Dipartimento di Ingegneria Gestionale

POLITECNICO DI MILANO

Milano, 31st March 2009

Peter MEHLBYE
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GRAND-DUCHÉ DE LUXEMBOURG

Re: Interim Report on TIPTAP - ESPON Project 2013/1/6

Dear Dr. Mehlbye

it is our pleasure to send you the Interim Report concerning the TIPTAP Project.

With our best wishes,

Sincerely yours

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(Project Coordinator)

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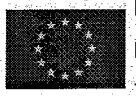
TIPTAP: Territorial Impact Package for Transport and Agricultural Policies

Applied Research Project 2013/1/6

Interim Report



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This report presents the interim results of an Applied Research Project conducted within the framework of the ESPON 2013 Programme, partly financed by the European Regional Development Fund.

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

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

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

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

This basic report exists only in an electronic version.

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1. EXECUTIVE SUMMARY

The general goal of the TIPTAP project is to provide a robust and fully operational Territorial Impact Assessment (TIA) tool, with a sound scientific and methodological basis.

This goal will be achieved building upon the experience of the TEQUILA1 model, through a completely renovated and improved model, tested by experts.

In particular:

- The model and its operational package are applied to two main policies of the European Union (EU): agricultural policies and transportation policies (considering also national policies).
- Four types of impacts are explored, as requested:
    1. Impacts on regional situation: economic/social/environmental.
    2. Impacts on regional competitiveness (Lisbon strategy).
    3. Impacts on climate change.
    4. Territorial impacts: the starting point in this case will be the theorisation at the base of the TEQUILA1 model.
- Definition and operationalisation of territorial goals – on which territorial impacts will be assessed – are related to the concept of *territorial cohesion*, elaborated into three components: Territorial Efficiency, Territorial Quality and Territorial Identity.
- The main hypotheses on cause-effect impact relationship will be presented for each of the two policy cases.
- The main structure of the assessment models – both the *single-dimension impact* (SDI) and the *summative impact* (SI) models – are assessed in terms of stability and robustness of the results provided. In particular for the SI model (defining typically the territorial impacts), two aspects are explored in depth:
    - the weighting system, devoted to guarantee the comparability (and compensability) between different kinds of impacts, Europe-wide (the relative weight of the economic vs. environmental or social dimensions);
    - the territorial value or utility function, generating changes on the general weighting system (see previous point) coming from the specificities of the single regions (e.g. the same impact in terms of GDP increase may be differently appreciated by a rich and a poor region).
- Impacts are assessed, where possible, at NUTS3 level, the most suitable for a truly territorial impact taking into consideration the geographical specificities of single regions. Agricultural policies will be assessed at NUTS2 level, due to the lack of necessary data.

- Mapping of results, conclusions and policy suggestions for a better compliance with the Lisbon agenda, climate change agenda or territorial cohesion strategies will be provided at the end of the project, on the basis of the work of all research groups.

This report aims at detailing the progress of the TIPTAP project. In particular, this report focuses on the following aspects:

1. **Methodology**. One Expert meeting has been organised and held at Vrije Unievrsiteit in Amsterdam to assess the parameters of the current TEQUILA model by means of gathering expert knowledge. This report describes the assessment strategies applied and summarizes the main results achieved. In particular three elements have been assessed:
    a. Weight values of the main criteria, *Territorial efficiency, Territorial quality and Territorial identity*. This was done by applying the Analytic Hierarchy Process (AHP).
    b. For each of the main categories *Territorial efficiency, Territorial quality* and Territorial *identity* a so-called multi-attribute value function model was assessed on the basis of the associated three sub-criteria and weight values.
    c. Weight values for sensitivity parameters (desiderability and vulnerability), which are region specific, were assessed by means of AHP in order to take into account fragilities and potentials of different types of regions. This is a relevant step to proceed to the mapping of impacts for different types.
2. **Sectoral policies**. For both sectoral policies considered the following points are detailed:
    a. The precise elements and policy measures that will be assessed.
    b. The intensity of each policy measure in each region, either actual or forecasted.
    c. The criteria and sub-criteria for impact assessment.
    d. The impact indicators for each criterion and sub-criterion they refer to and the source for such data.
    e. A clear description of the logical chain that links policy measures to impacts.
    f. The description of the methodology chosen and, eventually, implemented to compute policy impact measurement.

Of what concerns the **methodology**, the expert knowledge gathered allowed us to achieve three main advances:

1. To specify the importance of the single components of the current version of the TEQUILA model in more detail (i.e. weights). Results indicate that more emphasis should be put on *Territorial efficiency* and *Territorial Quality* and less on *Territorial identity*. Also, *economic growth* should be considered the most important criterion when designing policies which focus on *territorial development and cohesion*.

2. To obtain a more detailed specification of the value functions for the various criteria. Most previous assumptions with regard to the functional form of the value functions do hold and the value functions for the various criteria are actually confirmed to take the linear form.
3. To obtain weight values reflecting the desiderability for and the vulnerability of a region for a specific impact. These weight values can be used in the current TEQUILA model to adjust impacts on criteria for region-specific fragilities and potentials.

Of what concerns the sectoral policies, achievements can be summarised as follows:

Agricultural policies.

1. The policy chosen is concerned with increasing the level of modulation of funds from Pillar 1 to Pillar 2 of the Common Agricultural Policy (CAP). In particular:
    a. compared with the baseline year of 2006, there will be a 20% reduction in the SFP received by farms in the EU-27;
    b. an increase in funding for Pillar 2 of half this amount will occur, composed of modulated SFP funds plus a similar sum made available by individual member states through the process of co-financing.
2. Policy impact are examined in relation to two scenarios: a buoyant world economy, in which there is slowly growing demand for food, and one of low global growth and relatively low world market prices for food commodities.
3. Regional impacts are supposed to differ according to the quality of agricultural land and farming efficiency.
4. The policy intensity (PI) in each region is determined by expenditure changes.
5. Spreadsheet calculations will be employed to generate estimated values of impacts. However, such calculations will rely on a number of simplifying assumptions (e.g. the income level at which farmers will exit and sell their land; re-employment rates of redundant farm labour; out-migration rates, and propensity of farmers to engage in new tourism or supply chain activities).
6. Impact criteria are defined as follows:
    a. For Territorial Efficiency: Economic growth (E1), Unemployment (E2), Local asset use for tourism (E3), Land abandonment (E4);
    b. For Territorial Quality: Environmental quality (Q1), Community viability (Q2), Climate change (Q3), Soil erosion (Q4);
    c. For Territorial Identity: Landscape diversity (I1), Community identity (I2), Food identity (I3).

Transport policies.

1. The policy chosen are infrastructure and regulatory policies.
2. Infrastructure policy impact will be examined in relation to three scenarios as defined in the TRANSVision study (DGTREN, 2008b): a baseline scenario, a conservative estimate of what could be accomplished in the next 10 years; a high growth scenario including policies oriented to infrastructure enhancement, and a low growth scenario characterised by increasing energy costs, negative population development and policy attention to internalisation of environmental externalities of transport,.
7. The sub-criteria considered for each main criteria (Territorial Efficiency, Quality and Identity) are based on the first version of the TEQUILA model, but considerably enriching and enlarging this basis. Impact criteria are defined as follows:
    a. For Territorial Efficiency: Economic growth (E1), Productivity of inland infrastructure (E2) and of airports (E3), Accessibility (E4), Regional infrastructure endowment (E5);
    b. For Territorial Quality: Reduction in the number of accident (Q1), Regional connectivity in time by rail (Q2) and by road (Q3), National connectivity (Q4);
    c. For Territorial Identity: Accessibility to local cultural heritage (I1), Internationalisation: connectivity (I2) and connectivity from abroad (I3).
3. TRANSTOOL forecast model will be used to compute PI, which is a 4-step modelling framework, consisting on a successive modelling of transport generation (at NUTS3), distribution (among NUTS3 and NUTS2), modal split (between transport modes) and network assignment.

Some dissemination activities have already been undertaken. In particular, the working of the TEQUILA model and its application to transport policies and CAP have been presented at the internal ESPON Seminar on 10-11 December in Bordeaux and to the EU Seminar on tTerritorial Impact of EU Policies on 5 March in Amsterdam.

Next steps in the project will be detailed in section 4 and can be summarised as follows:

1. Two Expert meetings are planned by mid May, to be held respectively in Barcelona on 27-28 April and Newcastle on 11and 12 May. These have the specific goal to assemble a pool of sectoral experts and policy-makers (respectively, on transport and agricultural policies) and to conduct assessment of specific elements of the different value functions.
2. During the upcoming meetings, we will assess different value functions for desiderability and vulnerability parameters to indicate in a more precise manner the desiderability for, or vulnerability of, a region for a specific impact. This will make mapping of impacts for different types of regions possible and relatively straightforward.
3. Policy impacts, weight values for each criterion and sub-criterion, desiderability and vulnerability functions, will be embedded in the TEQUILA2 model to obtain SDI (i.e.

impacts on competitiveness, economic and social structure, environmental aspects, climate change, etc.). These SDI will afterwards be aggregated into a SI, encompassing the three dimensions of Territorial Efficiency, Territorial Quality and Territorial Identity.

4. The new operational model will integrate mapping procedures directly inside the computational machine, in order to avoid transfer procedure from impact calculation to impact mapping.
5. We will also consider the case where compensation among impacts could not be acceptable (the Flag model), and devices to show this result in the single regional cases will be included.

The TEQUILA model is the only existing operational model for a regionalised and quantitative assessment of impacts of policies on the EU territory. Methodology has to be adapted to the specificities of each policy to data availability and to a precise external definition of policy intensity in each EU region. All this makes our task a complicated one. No other studies can be really of use.

The remainder of this report is organised as follows.

Section 2 reports on the methodology used during the first TIPTAP expert meeting by detailing the assessment strategies applied to the values and parameters of TEQUILA1 model and summarising the main results achieved.

Section 3 reports on the main results achieved so far in territorial assessment of agricultural and transport policies on the basis of the project specification, Annex III to the subsidy contract and the recommendations of the Coordination Unit in response to the Inception Report.

Section 4 outlines further proceeding towards the Draft Final Report.

2. Outline of the methodology

This section reports on the assessment strategies of all components of the TEQUILA model (section 2.1-2.3), on the procedures applied during the first TIPTAP Expert meeting held on 4 March in Amsterdam and on the main results achieved (section 2.4). The main goal of the meeting with experts was to assess the parameters and variables used in the current TEQUILA1 model by means of gathering expert knowledge.

2.1. A short introduction to the TEQUILA model

The TEQUILA model is aimed at assessing the territorial impacts of various policies. The model is based on Weighted Summation, which finds its roots in Multi Attribute Utility Theory and incorporates the following three main components of territorial cohesion:

Territorial quality: the quality of living and working environment; comparable living standards across territories; similar access to services of general and interest and knowledge;

Territorial efficiency: resource-efficiency with respect to energy, land and natural resources: competitiveness of the economic fabric and attractiveness of the local territory; internal and external accessibility;

Territorial identity: presence of "social capital"; capability of developing shared visions of the future; local know-how and specificities, productive "vocations" and competitive advantage of each territory.

The TEQUILA model has the following form:

$TIMr = \Sigma c\ \theta c\ .\ Sr,c\ .\ PIMr,c$

Where:

TIM = territorial impact

PIM = potential impact of policy

r = region considered

c = criterion

θc = weight assigned to criterion c $\quad 0 \leq \theta c \leq 1\ ; \quad \Sigma c\ \theta c = 1$

Sr,c = sensitivity of region r to criterion c $\quad 0 \leq Sr,c \leq 1$

Various criteria (c) are included in the first version of TEQUILA (i.e. TEQUILA1) to measure the impact of a policy on *Territorial efficiency, Territorial quality* and *Territorial identity*. Each category consists of three sub-criteria and their definition and measurement units are specified in the Table 1. It is worth mentioning that the scores on these criteria, measured in different units, are integrated into the TEQUILA model by means of weights and normalisation processes.

However, the actual impact of a policy can differ across European regions, according to their internal characteristics. The TEQUILA model takes these differences in impacts into consideration by means of Sr,c which is a vector of regional characteristics defining:

- the vulnerability/receptivity of a region to single types of impacts (Vr,c);
- the desirability of the impacts for a region (Dr,c)

Sr,c can then be specified as: Sr,c = Dr,c . Vr,c

In the present project, the different components of TEQUILA are being assessed by means of expert knowledge. This applies especially to the value functions for the three criteria, the weight value of each criterion, Dr,c, and Vr,c components of the model.

2.2 Assessing the components of the TEQUILA Model

To assess the components of TEQUILA (i.e. PIM, θc, Dr,c and Vr,c) we will make use of the so-called value functions for these components.

The value function theory is a branch of a more general theory based on the concept of utility maximisation. The fundamental assumption in utility theory is that there exists a real-value function, called utility function, which transforms the impacts of an alternative into a utility score. This utility score is what the decision-maker wants to maximise. Value functions do also translate the impacts (scores) of a policy into a single score, usually this score is normalised from 0 to 1, where 0 and 1 values represent the worst and best situations attainable. The TEQUILA model above can be interpreted as a combination or aggregation of such value functions. For each policy alternative the model aggregates, in a weighted manner, the value attached to each criterion score. The construction of such a multi-attribute value function model requires five steps:

1. The selection and specification of evaluation criteria;
2. The definition of the range of scores *(Ri)* for each criterion *(Xi)*;
3. The assessment of value functions for each criterion;
4. The assessment of weights;
5. The combination of value functions into a value function model.

The specification of the ranges of scores defines the evaluation domain. The set of best and worst scores for all attributes determine the best $x^* = (x_i^*,..,x_n^*)$ and worst $x_* = (x_{i*},..,x_{n*})$ situations (alternatives) attainable with regard to the fulfilment of the decision objectives.

The value functions are used to translate the score of a policy on a criterion into a value between 0 and 1. The calculated value represents the relative preference/performance of that policy on the criterion concerned in comparison with the best and worst scores attainable.

Weights are used to combine the value functions into a value function model. In the value function model, the weights represent the relative importance of each attribute (criterion) to the others.

The components of the TEQUILA model have been assessed during various expert sessions aimed at establishing the appropriate form of the value function model (additive, multiplicative, etc.), and at assessing the value function and weights for each criterion included in the model on the basis of expert knowledge.

Within this research project we make use of both holistic scaling and decomposed scaling to assess value functions. In decomposed scaling, the marginal value functions and weights are assessed separately and the value function model is constructed by combining these parts through the additive combination. Various techniques exist for assessing value functions by means of decomposed scaling. Amongst the most frequently used are: direct rating, curve selection, bisection, difference standard sequence, parameter estimation and semantic judgment. The most common assessment techniques for weights are: the swing method, rating, pairwise comparison, trade-off method and qualitative translation. On the other hand, holistic scaling is based on overall value judgements of multi-attribute profiles. These profiles can be real alternatives or artificial profiles designed for the assessment and experts are asked to judge these profiles. Based on obtained judgements, weights and value functions are then estimated through optimal fitting techniques, such as regression analysis or linear optimisation, and are the best representation of the assessors' implicit value functions and weights. The Utilité Additives (UTA) method is amongst the most frequently used approaches for holistic scaling. This method is developed by Jacquet-Lagrèze and estimates piecewise value functions through linear optimisation (Jacquet-Lagrèze and Siskos, 1982).

