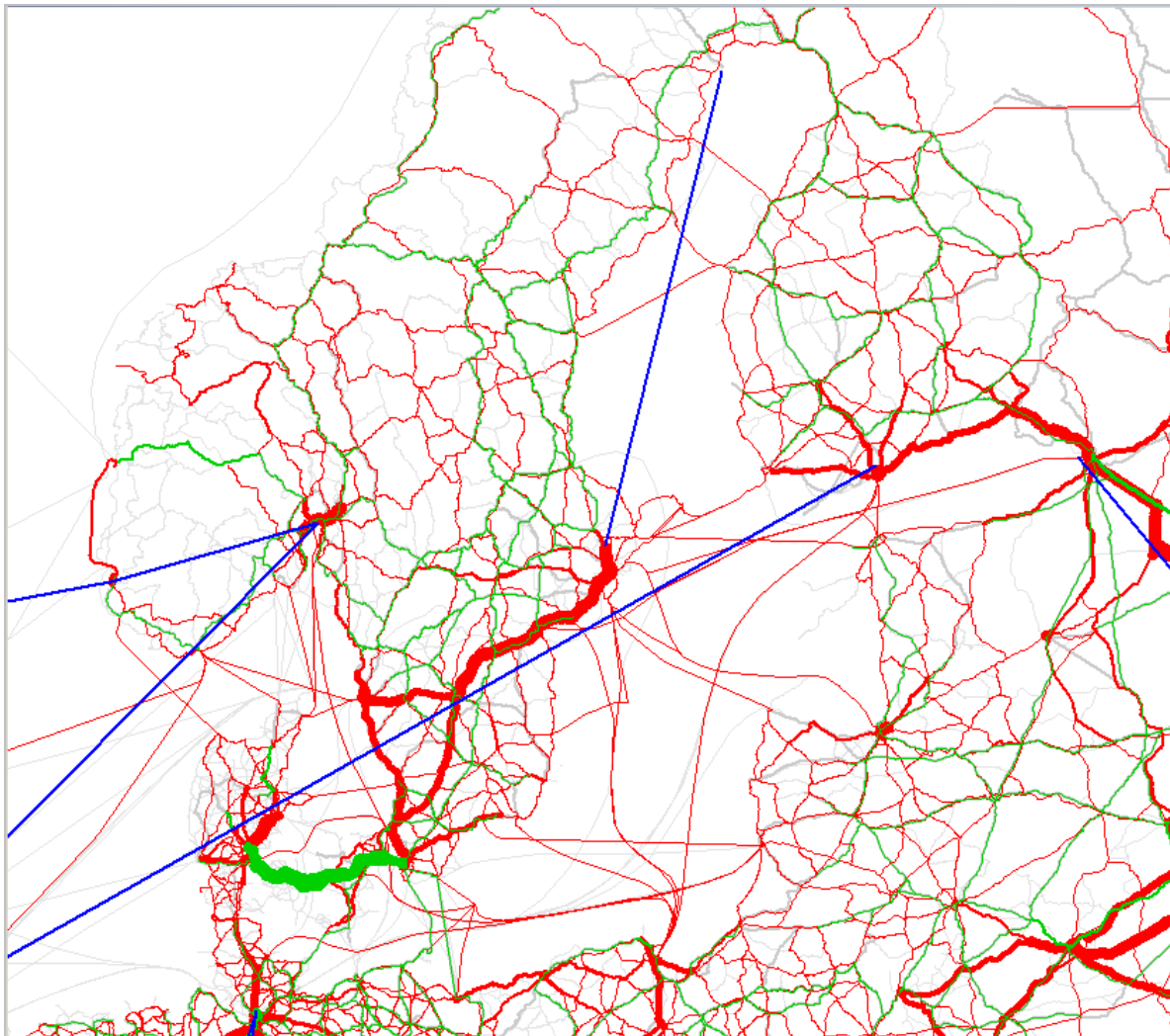
Holidays and leisure traffic assigned in the INTERCONNECT multi-modal graph



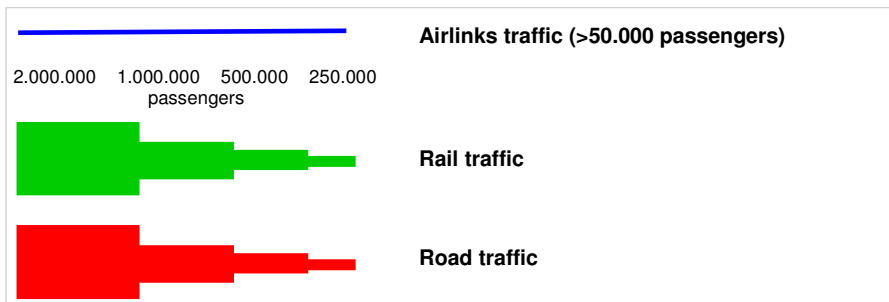
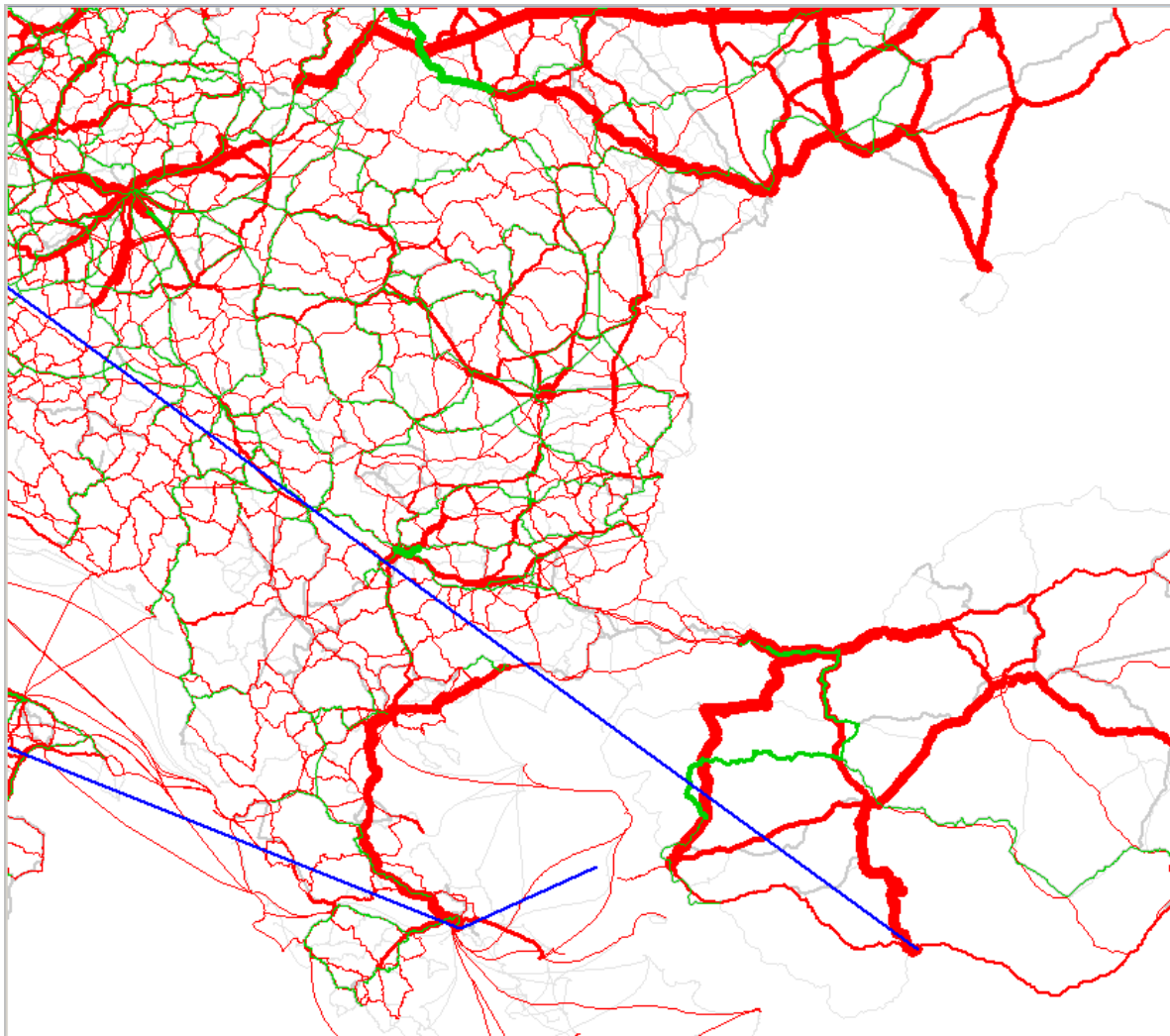
(source: Interconnect, based on TRANS-TOOLS 2005 databases)  
**Traffic assignment for holiday trips in the Mediterranean arch**



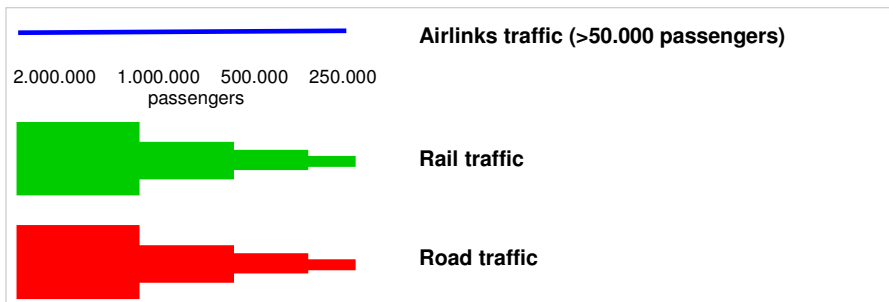
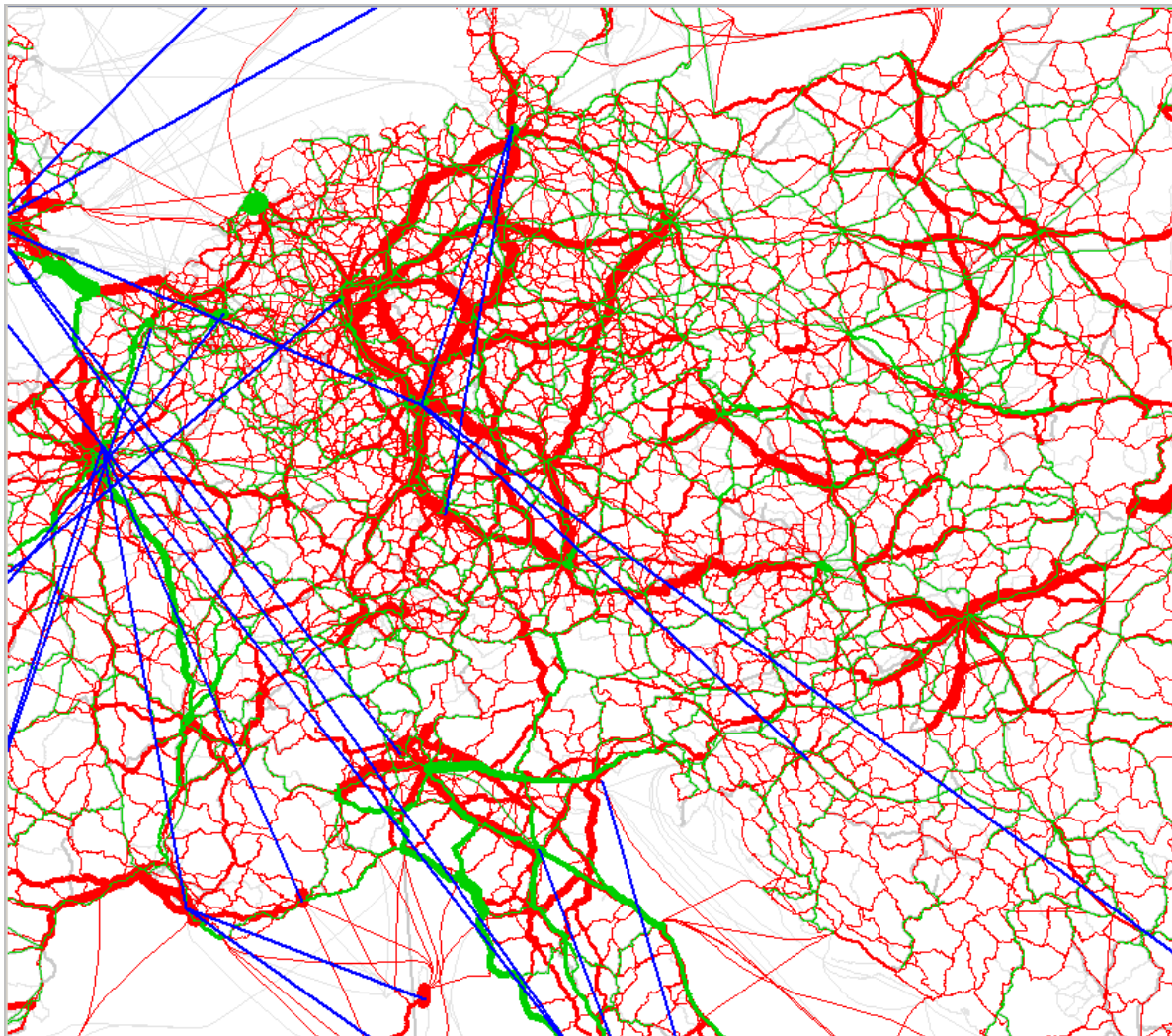
(source: Interconnect, based on TRANS-TOOLS 2005 databases)  
**Traffic assignment for holiday trips London-Paris-Benelux**



(source: Interconnect, based on TRANS-TOOLS 2005 databases)  
**Traffic assignment for holiday trips in the Baltic Region**



(source: Interconnect, based on TRANS-TOOLS 2005 databases)  
**Traffic assignment for holiday trips in the Aegean and Black Sea**



(source: Interconnect, based on TRANS-TOOLS 2005 databases)  
**Traffic assignment for holiday trips in Central Europe**

## APPENDIX 2 - IC MODULE VALIDATION

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### ITERATION NOTE SHEETS

*Name of assignment: 1st Assignment*

Date of assignment: 08/03/2011

Description: In this assignment, travel costs and values of travel time has been extracted from Trans-tools parameters. Initial values for interconnection impedance parameters, evaluated according to a basic set of shortest path assignments between representative NUTS-3 pairs.

Main Parameters:

**Value of travel time in euro/hour**

- Business: 15 €/h
- Private: 10 €/h
- Commuters: 7.5 €/h
- Holiday: 5 €/h

**Interconnecting costs in euro/km**

- City-road connector: 0.15 €/km
- City-train connector: 0.15 €/km
- Airport-road connector: 0.5 €/km
- Airport-train connector: 0.5 €/km
- Train-road connector: 0.5 €/km

**Travel Costs in euro/km**

- Road: 0.1 €/km
- Short-distance train: 0.1 €/km
- Medium -distance train: 0.1 €/km
- Long -distance train: 0.2 €/km

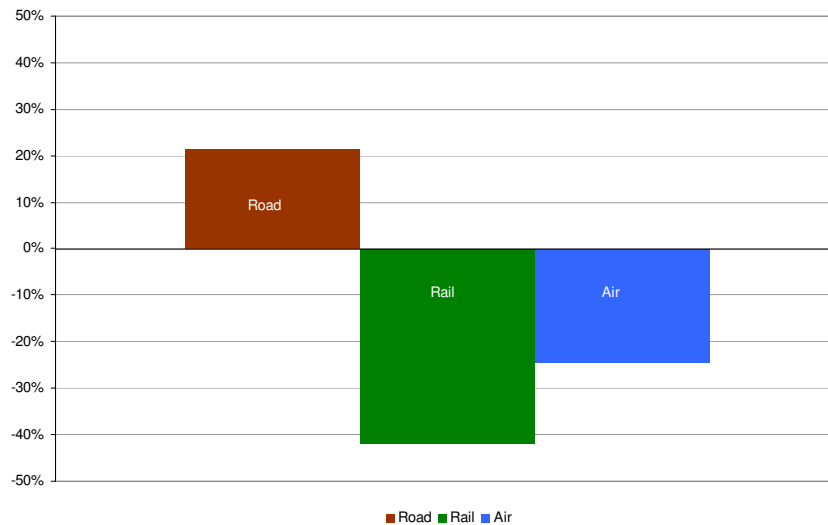
**Dispersion of travel cost and time cost values: 0.1**

**Time Penalty for interconnecting at airports: 90min**

Output Analysis

Globally, there are too many users that are travelling on road in this assignment than in the TRANS-TOOLS assignment, while rail and air are staying behind than in TRANS-TOOLS assignment. The dysfunction is mostly happening with business travellers, who should apparently use more airplane.

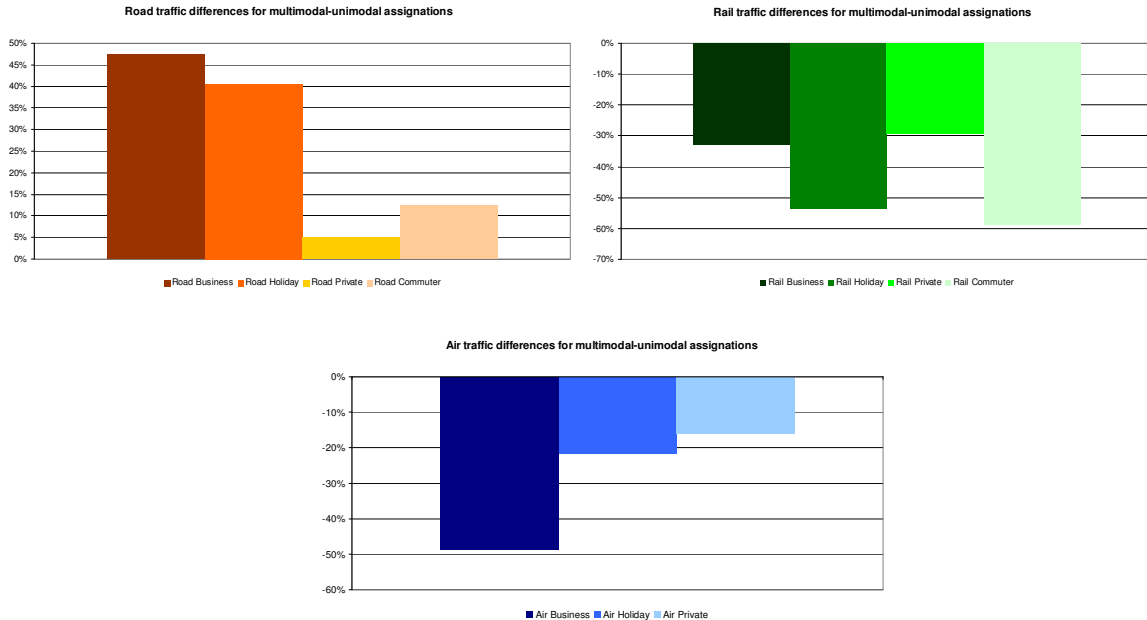
**Traffic differences for multimodal-unimodal assignments**



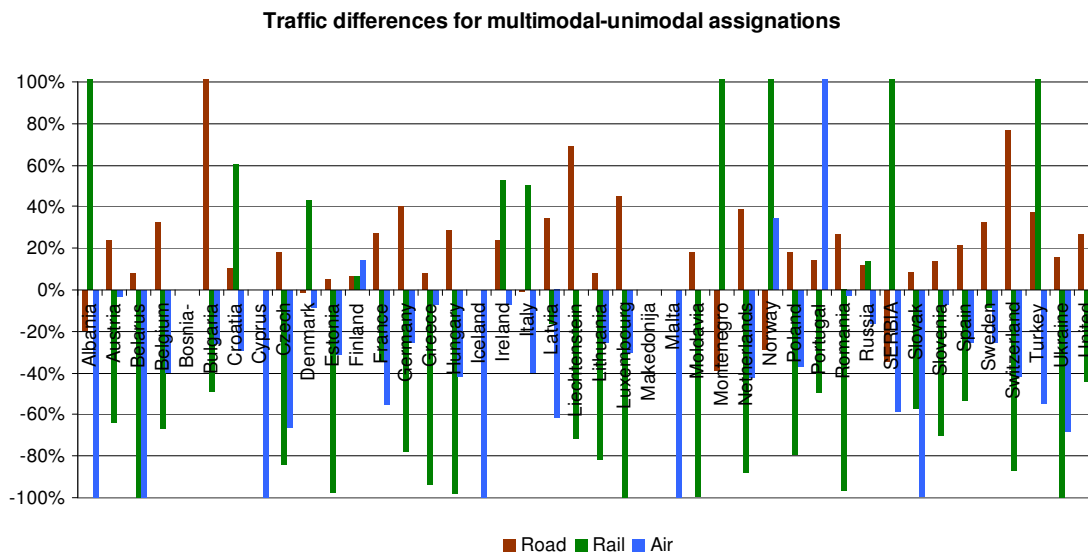
In the road traffic graph, there are more business and holiday trip users in this assignment than in the TRANS-TOOLS assignment. While commuters trip users and private trip users are just a bit more in this assignment than in TRANS-TOOLS assignment

In the rail traffic graph, holiday and commuter trip users are the group which experiments a high fall in this assignment than in the TRANS-TOOLS assignment. While business and private users have a lower decrease.

In the airport traffic graph, there are strong drop in the group of users with a business trip purpose in this assignment than the TRANS-TOOLS assignment. Holiday trip users also decrease but less than business trip user. While, private trip users are that suffer the smallest drop.



The figure below represents the relative error between TRANS-TOOLS' traffics and the IC Module's, for each country and for road (red), rail (green) and air (blue). The levels of error are relatively low in most cases for the EU27 Member States. Major disfunctions tend to concentrate in peripheral non Member States, where modelling is less accurate, and in the rail and the air modes



**Summary conclusions**

There are too many travellers that are travelling on road, while rail and air are staying behind. The disfunction is mostly happening with business travellers, who should apparently use more airplane.



*Name of assignment: 2nd Assignment*

Date of assignment: 09/03/2011

Description: In this assignment have been increased road and rail mid-distance costs. Besides, there have been made some adjustments in connection costs in order to penalise road transport mode and to benefit rail and air transport modes.