2.3 Assessment strategies applied during the first expert meeting

During the first expert meeting three assessment exercises have been conducted. They were applied to the results of TEQUILA1 as the new impacts (from TEQUILA2) were not available in a full quantitative form.

First exercise: Weight values for Territorial efficiency, Territorial quality, Territorial identity

During the first assessment exercise expert knowledge was gathered and used to assess the weight values for the main categories of criteria, *Territorial efficiency, Territorial quality and Territorial identity*. This was done by applying the Analytic Hierarchy Process (AHP).

AHP is a decision support tool that is often used in complex decision problems. The method uses a multi-level hierarchical structure of objectives, criteria, subcriteria and alternatives. IN particular, the Saaty method, developed by Thomas Lorie Saaty in the 1970s (Saaty, 1977), is based on ordinal pairwise comparisons aimed at obtaining the weights of the decision criteria, and the relative performance measures of the alternatives in terms of each criterion. In other words, it addresses preference statements. For each pair of criteria the decision-maker is asked to which extent a criterion is more important than an other one. By means of such a comparison the method defines the relative position of one criterion in relation to all the other criteria. By using an eigenvalue matrix technique, quantitative weights can be assigned to the criteria.

This method is based on three important components:

- The hierarchy articulation of the elements of the decision problem;
- The identification of the priority;
- A check of the logic consistency of the priority.

After defining the hierarchy articulation of the elements, the second step consists of assessing the value of the weights related to each criterion through the pair-wise comparison between the elements. The comparison of the criteria is carried out using a questionnaire, where for each couple of criteria the relative preference is expressed).

The Saaty method employs a semantic 9-point scale (Table 2) for the assignment of priority values. This scale relates numbers to judgements, which express the possible results of the comparison in qualitative terms. In this way, different elements can be weighted with a homogeneous measurement scale.

Through this method, the weight assigned to each single criterion reflects the importance attached by every party /agent /group involved in the project to the objectives. In addition to this, the method verifies the fit between the components of the weight vector and the original judgements. From the pair-wise comparison a 'comparison matrix' is derived from which, through the eigenvector approach, it is possible to calculate the weight vector under investigation. Finally, the method is able to check the consistency of the matrix through the calculation of the eigenvalue.

Second exercise: Value functions and weights for sub-criteria

For each main category of criteria, i.e. territorial efficiency, territorial quality and territorial identity a multi-attribute value function model was assessed separately. The multi-attribute value function model for each indicator contained value functions for the associated three sub-criteria and weights (Table 1).

The assessment strategy used is holistic scaling and the respondents were asked to state their preferences over various fictitious alternatives. The resulting rankings of alternatives were then used to assess the value functions and weight values for the criteria considered. The fictitious alternatives used are described by differing scores on three criteria. To construct the fictitious alternatives different scores on the criteria are combined.

Various so-called designs are at our disposal for doing so of which the factorial, fractional and bi-attribute designs are the most frequently used. To limit the number of fictitious alternatives, we used the orthogonal design, the most commonly used fractional design in holistic scaling (Currim and Sarin, 1983 and 1984; Scannella and Beuthe, 2001). Within an orthogonal design each attribute level is combined with another level only once. In case *n* attributes are used and *r* levels are selected per attribute, the number of multiattribute profiles being created is equal to r^2. This implies that in with three criteria and four levels, the respondent is asked to evaluate sixteen fictitious alternatives, which is a significant reduction. Furthermore, sixteen observations are sufficient for UTA to produce a statistical assessment that is precise and of a good quality.

Various techniques can be used for assessing the reference alternatives such as, profile ranking, profile rating, and pairwise comparisons. Since the number of pairwise comparisons was too large for a consistent and meaningful assessment, we opted to apply profile rating and ask the respondent to assign a value between 0 and 10 to the profiles while taking into account the complete set of (three) criteria. The obtained ratings were converted into a ranking that is verified by the respondent during the choice experiment.

The choice experiment was structured as follows. First, an introduction was given to the main objectives of the research as well to the assessment procedure. Furthermore, the various criteria used in the choice experiment were described as well as the associated score ranges. During the choice experiment, the respondents were shown descriptions of the multi-attribute profiles on a computer screen and asked to rate these, while taking all criteria scores into account.

Once the rating was completed, the respondent was asked to indicate which criteria were decisive in his or her decisions; this produced a ranking of attributes. The final step in the assessment procedure concerned a consistency check. The respondent was shown a ranking of multi-attribute profiles, which was based on the ratings given and asked to comment on it. In case an inconsistency exists in the ranking, the respondent was given the opportunity to adjust the rating given to a profile. The resulting ranking was used by UTA to construct the multi-attribute value function model of the respondent.

This exercise produced three multi-attribute value function models containing value functions and weights for *Territorial efficiency, Territorial quality* and *Territorial identify.* These three models were next integrated into one model by means of the weights values obtained in the first exercise.

Third exercise: Weight values for Dr,c and Vr,c

We assessed parameters in terms of weight values which are region specific. During the assessment session experts were asked to make pairwise comparisons (AHP method) which form the foundation for the calculation of weight values for Dr,c and Vr,c. In the remainder of the project both parameters will be defined and specified by means of a value functions which will be assessed for each region considered. This exercise was aimed at understanding to what extent impacts may differ across different types of regions endowed with different fragilities and potentials. Also, This is a relevant step to proceed to the mapping of impacts for different types of regions.

2.4. Programme and results of the first expert meeting

Thirteen experts in the domain of transport and infrastructure research and rural development participated to the first meeting (see Annex 1 for the full list). They were introduced to the ESPON TIPTAP project and to the TEQUILA-model, its functioning and its current specification by Prof. dr. Camagni. The respondents were given the opportunity to familiarize themselves with the model and to critically review it.

Next, the participants were introduced to the main objectives and activities of the meeting. The criteria and sub-criteria included in the model and their score range were discussed in more detail. Also, what kind of input was expected from the experts during the meeting was explained. In the remainder of this section we will discuss the three exercises conducted and the results produced.

Exercise 1: AHP. Establishing the weight values for Territorial efficiency, Territorial quality and Territorial identity.

The first assessment exercise was relatively easy and short. The exercise was setup to allow the participant to familiarize themselves with the assessment exercises and the questionnaires used.

During the exercise the participants were asked to compare *Territorial efficiency, Territorial quality* and *Territorial identity* in a pairwise manner. The experts had to indicate which of the criteria is more important, according to the scale reported in Table 2.1 (Annex2).

The results of the first exercise are the weight values for *Territorial efficiency, Territorial quality* and *Territorial identity*, calculated on the basis of the results of the pairwise comparisons and by means of AHP (Table 2.2 and Table 3, second column).

The results suggest that the majority of respondents deems *Territorial efficiency* the most important category of criteria or effects which policies should be aimed at in order to improve territorial cohesion (Table 3 , first column).

Exercise 2: Holistic scaling. Establishing value functions and weights for sub-criteria.

For each of the main categories *Territorial efficiency, Territorial quality* and Territorial *identity* a so-called multi-attribute value function model was developed on the basis of the associated three sub-criteria and weights values.

As explained in the previous section, the strategy used is holistic scaling. The participants were asked to state their preferences over 16 fictitious policy alternatives and to assign a value between 0 and 10 to the alternatives while taking into account the scores on the complete set of (three) criteria.

The exercise was structured as follows. First an introduction was given to the main objectives of the exercise as well as the questionnaire used. Furthermore, the various criteria were described as well as the associated score ranges. During the choice experiment, the experts are given descriptions of the fictitious alternatives and were asked to rate these, while taking all criteria scores into consideration.

The exercise produced three multi-attribute value function models containing value functions and weights, one for *Territorial efficiency*, one for *Territorial quality* and one for *Territorial identity*. These three models were next integrated into one model by means of the weight values obtained during the first exercise (Table 2.2).

The model contains three sub-criteria for *Territorial Efficiency* namely, *Internal connectivity, External accessibility* and *Economic growth.* Especially the criterion *Economic growth* received a

relatively large weight value (0,70): the majority of experts signalled that measures stimulating economic growth should form the main ingredient of policies focusing on territorial efficiency and cohesion (Table 2.3).

The value functions for the three attributes transform a score on the respective criteria into a value between 0 and 1 (see Figures 2.1-2.3). For instance, let's assume a policy that increases economic growth as measured in GDP per capita by 4%. The associated value is equal to 0,82. This implies that the policy will yield 82% of the weight value assigned to the criterion economic growth (0,70) which is 0,54 weight points (i.e. the score is multiplied times the weight value assigned to the criteria).

Figures 2.1 to 2.3 also show that the value functions are almost linear, supporting the assumptions of the TEQUILA1 model.

The experts gave almost equal weight values to the criteria *Congestion* (0,29) and *Transport sustainability* (0,26). However, the criterion *Emissions* was given the largest weight value (0,45) (Table 2.4).

The value functions for *Congestion* and *Emissions* depicted in the graphs below are monotonically decreasing and have a linear form (Figure 2.4 and 2.5), differently from the value function for *Transport sustainability* (Figure 2.6).

The value functions for *Congestion* and *Emissions* also signal the relative importance of these criteria. In fact, approximately 60% of the weight values for these criteria is realized when the third level is attained. *Congestion* should be reduced at least to 2500 mln vehicles/Km to be considered as reasonably effective by the experts and thus improving on the welfare of a region.

Policies aiming at the reduction of *Emissions* produce approximately 60% of the weight value (0,45) once the realized reduction is at least 1,33 mln tons CO2 per year.

The weight values for sub-criteria of *Territorial identity* indicate that *Landscape fragmentation* is the most important criterion of this group. Also, the criterion *Creativity* is placed above *Cultural heritage* (Table 2.5).

The value functions of the three criteria are almost linear (Figures 2.7-2.9). Only the value function for *Creativity* slightly deviates from the linear form. This value function also shows that 84% of the weight value assigned to creativity is realized once the score on the criterion is equal to or higher than 10 mln persons. This is 70% and 55% for *Cultural heritage* and *Landscape fragmentation*.

This implies that for the latter two criteria higher scores are required. So, policies aimed at stimulating *Cultural heritage* and limiting *Landscape fragmentation* need to result in relatively large changes in the criteria scores before they become effective. For example, a policy reducing *landscape fragmentation* with 0,03 Km/GDP will produce only 0,11 utility points (0,25*0,44).

Larger reductions are therefore necessary before a significant share of the weight value is contributed.

These two assessment exercises produced two types of results.

The results of the first exercise allowed us to calculate the weights for the main categories of criteria included in the TEQUILA model (Table 3, second column). The second assessment exercise produced a multi-attribute value function model for each of these main categories. These models consist of a value function and a weight value for each criterion belonging to a main category. These weight values indicate the contribution of a single criterion to the score on one of the main categories. For example, the maximum contribution of the criterion *Economic growth* to *Territorial efficiency* is equal to 0,71 (Table 3, third column). In order to get an impression of the maximum contribution of a single criterion to the *Territorial cohesion* we need to multiply the weight assigned to each main category with the weight of individual criteria (Table 3, last column). One can read that the criterion *Economic growth* is the largest contributor to the concept of *Territorial cohesion.* This criterion is followed by *Emissions* and *Congestion*. Criteria belonging to *Territorial identity* are relatively small contributors to *Territorial cohesion*. The analysis shows that the experts believe that policies focussing on economic growth are considered to be the most effective or important ones to reduce regional differences.

Exercise 3: AHP. Establishing value for Dr,c and Vr,c

The TEQUILA model takes differences between European NUTS3 regions into account when assessing the effectiveness or welfare consequences of policies by means of the desirability (Dr,c) and vulnerability (Vr,c) parameters. The experts were asked to discuss the desiderability for and vulnerability of a region for an impact on the different criteria. The exercise made use of the following regional distinctions aimed at capturing regional fragilities and potentials:

- Urbanized European NUTS3 regions VS rural European NUTS3 regions;
- Advanced European NUTS3 regions VS Developing European NUTS3 regions;
- Northern, Southern, Western and Eastern European NUTS3 regions.

The assessment exercises took the form of AHP and the experts were asked to compare regions in a pairwise manner with regard to the desiderability of a criterion and the vulnerability of a specified region for an impact on a criterion (according to the scale in Table 2.1). Based on the assigned importance degree, weight values for each region indicating the desiderability of good score on a criterion or its vulnerability of that region for an impact were calculated (Table 2.6 and 2.7). Higher weight values imply a higher desirability and vulnerability of an impact.

Except for *Landscape fragmentation*, the selected criteria are more desirable for urbanized European NUTS3 regions than for regions which can be marked as rural (Table 2.6). *Internal*

connectivity is relatively more desirable for advanced than for developing regions. This also applies to the criteria *Congestion, Emissions* and *Transport sustainability*. Policy impacts on *Economic growth*, *Creativity, Cultural heritage* and *Landscape fragmentation* are deemed more desirable for developing European regions. In general, impacts on *Territorial quality* are more desirable for advanced European NUTS3 regions while impacts on *Territorial identity* for developing NUTS3 regions.

Measures influencing *Territorial efficiency* will affect Eastern European NUTS3 regions more than others (Table 2.6). Also, measures aimed at improving *Territorial quality* seem to be more appropriate for Northern European regions. Overall, however, the differences between regions are small on most sub-criteria but *Creativity*, since Eastern European NUTS3 regions are barely affected by an impact on this criterion.

Finally, especially urbanized regions are vulnerable to impacts on most criteria but *External accessibility* and *Landscape fragmentation* (Table 2.7). Also, the experts indicated that, except for congestion, developing regions are more vulnerable to impacts on the various criteria.

In conclusion, the expert knowledge gathered allowed us to specify the components of the current version of the TEQUILA model in more detail. The results obtained allow us to adjust the weight values for the main categories of TEQUILA criteria. In fact, more emphasis should be put on *Territorial efficiency* and *Territorial Quality* and less be given to *Territorial identity* (the weight value should be lowered from 0,33 to 0,10). Also, *economic growth* should be considered the most important criterion when designing policies which focus on *territorial cohesion* (Table 3).

Furthermore, the application of holistic scaling resulted in a more detailed specification of the value functions for the various criteria. Most assumptions with regard to the functional form of the value functions do hold. The value functions for the various criteria are confirmed to take the linear form.

AHP has been successfully applied to obtain weight values reflecting the desiderability for and the vulnerability of a region for a specific impact. The weight values obtained can be used in the current TEQUILA model to adjust impacts on criteria for different types of regions.

During the upcoming meeting we will, however, assess different value functions for this parameters. To do so, functions will be specified for each desirability and vulnerability parameters. These functions are missing in the current version of the TEQUILA model. The adjusted assessment exercise will allow us to estimate value functions which indicate in a more precise manner the importance for or desiderability of a region for a specific impact.

3. PRESENTATION OF MAIN RESULTS ACHIEVED

In this section, results achieved by the two partners taking care of the two sectoral policies inspected are presented: agricultural policies (section 3.1) and transport policies (section 3.2)

3.1. AGRICULTURAL POLICIES

There exists considerable uncertainty about the substance and depth of the next reform of the Common Agricultural Policy (CAP), due in 2013. However, it does appear likely that future reform will follow the direction established by the 2003 CAP reform and the 2008 review, the CAP Health Check. This would include the continuation of decoupled direct payments, and greater expenditure on rural development and environmental quality improvements (speech by Mariann Fischer Boel, EC Commissioner for Agriculture and Rural Development, Nov 2008). The reform will take place within the context of the EC's current Budget Review process by which the size or distribution of future CAP funds could be altered.

For the present project the more radical suggestions for policy changes, such as a altering the total budget size, redistributing allocations between member states, or the extension of national co-financing to encompass both Pillar 1 and Pillar 2 policies (Bureau and Mahé, 2008), appear unsuitable due to the difficulty in foreseeing their likely impacts. Consequently the policy chosen for TEQUILA2 is concerned with increasing the level of modulation of funds from Pillar 1 to Pillar 2 of the CAP. The CAP is structured in 2 pillars, with Pillar 1 supporting farm incomes through direct payments to farmers and market support measures. Pillar 2 supports agri-environment and rural development objectives. Following the 2003 CAP reform, the majority of direct payments paid to farmers under Pillar 1 are made as Single Farm Payments (SFP), in return for which farmers must comply with fairly minimal environmental and production standards. The SFP is significant in decoupling the level of direct support from the level of output.

Under Pillar 2, payments are available to farmers (and some other rural actors) in support of the production of conservation, amenity, recreation and environmental (CARE) goods and for rural development. There are 4 high level policy objectives (or axes) along which Pillar 2 funds are allocated. Axis 1 aims to improve the competitiveness of the agriculture and forestry sectors. Axis 2 supports land management for the improvement of the environment and countryside. Axis 3 aims to enhance the quality of life in rural areas and promote economic diversity, and Axis 4 funding supports bottom-up projects which contribute to the other 3 axes. Within limits laid down by the EC, there is national discretion in allocating the Pillar 2 budget between axes, the allocation consequently reflecting individual national priorities.

Aggregate expenditure under Pillar 1 far exceeds that under Pillar 2. However, within EU-15 states, a small but increasing percentage of the Pillar 1 budget is compulsorily transferred to Pillar 2, through the process of modulation, permitting a small shift in emphasis within the CAP budgetary discipline. In fact, levels of modulation were increased in the 2008 health Check but at

a substantially lower rate than originally proposed. Modulation forms the basis of the policy scenario selected for TEQUILA2.

The policy elements which will be included in Tequila 2 are as follows:

1. Compared with the baseline year of 2006, there will be a 20% reduction in the SFP received by farms in the EU-27.

2. Under the scenario, an increase in funding for Pillar 2 of half this amount will occur, composed of modulated SFP funds plus a similar sum made available by individual member states through the process of co-financing. The remaining unmodulated part of the SFP reduction will result in a reduction in the CAP's overall budget. Thus there will be a transfer of funding between support for farm incomes to funding for providing CARE goods and rural development. It is postulated that this transfer will occur in both EU-15 and EU-12 states. The distribution of additional Pillar 2 funds across the 4 axes will be conservative and will be in the existing proportions. It is important to note that farmers do not automatically receive Pillar 2 funds in place of SFP. To receive them they must agree to undertake certain forms of land management or develop or diversify their business, and in some cases they must compete with other farmers for funds.

3. The conditions facing EU farmers are strongly influenced by those in the world economy. It is proposed that the policy impact will be examined in relation to two scenarios: a buoyant world economy, in which there is slowly growing demand for food, including higher value products such as meat, which ensures that world market prices are relatively high. In this situation the rewards to farmers for producing food commodities are relatively high. Alternatively, the policy impact against a background of low global growth and relatively low world market prices for food commodities will be considered. In this case, where it is more difficult to make a living from food production, the payments and stability offered by agri-environment schemes or the chance to diversify may seem more attractive, causing participation rates in them to be enhanced.

4. Regional impacts would be expected to differ according to the quality of agricultural land. Specifically, high quality land is often capable of intensification, and offers flexibility of use, whereas the Less Favoured Areas of the EU are less productive and have few options apart form extensive livestock rearing.

3.1.1. Policy Intensity

The policy intensity (PI) in each region will be determined by expenditure changes. Current spending on the Single Farm Payment at sub-national level may be calculated from FADN data, and so PI is determined by the absolute reduction in SFP. The policy intensity for the Pillar 2 measure depends on the allocation between axes within individual member states, a summary of which may be obtained from the project 'The implementation of the CAP and visions of its future role across 27 EU Member States EU 27' (website at http://www.rlg.nl/cap/manual.html)

3.1.2. The logical chain between policy scenario and impacts: The narrative

1. The policy scenario begins with a reduction in farm income resulting from the reduction in SFP. Some farm managers may accept the income reduction. Others will respond by allocating the farm's resources differently in an effort to maintain the original income level. The nature of the shift in resources will depend on the relative profitability of the various options available and the farmer's own preferences. The available options for food production in poor agricultural areas (for example those designated Less Favoured Areas) are often very limited and are often confined to extensive livestock rearing methods. By contrast, in fertile lowland areas there is much greater flexibility of land use allowing switching between livestock and arable activities.

2. One particular change which farmers might make is to enter agri-environment agreements under Pillar 2 by which they will receive direct payments in return for adopting extensive land management practices or making other positive improvements to the environment. Under the policy scenario it is envisaged that additional funds will be made available for such agreements. Entry to these schemes is most attractive to farmers when returns from commodity production are comparatively poor or volatile, in which case diversification into a guaranteed revenue stream is attractive. Such schemes will be most attractive to LFA farmers who have few options to intensify production. Non-LFA farmers will find them most attractive in the event of a decrease in the value of commodity sales. In non-LFA areas, extensification of production would be expected under agri-environment schemes, resulting in fewer livestock (see PIM_Q3), lower yields and lower use of external inputs such as agrochemicals.

3. Another important strategy will be to reduce average costs by reducing labour or by gaining economies of scale through farm expansion, or through capital investment (e.g. in new buildings) to increase intensity and efficiency. These strategies will typically lead to less labour use and increased farm size.

4. A crucial process likely to be exacerbated by intensification is global warming. Agriculture has both positive impacts on climate change – for example by 'locking up' carbon in soil - and negative effects. Agriculture is a significant contributor to overall greenhouse emissions and these would be expected to change in the event of livestock numbers changing.

5. Some farm managers will be unable to adapt their activities to compensate for the income loss, and marginal farms will no longer be viable. Factors contributing to the lack of viability will be small physical area, lack of capital, and a lack of human capital (management skills). Typically the farms affected will be very small and occupied by elderly farmers and the land will either be abandoned or incorporated into another farm. Stereotypically, the agricultural land which is least valued for its landscape quality is intensively farmed, has large fields and is lacking in diversity and small scale features. The loss of small farms through amalgamation is hypothesised to contribute to a reduction in landscape diversity.

6. The loss of land and the shedding of labour in an effort to reduce costs implies partial or total loss of livelihoods for affected individuals. In locations with high employment rates, alternative employment might be found. However in some localities individuals may remain unemployed, especially in areas of sparse population (few businesses) or high unemployment rates.

7. In areas with a strong dependency on agriculture for employment provision, the decline of employment in agriculture is associated with population decline as younger people out-migrate to find work. This results in a smaller population and an age structure biased towards the older age groups. This has important implications for community viability. The quality of life experienced by residents may gradually deteriorate as businesses (e.g. shops) and services (such as schools, health centres) cease operating due to insufficient demand.

8. The attractiveness of other options to farmers can be enhanced by the provision of financial incentives, and measures exist under the 2nd Pillar to encourage the development of new revenue streams. These include the extension of the farmer's activities along the supply chain to capture a greater share of the value added, for example by the processing and selling of food directly to end-customers. Farm resources can also be diverted into alternative uses, for example converting buildings for use as business premises or tourist accommodation. By means of branding, these activities can be intrinsically linked with the resources of the particular territory. However, such products are relatively income elastic and, in the low world price scenario, the willingness of customers to pay premium prices for such products would be diminished.

3.1.3. Criteria and sub-criteria

TEQUILA1 components of territorial cohesion, namely territorial quality, territorial efficiency, and territorial identity will still represent the main components for Summative Territorial Impact, although each single sub-component will be inspected per se and aggregated also in other ways to compute Single Dimension Impacts (on climate change, competitiveness, etc.). Within each component/criterion a number of sub-criteria have been identified, and in this section their relevance is briefly explained.

Territorial efficiency

- *Economic growth (PIM_E1)*

The Lisbon agenda encourages improvement in economic performance, efficiency and competitiveness. Improvement in economic performance, especially in poorly performing regions is a key goal of territorial policy.

- *Unemployment (PIM_E2)*

An important driver of improvements (or otherwise) in economic performance is the optimisation of resource use. Changes in the number (or rate) of unemployed people reflect whether progress is made under a policy scenario.

- *Local asset use for tourism (PIM_E3)*

Economic activity utilising local assets is regarded as an effective way of boosting regional economic performance because of its local embeddedness. Tourism is one such activity and is

regarded as an important and appropriate activity in rural areas. It is connected to agricultural policy which, through influencing land management practices, affects the infrastructure such as landscape, which supports tourism.

Some aspects of the competitiveness agenda such as growth and employment are relatively straightforward to implement. However other aspects such as efficiency of resource use (denoted by factor productivity) and quality level, though easy to conceptualise, are impractical to operationalise. In this context the diversification by farmers of their activities (into tourism), can also be regarded as an indirect indicator of innovation or entrepreneurship.

Land abandonment (PIM_E4)

The asset base on which agriculture depends, namely land, can be maintained, improved or degraded as a result of agricultural practice. Thus agricultural policy which alters land management practices directly influences the future sustainability of farming.

Territorial quality

Territorial quality encompasses both environmental and socio-economic factors.

- *Environmental quality (PIM_Q1)*

Attributes which contribute to a high quality physical environment include: absence of pollution, high levels of biodiversity, and careful land management that conserves natural resources. The incidence of these attributes is subject to change as agricultural management practices change, in response to policy.

- *Community viability (PIM_Q2)*

Census statistics have long shown declining population sizes in areas highly dependent on agricultural employment. This is commonly conceptualised as a vicious circle whereby farm labour is replaced by capital and, due to a lack of alternative employment opportunities, there is out-migration, especially by young people. This leads to a diminishing population size with an age structure biased towards older age groups. The implications for the quality of life experienced in such localities are that minimum population thresholds to support service provision may no longer be reached, and there may be an unbalanced age distribution.

- *Climate change (PIM_Q3)*

Global warming is recognised as one of the most serious challenges facing the world's population. Agriculture makes a significant contribution to the level of greenhouse gases (GHG), and the level of emissions is partly dependent on agricultural practice, which is in turn influenced by policy.

- *Soil erosion (PIM_Q4)*

Risk of soil erosion depends on various hydro-geological and climate factors, but may greatly increase due to trends in agricultural exploitation of lands, and namely on land abandonment (E4).

Territorial identity

- *Landscape diversity (PIM_I1)*

Agriculture is a multifunctional activity which produces a range of environmental and recreational goods as well as food and fibre. Farmed landscapes are the product of the particular agricultural production methods employed. They may be quite distinct to a locality and therefore contribute its territorial identity. Specialisation and intensification in agriculture result in landscape changes by reducing its diversity.

- *Community identity (PIM_I2)*

Strong community identities may develop in localities, shaped by factors including the predominant occupational activities of residents. The decline in a predominant sector would slowly lead to a weakening of this identity which may be further diluted by in-migration. The character of distinct communities and cultures may be used as a driver in promoting tourism.

- *Food identity (PIM_I3)*

The territory in which food is produced may give rise to the production of locally distinct foods. These result from the particular crops, farming methods and food processing techniques which have evolved locally. The drive for technical efficiency and in both agriculture and food distribution has led to greater homogeneity in the food outputs produced. Commodification of such indigenous foods can strengthen rural economies.

Indicators' summary: description and calculation

Indicators of these sub-criteria have been identified and are listed in Table 4. In this section a brief description of each indicator is provided along with an outline of how it will be calculated. As explained in a later section, there are a lack of suitable available data to use in the TEQUILA model, and so manual computation will be required, relying on a large number of simplifying assumptions

Key assumptions will be made to derive the proportion of farms (and accompanying land area and employment) which follow each of the business development pathways identified in the earlier Narrative. These pathways may be summarised as follows:

i. accept the income reduction and otherwise maintain the status quo;

ii. exit from farming

iii. change enterprise, possibly by increasing specialisation

iv. reduce costs

v. intensify production

vi. obtain Pillar 2 payments by entering an agri-environment scheme

vii. diversify farm income, possibly by means of a Pillar 2 payment

Simple decision rules based on dependence on SFP, farm size, farm type, yields and Pillar 2 spending priorities will be applied to determine the numbers of farms (and their aggregate area and employment) which follow each pathway. The proportions following each pathway will be different according to whether or not farms are in receipt of LFA payments, and whether world market prices are low or high.

PIM_E1, economic growth

The indicator by which economic growth is measured in this scenario, agricultural income, would be subject to a number of changes as a result of the policy scenario. Negative changes would be expected from the reduction in SFP and reduced revenue from falling product prices. These could be partially or wholly offset by increasing product prices, decreasing production costs, accessing Pillar 2 payments, and indirectly through the establishment of new revenue streams (such as tourism or food processing).

PIM_E2, unemployment

Against a long term trend of reduced labour use in agriculture it is assumed that there will be no net gains in employment, but that any new jobs will offset those lost as a result of the SFP reduction. Consequently change in unemployment will equal jobs lost through reductions from agriculture (due to farm amalgamations and increased labour productivity) minus jobs gained in other sectors. It will be assumed that the probability of re-employment of redundant agricultural labour depends on the local level of unemployment.

PIM_E3, local asset use

Changes in the level of tourism capacity, denoted by tourists beds, will be assumed to be nil in areas with poorly developed infrastructure (as indicated by trend information) but higher in those areas which already have a developing tourist industry. There are a lack of data by which tourism development is related to CAP expenditure, so an assumption of the form 'for an increase of x% in Pillar 2 funding, y% extra tourist beds will be created' will be employed.

PIM_E4, land abandonment

Land abandonment represents a failure in the process of wise utilisation of local resources, namely land resources. Abandonment may take place in areas characterised by fragile and marginal practices. The area of 'hotspot' farms which would be abandoned as a result of a policy scenario will be estimated.