Main Parameters:

**Value of travel time in euro/hour**

Business: 15 €/h

Private: 10 €/h

Commuters: 7.5 €/h

Holiday: 5 €/h

**Interconnecting costs in euro/km**

City-road connector: 0.2 €/km

City-train connector: 0.15 €/km

Airport-road connector: 0.5 €/km

Airport-train connector: 0.25 €/km

Train-road connector: 0.25 €/km

**Travel Costs in euro/km**

Road: 0.15 €/km

Short-distance train: 0.1 €/km

Medium -distance train: 0.125 €/km

Long -distance train: 0.2 €/km

**Dispersion of travel cost and time cost**

values: 0.1

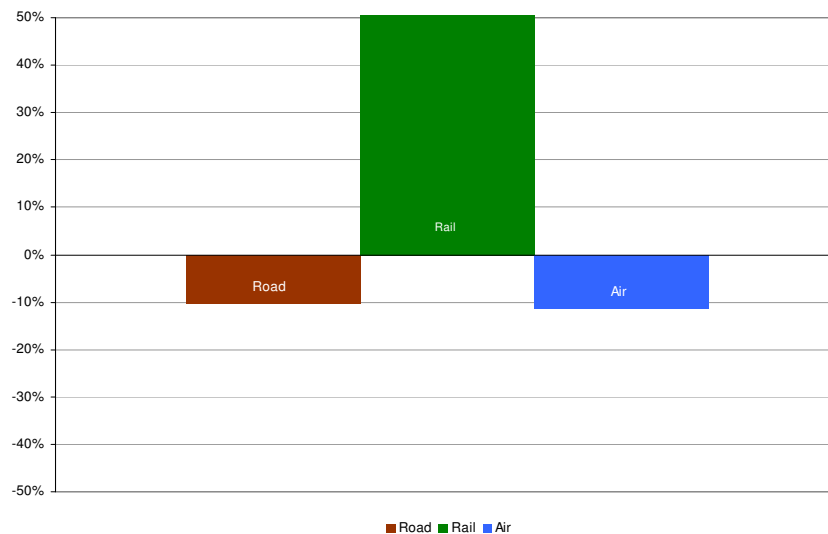
**Time Penalty for interconnecting at airports:**

90min

Output Analysis

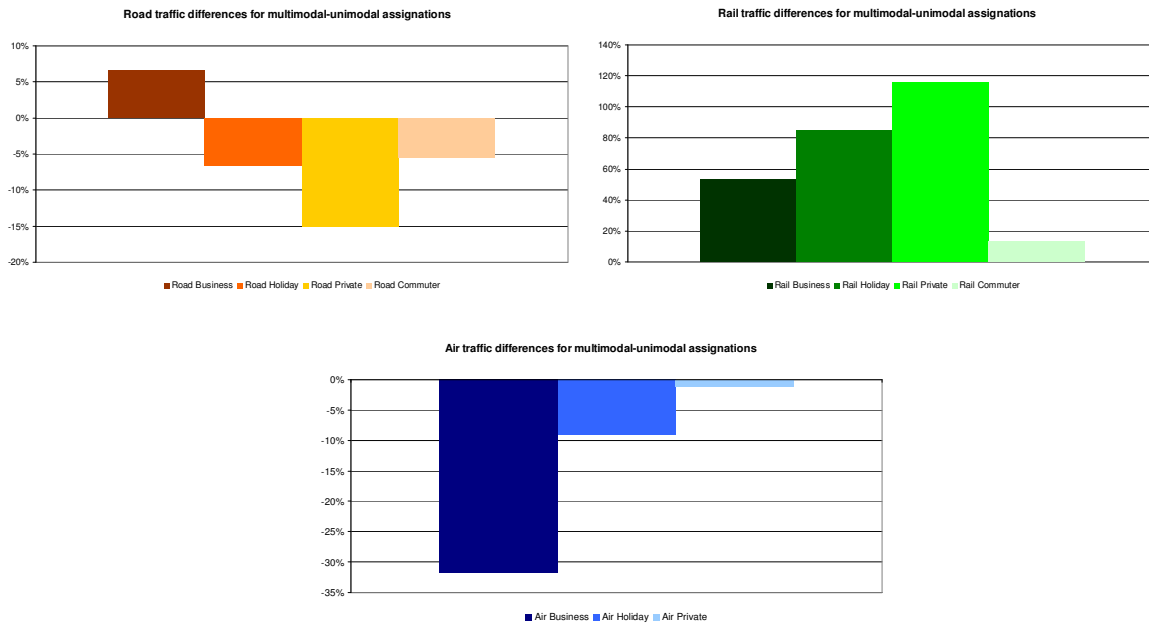
Broadly, there a huge difference in rail traffic between this assignment and TRANS-TOOLS assignment. However, road and air modes, which present similar behaviours, haven't big disparities between both assignments, by 10% less in this assignment than in the TRANS-TOOLS assignment.

Traffic differences for multimodal-unimodal assignments



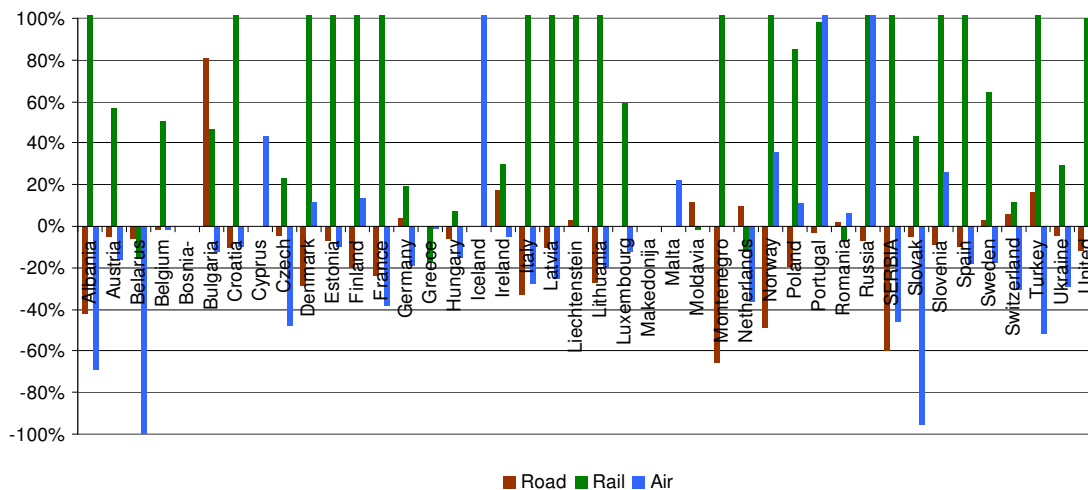
In the road traffic graph, most of the type of trips –holiday, private and commuter- suffer a decline in this assignment respect than TRANS-TOOLS assignment. Just road business road trips experiments an increase around 7%

In the rail traffic graph, all kind of trips has the same behaviour; all of them have a huge growth with values higher than 50%, in this assignment in comparison with the TRANS-TOOLS assignment  
 In the airport traffic, almost all of kinds of travellers have the same path, basically most of them fall in different size in this assignment respect the TRANS-TOOLS assignment. Overall, business trip experiments a significant drop near 30%, while holidays trip have a low drop –less than 10%-. Finally, private travellers have an insignificant decline.



The figure below represents the relative error between TRANS-TOOLS' traffic and the IC Module's, for each country and for road (red), rail (green) and air (blue). The levels of error are relatively low in most cases for the EU27 Member States. Major disfunctions tend to concentrate in peripheral non Member States, where modelling is less accurate, and in the rail and the air modes.

**Traffic differences for multimodal-unimodal assignments**



Summary conclusions

To sum up, in this assignment road and rail transport modes are now much more adjusted in comparison with the TRANS-TOOLS model but rail is used too much, mainly by private and holiday trips.

*Name of assignment: 3rd Assignment*

Date of assignment: 09/03/2011

Description: In this assignment have been changed travel costs for road and rail modes but dispersion has been reduced to a minimum value of 0 in all parameters in order to see the impact of having no regional variations on the global results

Main Parameters:

**Value of travel time in euro/hour**

Business: 15 €/h

Private: 10 €/h

Commuters: 7.5 €/h

Holiday: 5 €/h

**Interconnecting costs in euro/km**

City-road connector: 0.2 €/km

City-train connector: 0.15 €/km

Airport-road connector: 0.5 €/km

Airport-train connector: 0.25 €/km

Train-road connector: 0.25 €/km

**Travel Costs in euro/km**

Road: 0.15 €/km

Short-distance train: 0.1 €/km

Medium -distance train: 0.125 €/km

Long -distance train: 0.2 €/km

**Dispersion of travel cost and time cost**

values: 0

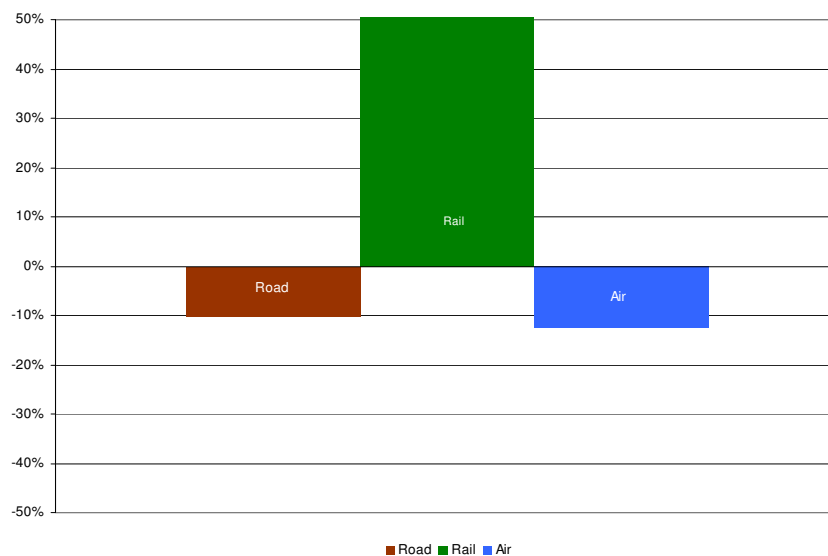
**Time Penalty for interconnecting at airports:**

90min

Output Analysis

At large, there a huge difference in rail traffic between this assignment and TRANS-TOOLS assignment. However, road and air modes, which present similar behaviours, haven't big disparities between both assignments, by 10% less in this assignment than in the TRANS-TOOLS assignment.

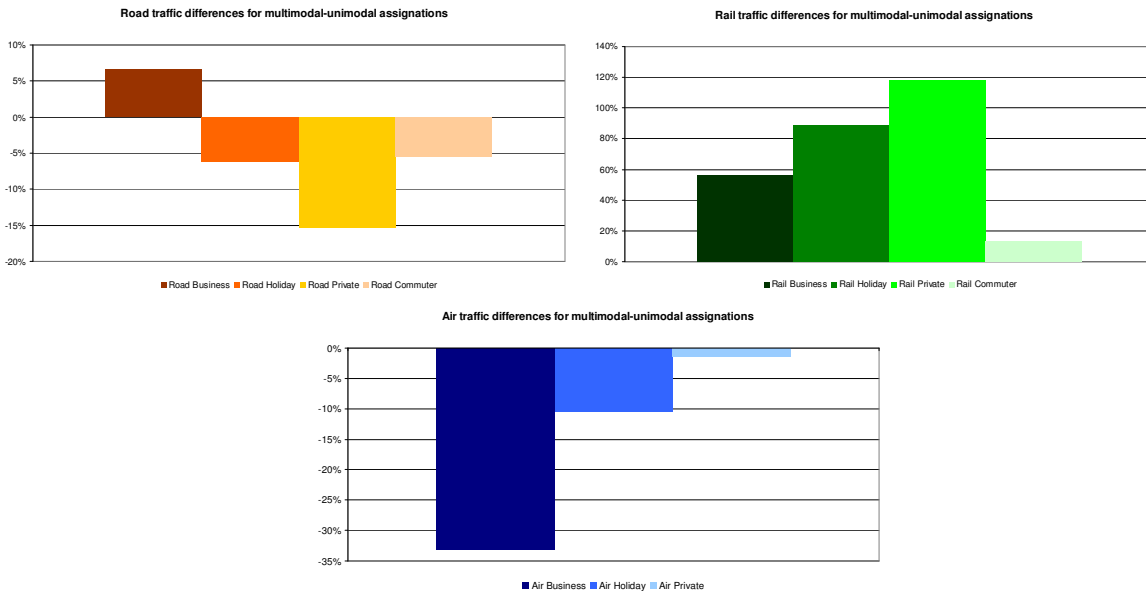
Traffic differences for multimodal-unimodal assignments



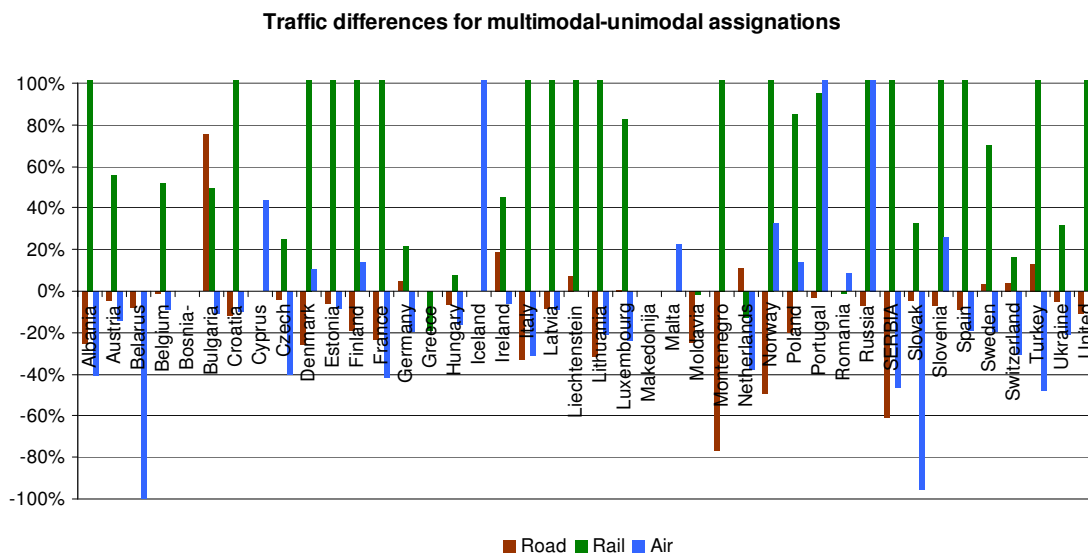
In the road traffic graph, most of the type of trips –holiday, private and commuter- suffer a decline in this assignment respect than TRANS-TOOLS assignment. Just road business road trips experiments a increase of nearly 7%

In the rail traffic graph, all kind of trips has the same behaviour; most of them –business, holiday and private- have a huge growth with results higher than 50%. While, commuter trips have a lower growth, nearly 10%.

In the airport traffic, all kind of users fall in this assignment. Overall, business users experiments a significant decrease near 30%, then holidays users have a lower drop –less than 10%-. While, private travellers decline slightly, by 2%.



The figure below represents the relative error between TRANS-TOOLS' traffic and the IC Module's, for each country and for road (red), rail (green) and air (blue). The levels of error are relatively low in most cases for the EU27 Member States. Major disfunctions tend to concentrate in peripheral non Member States, where modelling is less accurate, and in the rail and the air modes.



**Summary conclusions**

In conclusion, in this assignment a dispersion of value 0 makes all prices and costs equal across the different regions. The result is a worse adjustment when compared to the scenario with dispersion 0,1.

*Name of assignment: 4th Assignment*

Date of assignment: 09/03/2011

Description: In this assignment have been changed travel costs for road and rail modes but dispersion has been increased to a maximum value of 1 in all parameters in order to see the impact of having regional variations on the global results

Main Parameters:

<b>Value of travel time in euro/hour</b>	<b>Interconnecting costs in euro/km</b>
Business: 15 €/h	City-road connector: 0.2 €/km
Private: 10 €/h	City-train connector: 0.15 €/km
Commuters: 7.5 €/h	Airport-road connector: 0.5 €/km
Holiday: 5 €/h	Airport-train connector: 0.25 €/km
	Train-road connector: 0.25 €/km

**Travel Costs in euro/km**

Road: 0.15 €/km
Short-distance train: 0.1 €/km
Medium -distance train: 0.125 €/km
Long -distance train: 0.2 €/km

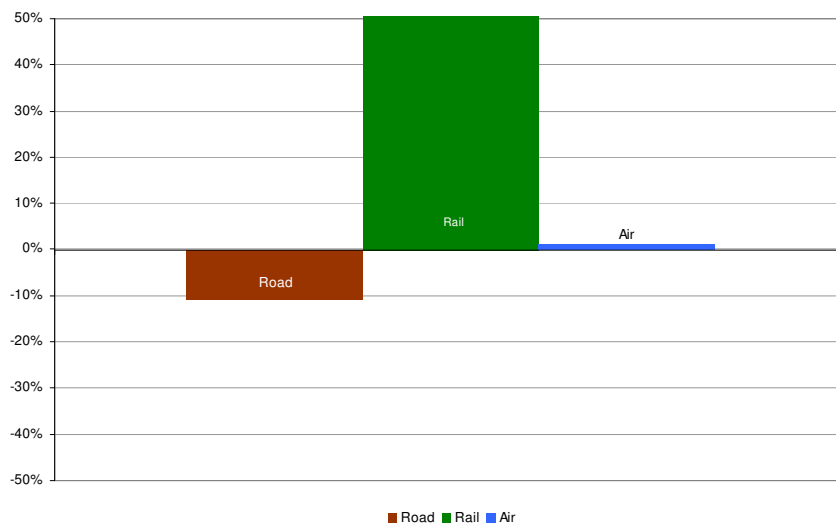
**Dispersion of travel cost and time cost values: 1**

**Time Penalty for interconnecting at airports: 90min**

Output Analysis

Globally, all transport modes –road, rail and air- have different behaviours, Air transport mode has results reasonable similar in this assignment in comparison with TRANSTOOLS model. Then, road transport mode declines nearly 10%. While rail transport mode increases too much, more than 50%.

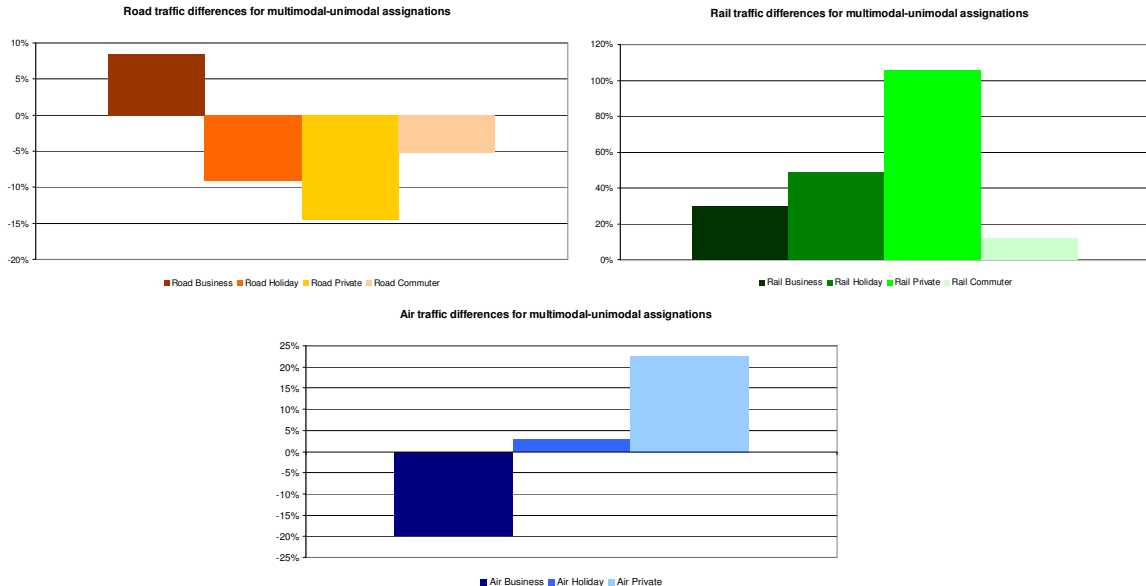
**Traffic differences for multimodal-unimodal assignments**



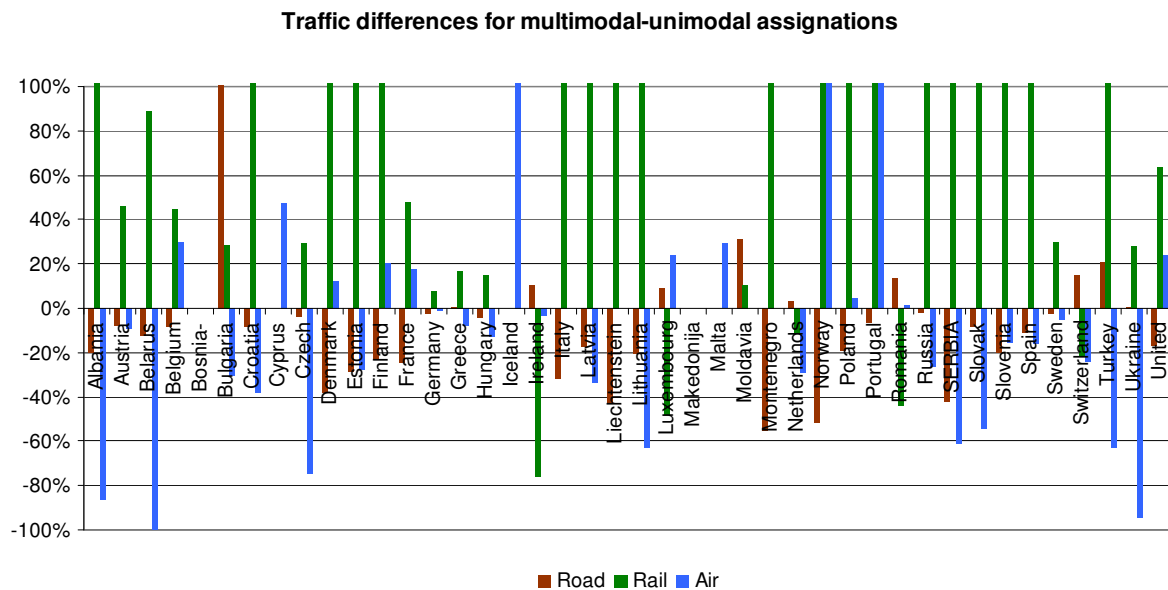
In the road traffic graph, most kind of travellers –holiday, private and commuter- decline in this assignment. Holiday is the kind of travellers that fall more deeply, by 15%, and commuter the group that experiment a lower decrease, nearly 5%. While business travellers increase nearly 7%.

In the rail traffic graph, all kind of trips has the same behaviour; private trips have a huge increase of more than 100%. Then holiday trips increase strongly, nearly 50%. And business trips grow more than 20%. Finally, commuter trips rise nearly 10%.

In the airport traffic, holiday users have a slightly increase nearly 3% and private users have a significant growth of more than 20%. By contrast, business users drop nearly 20%.



The figure below represents the relative error between TRANS-TOOLS' traffic and the IC Module's, for each country and for road (red), rail (green) and air (blue). The levels of error are relatively low in most cases for the EU27 Member States. Major disfunctions tend to concentrate in peripheral non Member States, where modelling is less accurate, and in the rail and the air modes.



**Summary conclusions**

To sum up, a higher dispersion means increasing the differences in prices and costs throughout Europe. The effect is a better fit with the original TRANS-TOOLS results. However, although there is a correct change from road to air, rail mode still has too many trips.

*Name of assignment: 5th Assignment*

Date of assignment: 15/03/2011

Description: In this assignment has been increased the Value of Time for the four types of travellers. Furthermore it has been made a correction of medium-distance rail costs

Main Parameters:

<b>Value of travel time in euro/hour</b>	<b>Interconnecting costs in euro/km</b>
Business: 20 €/h	City-road connector: 0.2 €/km
Private: 12 €/h	City-train connector: 0.15 €/km
Commuters: 10 €/h	Airport-road connector: 0.5 €/km
Holiday: 7,5 €/h	Airport-train connector: 0.25 €/km
	Train-road connector: 0.25 €/km

**Travel Costs in euro/km**

Road: 0.15 €/km
Short-distance train: 0.1 €/km
Medium -distance train: 0.15 €/km
Long -distance train: 0.2 €/km

**Dispersion of travel cost and time cost**

**values:** 0,1

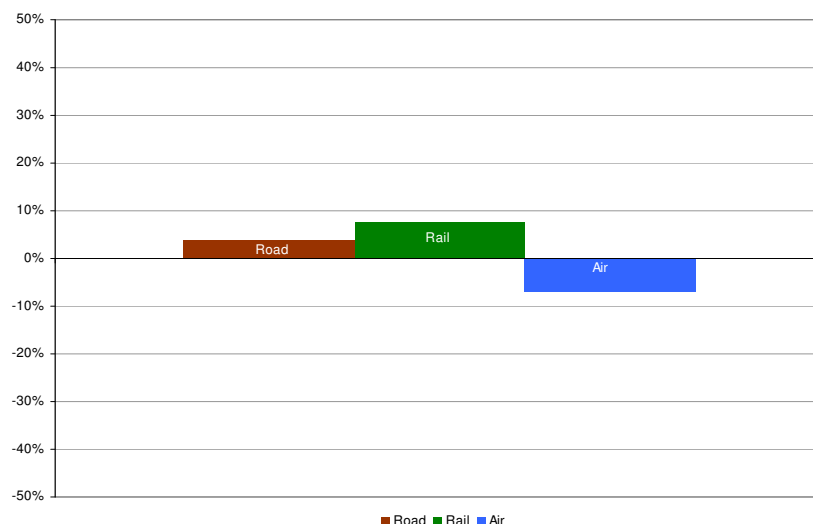
**Time Penalty for interconnecting at airports:**

90min

Output Analysis

In general terms, this assignment offers values quite adjusted values, the differences between the results of this assignment and the TRANS-TOOLS assignment results are below 10 %. Road transport mode increases by 4% and rail transport mode rises nearly 7%. While air transport mode declines nearly 8%.