PIM_Q1, environmental quality

Agri-environment schemes, funded under Pillar 2, require farmers to manage land to secure a range of environmental benefits. The area of agricultural land entered into new agri-environment agreements is therefore a relevant indicator of change of environmental quality, and will be assumed to be proportional to the funds allocated to Axis 2. Different rates of entry to schemes will prevail according to which world market price assumption is adopted.

PIM_Q2, viability

Population size change is an appropriate indicator of community viability. Its value will be derived from the change in unemployment already calculated, and the propensity to out-migration as shown by population trend statistics. Regions in which both unemployment and the dependency on agriculture are relatively high will be particularly susceptible to out-migration.

PIM_Q3, climate change

The overall calculation of changes in emissions of GHG from agriculture is complicated, relying on a wide range of variables including land use, land management practice, and local environmental factors such as rainfall and winter temperature. Enteric methane is an important source of GHC resulting from digestion in ruminant animals. Changes in livestock numbers of a given type will produce directly proportional changes in methane (CH4) emissions. For TIPTAP, change in total enteric methane emissions as a result of the policy scenario will be calculated using change in livestock numbers multiplied by appropriate coefficients derived from International Panel on Climate Change methodology (IPCC, 2006). This is a simplified calculation which ignores differences in manure management and between livestock breeds.

PIM_Q4, soil erosion

Certain conditions of slope and climate predispose some areas to irreversible soil erosion in the event that agricultural management is abandoned. Soil erosion statistics, showing annual per hectare soil losses, reveal 'hotspots'. Of particular relevance are those in parts of Greece, Spain, Portugal and France where abandonment, and a consequent failure to maintain terracing, would lead to soil erosion.

PIM_I1, landscape diversity

Small farms will be used as a proxy for landscape quality. As already outlined, an estimate will be made of the number of small farms (below 5 hectares) which discontinue farming under their present owners. It is assumed that such land will either be abandoned or amalgamated into bigger holdings with loss of distinctive landscape features such as hedges, walls, small fields and vernacular buildings. The relevant indicator is total area on farms below 5ha.

PIM_I2, community identity

It can be argued that agricultural communities are distinctive from others. Furthermore, heritage aspects may be embedded in farming traditions, especially where labour intensive production methods are still used. The indicator selected is the size of the agricultural workforce. Loss of employment in agriculture is calculated as the number of farmers which exit from the industry plus the redundant labour. The possibility of incorporating a factor relating to the scale of in-migration will also be considered because, as explained earlier, this will lead to further dilution of occupational identity.

PIM_I3, local food identity

The chosen indicator to represent changes in local food identity is the number of locally distinctive products registered under the three EU schemes, Protected Designations of origin (PDO),

Protected Geographical Indications (PGI), and Traditional Specialities Guaranteed (TSG). It is uncertain how many new food products will be launched as a result of CAP expenditure but it will depend on the existence of potential products and the capacity of individual businesses and institutions to develop them. It will be assumed that greatest active encouragement, and greatest successful launch will occur in member states in which relatively large proportions of Pillar 2 expenditure is devoted to Axis 1, especially Measure 123, 'Adding value to agricultural and forestry products'. Such products are likely to make a modest positive impact on GDP.

3.1.4. Calculating regional policy impacts for agriculture

The TEQUILA methodology encompasses three dimensions - environmental, economic and social - at a fairly low level of spatial geography. It therefore potentially provides a means of visualising and synthesising impacts to a broader range of indicators than other current agricultural policy analysis tools available for territorial level analysis. For example, CAPRI, a well-established modelling tool developed to examine the regional impacts of agricultural policy measures, is focused on commodity production, consumption and trade and does not include either Pillar 2 expenditure or impact variables relating to wider environmental or socio-economic changes (Britz et al, 2007).

However, several EU projects have sought to develop integrated assessment tools which capture the multifunctionality of agriculture. SEAMLESS-IF, currently in a late stage of development, is designed to examine the impacts of changes to policy or market conditions on environmental, economic and social outputs at a range of geographies including NUTS2 level. Like other approaches, it is based on a series of linked models, and combines both top-down models (CAPRI), and also bottom-up models (scaled up from field models) showing environmental impacts. However, like CAPRI, it will contain minimal social indicators, and does not include Pillar 2 expenditure.

The FP6 project MEA-Scope (see http://www.mea-scope.org/) models multifunctional agriculture at regional level and produces a range of agri-economic and environmental outputs. It is built on three core models, including FASSET, which models nitrate and GHG emissions, and AgriPoliS which uses agent-based modelling to capture the decision-making behaviour of farms. However its application appears to be limited to 7 case-study regions and wider societal impacts are ignored.

The Regional Multiagent Simulator (regMAS) uses a bottom-up approach combining linear programming and agent-based modelling (Lobianco and Esposti, 2008). It is also based on AgriPoliS with an important difference that it uses 'real' land use data. Outputs are produced at regional level but again are limited to farm income and land use variables. RegMAS is available as open source software (see http://sourceforge.net/forum/forum.php?forum_id=777125). It is unsuitable for use within the short time scale of the current project as it would require loading with regional level data, including individual farm level data from the FADN for all regions in EU-27.

The POMMARD model, developed by Bergmann et al (2008) is exceptional in linking agriculture to wider societal impacts and producing both agricultural and rural development outputs. Using

region-specific Social Accounting Matrices (SAMs) the behaviour of rural regions is simulated and values for a wide range of output variables are produced. However to adapt the model for each region is very labour intensive (Bergmann and Thomson, 2008) and its application as yet is limited to a few case study regions. Nevertheless, the design of the POMMARD model, in particular the identification of processes and flows, has been used to underpin the choice of indicators in TEQUILA 2.

TIPTAP requires data for a wide range of variables with comprehensive coverage of EU-27 at sub-regional level. Although there are several models capturing the multifunctional nature of agriculture it appears that currently none are capable of generating the necessary data at the relatively low spatial geography required for TIPTAP.

In the absence of a satisfactory simulation approach, spreadsheet calculations will be employed to generate estimated values of impacts. As already discussed such calculations will rely heavily on a number of simplifying assumptions. These will relate to, inter alia, the income level at which farmers will exit and sell their land; re-employment rates of redundant farm labour; out-migration rates, and propensity of farmers to engage in new tourism or supply chain activities.

3.2. TRANSPORT POLICIES

3.2.1. An outlook on Trans-European Transport Networks and its near evolution

The territorial strategic evaluation of future Trans-European Transport Networks (TENs) in the 2020 horizon requires:

- First, to define hypotheses on how TENs will likely be redefined by the EC, as well as other transport policies related to infrastructure supply, traffic and demand management directly linked to the economic and territorial impact of TENs.
- Second, a consistent socioeconomic scenario in order to estimate the future evolution of transport demand.

It is worth mentioning that European transport policies are currently being redefined for the next ten years. In particular:

- A Green paper in TENs revision is going to be published by DGTREN and will be publicly discussed during 2009.
- DGTREN is also preparing the revision for the White Book (2010-2020) for next year. The first step envisaged is a *Communication of the Future of Transport* planned for June 2009.

The outcome that will result from these initiatives is still unknown. Among few other studies, TEN_CONNECT and TRANSVsions studies were launched by DGTREN to support the initiatives.

In this context, the main added value of the application of the TIPTAP evaluation framework will be to obtain a regionalised evaluation (at NUTS3) of TENs according to a systematic and comprehensive framework.

The creation of TENs, transport infrastructure networks covering all modes, ensuring sustainable mobility and providing efficient and high quality infrastructure for growing trans-national transport flows within the EU, is one of the main elements of the European Common Transport Policies (CTP).

The process towards defining Trans-European transport networks has been long and complicated (see Annex3 for the list of the CTP origin and evolution milestones). The first Community document fully devoted to transport infrastructure was published in 1979. Several categories of investments were identified in order to achieve the following goals: elimination of bottlenecks, improvement of international links between major urban centres, adequate connections between peripheral regions and construction of missing links.

After some years, studies and proposals (e.g. the 1986 "Towards a European Highspeed Train Network"), the TENs Guidelines and the first White Paper on Transport Policy of 2001 launched, under the umbrella of the Maastricht Treaty, a new phase of CTP). Besides TENs, environmental considerations, internalisation of externalities and safety were introduced as main policy aims. The revision of the White Paper was approved in 2006, and a third version is planned to be approved in 2009, for implementation during the period 2010-2020[1].

Presently, TENs are basically the juxtaposition of networks proposed by Member States, on their own understanding of national and European needs. A more European-based approach to the definition of the future TENs is thus required, in line with the 2006 revision of the Transport White Book main policy-aims and the global evolution of transport systems.

Actually, investments on TENs have not developed as expected and the current situation, marked by growing congestion under changing mobility patterns, is not better than in 1991 when the first proposals to improve the situation were made. Investment in infrastructure has lagged behind expectations, but social, political, technological and environmental developments have pointed to new parameters to be considered to balance demand and supply of transport across Europe.

[1] On the other hand, the United Nations Economic Commission for Europe (UN-ECE) has devoted a substantial amount of time and effort to develop transport infrastructure and related standards inside Europe and also for connections between Europe and Asia. The European agreement on main international traffic arteries (AGR) and the European agreement on main international railway lines (AGC) of 1975 and 1985 respectively set up the E-road and E-rail networks and the related standards. The UN-ECE envisaged also a similar agreement for inland waterways (European agreement on main inland waterways of international importance (AGN) 1996). The UN-ECE has also developed master plans for a backbone road and rail network (so called TEM (Trans-European Motorways) and TER (Trans-European Railways)) comprising 21 Central, Eastern and South-Eastern European countries in view of a short, medium and long term investment strategy. UN-ECE together with the UN Economic and Social Commission for Asia Pacific (UN-ESCAP) have been actively developing transport connections between Europe and Asia.

The first TENs priority projects were approved by the Christophersen Group in late 1993, consisting in a list of 14 projects, of which only 9 are still included in the White Book of Transport (Map 2.1 in Annex2).

The TENs policy was revised in 2004. Thirty priority axes and projects were identified to strengthen the internal market and cohesion within the EU and to reinforce competitiveness of the extended EU. The 30 priority projects focus clearly on the enlargement of the EU by integrating the networks of the 10 new member states. The 30 priority axes and projects serve primarily long-distance and international traffic within the European Union. The projects comprise all modes and should reduce congestion and stimulate sustainable development by supporting investments on intermodal solutions and Motorways of the Sea (Map 2.2 in Annex2). To track the development of the identified axes and according to the TEN Guidelines, the EC is expected to produce a report in 2010 revising the list of axes and projects.

In light of this, the Pan-European Corridors have been identified. Differently from TENs, the assessments of infrastructure needs and impacts have been carried out by secretariats located in selected Eastern and Central European countries and in selected neighbouring countries, and the assessment methodologies have mainly followed national procedures. Also, the assessments have not focussed on international transport flows and seldom on the organisational and legal bottlenecks in the Corridors, but mainly on the infrastructure-related bottlenecks.

Also, the extension of the major trans-European transport axes to the neighbouring countries and regions concluded in November 2005 (Map 2.3 in Annex2). Two aspects, reflecting "Pan-European interest", were considered for the identification of priority axes connecting the EU with the neighbouring countries or broader regions comprising several countries:

1. Institutional dimension – a priority axis should facilitate and stimulate the development of exchanges between the EU and its neighbours by extending the major TEN axes to the neighbouring countries or broader regions.

2. Functional dimension – a priority axis should be an important route for international traffic flows between the EU and the neighbouring countries or regions, in particular in the longer term, besides carrying significant volumes of inter-regional long-distance traffic. In addition, a priority axis could be a route that allowed traffic to avoid a major environmental bottleneck or barrier[2].

[2] This dimension was assessed using the following criteria: the amount of long-distance inter-regional traffic in the current situation and forecast for 2020; or the volume of transit traffic, in the current situation and estimated for 2020, with origin or destination in the Union and using the infrastructure of the neighboring country or region; or the axis offers an alternative, which would be potentially much shorter (less costly to users), environmentally friendlier or safer than the alternative, established route

The contribution to balanced sustainable development in terms of economic, environmental and social impacts was stated to be crucial to identify and select the relevant projects[3]. In particular, three criteria have been put forward:

- Improving economic efficiency – notably cost savings, including time savings, to international users of the transport system – both passengers and freight - and to operators offering transport services.
- Enhancing environmental sustainability of the transport system - Reduction in air pollution, noise, green house gases and other environmental impacts including the issue of biodiversity, e.g. through changes in the existing modal shift.
- Improving transport safety and security - Reduction in the number and severity of accidents caused by international traffic and in security incidents to international operators, e.g. through modal shift or re-routing to safer modes or infrastructure.

Nowadays, the EC is in process of redefining TENs and priority projects. One possibility being studied is to define "Core Networks", a limited number of axes with highest European interest for both EU-27 and neighbouring countries. The TEN CONNECT study for the 2010-2020 period applied a strategic method and a logical approach to create high level networks, which takes into account the likely demand an efficient, cohesive and sustainable transportation network will yield. Accordingly, the following criteria seem to be crucial to identify and select the relevant projects:

A. Importance for the single market (efficiency) such as overall efficiency of the transport network, easy access between complementary production and consumption areas, the absolute traffic flow in the link, distinguishing between passenger and freight flows, the share of the international and long-distance traffic flow, the share of pure transit traffic, distinguishing port hinterland transit when one node is a port, the current and potential future import and export from a region, the full logistic chain through the corridors for selected commodities, and the modal split in the link.

B. Importance for social and territorial cohesion (cohesion) such as reduction of accidents, of economic differences between countries in terms of GDP per capita, of differences in unemployment, development of a production structure entailing more equal conditions in EU, and possibilities of development of new activities (such as tourism, logistics, production of raw materials).

[3] The impacts, calculated in monetary terms as far as possible, should be compared to investment, maintenance and running costs of the project. The resulting net benefits should be significantly positive overall and to the extent possible for each separate criterion. Only projects with a sufficiently high economic rate of return, about 6%, should be considered.

C. Importance for territorial integration (integration) such as easy access across borders, improvement of connectivity of areas with low accessibility within EU and the neighbouring countries.

D. Environmental considerations (sustainability) such as improving energy efficiency, reduction of CO2 emissions and of land-consumption.

3.2.2. An outlook on transport policies 2010-2020 trends

The DGTREN presentations delivered on *Conference on the Future of Transport* in Brussels, 9-10 March 2009 by DGTREN, and based on the Focus Group and the TRANSVisions study provide an updated and synthetic view of transport policy initiatives.

In particular, the operation of the current EU transport policy levers has to be seen in the context of the 2001 White paper and its 2006 mid-term review. Broadly speaking, the 2001 White Paper indicated that if European institutions and companies invest in railways and put charges on roads the transport system will go in the right direction (CO2 reduction, less accidents and congestion). This approach was based on the understanding that road transport was not paying for all the costs it produced and took into account that railway networks were the least interconnected modes. The mid-term 2006 review further stressed the need to improve the efficiency of transports as a whole, including the largest sector, i.e. road transport. However, a more efficient road transport sector can improve the efficiency of the transport system as a whole, but it may also produce unwanted rebound effects. This is a permanent dilemma of the transport .

Target setting for environmental purposes has become possibly the most determinant policy instrument for the next years. In the framework of the Climate and energy package the European institutions have set up legally binding targets, by 2020, to cut GHG emissions by 20%, to establish a 20% share for renewable energy, and to improve energy efficiency by 20%. The GHG objective could be revised upwards to 30% if a satisfactory international agreement is reached. Moreover the European Council has expressed its wish to aim at a global reduction of 80% by 2050 compared to 1990. The total effort for GHG reduction will be divided between the EU Emissions Trading System (ETS) and non-ETS sectors. Most of the transport sector, together with housing, agriculture and waste sectors are among the latter. For instance, electric railways are already covered by the ETS system through their power purchases, and aviation will be subject to ETS from 2012. The EU ETS sectors will reduce emissions by 21% compared to 2005 by 2020, the non-ETS taken as a whole will reduce their GHG emissions by 10% within the same period; together they will reduce GHG by 20% compared to 1990. However, member States are allowed to decide the extent to which they will focus their efforts to reach the non-ETS 10% target on the

transport sector, while the Commission will keep mostly a monitoring role, thus producing a sort of "distributed" European transport policy.

In light of this, transport policy instruments to be envisaged as complementary to infrastructure policies, could be listed as follows:

- Regulations on the energy efficiency of vehicles: Passenger cars account for about 12% of the Union's CO2 emissions, almost half of the 27% due to the transport sector. A new regulation will set emission performance standards for new passenger cars registered in the EU.
- Increase in funds for research and development in particular towards energy efficiency improvements and breakthrough (e.g. fuel cells and hydrogen or the Clean Sky Joint technology Initiative).
- Enhanced support to technological innovation and applied research is a key policy to facilitate the fastest possible implementation of new technologies.
- Market opening and liberalisation to complete the internal market within the respect of social and public service constraints: the current liberalisation policies could be reinforced to improve productivity by facilitating healthier competition. Actually, the European Parliament has asked Road cabotage liberalisation by 2014.
- Better use of existing infrastructures: Information and Communication Technologies (ICT) and on-line supply management technologies have to be applied to make the best possible use of scarce capacity, especially when heterogeneous traffic flows overlap.
- Getting right prices is indispensable to assure the user-pays and polluter-pays principles, so users have the incentive to rationalize their consumption of transport overtime. Road pricing, starting by the Eurovignette directive and its ongoing revision, will be based on a cost-recovery and internalisation of social and environmental impacts due to road traffic.
- Taxation will change in the coming years because of the expected reduction on oil consumption. Nowadays, oil taxation represents approximately 1,9% of GDP, with taxes on vehicles 0,6%, but the public revenues generated by the transport sector do not compensate overall the budget allocated (1% infrastructure investments), the externalities generated (-1% of GDP), congestion and road safety costs (-1,1% and -0,5% of GDP, respectively). This does not mean that the system is efficient as payments apply the polluter and user pay system in a very blunt way, mixed with the need to collect fiscal resources.
- Move to self-financing. For a maximum assurance, in a public finance context whether other social expenses may have more priority than the transport system, the latter should

also be able to finance itself in a close loop if need be. This does not mean giving up the possibility of grants to compensate socio-economic benefits, but this is an element of resilience to a scarcity of public funds.

- The establishment of bans (e.g. to road vehicles with emissions higher to a given threshold, as well as to certain type of infrastructures, like motorways passing-through urbanised or protected areas...) may have a contradictory impact: while in the short-term may reduce to some extent the economic growth, in the longer run may result in more technologic innovation and higher productivity. Another regulatory instrument is the introduction of the same private car speed limit as in the USA. Road congestion could be fought with regulatory measures such as dynamic speed management, high occupancy vehicle lines or ramp metering.
- An urban transport dimension may be found for most of the previous policies and measures. Cities are actually key to economic development.

3.2.3. Policy measures to be assessed

In this project, we will precisely focus on infrastructure and regulatory policies (i.e. transport pricing).

Infrastructure networks to be assessed include road network, railways dedicated to freight traffic, railways dedicated to passenger traffic, airports and ports. Networks will cover both EU-27 and neighbouring countries. The analysis will be carried out at NUTS3 level by exploting the TRANS-TOOL forecast model.

In order for the TRANS-TOOLS model to function properly improvement of links of both national and international importance needs to be integrated in the TRANS-TOOLS network. The links proposed to be included in the analysis of the axes refer to extensions and changes to the existing 2005 road and rail network.

The transport networks include the links and nodes to which the traffic of the different transport modes is assigned. The networks are also used for calculating the travel/transport time and transport distances between all zones in the TRANS-TOOLS transport model for the different transport modes. An improvement of a link in one of the networks will therefore lead to an improvement in time and/or distance for the transport mode under consideration.

The first scenario to be used is the Baseline 2020 as defined in TRANSVisions study, but also other alternative policy-scenarios and time horizons are considered (DGTREN, March 2009; see Table 5 for a synthesis of the basic characteristics)[4].

In the **baseline scenario** links which have been constructed between 2005 and 2008 and links, which are currently under construction or already planned for construction are added. Therefore, the baseline is a conservative estimate of what could be accomplished. The roads indicated on the maps are road projects improving the main road network. Two different types of road works are foreseen, namely new construction and changes of existing infrastructure. Most of the changes are related to roads changing class or speed. A class change varies the attributes on a road link, e.g. moving from ordinary two-lane road to expressway or motorway standard, or moving from a 4 lane motorway to a motorway with 6 or more lanes. Although it is obvious that a motorway is not constructed in exactly the same alignment as an existing two lane road, it is assumed that the change in length is negligible. If roads are constructed in completely new alignments this is termed "New roads". The same terminology applies to the rail links. Either it is a change of attributes to existing links, e.g. speed improvement, or it is new construction. The road and rail networks in the baseline scenario are presented in Maps 1 and 2.

The second scenario is a **High Growth** one where policies are oriented towards an infrastructure enhancement. It is based on High growth 2020 as defined in TRANSVisions study. In this case, a more comprehensive infrastructure development than foreseen in the baseline is assumed. The 30 priority projects are assumed to be completed as well as a number of other projects of relevance to the coherence of Europe. These developments are mainly located in the eastern countries. The road and rail networks in the high growth scenario are shown in Maps 3 and 4.

Regarding vehicle technology, policies will be applied to accelerate the renewal of the fleet with more efficient vehicles. The effect is reducing the average emission ratios of pollutants and the energy consumption. This target can be achieved by banning the presence in roads of old vehicles and by enforcing legal limits of emission ratios in newly manufactured vehicles.

The third scenario is based on **Low Growth 2020** as defined in TRANSVisions study, characterised by a low economic development further emphasized by a negative population development. Low growth occurs because of increasing costs of energy, particularly oil. Europe's answer to the increasing energy costs is mobility reduction in terms of higher operating costs which reflects the high energy prices. Policies in this scenario are oriented towards taxation, internalisation of transport externalities, and to put incentives for a modal shift towards rail.

[4] The baseline scenario refers to year 2020; it is developed by exploiting the TRANSTOOLS model within the policy framework of the Revision of Transport White Book 2010-2020 and the Green Book on TENs revision.

Of what concerns transport pricing, in the Low Growth Scenario research and development initiatives are in line with the baseline, but fuel cost for passenger cars is expected to be 20 % higher than in 2005, in constant 2005 prices. Also, distance based transport costs for heavy goods vehicles is assumed to increase 10% in constant 2005 prices.

Additionally, the network is assumed to be the same as in the baseline scenario. However, cost recovery for heavy goods vehicles is being anticipated in the Vignette countries. In the low growth scenario the introduction of the cost recovery is assumed a necessity in order to carry out necessary maintenance and reconstruction of the network under low growth conditions.

Internalisation is anticipated at the slightly higher level than in the Baseline scenario (i.e. internalisation of noise, air pollution and congestion has the same values per km as indicated in the Baseline scenario plus an increase of 0,04/km).

Passenger rail fares are expected to be the same as in the Baseline scenario. For rail freight the rail transport costs are assumed to increase mainly because the improvements in rail technology and cross border operations are not advancing as fast as in the Baseline scenario. An increase of rail transport costs of 6% has been assumed.

The air transport industry is supposed to be under strain because of high oil prices and a slow economic development. In order to ensure profitability of the business the 2005 air fares are assumed to increase 20% in real terms.

The transport costs of freight transport by inland waterways are unchanged compared to the Baseline scenario. Also, maritime transport are supposed to develop along the same path as truck transport, i.e. maritime transport costs is assumed to increase 10% in real terms.

3.2.4. Evaluation criteria

The criteria for the evaluation of transport policies should be based on the political goals of the EU. The paramount goal of the EU is to improve general competitiveness of its territory (i.e. Lisbon strategy) but also the living standards of its citizens by assuring a *sustainable and balanced development*. Accordingly, the transport system should contribute to the attainment of these objectives by increasing its own efficiency in the use of resources, including natural ones, the efficiency of the other sectors of the economy, the internal accessibility of the EU territory and the quality of life of citizens.

Given TEN's relevance for single market, cohesion and trade with the neighbouring countries and other main trade partners, the strategic evaluation indicators used in previous exercises of TEN evaluation were the conventional ones used in transport networks assessment, namely:

- Territorial cohesion:
    - Endowment: territorial endowment at National level
    - Connectivity: minimum distances from cities to the different networks
    - Accessibility: population/GDP at a given generalised cost from transport international terminals
- Economic efficiency:
    - Connectivity: shortest paths between largest cities to ports and/or airports
    - Traffics: minimum % of international or long-distance traffic
    - Intermodality: Assuring the multimodal connection of ports and aiports.
- Environmental sustainability: Minimising land-taken, or total length of the network
- Political feasibility: Consideration of links included in previous EU plans

Territorial impact assessment looks rather different. On the basis of the experience of the first version of the TEQUILA model (Table 1), the specific indicators to be considered in the present project are as follows (see Table 6).

Efficiency:

E1 – Productivity of internal infrastructure (change)
E2 – Productivity of airports (change)
E3 - GDP growth
E4 – Congestion (generalised + roads, together)
E5 – Market potential (change) (to GDP and People)
E6 – Infrastructure endowment (change)

Quality:

Q1 – Road freight traffic passing through
Q2 – CO2 emissions (change)
Q3 - accidents (change)
Q4 – Regional connectivity (rail + road) (change)
Q5 – National connectivity (change)

Identity:

I1 – Landscape fragmentation
I2 – Accessibility to local cultural heritage
I3 – Internationalisation (openness to foreign passengers)

The main difference in relation to TEQUILA1 refers to:

- The inclusion of productivity of infrastructure and airports in Efficiency;
- The inclusion of freight traffic passing through regions, and of accidents in Quality;
- The exclusion of an indicator of "Creativity" in the Territorial Identity criterion, judged too weak.
- The inclusion of an indicator of globalisation in Territorial Identity[5].

Other refinement will be added once the results from TRANS-TOOLS models will be available according to TEQUILA evaluation framework requirements.

3.2.5. Logical chains and methodology to compute policy impacts

TRANS-TOOLS, official DGTREN forecast model will be used to move from policies to the evaluation indicators above defined. TRANS-TOOLS follows a state-of-the-practice 4-step modelling framework, consisting of a successive modelling of transport generation (at NUTS3), distribution (among NUTS3 and NUTS2), modal split (between transport modes) and network assignment.

Policies are expressed in terms of networks (e.g. TENs), as well as in costs and times by passengers and/or freight travelling across the networks.

TRANS-TOOLS is the best state-of-the-practice transport-oriented 4-steps forecast model available at EU level[6], that includes specific socioeconomic modules based on complementary modelling paradigms.

The modelling capabilities of TRANS-TOOLS are related directly to input variables describing the infrastructure networks and aspects related to the networks e.g. transport costs or transport times, as well as flows between NUTS3 and NUTS2 regions. Therefore, the TRANS-TOOLS model is also able to offer answers on policy questions indirectly affecting transport costs and transport times, as well as demand evolution.

[5] A lively discussion took place among partners concerning Territorial Identity indicators. Transport experts judged regional and national connectivity as leading to reinforce regional and national identity. On the other hand, territorial experts judged connectivity as an element of Territorial Quality and intended Territorial Identity as "local" identity.

[6] It is a 4-steps transport equilibrium model (version November 2008, developed by DTU and others in TEN_CONNECT), calibrated on 2005 data.

Pros and cons of TRANS-TOOLS can be summarised as follows:

- It provides results only for 2020 and 2030 (or a fixed year, but it does not give evolutions overtime).
- Policies are translated into generalised user costs in 2030, either in values of time or in costs vehicle operation.
- It covers EU27 and neighbouring countries (refined for Eastern European countries) but not Northern Africa.
- The new road assignment procedure implemented (Stochastic User Equilibrium (SUE) local traffic generated and preloaded, assignment by periods of the day) allows a detailed analysis of congestion on roads (and therefore the impact of transport policies such as speed-limits).
- The new trade model facilitates the analysis of import/export freight.
- Passenger trips with origin or destination outside EU27 are included but not explicitly modelled (except neighbouring countries, but not Northern Africa).
- In the case of aviation, trips with origin or destination outside EU27 are not modelled (EU-27 trip segments are included, in non-direct flights).
- Freight trips with origin or destination outside EU27 are included as if they had their origin or destination in a European port (except for neighbouring countries).
- Air freight is not included.
- There is no explicit modelling of ferries (included as road and rail links) There is no policy-interface, producing a synthesis of the 2 Gb results produced in each scenario run (leading to a very time-consuming process of analysis).

The process in order to compute the territorial impact on the different criteria consist in two simultaneous steps:

1. TRANS-TOOLS results are regionalised at the NUTS3 (e.g. freight forecasts are obtained at NUTS2 level and need to be attached to NUTS3);
2. The specific TEQUILA2 indicators are computed.

A routine is being programmed in order to transform TRANS-TOOLS results into the indicators required by TEQUILA, linked to a GIS. Additionally, some refinement and additional work are required for the regionalization process, basically splitting networks segments or links at NUTS3 level.

4. Description of further proceeding towards the Draft Final Report

This report has detailed the progress of the TIPTAP project, both in the methodology and sectoral policies. In particular, the following **achievements** have been reached:

1. Of what concerns the **methodology**, the expert knowledge gathered allowed us to achieve three main advances:

    a. To better specify the importance of the different components of the current version of the TEQUILA model. The results obtained allow us to adjust the weight values for the main criteria. More emphasis should be put on *Territorial efficiency* and *Territorial Quality* and less to *Territorial identity*. Also, *economic growth* should be considered the most important criterion when designing policies which focus on *territorial cohesion*.

    b. To obtain a more detailed specification of the value functions for the various criteria. Most assumptions with regard to the functional form of the value functions do hold and the value functions for the various criteria are actually confirmed to take the linear form.

    c. To obtain weight values reflecting the desiderability for and the vulnerability of a region for a specific impact. These weight values can be used in the current TEQUILA model to adjust impacts for fragilities and potentials of different types of regions

2. Of what concerns the sectoral policies, achievements can be summarised as follows:

Agricultural policies.

    d. Definition of the policy measure and scenarios;

    e. Differentiation of regional impacts according to the quality of agricultural land and the efficiency of farms;

    f. Determination of PI in each region on the basis of expenditure changes.

    g. Definition of spreadsheet calculations to generate estimated quantitative values of impacts. Such calculations will rely heavily on a number of simplifying assumptions.