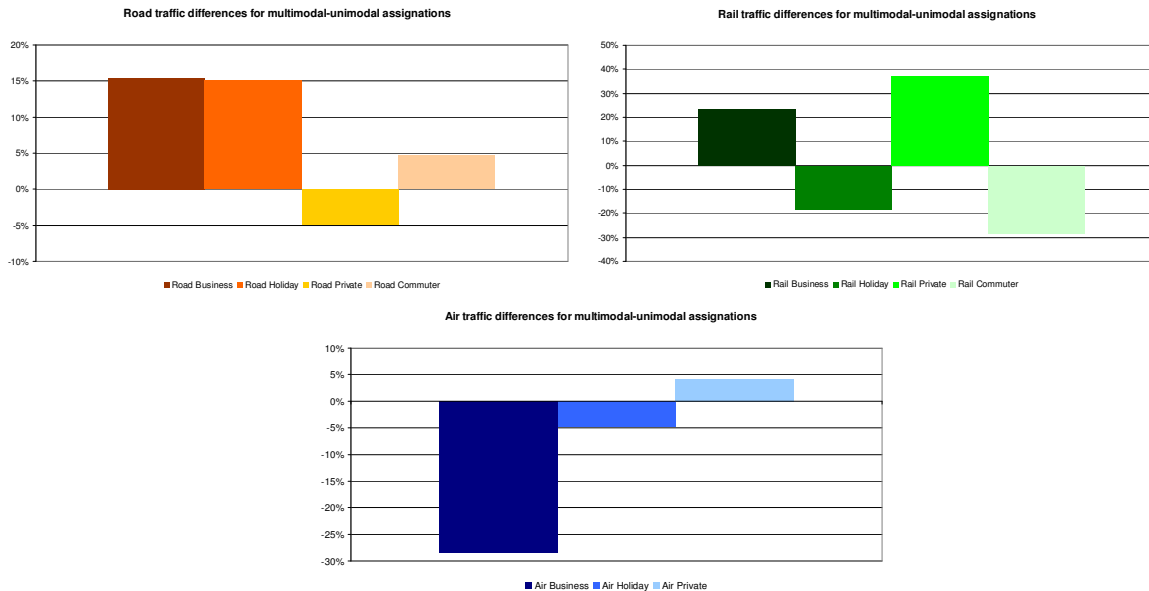
Traffic differences for multimodal-unimodal assignments



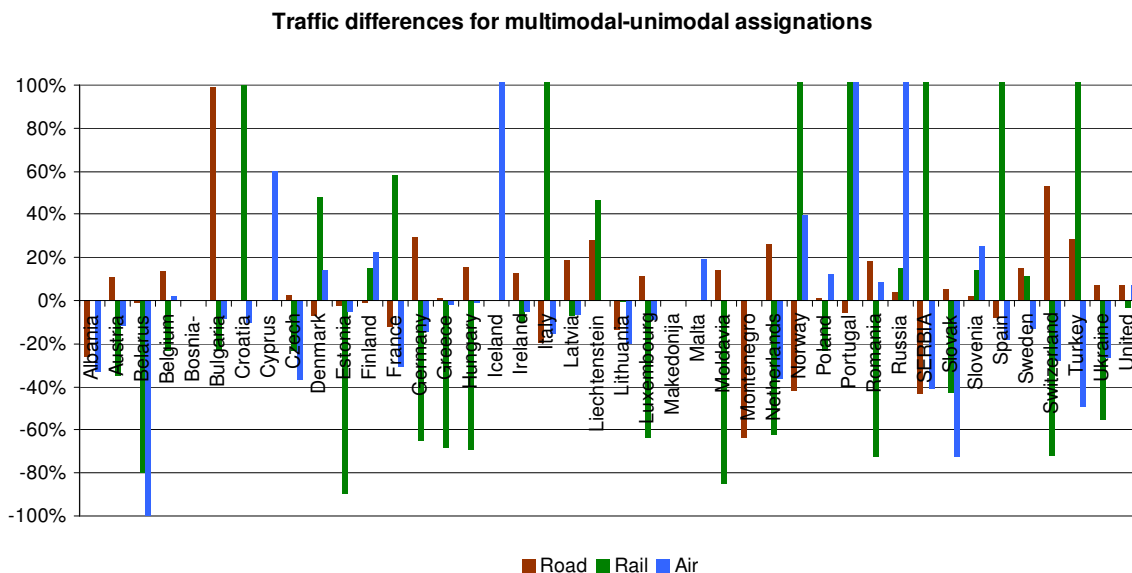
In the road traffic graph, business and holiday users have the same path, both grows a 15% in this assignment in comparison with the TRANS-TOOLS assignment. Commuters users also increase, but not so much, less than 5%. While private users have a small decline by 5%.

In the rail traffic graph, private and business trips increase more than 35% and more 20% respectively in this assignment respect the TRANS-TOOLS assignment. While commuter and holidays trips falls more than 25% and 15% severally.

In the airport traffic graph, business users experiment a high decrease in this assignment in comparison with the TRANS-TOOLS results. While holiday and private trips have less differences between both assignments, air users have a low decline and private users a low increase respectively.



The figure below represents the relative error between TRANS-TOOLS' traffic and the IC Module's, for each country and for road (red), rail (green) and air (blue). The levels of error are relatively low in most cases for the EU27 Member States. Major disfunctions tend to concentrate in peripheral non Member States, where modelling is less accurate, and in the rail and the air modes.



Summary conclusions

In conclusion, in this assignment the increase in Value of Time has resulted in a more accurate fit of Transtools results, with differences by mode under 10%, although these differences are bigger when looking at the trips per travel purpose.



*Name of assignment: 6th Assignment*

Date of assignment: 15/03/2011

Description: This assignment is based on the scenario with increased Value of Time, with slightly higher road and rail costs and cheaper interconnection to air mode. Also a higher dispersion value has been adopted, provided that it seems that higher dispersion gives a better fit to TRANS-TOOLS results.

Main Parameters:

**Value of travel time in euro/hour**

Business: 20 €/h

Private: 12 €/h

Commuters: 10 €/h

Holiday: 7,5 €/h

**Interconnecting costs in euro/km**

City-road connector: 0.1 €/km

City-train connector: 0.1 €/km

Airport-road connector: 0,125 €/km

Airport-train connector: 0,125 €/km

Train-road connector: 0.25 €/km

**Travel Costs in euro/km**

Road: 0,155 €/km

Short-distance train: 0,11 €/km

Medium -distance train: 0.16 €/km

Long -distance train: 0.2 €/km

**Dispersion of travel cost and time cost**

**values:** 0,5

**Time Penalty for interconnecting at airports:**

90min

Output Analysis

Generally, this assignment has given quite fit results, but not for all transport types. The fittest values are in the air transport mode, almost equal that in the TRANS-TOOLS assignment. While the results from the road transport mode are quite satisfactory, below 5% more. However, results from rail transport mode could be improved.

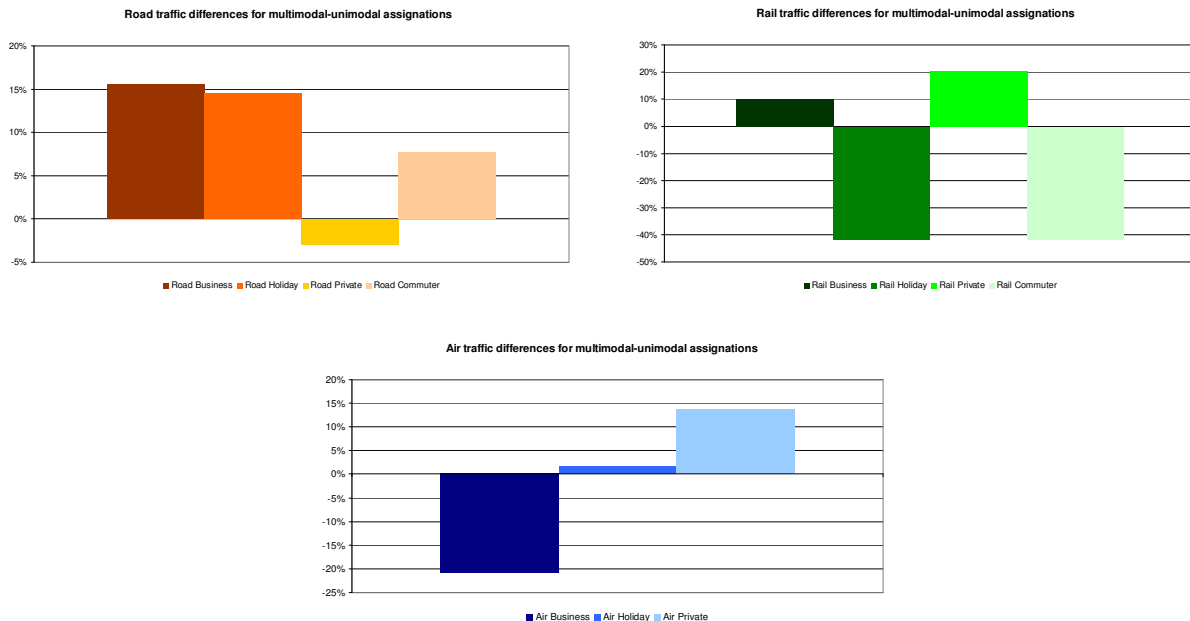
Traffic differences for multimodal-unimodal assignments



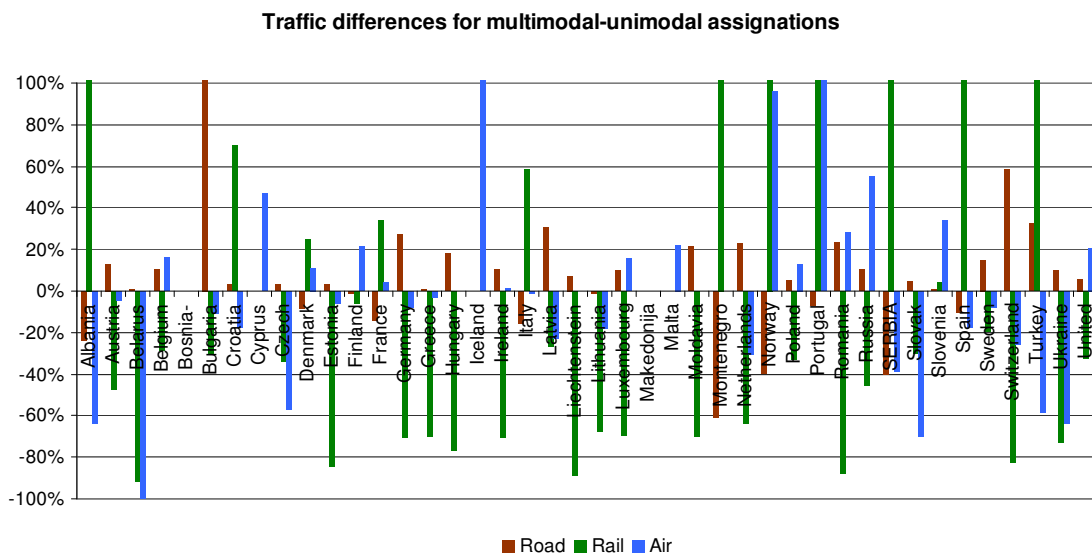
In the road traffic graph, most of the trip types –business, holiday and commuter- present an increasement of users in this assignment in comparison with the TRANS-TOOLS results. Nonetheless, road private users slightly decrease in this assignment.

In the rail traffic graph, private and business users grow, 10% and 20% respectively. While, holiday and commuter users have a high decline, near of 40%.

In the airport traffic graph, private trip gains near a 15% of users in this assignment respect TRANS-TOOLS assignment, holiday users experiment a insignificant increase, while business trip suffers a fall of 20% of users.



The figure below represents the relative error between TRANS-TOOLS' traffic and the IC Module's, for each country and for road (red), rail (green) and air (blue). The levels of error are relatively low in most cases for the EU27 Member States. Major disfunctions tend to concentrate in peripheral non Member States, where modelling is less accurate, and in the rail and the air modes.



Summary conclusions

To sum up, the model is highly sensitive to rail cost, and a slight increase has resulted in a big decrease in the use of rail. Air mode has now a good fit when measured globally.

*Name of assignment: 7th Assignment*

Date of assignment: 15/03/2011

Description: This assignment is based on a mix of the scenarios "Increase in Value of Time" and "Variation in rail and air costs", but with an interconnection penalty of 0 minutes for changing between air services.

Main Parameters:

**Value of travel time in euro/hour**

Business: 20 €/h

Private: 12 €/h

Commuters: 10 €/h

Holiday: 7,5 €/h

**Interconnecting costs in euro/km**

City-road connector: 0.2 €/km

City-train connector: 0.2 €/km

Airport-road connector: 0,250 €/km

Airport-train connector: 0,250 €/km

Train-road connector: 0.5 €/km

**Travel Costs in euro/km**

Road: 0,155 €/km

Short-distance train: 0,11 €/km

Medium -distance train: 0.16 €/km

Long -distance train: 0.2 €/km

**Dispersion of travel cost and time cost**

values: 0,1

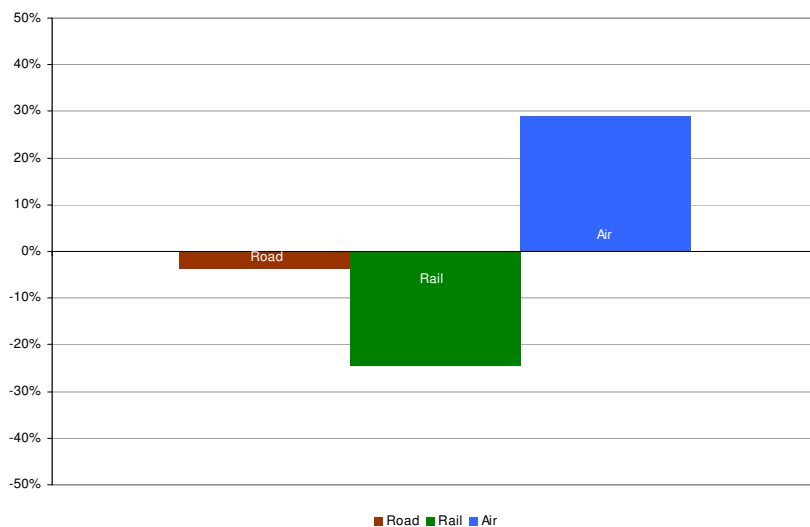
**Time Penalty for interconnecting at airports:**

0min

Output Analysis

At large, this assignment presents good results in road transport mode, with a small decrease of less than 5% in comparison with the TRANS-TOOLS assignment. While rail and air transport modes have less fit results. The first one drops more than 20% and the second one grows more than 25%.

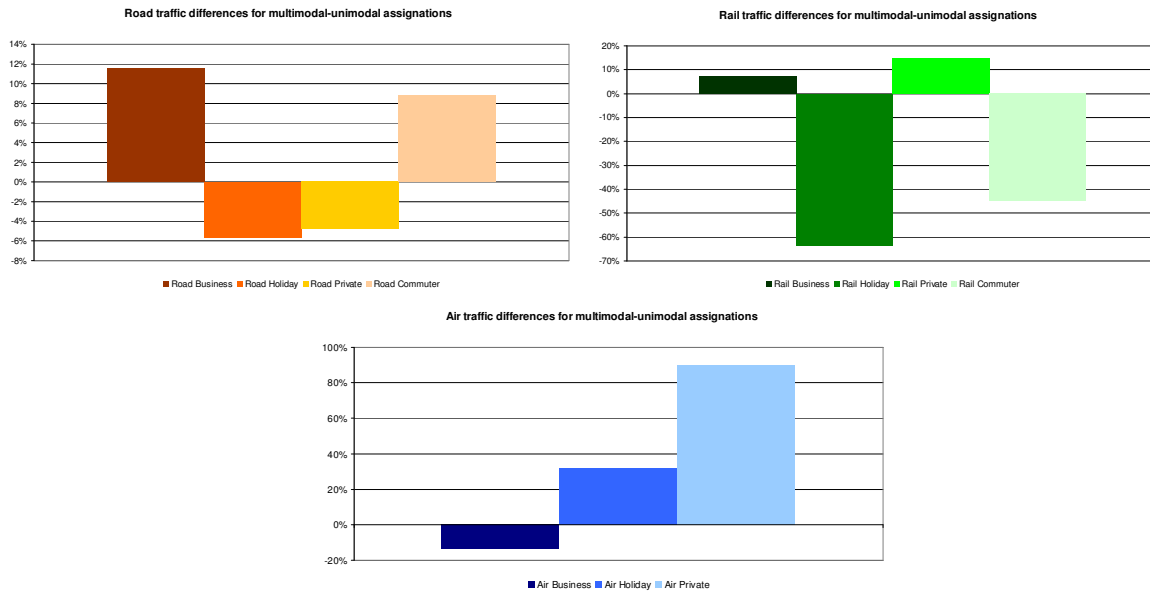
Traffic differences for multimodal-unimodal assignments



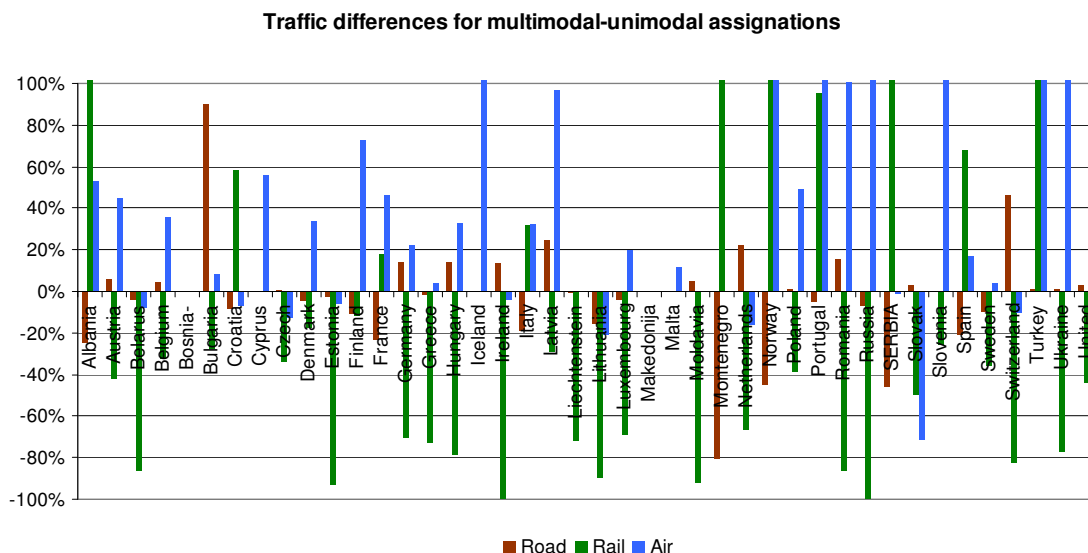
In the road traffic graph, business and commuter travellers experiment a increasement near 10% in this assignment in comparison with the TRANS-TOOLS results. While holiday and private travellers suffer a slightly drop very similar, near 5%.

In the rail traffic graph, holiday and commuter travellers have high decreases, more than 60% and more 40% respectively. While business and private travellers experiments mild growths, more than 5% and more 10% respectively.

In the air traffic graph, private travellers group grows too much in this model, more than 80%. Holiday travellers increase but less, more than 30%. While, business travellers declines more than 10%.



The figure below represents the relative error between TRANS-TOOLS' traffic and the IC Module's, for each country and for road (red), rail (green) and air (blue). The levels of error are relatively low in most cases for the EU27 Member States. Major disfunctions tend to concentrate in peripheral non Member States, where modelling is less accurate, and in the rail and the air modes.



**Summary conclusions**

In conclusion, when in the model the penalty waiting time between consecutive planes is reduced to 0, it generates an enormous increase in plane use, mainly coming from road trips but also some from the rail.

*Name of assignment: 8th Assignment*

Date of assignment: 16/03/2011

Description: This assignment is based on a mix of the scenarios "Variation in rail and air costs", with slightly lower cost of road but higher interconnection cost from road to city. Slight reduction of short distance rail cost.

Main Parameters:

**Value of travel time in euro/hour**

Business: 20 €/h

Private: 12 €/h

Commuters: 10 €/h

Holiday: 7,5 €/h

**Interconnecting costs in euro/km**

City-road connector: 0.25 €/km

City-train connector: 0.1 €/km

Airport-road connector: 0,125 €/km

Airport-train connector: 0,125 €/km

Train-road connector: 0.25 €/km

**Travel Costs in euro/km**

Road: 0,15 €/km

Short-distance train: 0,1 €/km

Medium -distance train: 0.16 €/km

Long -distance train: 0.2 €/km

**Dispersion of travel cost and time cost**

**values:** 0,5

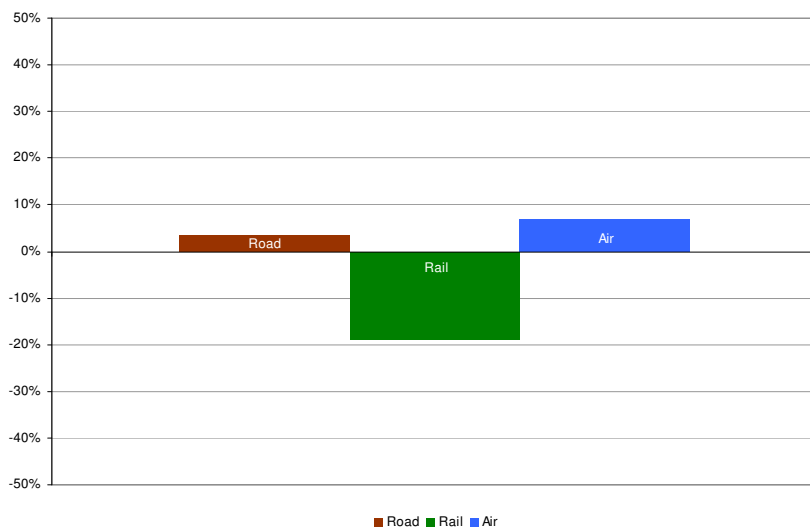
**Time Penalty for interconnecting at airports:**

60min

Output Analysis

Generally, this assignment presents fit results for the road and air transport modes, both have a small increase respect than the TRANS-TOOLS assignment. But rail transport mode is not adjusted yet; rail travellers have been cut up near 20% in this model.

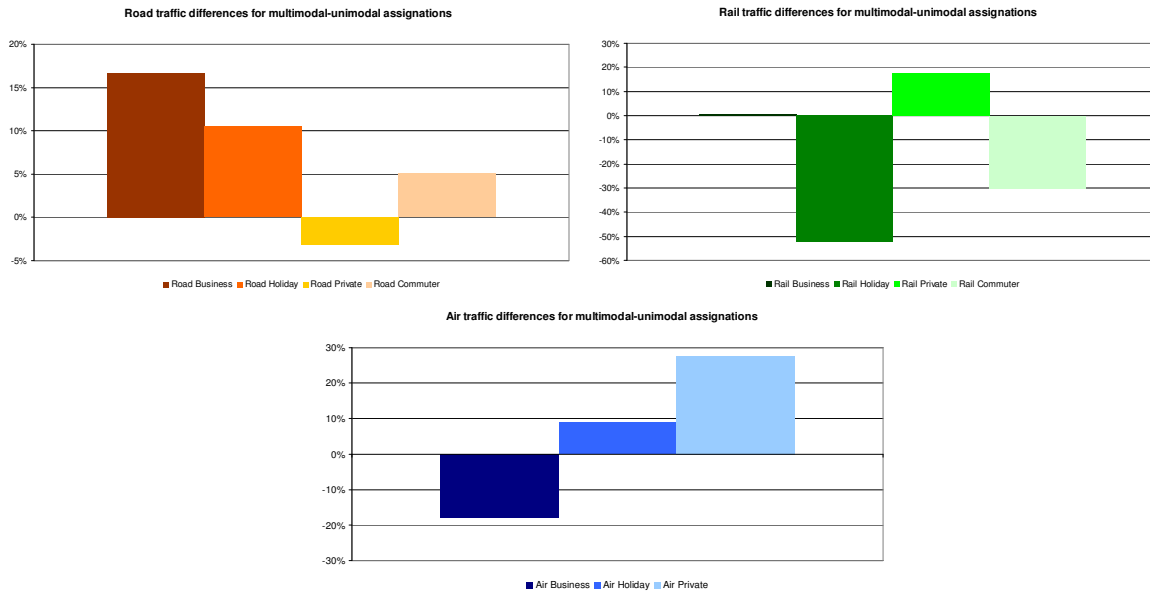
Traffic differences for multimodal-unimodal assignments



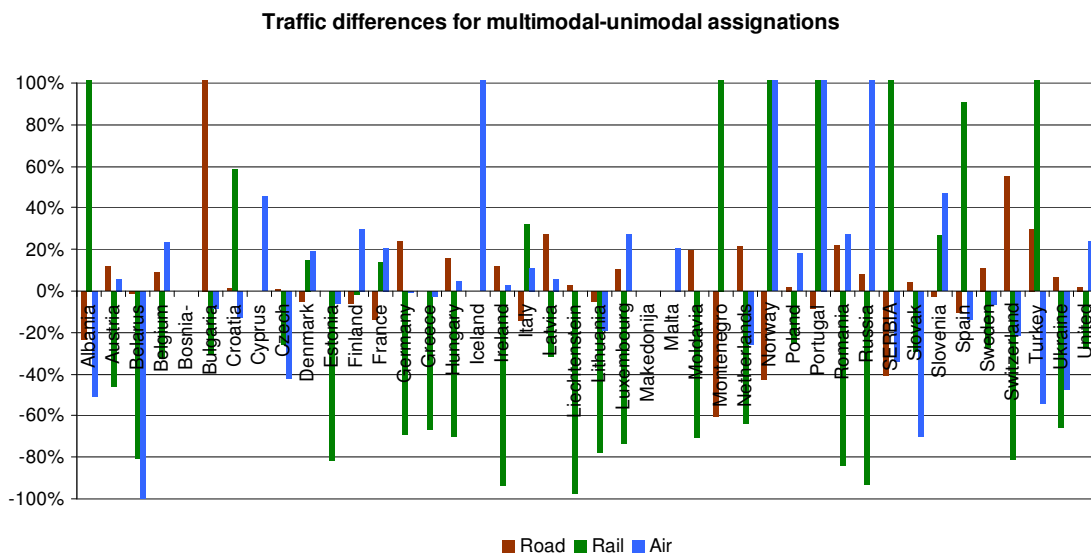
In the road traffic graph, most kind of trips –business, holiday and commuter- have a rise of travellers in this assignment in comparison with TRANS-TOOLS model. Specifically, business trips increase more than 15%, holiday trips increase 10% and commuter trips increase 5%. While private travellers suffers a small fall, of less than 5% TRANS-TOOLS model.

In the rail traffic graph, business trips appears as a good result in this model because it doesn't present any substantial difference with the results of the TRANS-TOOLS model. However holiday, private and commuter trips presents high disparities, holiday travellers fall more than 50% and commuters travellers drop 30%. While private trips grow near 20%.

In the air traffic graph, business travellers fall less than 20%, holiday travellers increase near 10%. While private travellers have a increase of more than 25%.



The figure below represents the relative error between TRANS-TOOLS' traffic and the IC Module's, for each country and for road (red), rail (green) and air (blue). The levels of error are relatively low in most cases for the EU27 Member States. Major disfunctions tend to concentrate in peripheral non Member States, where modelling is less accurate, and in the rail and the air modes.



Summary conclusions

To summarise, a reduction of 50% in the time penalty for air services has resulted in a high increase in use of the air mode. This increase comes in part from rail travellers but also from a great number of road travellers.

*Name of assignment: 9th Assignment*

Date of assignment: 21/03/2011

Description: This assignment is based on the scenario "Variation in interconnections and time penalty", with slightly lower cost of rail short distance, a dispersion parameter of 0.5 and time penalty of 60 minutes.

Main Parameters:

**Value of travel time in euro/hour**

Business: 25 €/h

Private: 10 €/h

Commuters: 10 €/h

Holiday: 7,5 €/h

**Interconnecting costs in euro/km**

City-road connector: 0.25 €/km

City-train connector: 0.1 €/km

Airport-road connector: 0,125 €/km

Airport-train connector: 0,125 €/km

Train-road connector: 0.25 €/km

**Travel Costs in euro/km**

Road: 0,15 €/km

Short-distance train: 0,09 €/km

Medium -distance train: 0.15 €/km

Long -distance train: 0.2 €/km

**Dispersion of travel cost and time cost**

**values:** 0,5

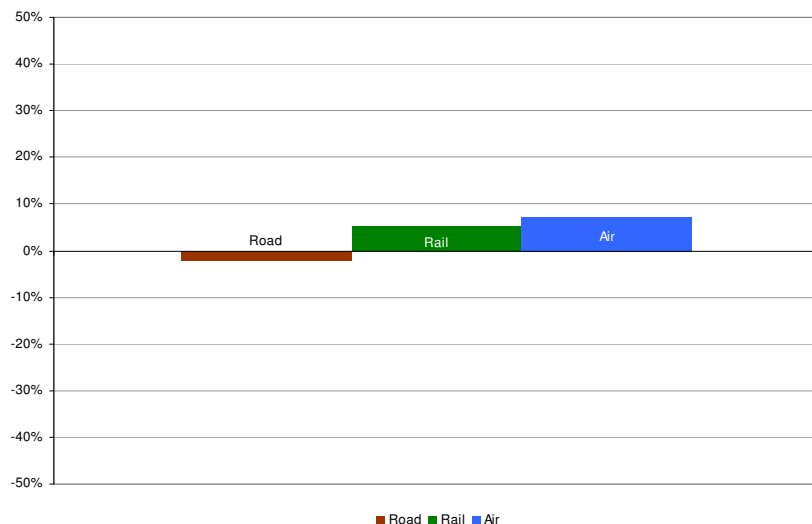
**Time Penalty for interconnecting at airports:**

60min

Output Analysis

Generally, this assignment presents very fit results. All transport modes have the same behaviour, with very low values between -2% -road transport mode- and 7% -air transport mode-.

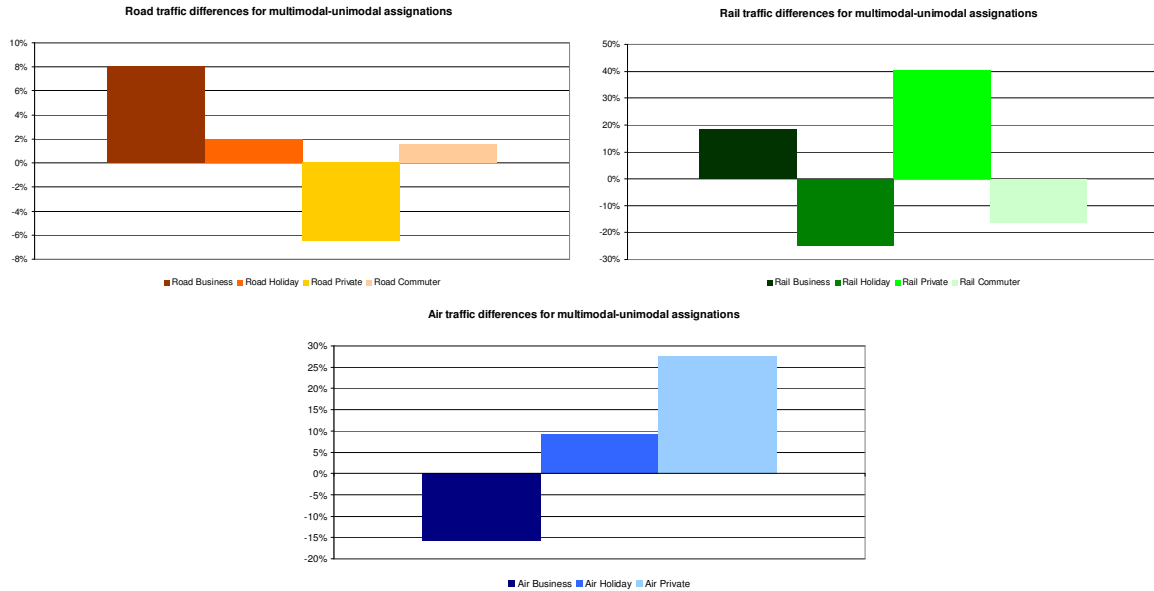
**Traffic differences for multimodal-unimodal assignments**



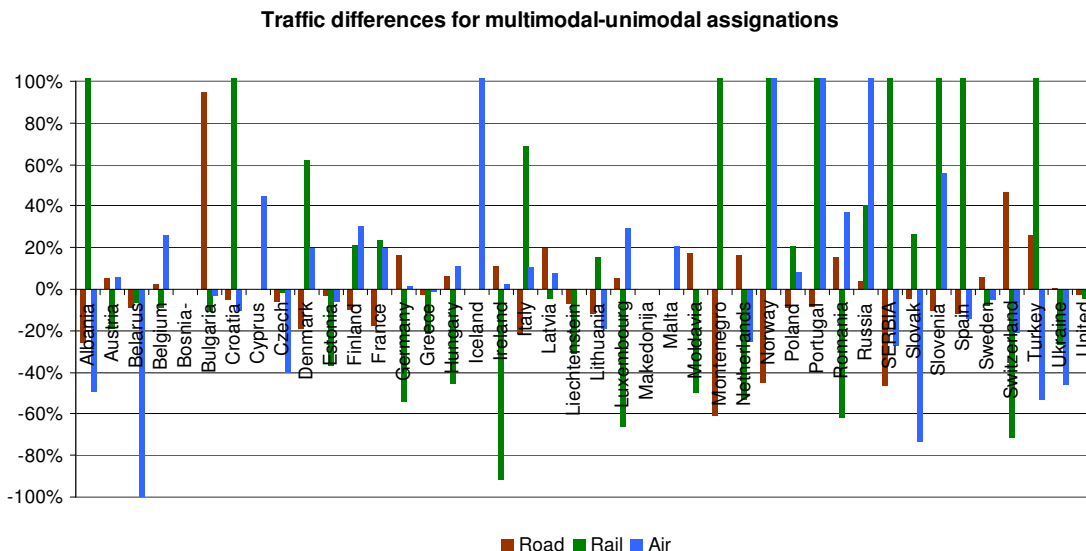
In the road traffic graph, business users increase an 8%, while holiday and commuter users have an insignificant increase, near 2% in comparison with the TRANS-TOOLS results. However road users fall near a 6%.

In the rail traffic graph, private trips have an important increasement of 40%, business trips also grows but less, almost 20%, While holiday users fall more than 20% and commuter drops more than 15% too.

In the air traffic graph, holiday and private users increase in this assignment in comparison with the TRANS-TOOLS assignment. While business trip drops more than 15%.



The figure below represents the relative error between TRANS-TOOLS' traffic and the IC Module's, for each country and for road (red), rail (green) and air (blue). The levels of error are relatively low in most cases for the EU27 Member States. Major disfunctions tend to concentrate in peripheral non Member States, where modelling is less accurate, and in the rail and the air modes.



Summary conclusions

To sum up, the slight reduction in rail cost has equilibrated the rail passengers moving them from the road mode. All transport modes have now less than 10% difference with respect to Transtools assignment.



*Name of assignment: 10th Assignment*

Date of assignment: 21/03/2011

Description: This assignment is based on the scenario "Variation in interconnections and time penalty", with slightly lower cost of rail short-distance, a dispersion parameter of 1 and time penalty of 60 minutes.

Main Parameters:

**Value of travel time in euro/hour**

Business: 25 €/h

Private: 10 €/h

Commuters: 10 €/h

Holiday: 7,5 €/h

**Interconnecting costs in euro/km**

City-road connector: 0.25 €/km

City-train connector: 0.1 €/km

Airport-road connector: 0,125 €/km

Airport-train connector: 0,125 €/km

Train-road connector: 0.25 €/km

**Travel Costs in euro/km**

Road: 0,15 €/km

Short-distance train: 0,09 €/km

Medium -distance train: 0.15 €/km

Long -distance train: 0.2 €/km

**Dispersion of travel cost and time cost**

**values: 11**

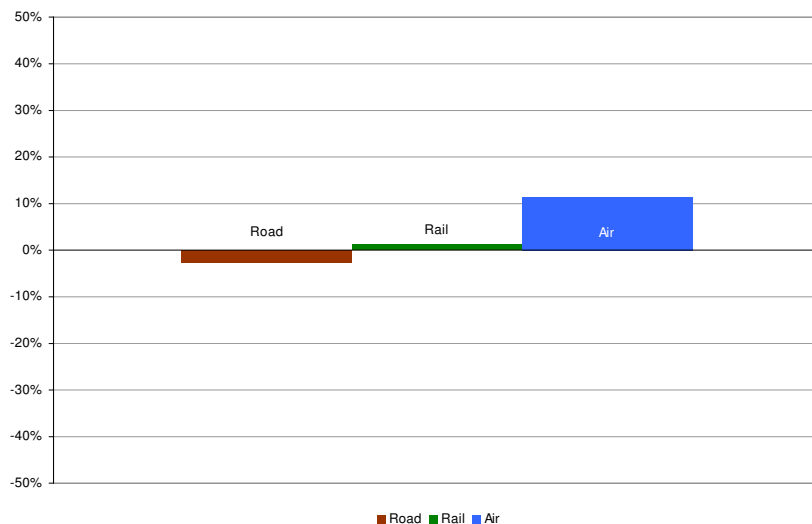
**Time Penalty for interconnecting at airports:**

60min

Output Analysis

Generally, this assignment presents quite accurate results for two of the the variables. rail and road transport modes have close results to the TRANS-TOOLS model. While in the air transport mode the differences between both assignments increase a 10%.

Traffic differences for multimodal-unimodal assignments

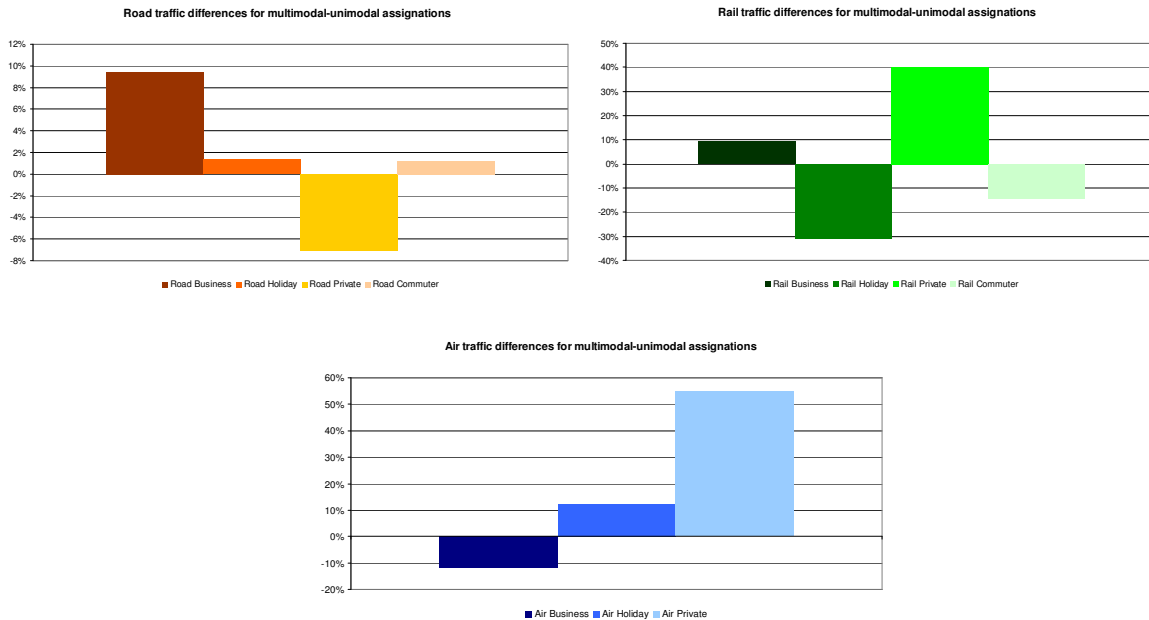


In the road traffic graph, business users have a substantially increase of almost 10%, and holiday and commuter users have a slightly grow, less than 2%, while private users fall more than 6%, in comparison with the TRANS-TOOLS results.

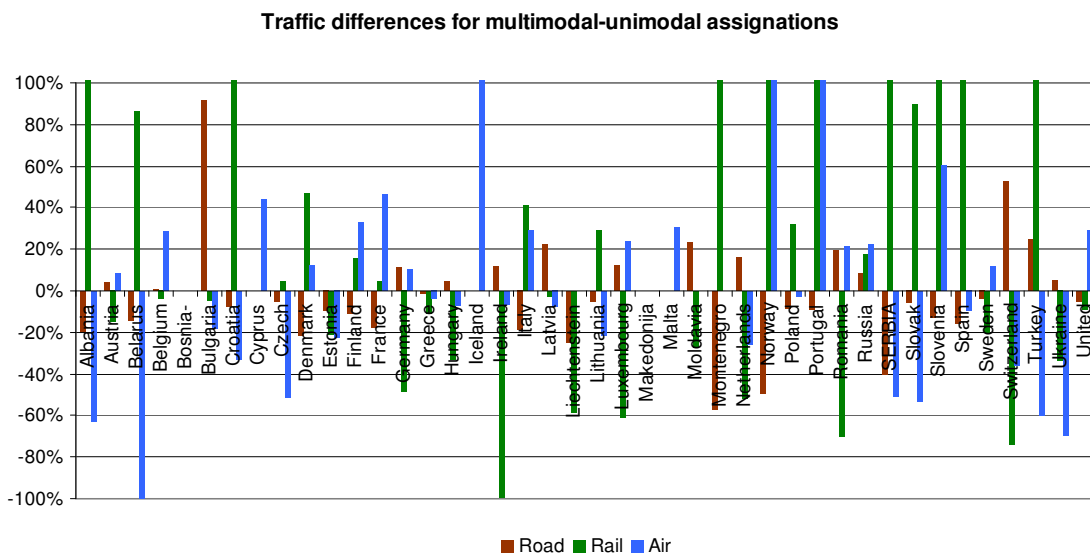
In the rail traffic graph, business and private trips presents high disparities, the first one decrease 30% and the second one grows 40%. Commuter users also decline, but lower, a bit more of 10%. While

that business users have a increase of almost 10%, in this model in comparison with the TRANS-TOOLS assignment

In the air traffic graph, holiday and private users increase, the first one too much, more than 50%, however private trips grows a 10%. While business users decline a bit more of 10% in this model in comparison with the TRANS-TOOLS assignment



The figure below represents the relative error between TRANS-TOOLS' traffic and the IC Module's, for each country and for road (red), rail (green) and air (blue). The levels of error are relatively low in most cases for the EU27 Member States. Major disfunctions tend to concentrate in peripheral non Member States, where modelling is less accurate, and in the rail and the air modes.



**Summary conclusions**

In conclusion, in this case a increase of dispersion factor has the effect of increasing the air trips. Globally the fit has worsened.

*Name of assignment: 11th Assignment*

Date of assignment: 21/03/2011

Description: This assignment is based on the scenario "Variation in interconnections and time penalty", with slightly lower cost of rail short distance, a dispersion parameter of 0.5 and time penalty of 90 minutes

Main Parameters:

**Value of travel time in euro/hour**

Business: 25 €/h

Private: 10 €/h

Commuters: 10 €/h

Holiday: 7,5 €/h

**Interconnecting costs in euro/km**

City-road connector: 0.25 €/km

City-train connector: 0.1 €/km

Airport-road connector: 0,125 €/km

Airport-train connector: 0,125 €/km

Train-road connector: 0.25 €/km

**Travel Costs in euro/km**

Road: 0,15 €/km

Short-distance train: 0,09 €/km

Medium -distance train: 0.15 €/km

Long -distance train: 0.2 €/km

**Dispersion of travel cost and time cost**

**values:** 0,5

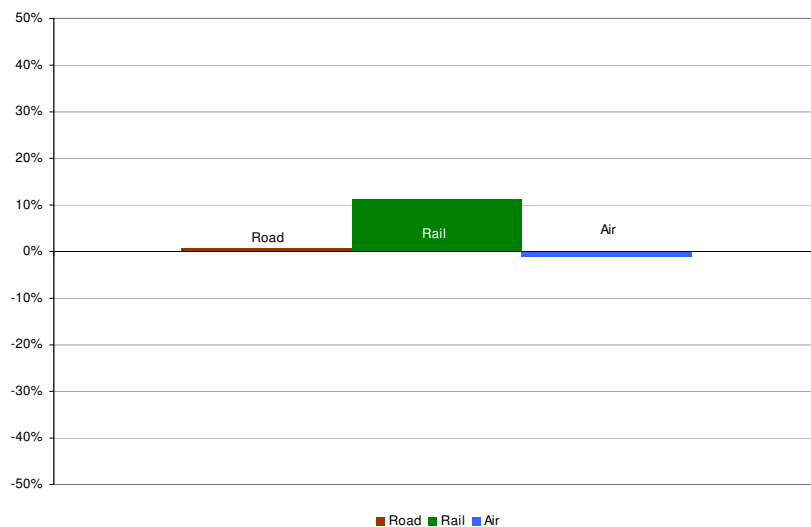
**Time Penalty for interconnecting at airports:**

90min

Output Analysis

In general terms, road and air results have been improved, overall road transport mode, which has almost equal values in this assignment and in the TRANS-TOOLS assignment. While results from rail transport are a bit worse, they have increased nearly 10%.

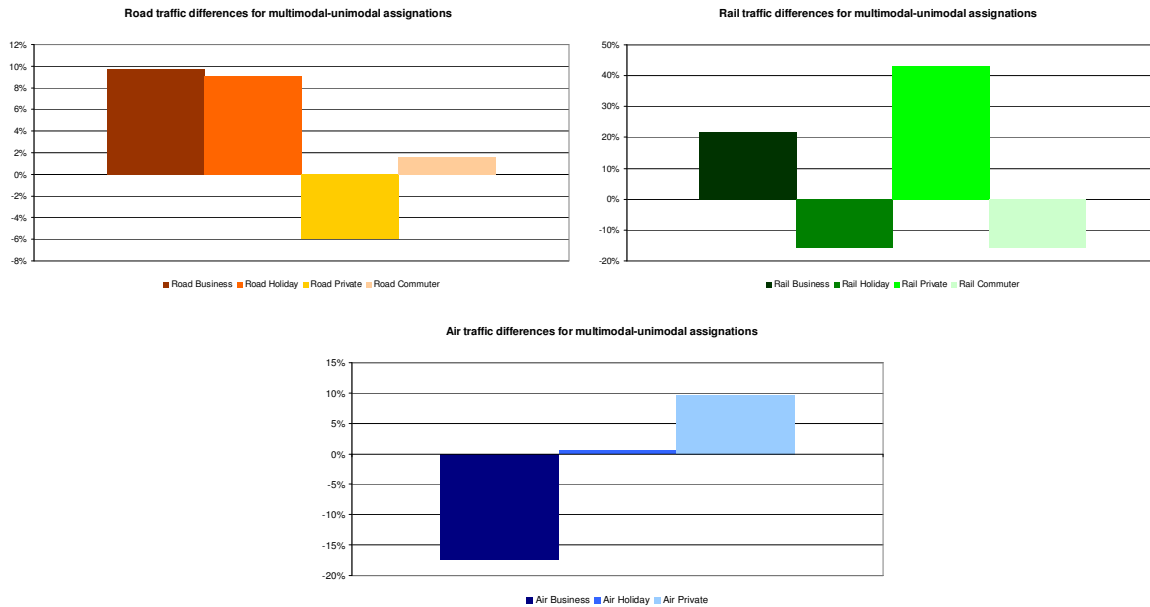
Traffic differences for multimodal-unimodal assignments



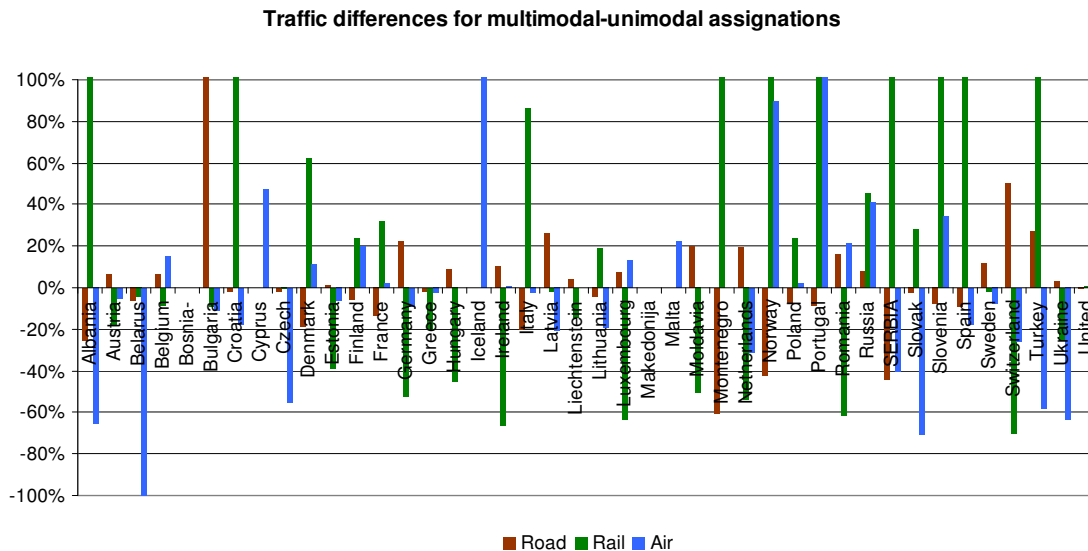
In the road traffic graph, business and holiday travellers have a similar behavior, they have a growth of nearly 10%. And commuter travellers present a insignificant increasement of less than 2%. While private travellers fall by 6%

In the rail traffic graph, holiday and commuter travellers decline more than 10%. While private trips have a high rise of more than 40% and business trips increase by 20%

In the air traffic graph, air holiday presents fitted results, with an unsubstantial growth. While business travellers drop more than 15% and private travellers increase nearly 10%



The figure below represents the relative error between TRANS-TOOLS' traffic and the IC Module's, for each country and for road (red), rail (green) and air (blue). The levels of error are relatively low in most cases for the EU27 Member States. Major disfunctions tend to concentrate in peripheral non Member States, where modelling is less accurate, and in the rail and the air modes.