Transport policies.

    a. Definition of the policy measure (i.e. infrastructure and regulatory policies) and scenarios (TRANSVision study, DGTREN, March 2009);

    b. Enrichment and enlargement of the sub-criteria considered for each main criteria (Territorial Efficiency, Quality and Identity) on the first version of the TEQUILA model;

    c. TRANSTOOL forecast model used to compute PI.

Some dissemination activities have already been undertaken. In particular, the working of the TEQUILA model and its application to transport policies and CAP have been presented at the internal ESPON Seminar on 10-11 December in Bordeaux and to the EU Seminar on Territorial Impact of EU Policies held on 5 March in Amsterdam.

Future work will proceed along four main directions:

1. On quantitative assessment of impacts of the two policies on each territorial criterion;
2. On methodology: definition of weights, value functions and territorial utility functions;
3. On refinements of the software package;
4. On final simulations of SDI and territorial impacts.
5. On prompt dissemination of the results achieved in the relevant scientific community, ESPON Seminars, and European or national events on territorial policies.

Of what concerns the methodology, two meetings are planned by mid May, to be held respectively in Barcelona on 27-28 April and in Newcastle on 11-12 May. These have the specific goal to assemble a pool of sectoral experts and policy-makers (respectively, on transport and agricultural policies) and to conduct assessment of specific elements of the different value functions referring to each impact indicators. The presence of experts from the Sounding Board as well as the involvement of policy makers indicated and invited by the ESPON Coordination Unit will be highly appreciated and welcome.

To do so, functions will be specified and controlled for each desirability and vulnerability parameters. The territorial value or utility function actually can generate changes on the general weighting system (tested during the first Expert meeting) coming from the specificities of the single regions. The same impact in terms of GDP increase may be differently appreciated by a rich and a poor region, so it is relevant to have information about different evaluations of the single impacts in north/south, east/west, advanced/lagging, urban/rural regions in order allow to the definition of the form of a possible *territorial utility function* (in cross-section among all EU regions). This will make mapping of impacts for different types of regions possible and relatively straightforward.

Indications derived from the first meeting suggest that experts did not have great difficulties in completing the assessment exercises but some refinements seem to be necessary to be added in the program. For example, this applies to precise specification of the TEQUILA criteria and their score ranges and the semantic scale used during the AHP exercises. Accordingly, the questionnaires will undergo adjustments to accommodate these requests in the upcoming workshops.

In particular, for what concerns transport policies, the discussion with experts will envisage two steps. The first step will consist in an in-depth discussion of trends, policies and likely impacts, and the second will be devoted to discuss the relative importance of the potential impacts being forecasted. Previously, a questionnaire specific for each theme will be circulated following a Delphi a process. This exercise will be conducted with a strategic and

forward-looking view, since impacts in transport policies need long-term horizons to be evident. A reference scenario will be defined based on the previously mentioned forecast exercises.

The TEQUILA model is the only existing operational model for a regionalised and quantitative assessment of impacts of policies in the EU territory. Methodology has to be adapted to the specificities of each policy to data availability and to a precise external definition of policy intensity in each EU region. All this makes our task a complicated one. No other studies can be really of use.

Of what concerns the software, TEQUILA1 model was operated through a software package that proved to supply promising results assessing the territorial impact of priority TEN projects (defined in 2000-01) on European NUTS3 regions. In the present case, the package will be substantially reconsidered and enlarged in four main directions:

1. The package was conceived as a tool for the general territorial impact assessment, what in this project is made reference to as SI. This structure will be maintained, but it will be accompanied by a simplified package for SDI (on competitiveness, economic and social structure, environmental aspects, etc.). In this case, all problems connected with value judgements on the relative importance of the different dimensions/criteria (economic vs. environmental vs. social vs. cultural, ...) are not present by definition. In all cases, even in SI assessment, the impacts on the single components will be treated and shown separately.
2. The new operational model will integrate mapping procedures directly inside the computational machine, in order to avoid transfer procedure from impact calculation to impact mapping.
3. The general procedure will consider the case where compensation among impacts could not be acceptable (the Flag model), and devices for showing this result in the single regional cases will be included (both in the listing of results and in mapping). In this case too an expert judgement will be necessary in order to pinpoint the threshold values beyond which compensation will be no more viable. For instance, a simple rule can be applied: in case the impact of a policy alternative exceeds a critical threshold value in some regions, it should not be compared or averaged with impacts on other dimensions/criteria and taken into consideration in the decision-making procedure; the case should be inspected per se and compensation interventions should be envisaged. This is a highly attractive method for pre-screening impacts by means of a critical threshold values analysis.
4. Possibilities of including inter-regional spillovers will be explored.

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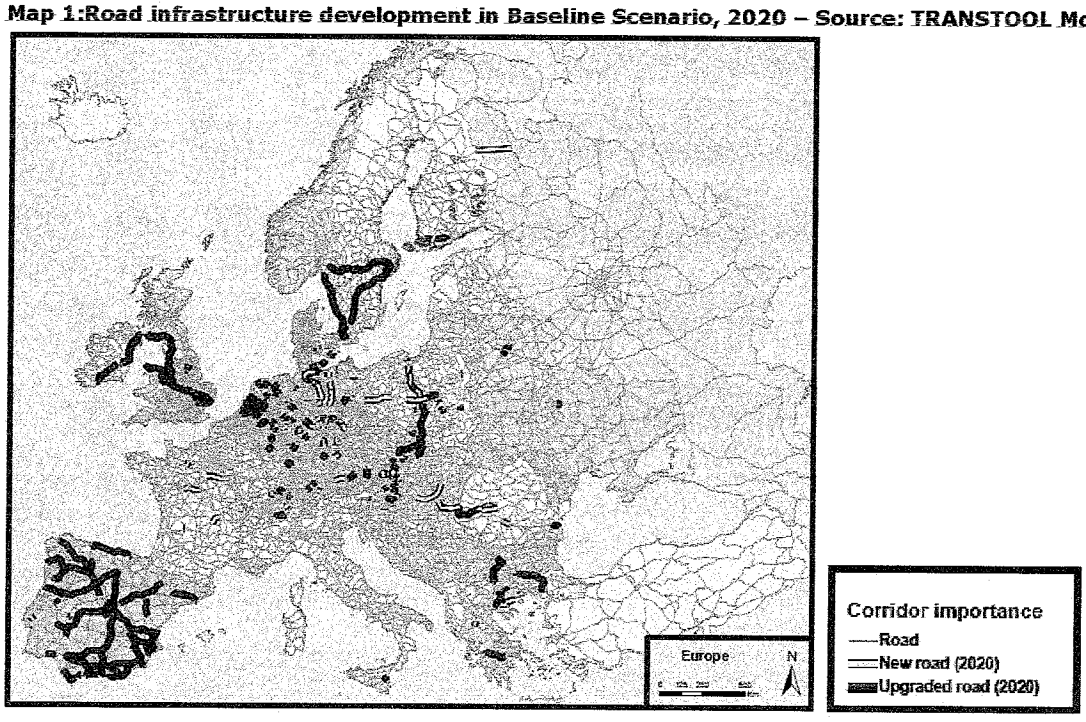
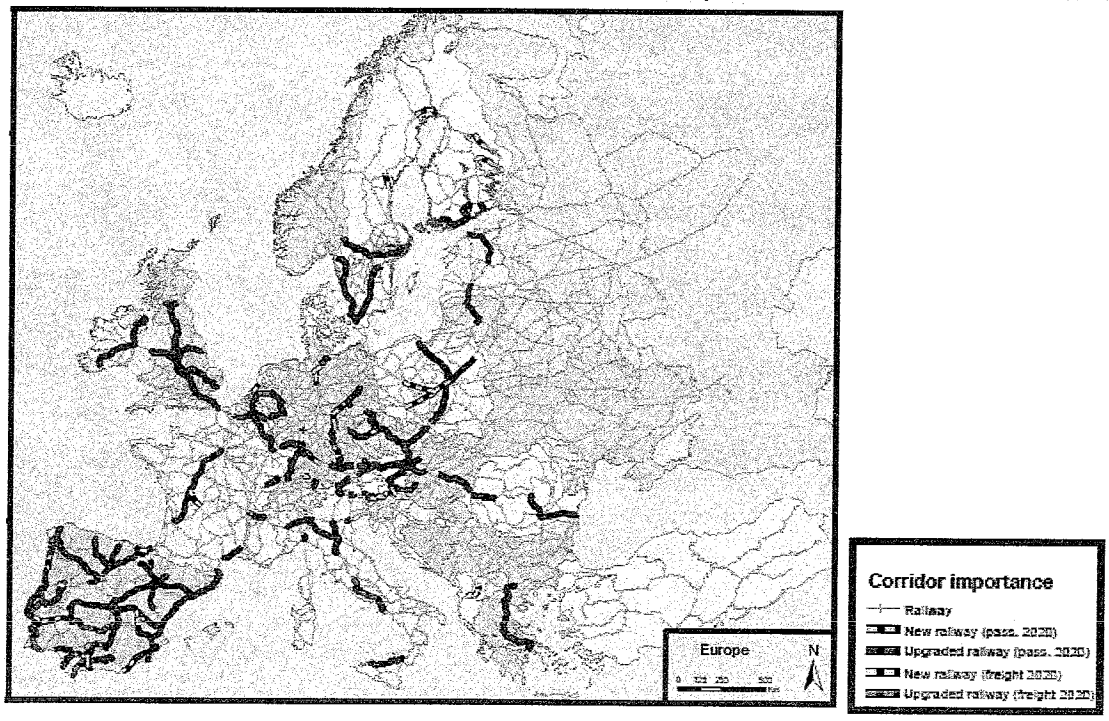
Maps

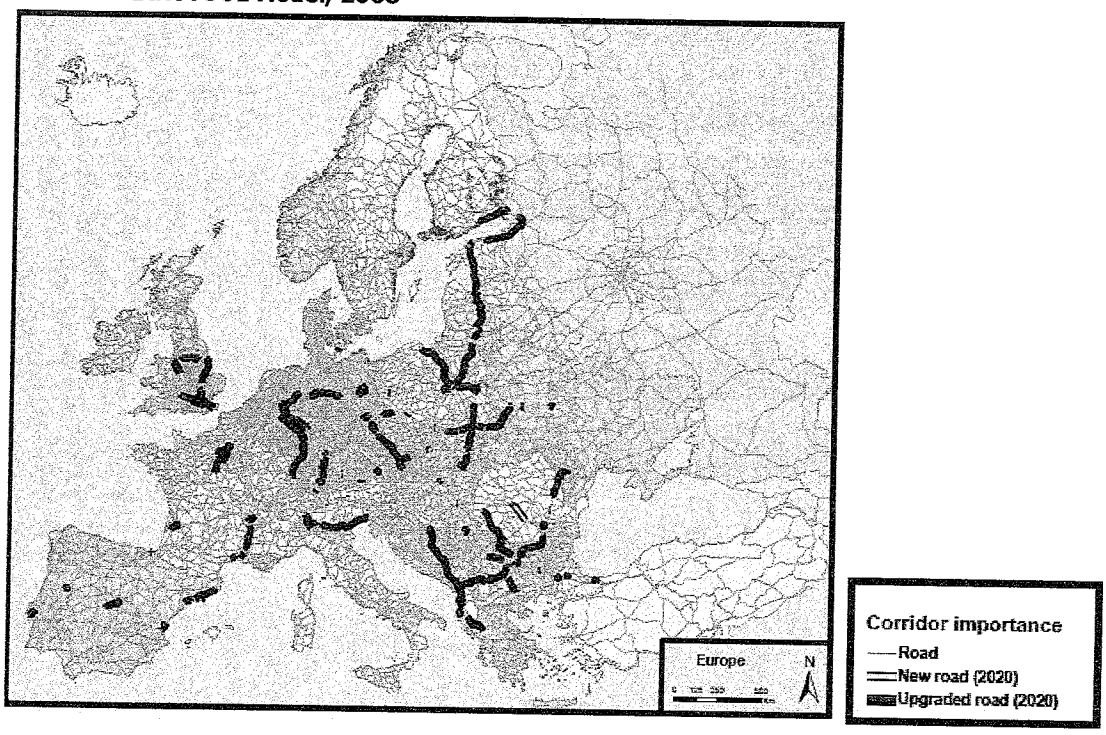
Map 1:Road infrastructure development in Baseline Scenario, 2020 – Source: TRANSTOOL Model, 2008



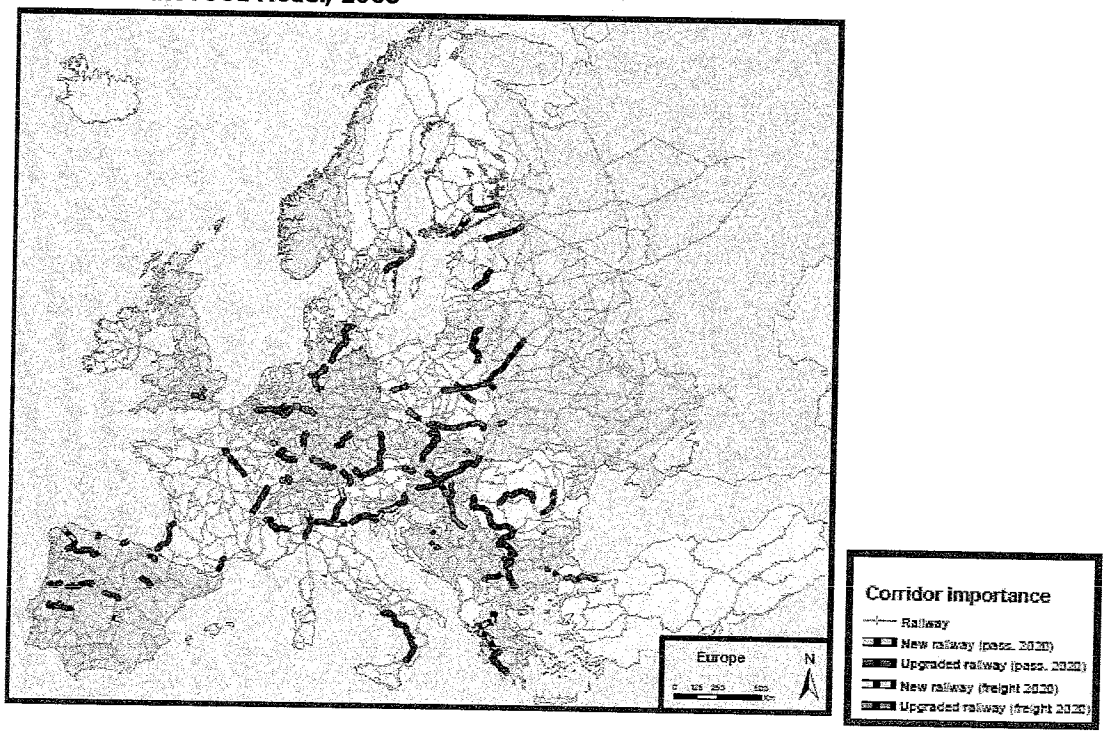
Map 2: Rail infrastructure development in Baseline Scenario, 2020 – Source: TRANSTOOL Model, 2008