Summary conclusions

To conclude, a higher time penalty in connecting flights produces that travellers move from air transport mode to road and rail transports modes, but the rail grows too much.

*Name of assignment: 12th Assignment*

Date of assignment: 21/03/2011

Description: This assignment is based on the scenario "Variation in interconnections and time penalty", with slightly lower cost of rail short distance, a dispersion parameter of 1 and time penalty of 90 minutes

Main Parameters:

**Value of travel time in euro/hour**

Business: 25 €/h

Private: 10 €/h

Commuters: 10 €/h

Holiday: 7,5 €/h

**Interconnecting costs in euro/km**

City-road connector: 0.25 €/km

City-train connector: 0.1 €/km

Airport-road connector: 0,125 €/km

Airport-train connector: 0,125 €/km

Train-road connector: 0.25 €/km

**Travel Costs in euro/km**

Road: 0,15 €/km

Short-distance train: 0,09 €/km

Medium -distance train: 0.15 €/km

Long -distance train: 0.2 €/km

**Dispersion of travel cost and time cost**

**values: 1**

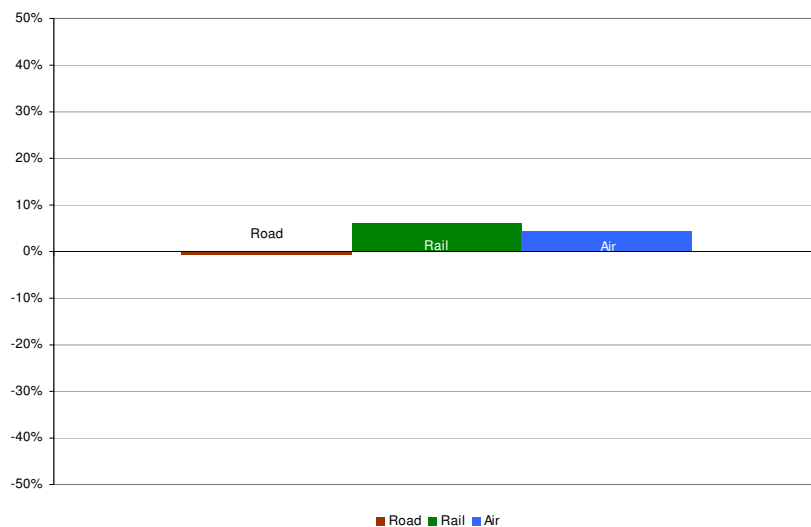
**Time Penalty for interconnecting at airports:**

90min

Output Analysis

At large, all transport modes have a similar behaviour, besides they presents very fitted results. The best values are from road transport mode, their results are equal in this assignment and in the TRANS-TOOLS model. While rail and air have a low increase, nearly 6%.

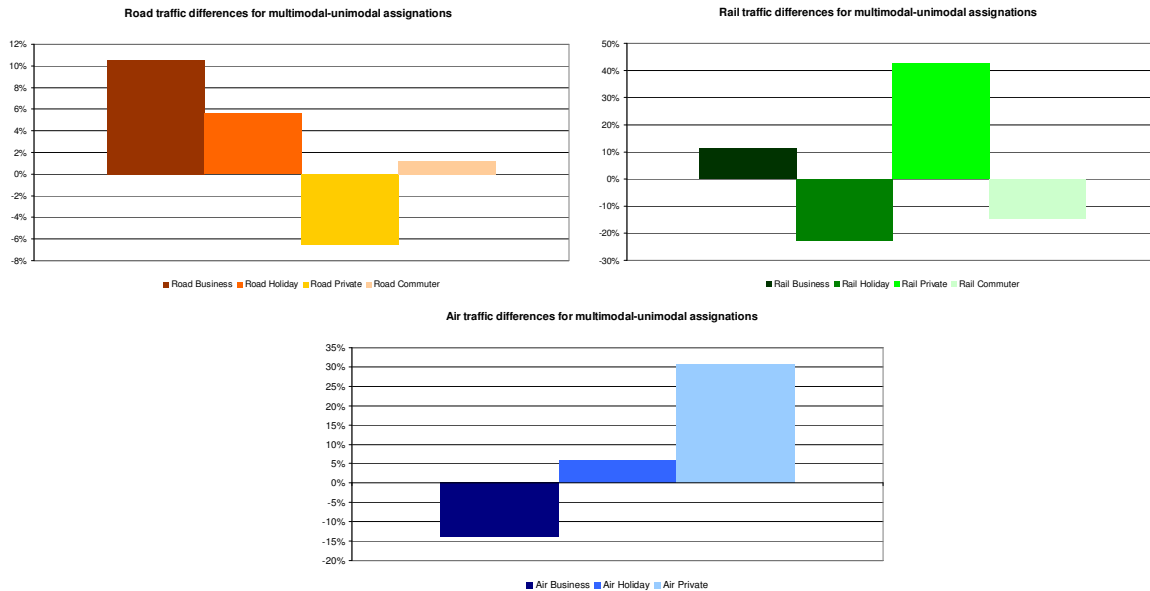
Traffic differences for multimodal-unimodal assignments



In the road traffic graph, most of the trips share the same path of growing, overall business travellers with a increase of more than 10%, holiday travellers with a growth nearly 6% and commuter travellers practically doesn't rise, under 1%. While private travellers drops by more than 6%.

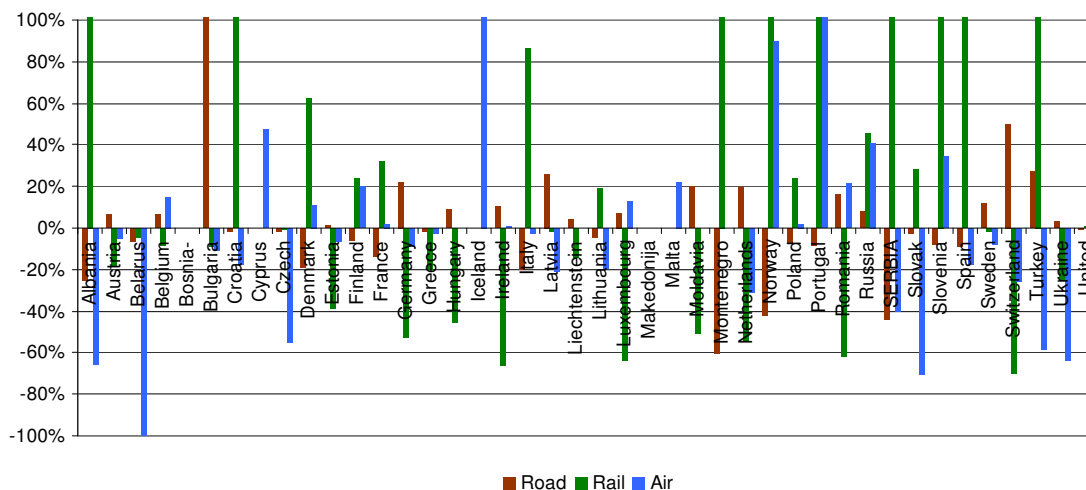
In the rail traffic graph, private trips have a high increase of more than 40%, business travellers also grow but less, nearly 10%. While, holiday and commuter travellers decline, more than 20% and more than 10% respectively.

In the air traffic graph, holiday trips have a slightly rise nearly 5%, and the private trips have a substantial increase by 30%. While business travellers drop almost 15%.



The figure below represents the relative error between TRANS-TOOLS' traffic and the IC Module's, for each country and for road (red), rail (green) and air (blue). The levels of error are relatively low in most cases for the EU27 Member States. Major disfunctions tend to concentrate in peripheral non Member States, where modelling is less accurate, and in the rail and the air modes.

**Traffic differences for multimodal-unimodal assignments**



Summary conclusions

To sum up, this assignment presents good results with fitted values under 6%, by increasing the dispersion value to 1.

*Name of assignment: 13th Assignment*

Date of assignment: 22/03/2011

Description: This assignment is based on the scenario "12<sup>th</sup> assignment with dispersion value of 1 and time penalty value of 90 minutes", with variations in the dispersion parameters: 1 for Value of Time, 0.5 for infrastructure costs and interchange costs

Main Parameters:

**Value of travel time in euro/hour**

Business: 25 €/h

Private: 10 €/h

Commuters: 10 €/h

Holiday: 7,5 €/h

**Interconnecting costs in euro/km**

City-road connector: 0.25 €/km

City-train connector: 0.1 €/km

Airport-road connector: 0,125 €/km

Airport-train connector: 0,125 €/km

Train-road connector: 0.25 €/km

**Travel Costs in euro/km**

Road: 0,15 €/km

Short-distance train: 0,09 €/km

Medium -distance train: 0.15 €/km

Long -distance train: 0.2 €/km

**Dispersion of travel cost and time cost**

**values: 1**

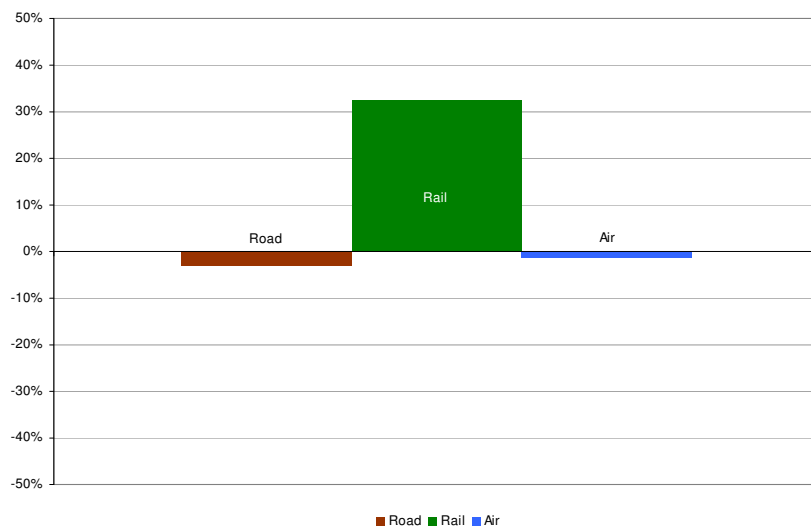
**Time Penalty for interconnecting at airports:**

90min

Output Analysis

Generally, road and air transport modes presents fitted results in this assignment in comparison with the TRANS-TOOLS model, they have a slightly decline, under 5%. While the difference between both assignment in rail transport mode has a high increase, nearly 30%.

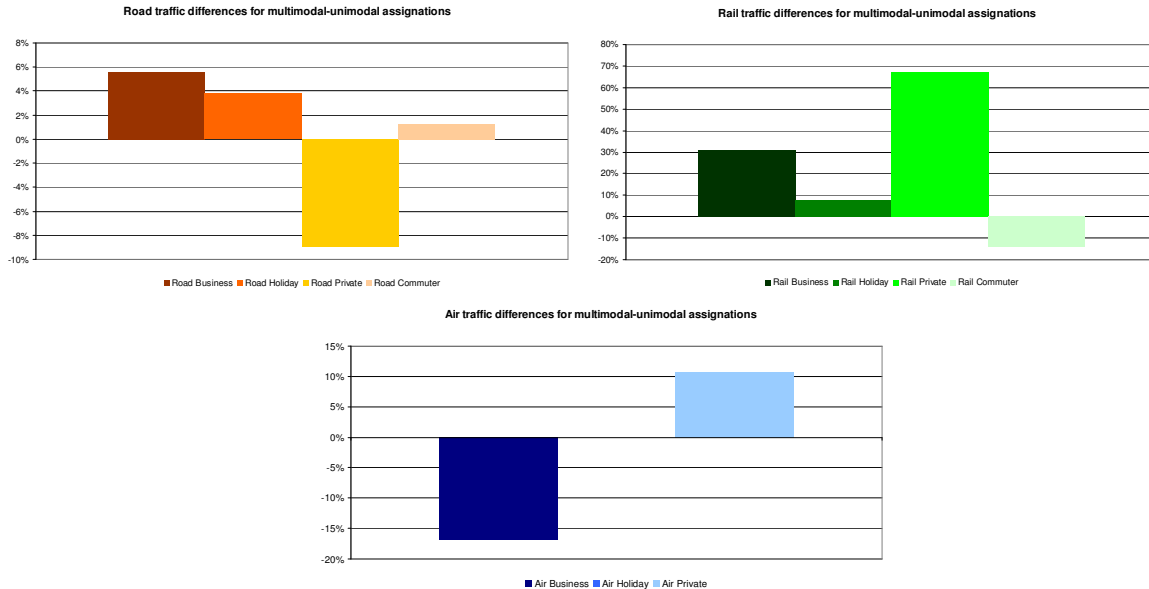
Traffic differences for multimodal-unimodal assignments



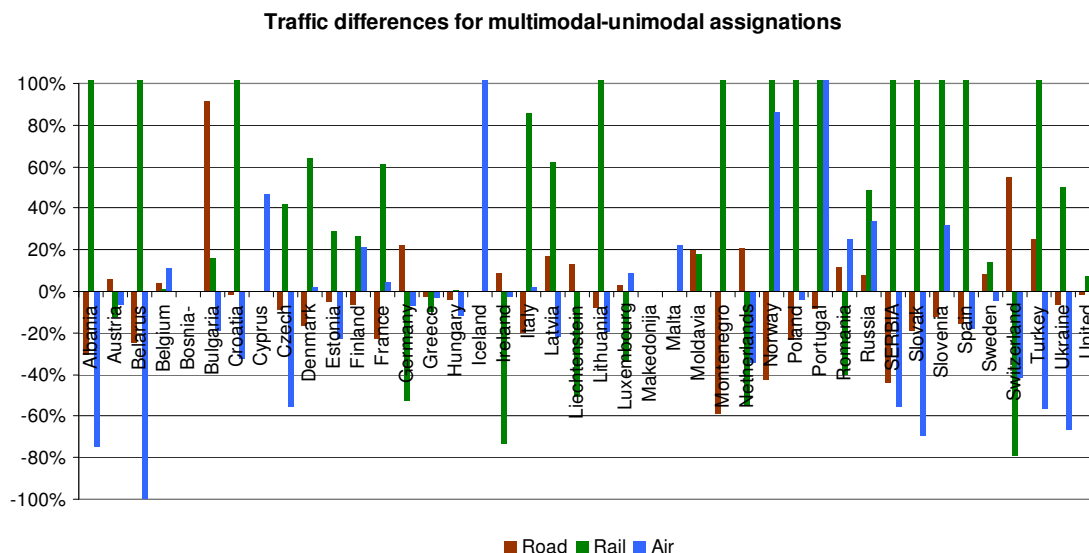
In the road traffic graph, all kind of trips have a difference under 10% between both assignments. Just private users fall by 9%. While business and holiday users increase, the first one nearly 6% and the second one nearly 4%. And commuter users are practically equal in both assignment, with a insignificant increase nearly 1%.

In the rail traffic graph, the results are worse than in road transport mode. Private trips increase too much, more than 60%. And business trips also have a high increase nearly 30%. Only holiday users have a slightly growth, nearly 5%. On the other hand, commuter trips drop more than 10%.

In the air traffic graph, holiday trips have the best fitted results because these haven't difference between both assignments. But business trips fall more than 15% and private trips increase nearly 10%.



The figure below represents the relative error between TRANS-TOOLS' traffic and the IC Module's, for each country and for road (red), rail (green) and air (blue). The levels of error are relatively low in most cases for the EU27 Member States. Major disfunctions tend to concentrate in peripheral non Member States, where modelling is less accurate, and in the rail and the air modes.



**Summary conclusions**

To conclude, the choice in dispersion values in this assignment has clearly favoured the rail transport mode at expense of both air and road transport modes.



*Name of assignment: 14h Assignment*

Date of assignment: 22/03/2011

Description: This assignment is based on the scenario "12<sup>th</sup> assignment with dispersion value of 1 and time penalty value of 90 minutes", with variations in the dispersion parameters: 1 for Value of Time, 0.5 for infrastructure costs and 0 for interchange costs

Main Parameters:

**Value of travel time in euro/hour**

Business: 25 €/h

Private: 10 €/h

Commuters: 10 €/h

Holiday: 7,5 €/h

**Interconnecting costs in euro/km**

City-road connector: 0.25 €/km

City-train connector: 0.1 €/km

Airport-road connector: 0,125 €/km

Airport-train connector: 0,125 €/km

Train-road connector: 0.25 €/km

**Travel Costs in euro/km**

Road: 0,15 €/km

Short-distance train: 0,09 €/km

Medium -distance train: 0.15 €/km

Long -distance train: 0.2 €/km

**Dispersion of travel cost and time cost**

**values: 1**

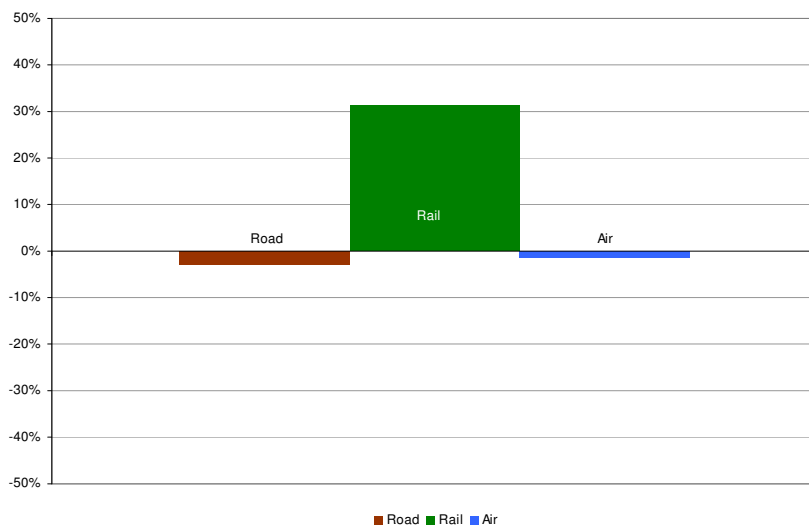
**Time Penalty for interconnecting at airports:**

90min

Output Analysis

In general terms, road and air transport modes presents fitted results in this assignment in comparison with the TRANS-TOOLS model, they have a slightly decline, under 5%. While the difference between both assignment in rail transport mode has a high increase, nearly 30%

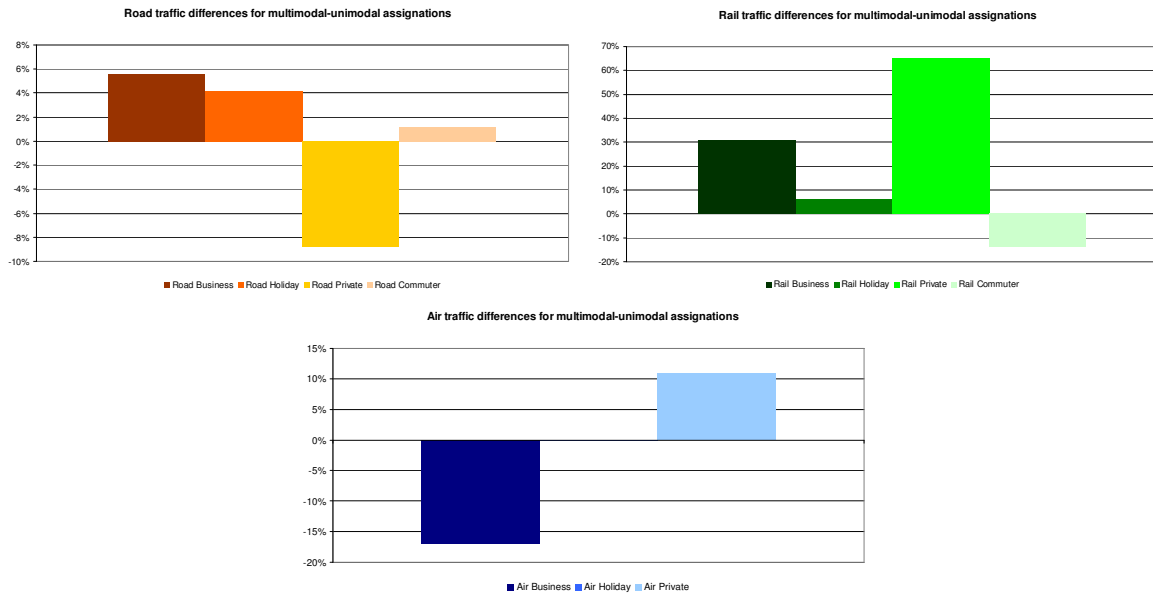
Traffic differences for multimodal-unimodal assignments



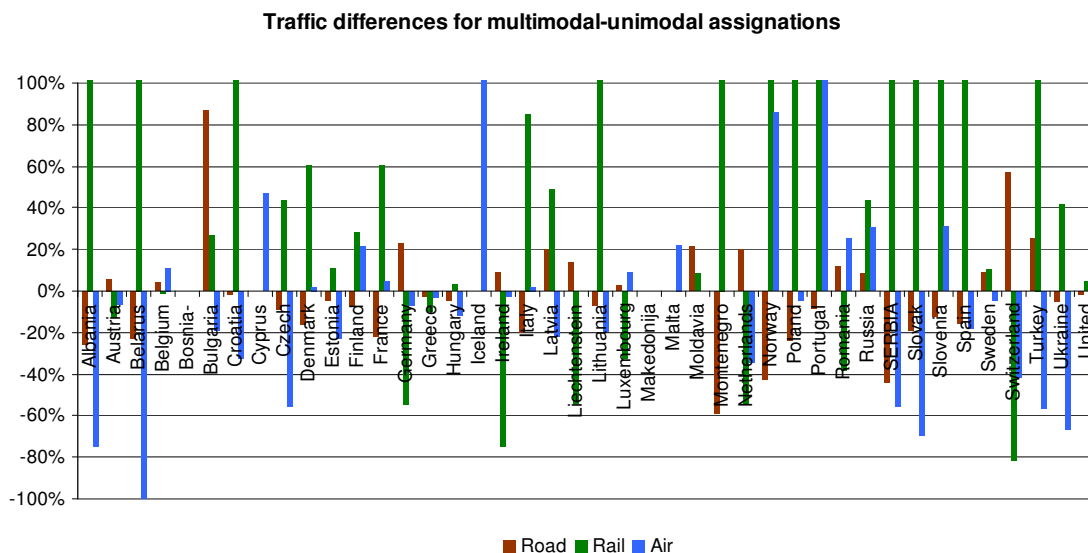
In the road traffic graph, all kind of trips have a difference under 10% between both assignments. Just private users fall by 9%. While business and holiday users increase, the first one nearly 6% and the second one nearly 4%. And commuter users are practically equal in both assignment, with a insignificant increase nearly 1%.

In the rail traffic graph, the results are worse than in road transport mode. Private trips increase too much, more than 60%. And business trips also have a high increase nearly 30%. Only holiday users have a slightly growth, nearly 5%. On the other hand, commuter trips drop more than 10%.

In the air traffic graph, holiday trips have the best fitted results because these haven't difference between both assignments. But business trips fall more than 15% and private trips increase nearly 10%.



The figure below represents the relative error between TRANS-TOOLS' traffics and the IC Module's, for each country and for road (red), rail (green) and air (blue). The levels of error are relatively low in most cases for the EU27 Member States. Major disfunctions tend to concentrate in peripheral non Member States, where modelling is less accurate, and in the rail and the air modes



**Summary conclusions**

To sum up, in this assignment a value of 0 in the dispersion parameter for interchange costs improves the fit to Transtools data, but only marginally.

*Name of assignment: 15h Assignment*

Date of assignment: 22/03/2011

Description: This assignment is based on the scenario "12<sup>th</sup> assignment with dispersion value of 1 and time penalty value of 90 minutes", with variations in the dispersion parameters: 0.5 for Value of Time, 0.5 for infrastructure costs and 0 for interchange costs

Main Parameters:

**Value of travel time in euro/hour**

Business: 25 €/h

Private: 10 €/h

Commuters: 10 €/h

Holiday: 7,5 €/h

**Interconnecting costs in euro/km**

City-road connector: 0.25 €/km

City-train connector: 0.1 €/km

Airport-road connector: 0,125 €/km

Airport-train connector: 0,125 €/km

Train-road connector: 0.25 €/km

**Travel Costs in euro/km**

Road: 0,15 €/km

Short-distance train: 0,09 €/km

Medium -distance train: 0.15 €/km

Long -distance train: 0.2 €/km

**Dispersion of travel cost and time cost**

**values:** 0.5

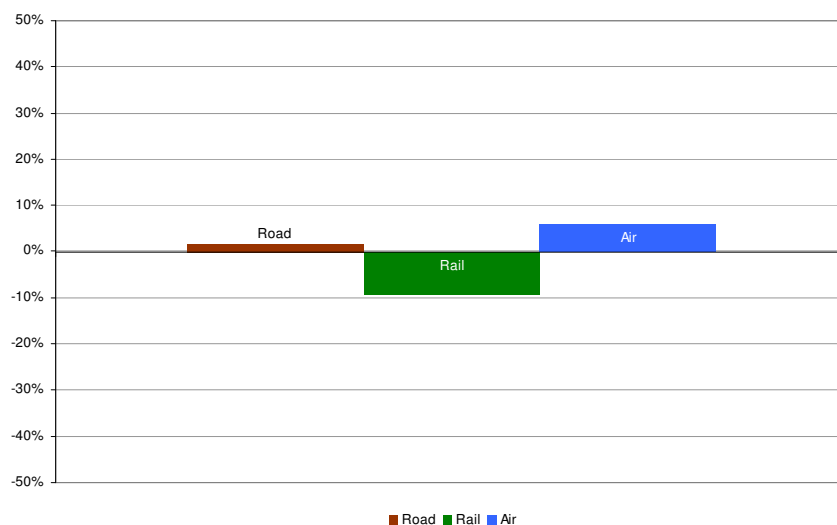
**Time Penalty for interconnecting at airports:**

90min

Output Analysis

Generally, all transport modes –road, rail and air- presents good results in this assignment, because the differences between this assignment and the TRANS-TOOLS model are under 10%. The fittest results are in the road transport mode, with a slightly increase, then air users grow by 5% and rail users fall nearly by 10%.

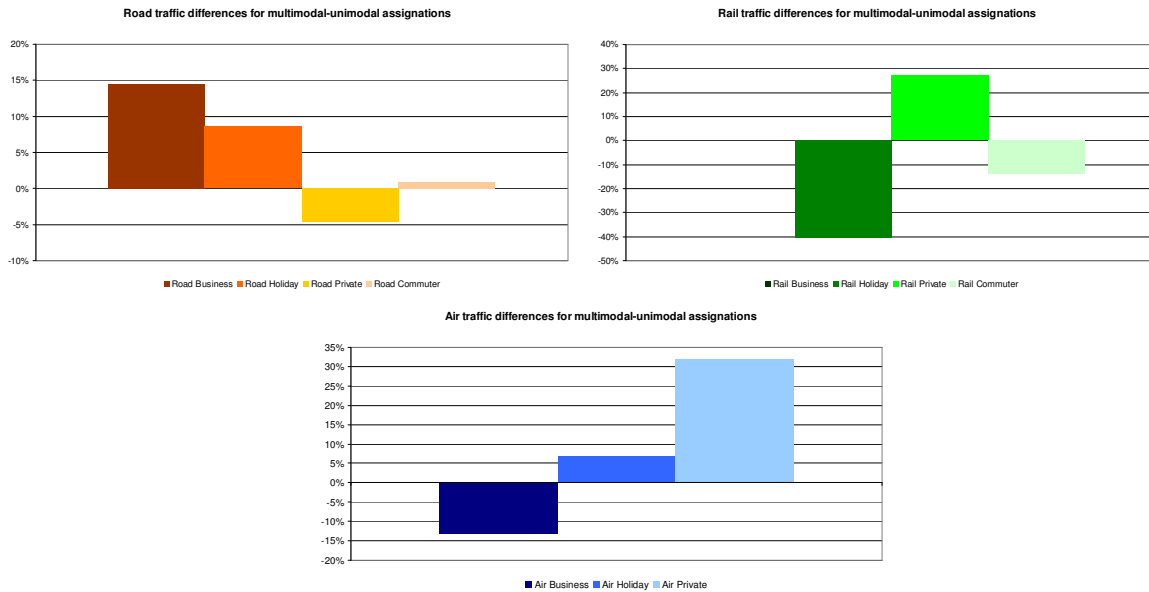
**Traffic differences for multimodal-unimodal assignments**



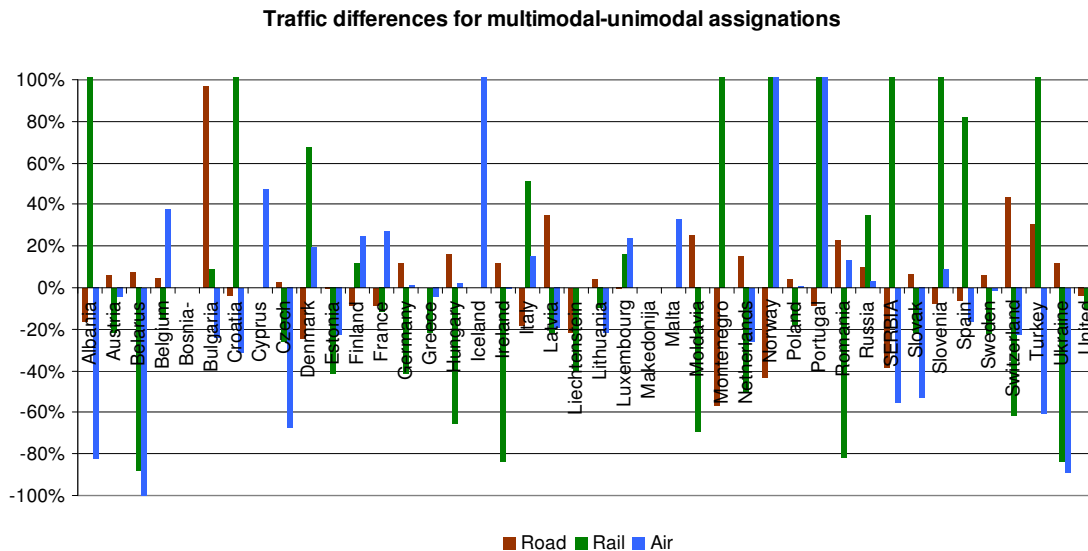
In the road traffic graph, business users are the group which has the highest increase, nearly 15%; then, holiday users grow more than 5%, and commuter users have a insignificant rise. While private users fall nearly 5%.

In the rail traffic graph, business trips are equal than in the TRANS-TOOLS model. While holiday trips drop strongly by 40%, and also commuter users fall more than 10%. In contrast to private users which grow substantially more than 25%.

In the air traffic graph, private trips have a high growth, more than 30%; while holiday trips increase more than 5%. Otherwise, business users decline more than 10%.



The figure below represents the relative error between TRANS-TOOLS' traffics and the IC Module's, for each country and for road (red), rail (green) and air (blue). The levels of error are relatively low in most cases for the EU27 Member States. Major disfunctions tend to concentrate in peripheral non Member States, where modelling is less accurate, and in the rail and the air modes



Summary conclusions

In conclusion, the choice of dispersion values in this scenario has a result in a situation similar to that of scenario "Sixth assignment Disp 1 TP 90", but road and rail shifting roles.

*Name of assignment: 16h Assignment*

Date of assignment: 22/03/2011

Description: This assignment is based on the scenario "12th assignment with dispersion value of 1 and time penalty value of 90 minutes", with variations in the dispersion parameters: 0.5 for Value of Time, 0.1 for infrastructure costs and 0 for interchange costs

Main Parameters:

**Value of travel time in euro/hour**

Business: 25 €/h

Private: 10 €/h

Commuters: 10 €/h

Holiday: 7,5 €/h

**Interconnecting costs in euro/km**

City-road connector: 0.25 €/km

City-train connector: 0.1 €/km

Airport-road connector: 0,125 €/km

Airport-train connector: 0,125 €/km

Train-road connector: 0.25 €/km

**Travel Costs in euro/km**

Road: 0,15 €/km

Short-distance train: 0,09 €/km

Medium -distance train: 0.15 €/km

Long -distance train: 0.2 €/km

**Dispersion of travel cost and time cost**

**values:** 0.5

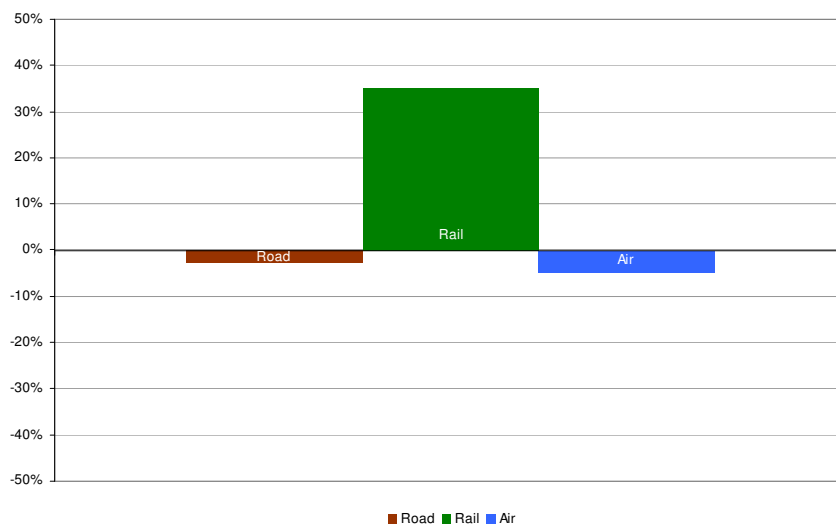
**Time Penalty for interconnecting at airports:**

90min

Output Analysis

Broadly, road and air transport modes present fitted results, their differences in comparison with the TRANS-TOOLS model are under 5%. But the result of rail transport mode is worst, it has a higher growth, more than 30%.

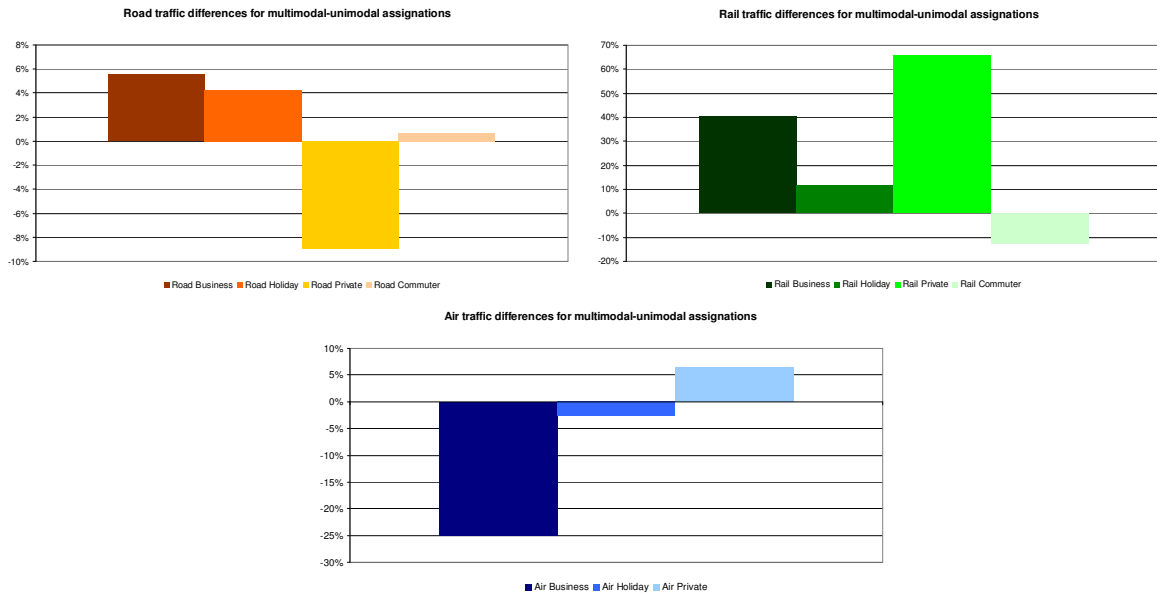
**Traffic differences for multimodal-unimodal assignments**



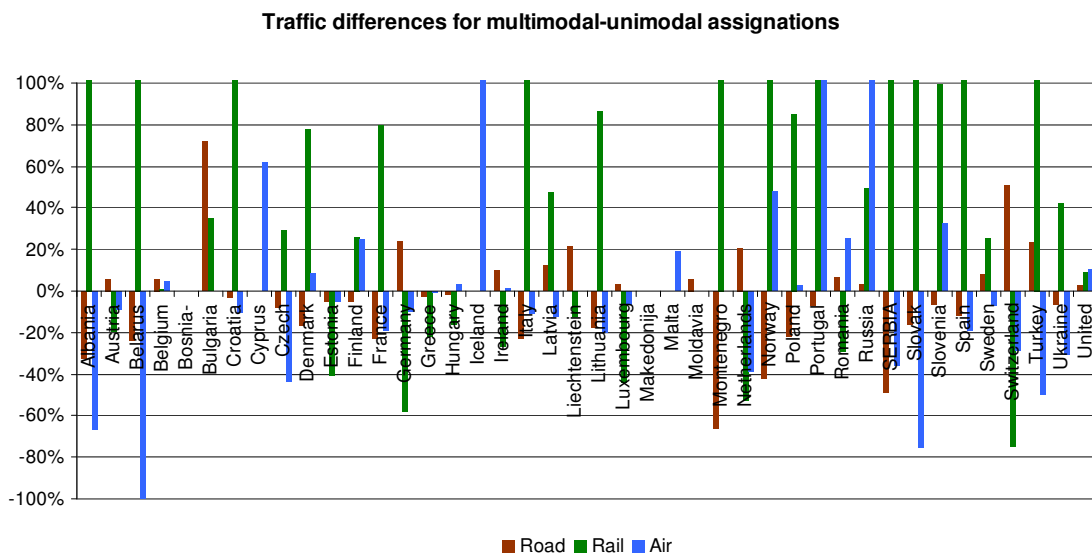
In the road traffic graph, all purpose trips have quite fitted results, all of them have differences under 10%. Business users grow more than 5%, and holiday users increase by 4%, while commuter users have an insignificant rise, growing less than 1%. In contrast to holiday users, which are the unique group that drops, less than 10%.

In the rail traffic graph, private and business trips haven't fitted results, because both grow too much, the first one more than 60% and the second one by 40%. While holiday users increase by 10%. In contrast to commuter users which decline more than 10%.

In the air traffic graph, private and holiday trips present quite good results, overall holiday purpose which has a slightly decline nearly 1%, while private users grows more than 5%. However, business users have a substantial decline by 25%.



The figure below represents the relative error between TRANS-TOOLS' traffics and the IC Module's, for each country and for road (red), rail (green) and air (blue). The levels of error are relatively low in most cases for the EU27 Member States. Major disfunctions tend to concentrate in peripheral non Member States, where modelling is less accurate, and in the rail and the air modes



Summary conclusions

To sum up, a lower value of dispersion for infrastructure costs in this assignment makes a high increase of rail trips.

**Name of assignment: 17h Assignment**

**Date of assignment: 23/03/2011**

**Description:** This assignment is based on the scenario "12<sup>th</sup> assignment with dispersion value of 1 and time penalty value of 90 minutes", with variations in the dispersion parameters: 0.75 for all parameters. And the time penalty is increased slightly to 120 minutes. Besides, airport-road connector and airport-train connector costs have been experimented a slightly rise.

**Main Parameters:**

**Value of travel time in euro/hour**

Business: 25 €/h

Private: 10 €/h

Commuters: 10 €/h

Holiday: 7,5 €/h

**Interconnecting costs in euro/km**

City-road connector: 0.25 €/km

City-train connector: 0.1 €/km

Airport-road connector: 0,15 €/km

Airport-train connector: 0,15 €/km

Train-road connector: 0.25 €/km

**Travel Costs in euro/km**

Road: 0,15 €/km

Short-distance train: 0,09 €/km

Medium -distance train: 0.15 €/km

Long -distance train: 0.2 €/km

**Dispersion of travel cost and time cost**

**values:** 0.75

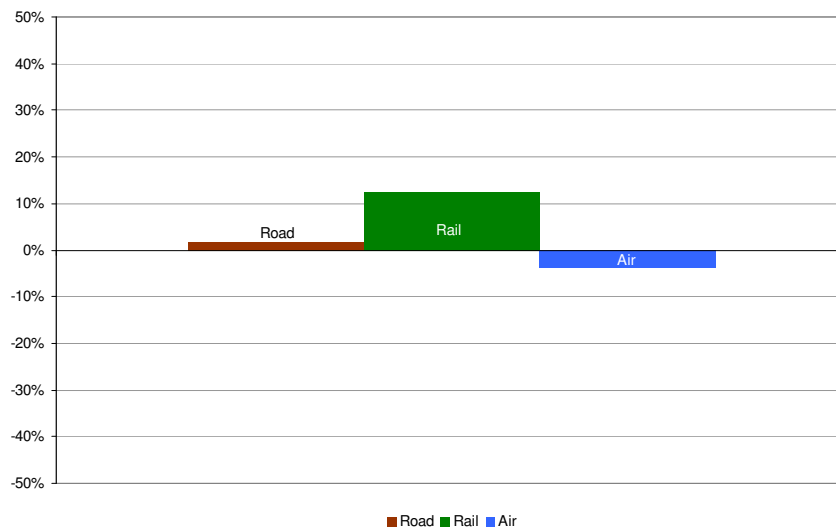
**Time Penalty for interconnecting at airports:**

120min

**Output Analysis**

At large, road and air transport modes present adjusted results in this assignment in comparison with the TRANS-TOOLS model, their values are reasonable similar in both assignments. Whereas, rail transport mode has a high increase by 12%.

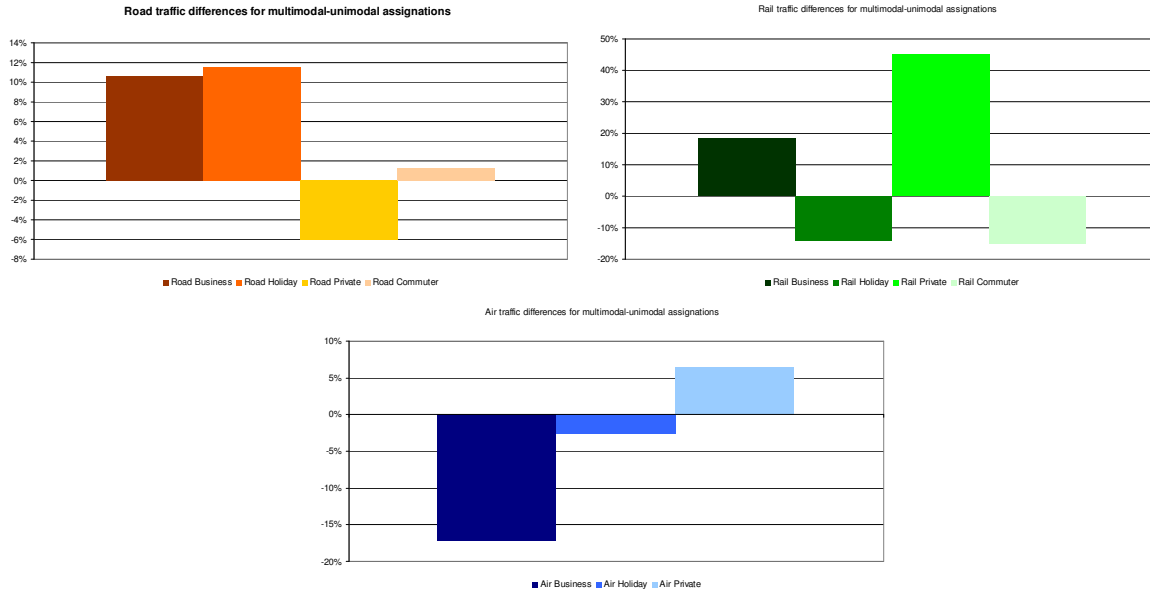
Traffic differences for multimodal-unimodal assignments



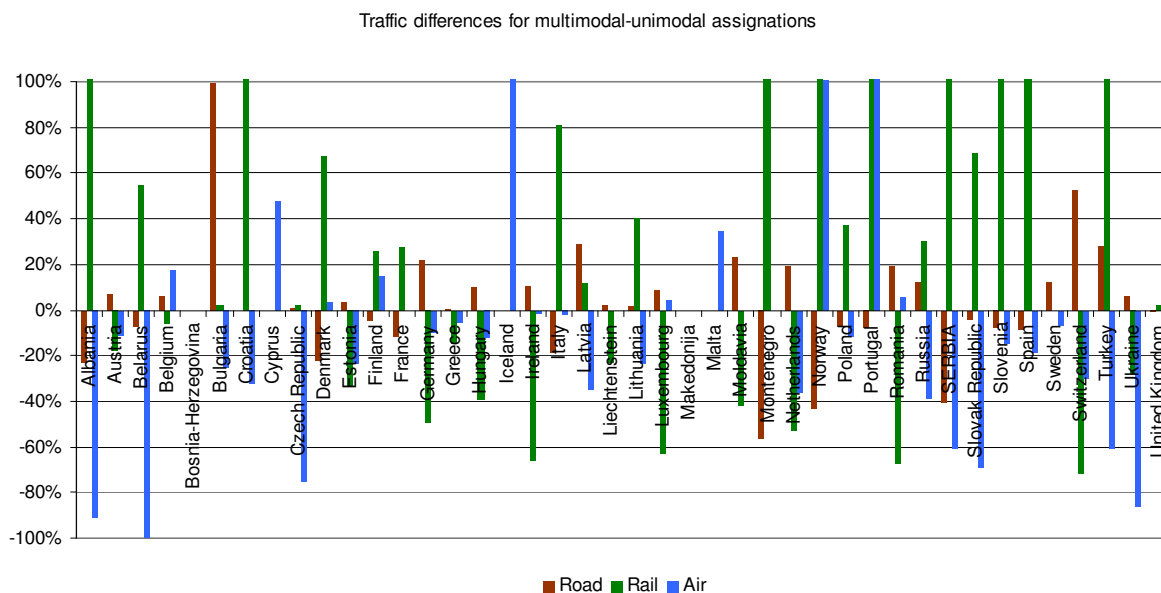
In the road traffic graph, holiday and business users increase, they grow more than 10%. While commuter travellers have an insignificant increase nearly 1%. Private travellers, meanwhile, fall by 6%.

In the rail traffic graph, private trips increase more than 40%, and business trips increase nearly 20%. While holiday and commuter trips both decline more than 10%.

In the air traffic graph, holiday travellers decrease slightly by 3%, while business travellers fall more than 15%. In contrast to private travellers which grow more than 5%.