Map 3: Road infrastructure development in the High Growth Scenario compared to Baseline, 2020
Source: TRANSTOOL Model, 2008



Map4: Rail infrastructure development in the High Growth Scenario compared to Baseline, 2020
Source: TRANSTOOL Model, 2008



Tables

Table 1. Criteria and variables specification in TEQUILA1 model

Criteria	Variable	Sub-criterion	Type	Definition	Measurement
Territorial efficiency	PIM_E1	Internal connectivity	Benefit	Dif transport endowment (new road + rail) / GDP	Km/GDP
	PIM_E2	External accessibility	Benefit	Dif accessibility is new passengers accessible by road/rail (potential)	Number of persons
	PIM_E3	Economic growth	Benefit	Dif GDP per capita, scenario B1 – Difference to baseline scenario 2000-2021	Dif % GDP/Inhabitant
Territorial quality	PIM_Q1	Congestion	Cost	Differential flows estimated	Million Vehicles/Km
	PIM_Q2	Emissions	Cost	Differential CO2 emissions estimated	Million Tons CO2/Year
	PIM_Q3	Transport sustainability	Benefit	New rail minus new roads with respect to scenario 2021	Km minus Km
Territorial identity	PIM_I1	Creativity	Benefit	Dif accessibility times [knowledge and creative services]	(# people)*(# libraries + theathres)
	PIM_I2	Cultural heritage	Benefit	Dif accessibility times [# monuments + museums]	(# people)*(# monuments – museums)
	PIM_I3	Landscape resources	Cost	Dif transport endowment (new km of road+rail)/GDP	Km/GDP

Table 2. Semantic scale of Saaty

Value	Definition
1	Equal importance
3	Moderate importance
5	Strong importance
7	Very strong importance
9	Extreme importance
2,4,6,8	Intermediate value

Table 3. Weight values of criteria and sub-criteria (revised TEQUILA1) – Experts judgements

Criterion:	Weight main category	Contribution of criterion to main category	Standardized weight
Internal accessibility	0,57	0,13	0,07
External accessibility	0,57	0,17	0,09
Economic growth	0,57	0,71	0,40
Congestion	0,33	0,29	0,10
Emissions	0,33	0,45	0,15
Transport sustainability	0,33	0,26	0,09
Creativity	0,10	0,33	0,03
Cultural heritage	0,10	0,23	0,02
Landscape fragmentation	0,10	0,44	0,04

Table 4. Impact criteria and sub-criteria in territorial impact assessment – CAP policies

Criteria	Variable	Sub-criterion	Indicator	Unit of measure	Direction	Source of data
Territorial Efficiency	PIM_E1	**Economic growth**	Aggregate agricultural income	millions euros	+	Eurostat, regional
	PIM_E2	**Unemployment**	Unemployed	1000 people	-	ESPON 2013
	PIM_E3	**Local asset use for tourism**	Tourist bed spaces	bed spaces	+	RD in the EU, 2007*
	PIM_E4	**Land abandoment**	Abandonment (derived)	1000 ha	-	RD in the EU, 2007
Territorial Quality	PIM_Q1	**Environmental quality**	Area agri-environment agreement	1000 ha	+	RD in the EU, 2007
	PIM_Q2	**Community viability**	Population	1000 people	+	ESPON 2013
	PIM_Q3	**Climate change**	Enteric methane emissions	Calculated from livestock units*conversion factor	-	Eurostat, regional
	PIM_Q4	**Soil erosion**	Areas at risk of soil erosion x E4	Ton/ha/year	-	Join Research Centre
Territorial Identity	PIM_I1	**Landscape diversity**	Total area, farms <5ha UAA (Derived)	Farms.	+	Eurostat, regional
	PIM_I2	**Community identity**	Agricultural work force	Annual work units (AWU)	-	Eurostat, regional
	PIM_I3	**Identity products**	Production of heritage food	Registered products	+	EC, Agric and RD, quality policy

*Rural Development in the European Union - Statistical and Economic Information - Report 2007. See annex to Chapter 3, Regional tables; Downloaded at: http://ec.europa.eu/agriculture/agrista/rurdev2007/index_en.htm

Table 5. Baseline scenario in transport policies assessment[7]

	Baseline (2020)	Infrastructure (2020)	Pricing policies (2020)
Transport cost relative to 2005			
- Rail and bus fare	50% GDP (max. 30%)	50% GDP (max. 30%)	50% GDP (max. 30%)
- Passenger car fuel cost	7%	7%	17%
- Air fare	0%	0%	15%
- Truck driving cost	4%	4%	10%
- Rail freight cost	-10%	-10%	5%
- IWW freight cost	0%	0%	0%
- Maritime transport cost	4%	4%	10%
Network			
- Road	Baseline 2020	High growth 2020	Baseline 2020
Passenger km cost	as in 2005	as in 2005	as in 2005
Passenger km internalisation	0	0	25 % of truck intern
Passenger km cost recovery vignette countries	0	0	0,02 Eu on motorways
Truck km cost	as in 2005	as in 2005	as in 2005
Truck km internalisation	IMPACT table	IMPACT table	IMPACT table + 0,04 Eu
Truck km cost recovery vignette countries	0	0	0,06 Eu on Motorways
- Rail passenger	Baseline 2020	High growth 2020	Baseline 2020
- Rail freight	Baseline 2020	High growth 2020	Baseline 2020
- Air	2005	Extra low cost lines	2005
- IWW	2005	2005	2005

Table 6. Impact criteria and sub-criteria in territorial impact assessment – Transport policies

	Strengthening/potentially positive	Challenging/ potentially negative
Territorial Efficiency	- Productivity of inland infrastructure (total traffic/km road and rail) - Productivity of airports (total external passenger traffic/airport capacity) - GDP growth (including marginal increase due to new transport infrastructure) - Market and people accessible for daily round-trips (GDP, Population reachable at 3:00 hours) - Regional infrastructure endowment (km motorways and rail by person or km2)	- Congestion level (generalised cost of congestion - Congested roads (roads under congestion)
Territorial Quality	- Reduction in the number of road accidents - Regional connectivity (time by rail to the other NUTS3 capitals in the same NUTS2) - Regional connectivity (time by road to the other NUTS3 capitals in the same NUTS2) - National connectivity (time by rail to the NUTS0)	- Road freight traffic passing-through - Direct CO2 emissions by cars and trucks
Territorial Identity	- Accessibility to local cultural heritage (Similar to TEQUILA1; see Table 1) - Internationalisation: o External passengers reaching the NUTS3 by the shortest transport mode at less than 3:00 hours. o External passengers from outside the country reaching the NUTS3 by the shortest transport mode at less than 3:00 hours.	- Landscape fragmentation (similar to TEQUILA1; see Table 1)

[7] **Zonal data relative to 2005**: Population: 0,6%; Employment: 0,0%; EU GDP: 44,2%; Overseas GDP: 55,8%; Carownership (average): 18,6%; CAP: 0%.

ANNEX 1

List of participants to the First Expert Meeting, VU University Amsterdam, March the 4th 2009

Prof. dr. Peter Nijkamp, Department of Spatial Economics, VU University Amsterdam.
Prof. dr. Piet Rietveld, Department of Spatial Economics, VU University Amsterdam.
Prof. dr. Roberto Camagni, Politechnico di Milano.
Dr. Henri de Groot, Department of Spatial Economics, VU University Amsterdam.
Dr. Jan Rouwendal, Department of Spatial Economics, VU University Amsterdam.
Dr. Frank Bruinsma, Department of Spatial Economics, VU University Amsterdam.
Dr. Gert-Jan Linders, Department of Spatial Economics, VU University Amsterdam.
Dr. Eveline van Leeuwen, Department of Spatial Economics, VU University Amsterdam.
Ceren Ozgen, Department of Spatial Economics, VU University Amsterdam.
Ahu Gulumser, Urban and Regional Planning Department, Istanbul Technical University
Dr. Eng. Andreu Ulied, MCRIT Barcelona
Efrain Larrea, MCRIT Barcelona
Dr. Camilla Lenzi, Politecnico di Milano.
Marian Raley, School of Agriculture, Food and Rural Development, Newcastle University.
Ron Vreeker, ARCADIS Nederland.

ANNEX 2

FIGURES

Figure 2.1. Value function for sub-criterion Economic growth (TEQUILA1)

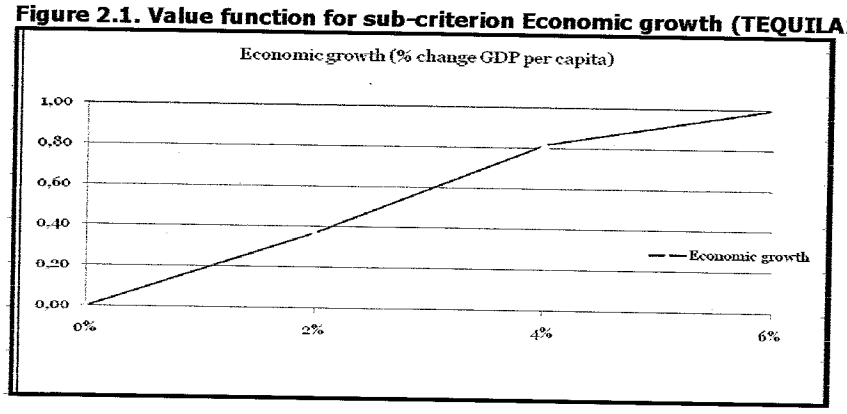


Figure 2.2. Value function for sub-criterion External accessibility (TEQUILA1)

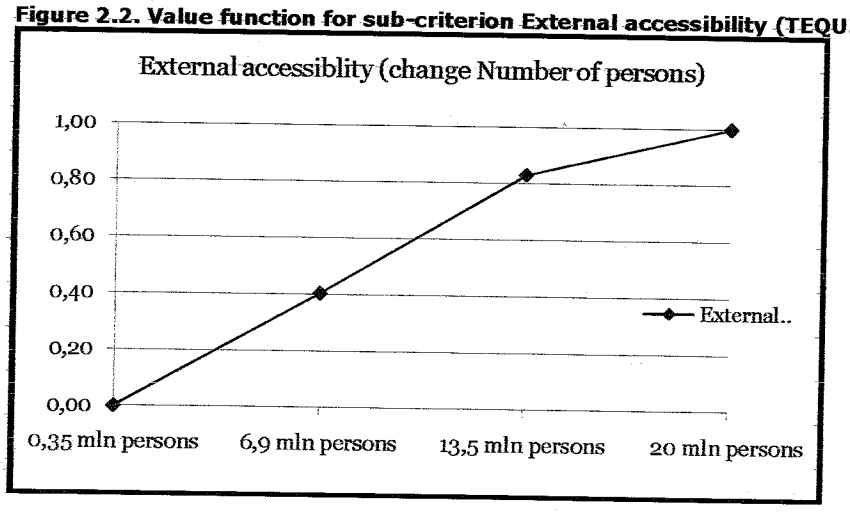


Figure 2.3. Value function for sub-criterion Internal connectivity (TEQUILA1)

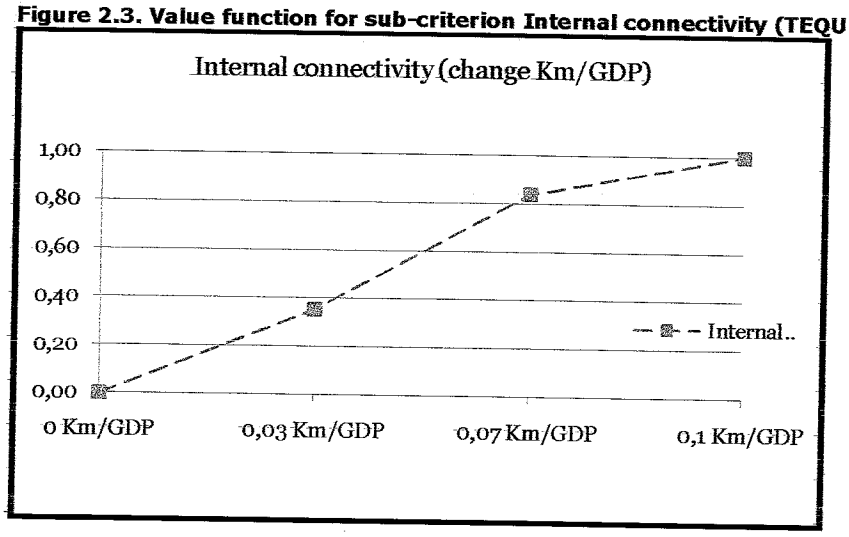


Figure 2.4. Value function for sub-criterion Congestion (TEQUILA1)

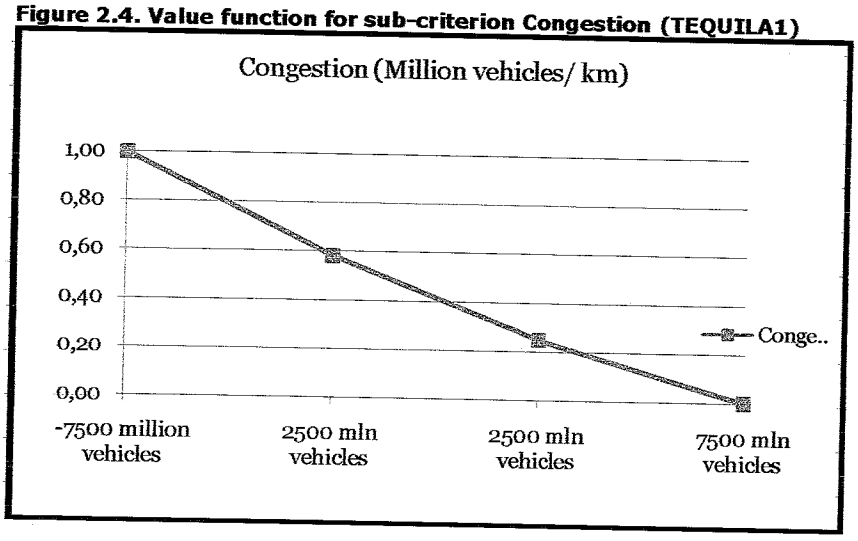


Figure 2.5. Value function for sub-criterion Emissions (TEQUILA1)