The figure below represents the relative error between TRANS-TOOLS' traffics and the IC Module's, for each country and for road (red), rail (green) and air (blue). The levels of error are relatively low in most cases for the EU27 Member States. Major disfunctions tend to concentrate in peripheral non Member States, where modelling is less accurate, and in the rail and the air modes



Summary conclusions

To sum up, a lower value of dispersion for infrastructure costs in this assignment causes a high increase of rail trips. While the results of road and air trips from this assignment are very similar to the results from the TRANS-TOOLS model.



*Name of assignment: 18h Assignment*

Date of assignment: 23/03/2011

Description: This assignment is based on the scenario "12<sup>th</sup> assignment with dispersion value of 1 and time penalty value of 90 minutes", with variations in the dispersion parameters: 0.75 for all parameters. Besides, airport-road connector and airport-train connector costs have been experimented a slightly rise.

Main Parameters:

**Value of travel time in euro/hour**

Business: 25 €/h

Private: 10 €/h

Commuters: 10 €/h

Holiday: 7,5 €/h

**Interconnecting costs in euro/km**

City-road connector: 0.25 €/km

City-train connector: 0.1 €/km

Airport-road connector: 0,15 €/km

Airport-train connector: 0,15 €/km

Train-road connector: 0.25 €/km

**Travel Costs in euro/km**

Road: 0,15 €/km

Short-distance train: 0,09 €/km

Medium -distance train: 0.15 €/km

Long -distance train: 0.2 €/km

**Dispersion of travel cost and time cost**

**values:** 0.75

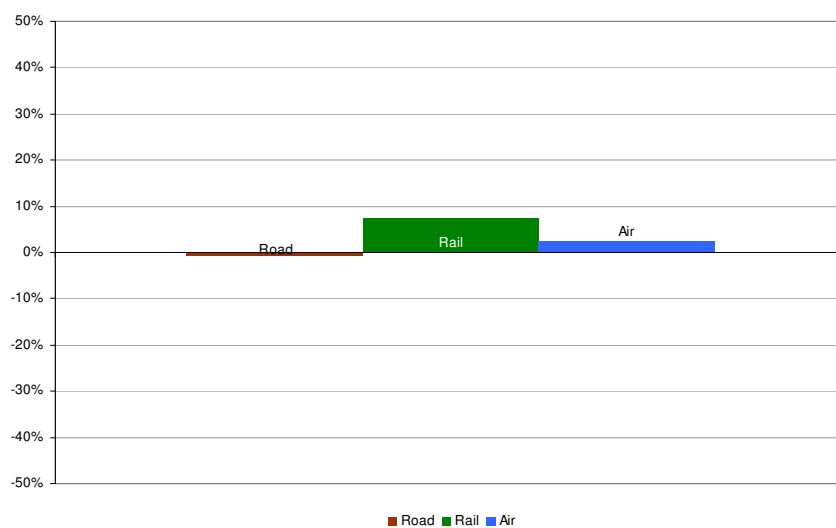
**Time Penalty for interconnecting at airports:**

90min

Output Analysis

Generally, all transport modes –road, rail and air- have quite adjusted results in this assignment in comparison with the TRANS-TOOLS model. Road transport mode presents the best results, increasing slightly by 1%. Then air transport mode has quite good values, it rises less than 3%. Whereas, rail transport mode grows nearly 8%.

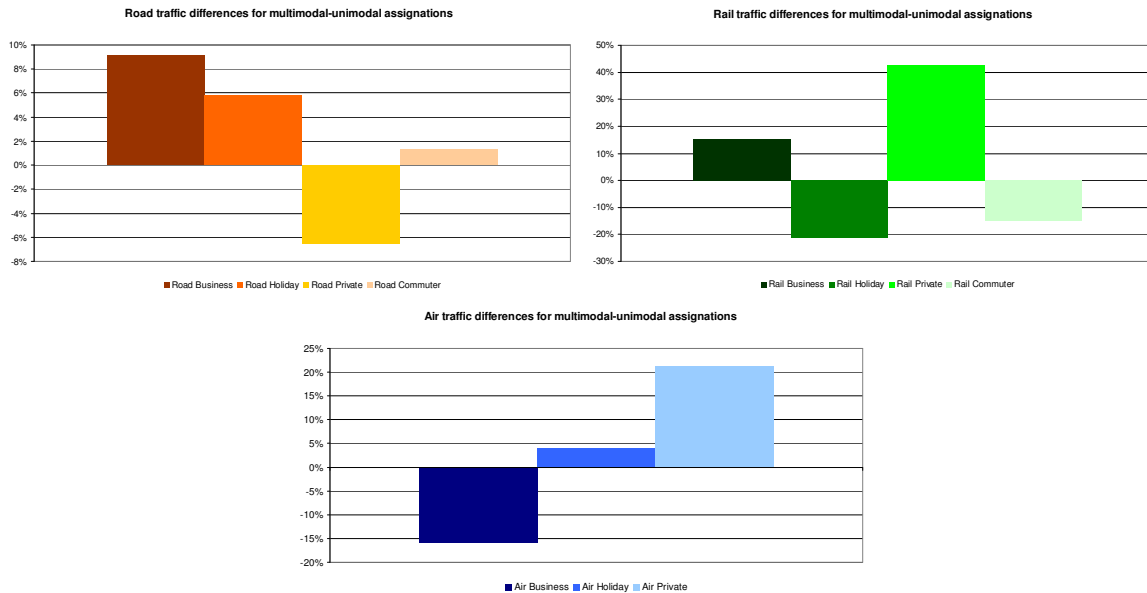
**Traffic differences for multimodal-unimodal assignments**



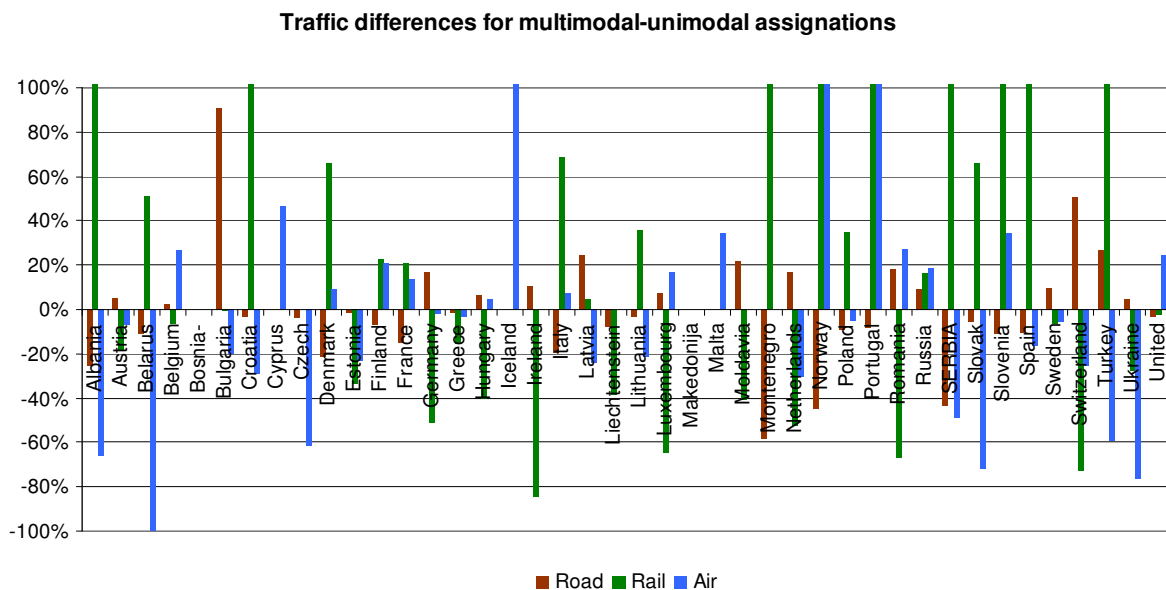
In the road traffic graph, business travellers increase more than 8%, and holiday travellers also grow nearly 6%. Commuter travellers, meanwhile, have an insignificant increase nearly 1%. By contrast, private travellers decline more than 6%.

In the rail traffic graph, private users have a substantial increase of more than 40% and business users also rise by 15%. Whereas holiday users drop significantly nearly 20% and commuter users decline by 15%.

In the air traffic graph, holiday trips increase slightly less than 5%, while private users rise more than 20%, In contrast to business users which decrease nearly 15%.



The figure below represents the relative error between TRANS-TOOLS' traffics and the IC Module's, for each country and for road (red), rail (green) and air (blue). The levels of error are relatively low in most cases for the EU27 Member States. Major disfunctions tend to concentrate in peripheral non Member States, where modelling is less accurate, and in the rail and the air modes.



**Summary conclusions**

In conclusion, the introduction of a lower value of dispersion for infrastructure costs in this assignment makes a high increase in the rail transport mode. Road and air transport modes, meanwhile, have adjusted values, they are reasonable similar with the results of TRANS-TOOLS model.

*Name of assignment: 19h Assignment*

Date of assignment: 23/03/2011

Description: This assignment is based on the scenario "12<sup>th</sup> assignment with dispersion value of 1 and time penalty value of 90 minutes", with variations in the dispersion parameters: 0.75 for Value of Time, 0.75 for infrastructure costs and 0 for interchange costs. Besides, airport-road connector and airport-train connector costs have been experimented a slightly rise.

Main Parameters:

**Value of travel time in euro/hour**

Business: 25 €/h

Private: 10 €/h

Commuters: 10 €/h

Holiday: 7,5 €/h

**Interconnecting costs in euro/km**

City-road connector: 0.25 €/km

City-train connector: 0.1 €/km

Airport-road connector: 0,15 €/km

Airport-train connector: 0,15 €/km

Train-road connector: 0.25 €/km

**Travel Costs in euro/km**

Road: 0,15 €/km

Short-distance train: 0,09 €/km

Medium -distance train: 0.15 €/km

Long -distance train: 0.2 €/km

**Dispersion of travel cost and time cost**

**values:** 0.75 // 0.75 // 0.75

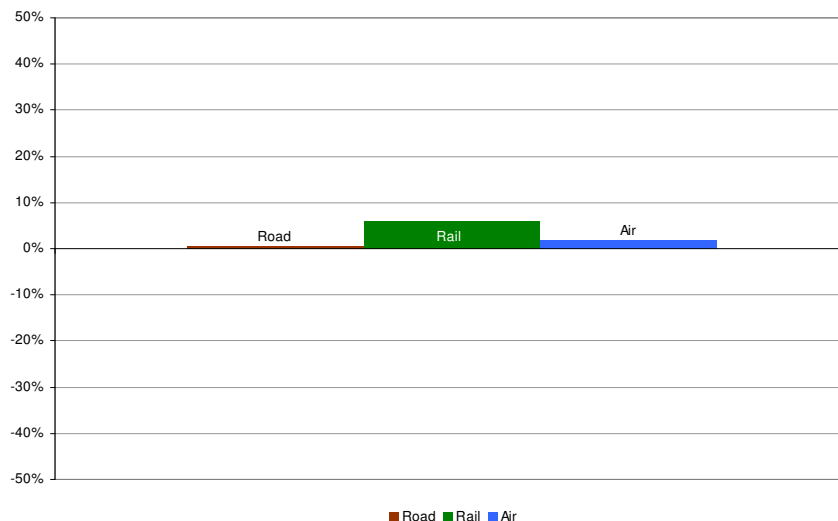
**Time Penalty for interconnecting at airports:**

90min

Output Analysis

In general terms, all trips have small differences, with increases below 6%, between this assignment and the TRANS-TOOLS model. Overall, road and rail transport modes have suitable results, with slightly growths under 2%. While rail transport mode increases nearly 6%.

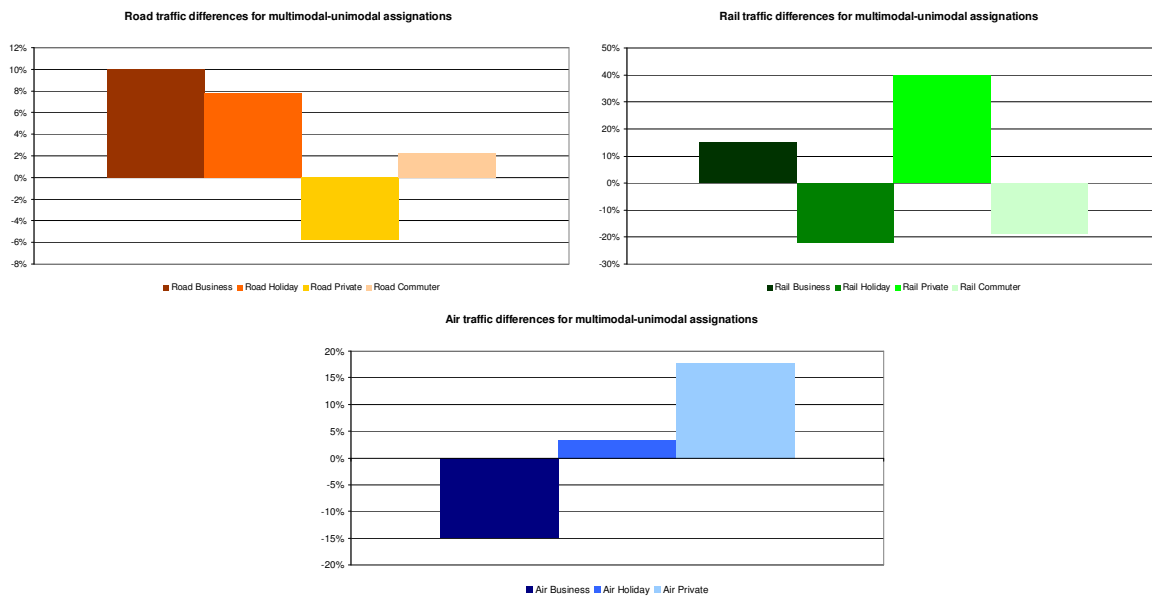
Traffic differences for multimodal-unimodal assignments



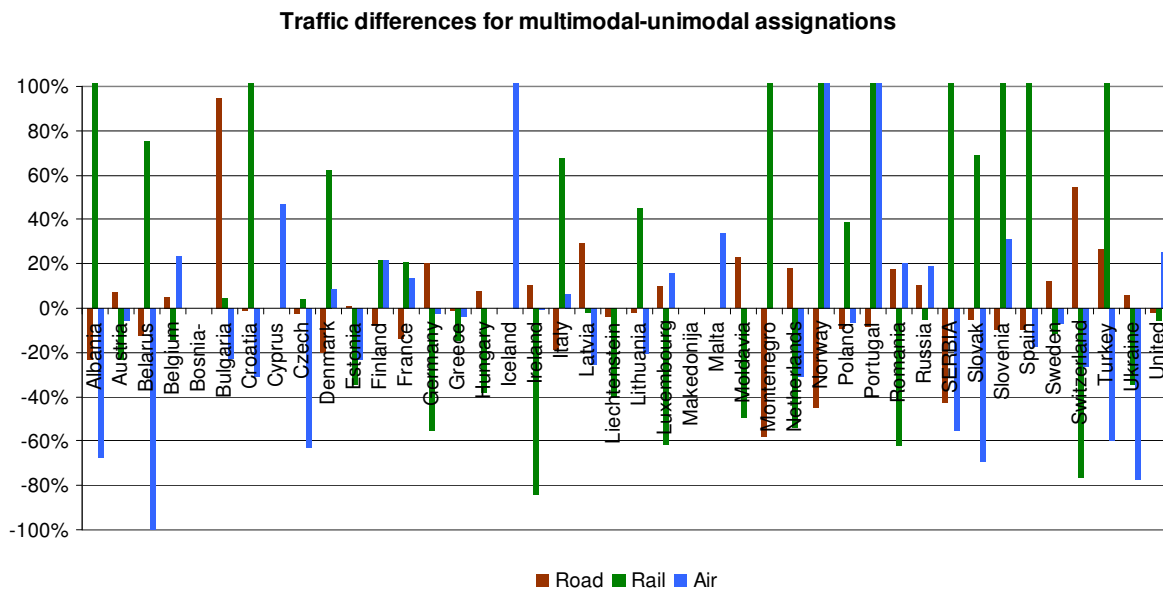
In the road traffic graph, business and holiday trips increase, the first one grows by 10% and the second one rises nearly 8%. While commuter trips have a insignificant increase by less than 2%. In contrast, private trips fall by 6%.

In the rail traffic graph, private users have a high growth of 40%, and business users also increase more than 10%. While holiday and commuter users drop substantially by 20%.

In the air traffic graph, holiday travellers have a slightly increase by less than 5%, while private travellers grow more than 15%. In contrast of business travellers which decline nearly 15%.



The figure below represents the relative error between TRANS-TOOLS' traffics and the IC Module's, for each country and for road (red), rail (green) and air (blue). The levels of error are relatively low in most cases for the EU27 Member States. Major disfunctions tend to concentrate in peripheral non Member States, where modelling is less accurate, and in the rail and the air modes.



Summary conclusions

To conclude, the impact of introducing a lower value of dispersion parameter for infrastructure costs in this assignment has been generate a high increase of rail trips, whereas road and air trips are very similar in this assignment in comparison with the TRANS-TOOLS model.

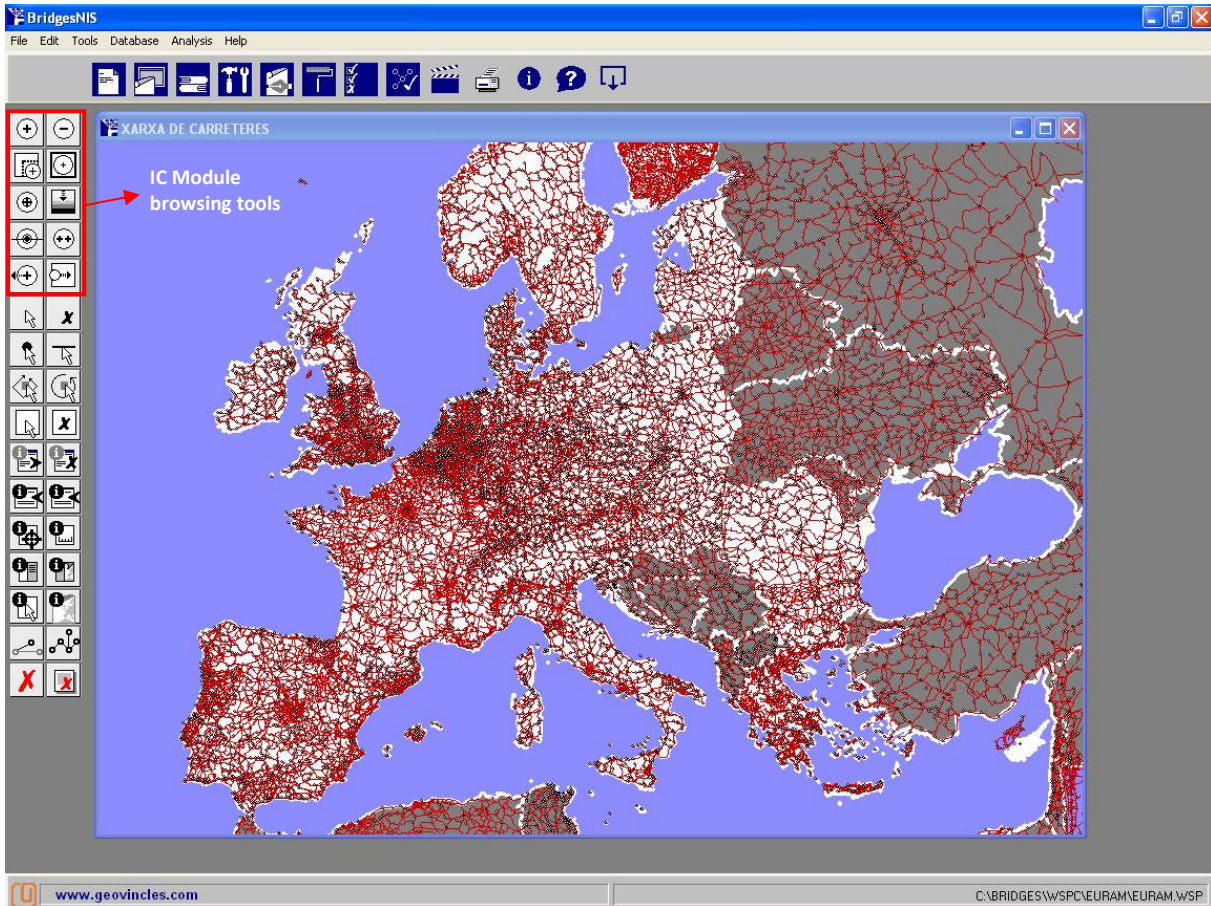
## **APPENDIX 3 - SOFTWARE**

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### **OPERATING THE IC MODULE**

### Browsing the Graph

A set of control buttons located on top of the left bar of the IC Module can be used to browse the transport graph. Zooms can be applied to examine details of the graph, e.g. transport terminal connectors, and movement is allowed through the pan option.




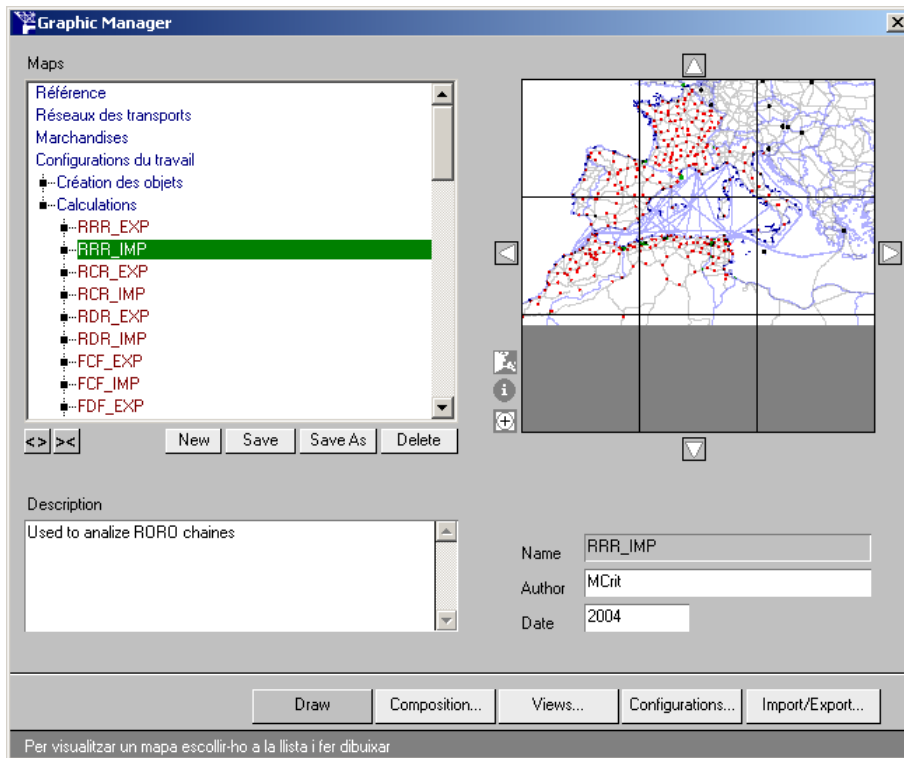
- 1 ZOOM IN. Select icon from menu and left-click onto the graph to apply.
- 2 ZOOM OUT. Select icon from menu and left-click onto the graph to apply
- 3 ZOOM WINDOW. Select the desired screen area and left-click to zoom to apply
- 4 ZOOM ALL. Shows all elements on the graph. Select icon from menu and left-click onto the graph to apply
- 5 ZOOM CENTER/SCALE: Shows a zoom centered on selected point and with typed scale factor. Select icon from menu and left-click onto the graph to apply
- 6 REDRAW: Refresh window. Select icon from menu and left-click onto the graph to apply
- 7 ZOOM SELECTED ELEMENT: Shows a zoom centered on first selected element, maintaining scale factor. Clicking successively over window, shows a zoom centered on next selected element
- 8 ZOOM ALL SELECTED ELEMENTS: Shows a zoom level such that all selected elements are displayed. Select icon from menu and left-click onto the graph to apply
- 9 ZOOM PREVIOUS: Shows previous zoom. . Select icon from menu and left-click onto the graph to apply
- 10 PAN. Move zoom maintaining scale factor. Select icon from menu. Left-click once onto the graph to select the anchor point, left-click twice to select pan direction, and left-click once again to apply.



## Graphic manager

Graphic Manager allows creating, editing, deleting and consulting maps based on objects class included in workspace. A map is a selection of classes with their graphic properties. A map can be printed and exported to text processors or multimedia applications, trough bmp format or directly through clipboard.

To enter Graphic Manager, click  on tool's bar or select *EDIT-MAPS* on main menu to open next window:



## Creating and editing maps


To create a new map, click *New* button (type a name and click *Apply*). It is also possible to enter a Description, the Author and Date of map.


To edit the map name, click *Save* button and retype the name. To change Description, Author and Date, just retype new data.


To delete a map, select it on the tree and click *Delete* button.

Clicking *Save as* button, a new map with the same objects class will be created.

## Previewing maps

When a map is selected on the tree, a small image of the map is shown. Clicking the left mouse button on any part of the map, a zoom of the area will be shown. To return to original size, clicking again left mouse button or .

To see an image of the map, click .

To see the legend of the map, click .

## Views

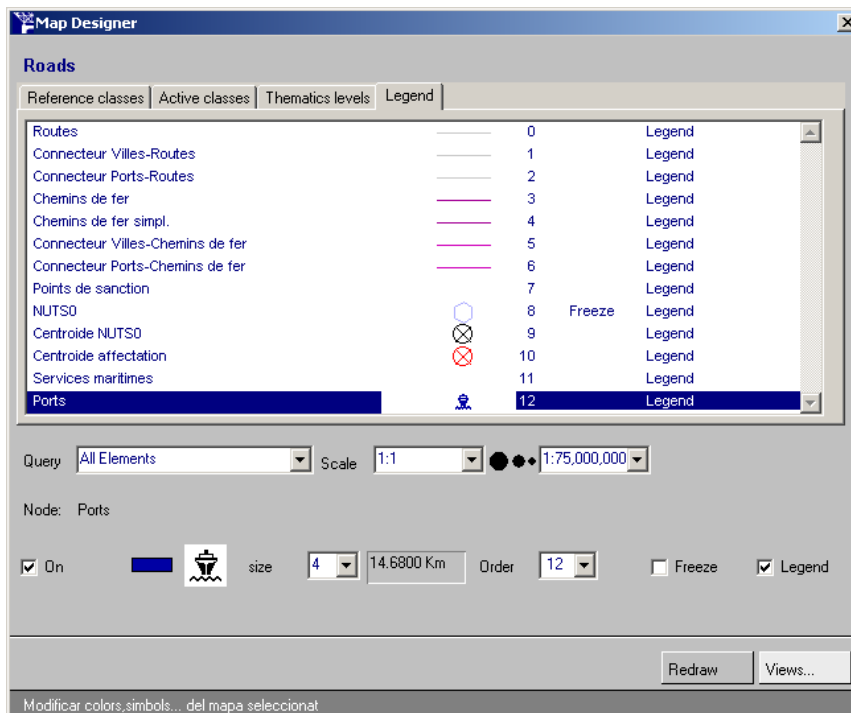
It is possible to define different partial views of one map. All views are distinguished by the Scale and Geographic area covered. *Views* button opens a window from where it is possible defining, deleting or loading views.

If button *New* is clicked, it is possible saving the actual view.

To load a saved view in actual map, select *View* in views list and double click (or button <). To delete a saved view, select *View* in views list and click *Delete* button.

## Map designer

*Configurations...* button opens Map Designer window, from where it is possible to choose classes and thematics included in map, and its graphic properties.




It has four tab sheets:

- **Reference classes:** Contains “reference” classes. The user can not edit them. These classes are protected and it is only possible changing their graphic properties (colour and width).
- **Active classes:** This sheet allows user to select objects classes included on a map. It is also possible editing graphic properties as colour, width, symbol, size, order and scale. Scale property determines the scale range where class must be shown in the map; if map has a scale not included in the range, class will be hidden.
- **NIS classes** that have to be part of a GRAPH, must not have Frozen checked. Elements of a Frozen class, can not be used as a GRAPH element and can not be consulted or modified.
- It is possible to show only a group of elements defined by a query. In this case, a query (previously defined on Data Manager) has to be selected on Query list. If no query is selected, all elements of the class will be shown.
- **Thematics levels:** Thematics levels are graphic representations of any objects class data. This sheet allows activate/deactivate thematics levels. Other properties that can be modified are Order and Frozen. To create, modify and delete thematics levels see Thematics Levels chapter.
- **Legend:** Contains all Reference classes, Active classes and Thematics levels included on map, all of them with their graphic properties. From this sheet it's also possible to check/uncheck Legend property (classes with Legend checked will appear on map legend.)



**Maps hierlinky**

Maps (also named Configurations from now on in this Manual) can be organized following a hierlinky, with titles and subtitles. These titles can be expanded or compressed using next buttons .

To modify maps hierlinky, select *FILES – OPEN WAREHOUSE* on main menu. New window is opened, and *Open* button must be clicked. Database (MDB) of workspace will be opened. Select table *ProjectVCN* and open it.



VcnId	IsTitle	Name	Parent	Description
100	1	Référence	0	
200	1	Limits	100	
300	0	Limits	200	
400	0	Limits_pays DESTIN	200	
500	0	Limits_Pays UE-DESTIN	200	
600	0	Limits_Europe sauf pays de l'	200	
700	0	Limits_pays candidats à l'UE	200	
800	0	Limits_Reste de pays de la Me	200	
900	0	Limits_Reste de l'Europe (y R	200	
1000	1	Géographie	100	
1100	0	Relief	1000	
1200	1	Réseaux des transports	100	


Table fields are:

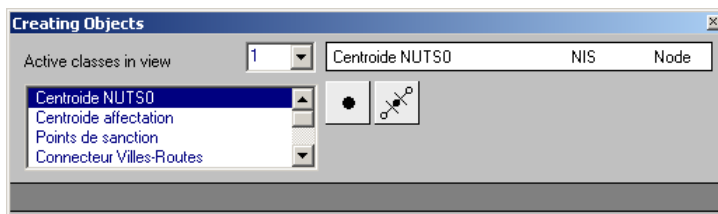
- VCNId: Indicates the order in which different configurations are shown. It can not be repeated.
- IsTITLE: Value 1 indicates it is a title (or group of configurations); value 0 indicates it is a map.
- Name: Name of the title or configuration.
- Parent: If the title or configuration belongs to a title, it indicates the VCNId of the parent title.
- Description: Description of the title or configuration.

Once the hierlinky is defined, workspace database must be closed, and *Read* button on Warehouse interface must be clicked.

**Introducing changes to the Graph**

It is possible creating new elements of any class configured as *Active* and *Not frozen*. To change these parameters, see the 5.3 *Graphic manager* chapter.

To access the control panel for interface for creating objects click  on upper toolbar or select *TOOLS–CREATING OBJECTS* on main menu to open following window:



*Active* and *Not frozen* classes appear listed in this window. To create a new element, it is necessary selecting first the class in which objects will be drawn and then clicking over one of the buttons. Depending on the selected class type, different buttons are showed. Every button has a different function (maintaining the mouse cursor over button, appears a hint explaining button function).

**Once an element is created, attributes must be loaded to this element so that it can be used as a part of a transport network.**

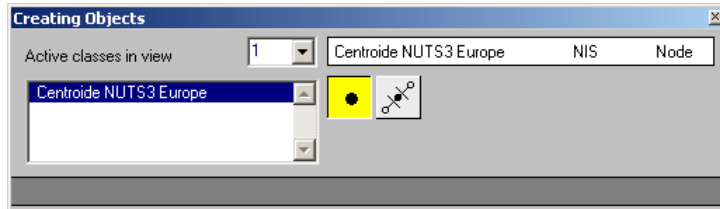
Most commonly elements created for transport networks analysis are nodes and links.

**Nodes**

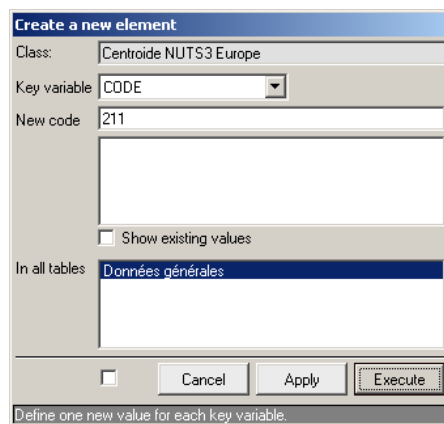
When a nodes class is selected, two different options to create new elements exist:

**Isolated node:**

First button allows creating isolated node.




Just locate the cursor over desired point and click left mouse button. Next window is opened:



By default, value of Key variable is the first available next to the last value used. However, it is possible to change it by typing it on New code edit. If new value is entered, it must not exist. Click Execute to create the node and to create a new register in all tables linked to the class.

This window appears always that a new element is created (nodes, links, etc.)

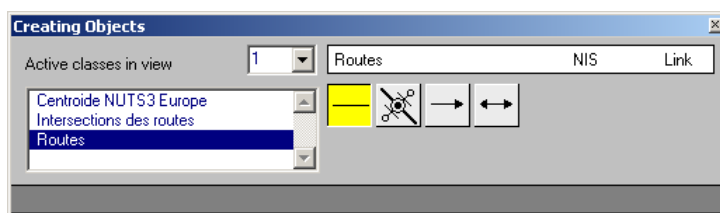
**Partition node:**

Second button  breaks an existing link in two links and creates a new node in the intersection. New two links are automatically connected to created node. Original link code, remains in one of two new links.

In this case, it is necessary to select first the link to be broken (clicking left mouse button over the link). Once the link is selected, click again left mouse button to situate the node. Once done this operation, two windows appear to confirm creation of new link and node. Clicking *Execute* in these two windows, link will be broken and a new node will be created in the intersection.

**Links**

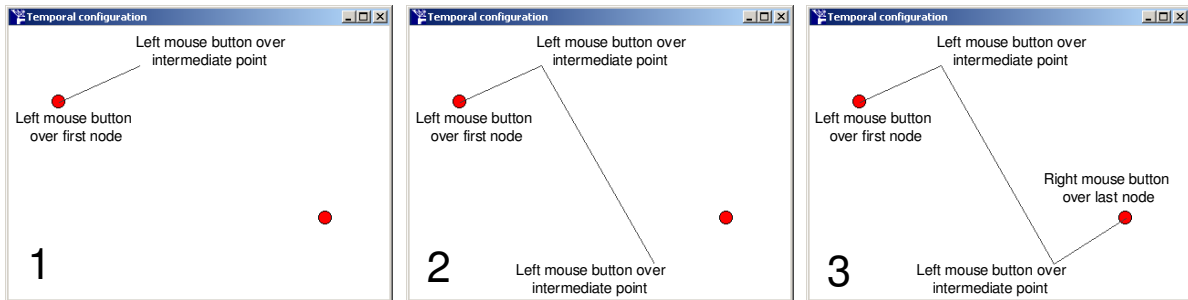
First button creates a link connected to two nodes (to get a navigable graph, links must be connected to nodes).




To create a link, next steps must be followed:

- Click left mouse button over origin node
- Click left mouse button over intermediate points (as many as desired)
- Finally, click right mouse button over destiny node.

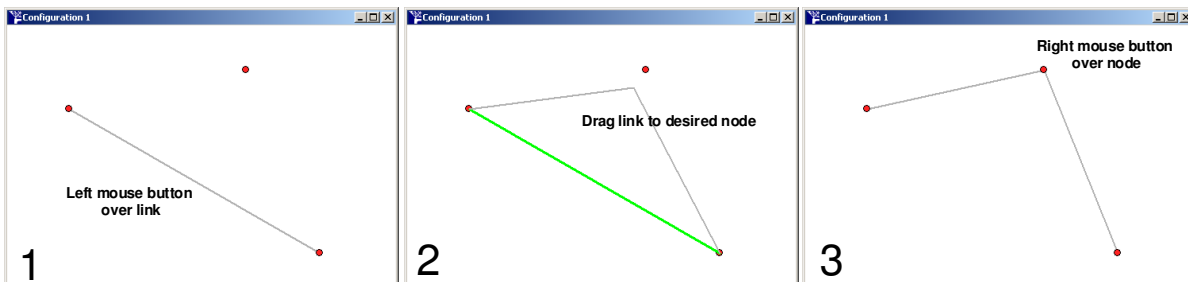
Clicking Esc (on keyboard), creation of link will be cancelled



Second button  breaks a link into two new links, and connect two links to a node.

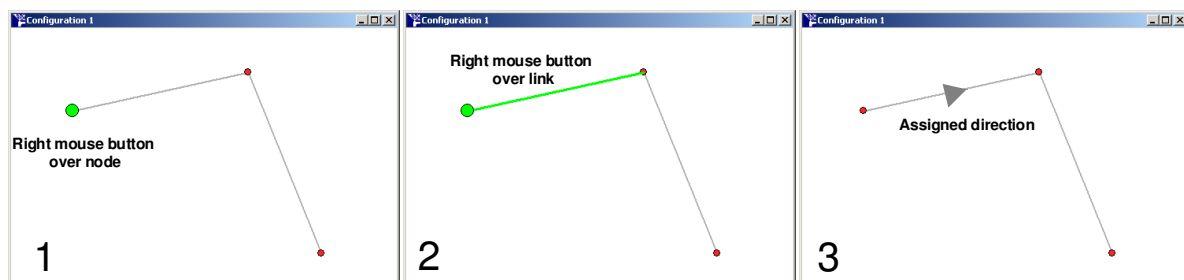
Next steps must be followed:

- Click left mouse button over link
- Click right button over node



Third button  allows assigning a direction to a link. Next steps must be followed:

- Click left mouse button over the node
- Click left mouse button over the link.




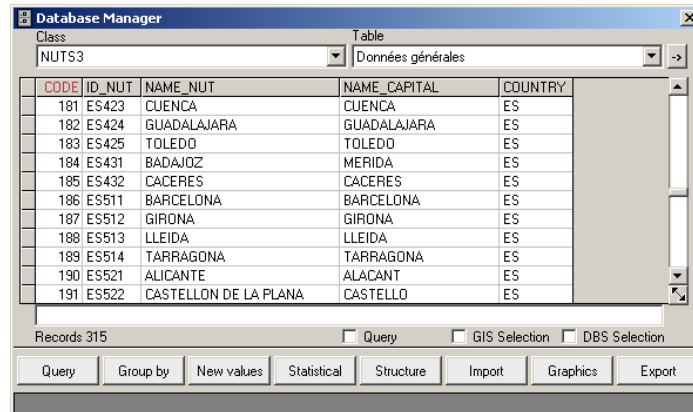
Fourth button  assigns double direction to a link. Next steps must be followed:

- Click left mouse button over any extremity node of the link.
- Click left mouse button over the link.

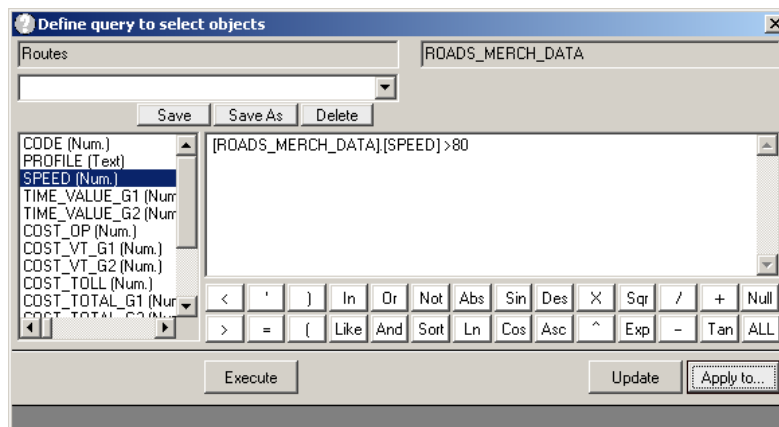
### Building a Query

A query allows selecting a group of registers fulfilling a condition (queries are defined in SQL language).

To build a new query, the Data Manager control panel must be activated. To do so, click button  on IC Modules upper toolbar or select DATABASE–DATA on main menu to open the window shown below:



The Button *Query* then opens the following window.

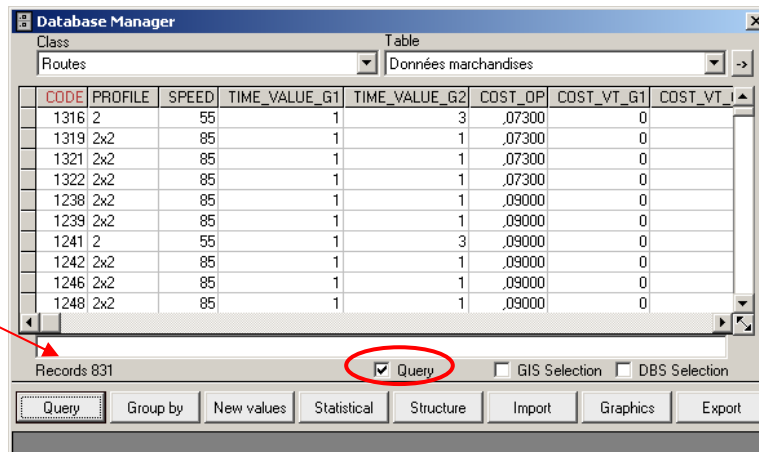


To define a condition, it is possible writing it entirely using keyboard although exist buttons and a fields list that can be useful to define it. Once the condition is defined, query is executed by clicking *Execute* button.

All queries can be saved, by clicking *Save* button. To load a saved query, it has to be select in queries list box and afterwards clicking *Execute*.


It is also possible deleting a saved query (selecting the query and clicking *Delete*) and saving it with another name (selecting the query and clicking *Save as*).

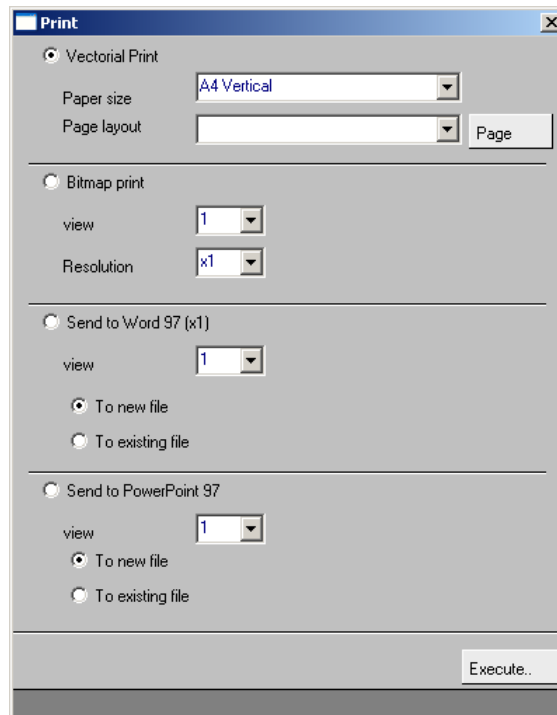
When a query is executed, check box named *Query* in the *Database Manager* control panel appears checked. It indicates that only are shown registers that fulfil the condition defined. *Records* shows how many registers are selected.



CODE	PROFILE	SPEED	TIME_VALUE_G1	TIME_VALUE_G2	COST_OP	COST_VT_G1	COST_VT_G2
1316	2	55	1	3	.07300	0	
1319	2x2	85	1	1	.07300	0	
1321	2x2	85	1	1	.07300	0	
1322	2x2	85	1	1	.07300	0	
1238	2x2	85	1	1	.09000	0	
1239	2x2	85	1	1	.09000	0	
1241	2	55	1	3	.09000	0	
1242	2x2	85	1	1	.09000	0	
1246	2x2	85	1	1	.09000	0	
1248	2x2	85	1	1	.09000	0	

**Exporting results**

To enter the *Print* control panel click  on the upper toolbar or select FILE-PRINT on main menu to open next window:



**Print**

Vectorial Print

Paper size: A4 Vertical

Page layout: [ ] Page

Bitmap print

view: 1

Resolution: x1

Send to Word 97 (x1)

view: 1

To new file

To existing file

Send to PowerPoint 97

view: 1

To new file

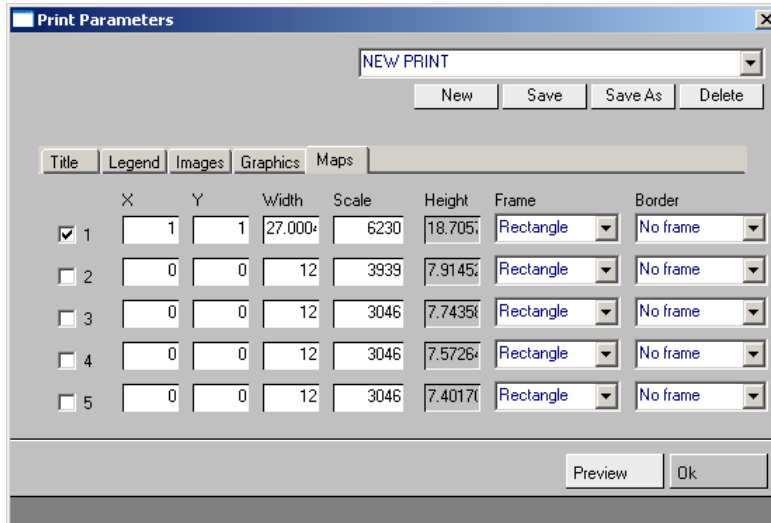
To existing file

Execute..

Different options are Vectorial print, Bitmap print, Send to Word and Send to PowerPoint.

Vector print

It is necessary choosing *Paper size* and a *Page layout*. To create, editing or deleting a *Page layout*, click over  button to open next window:

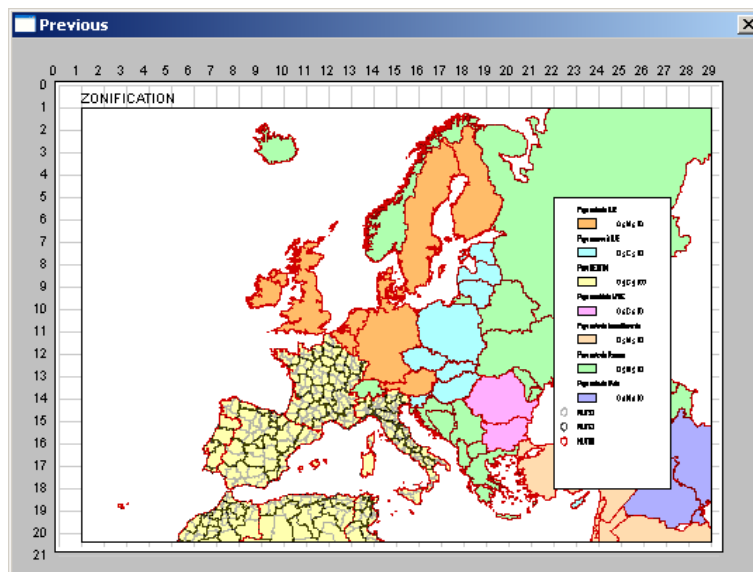


If any page layout is created, click *New* button. To modify a created page layout, select it and change options. To change layout name click *Save* button. To save a created layout with another name, select it and click *Save As* button. To delete a created layout, click *Delete* button.

It is necessary entering properties of elements that define a page layout:

- *Title*: Text, position (defined by X and Y coordinates), size and font type.
- *Legend*: Position (defined by X and Y coordinates), scale factor, border style and adjust.
- *Images*: If an image has to be included in the map, select file path, position (defined by X and Y coordinates), width and order.
- *Maps*: Select maps to be printed (at least select first check box), position (defined by X and Y coordinates), width, scale factor (automatically updated id width is changed), frame type (rectangle or circle) and border style. Maps are included in print with same view active on configuration.

Click *Preview* button to preview print. Next window is opened:



Click *Ok* to save page layout.

Once a *Page layout* and *Paper size* are defined, click *Execute* to print.

**BIPMAP print**

To generate a BMP file, select a *View* and *Resolution*, and then click *Execute*. A new window is opened to select path and name of BMP file.

**Sent map to Microsoft Office files (Word or Power Point)**

Select a *View* and choose if image has to be sent to a new file or to an existing file.