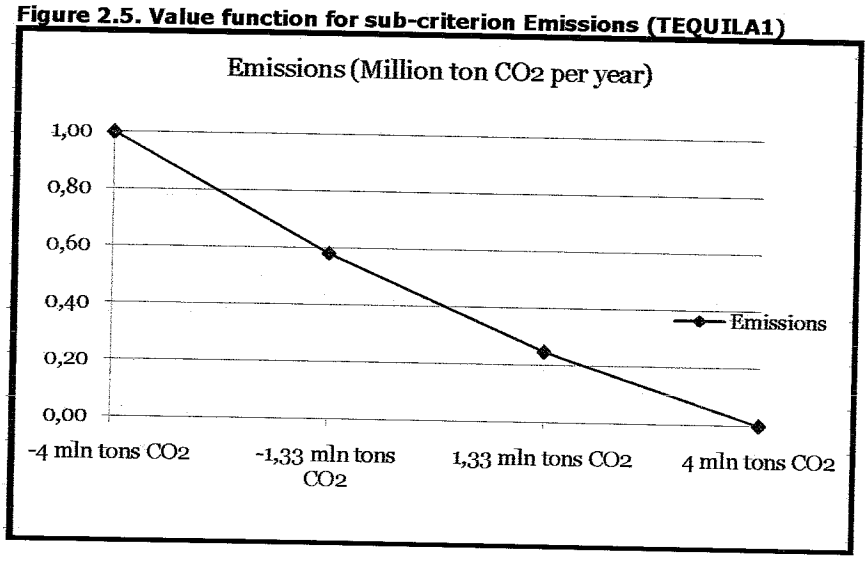


Figure 2.6. Value function for sub-criterion Transport sustainability (TEQUILA1)

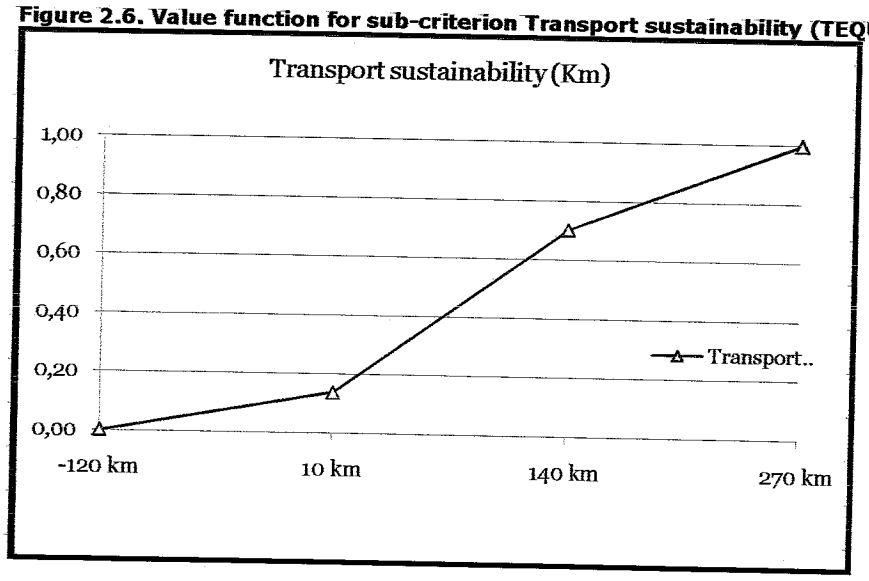


Figure 2.7. Value function for sub-criterion Creativity (TEQUILA1)

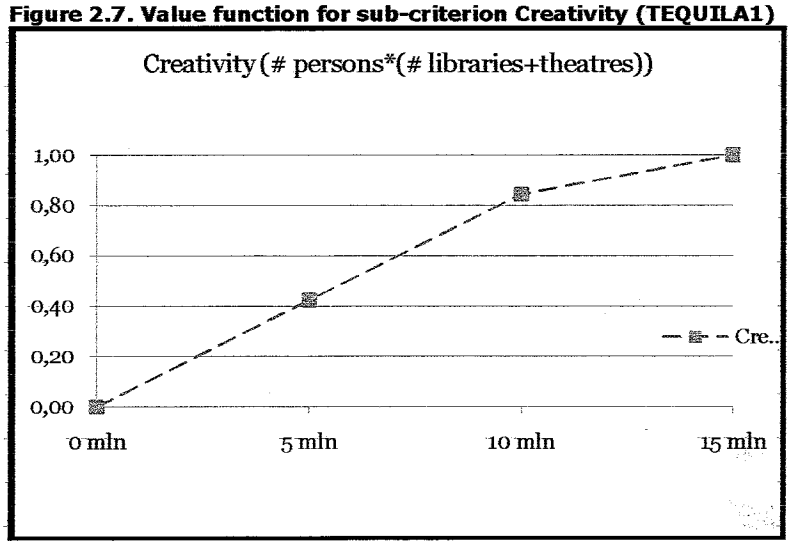


Figure 2.8. Value function for sub-criterion Cultural heritage (TEQUILA1)

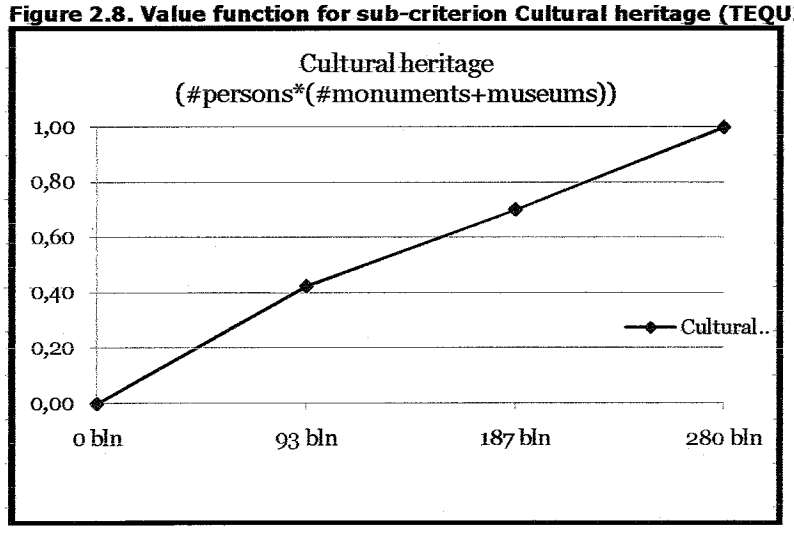
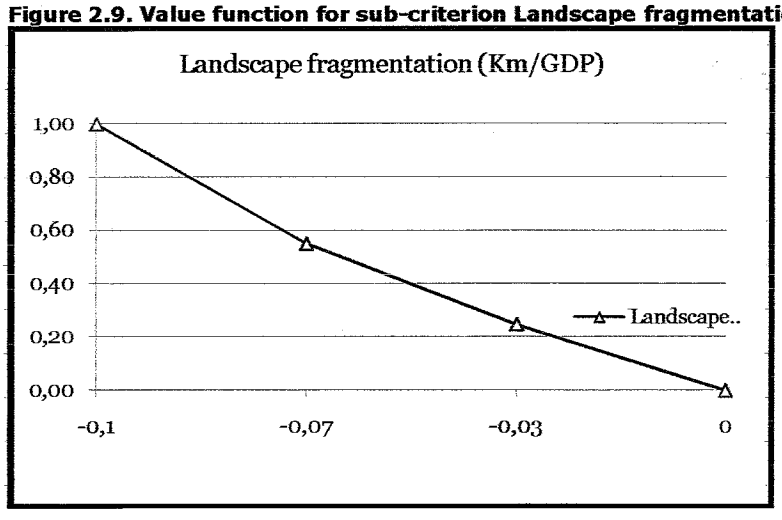


Figure 2.9. Value function for sub-criterion Landscape fragmentation (TEQUILA1)

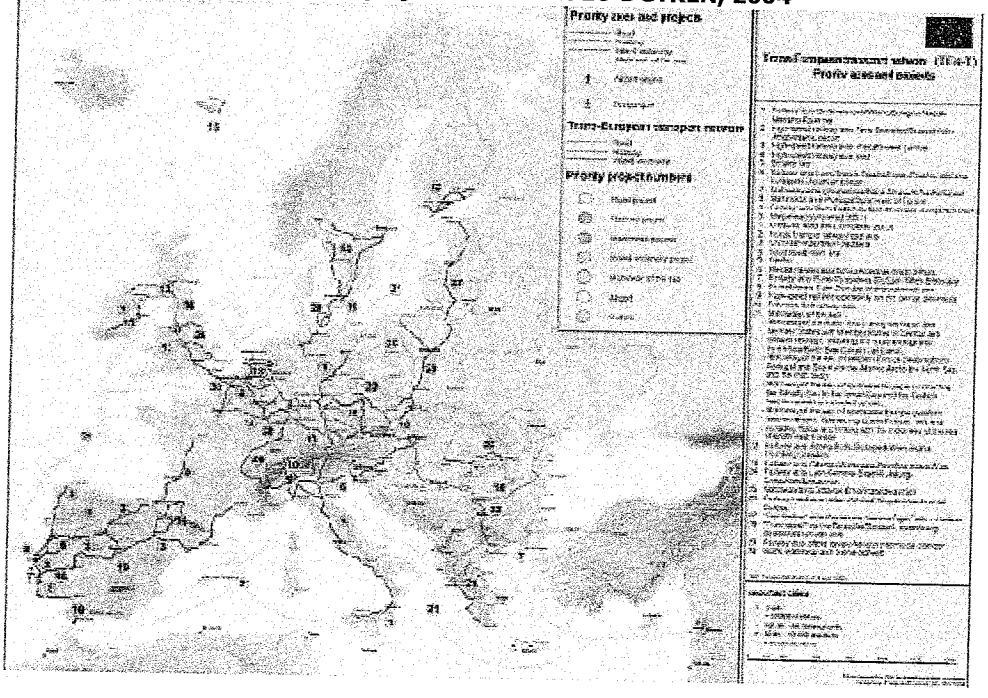


MAPS

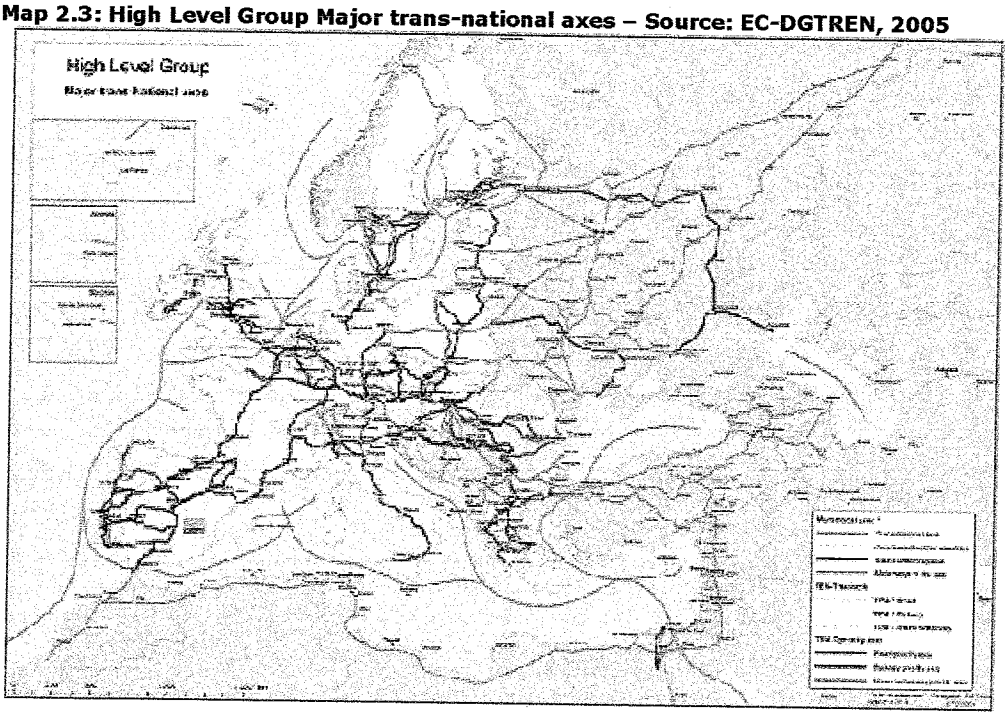
Map 2.1. Essen Priority Projects (1996) – Source: EC-DGTREN, 1996

Map of 'specific' projects adopted in 1996 ('Essen' list) (*)

Map 2.2: 30 Priority axes and projects – Source: EC-DGTREN, 2004



Map 2.3: High Level Group Major trans-national axes – Source: EC-DGTREN, 2005



TABLES

Table 2.1. Pairwise comparison format - AHP Saaty's method semantic scale

1	X is extremely more important than Y
1a	X is less then extremely more important than Y
2	X is very strongly more important than Y
2a	X is less then very strongly more important than Y
3	X is strongly more important than Y
3a	X is less then strongly more important than Y
4	X is moderately more important than Y
4a	X is less then moderately more important than Y
5	X is practically equally important as Y

Table 2.2. Experts' weight values for Territorial efficiency, Territorial quality, Territorial identity (TEQUILA1)

	Territorial efficiency	Territorial quality	Territorial identity
Expert 1	0,10	0,69	0,21
Expert 2	0,66	0,25	0,09
Expert 3	0,29	0,57	0,14
Expert 4	0,66	0,25	0,09
Expert 5	0,70	0,23	0,07
Expert 6	0,29	0,57	0,14
Expert 7	0,72	0,22	0,06
Expert 8	0,70	0,23	0,07
Expert 9	0,70	0,23	0,07
Expert 10	0,69	0,21	0,10
Expert 11	0,68	0,26	0,06
Expert 12	0,68	0,26	0,06
Expert 13	Did not participate in this exercise		
Min value	**0,10**	**0,21**	**0,05**
Max value	**0,72**	**0,69**	**0,21**
Average	**0,57**	**0,33**	**0,10**
STDEV	**0,21**	**0,17**	**0,05**

Table 2.3. Weight values for sub-criteria belonging to criterion Territorial efficiency (TEQUILA1)

	Internal connectivity	External accessibility	Economic growth
Min value	0,00	0,00	0,33
Max value	0,33	0,42	1,00
Average	0,13	0,17	0,70
STDEV	0,13	0,16	0,28

Table 2.4. Weight values for sub-criteria belonging to criterion Territorial quality (TEQUILA1)

	Congestion	Emissions	Transport sustainability
Min value	0,00	0,25	0,00
Max value	0,67	1,00	0,50
Average	0,29	0,45	0,26
STDEV	0,18	0,22	0,17

Table 2.5. Weight values for sub-criteria belonging to criterion Territorial identity (TEQUILA1)

	Creativity	Cultural heritage	Landscape fragmentation
Min value	0,00	0,00	0,00
Max value	1,00	0,50	1,00
Average	0,33	0,23	0,44
STDEV	0,29	0,19	0,35

Table 2.6. Desirability of impacts for specific European regions (TEQUILA1)

	Urban	Rural	Advanced	Developing	Northern	Southern	Western	Eastern
Internal connectivity	0,82	0,18	0,58	0,42	0,23	0,25	0,17	0,36
External accessibility	0,58	0,58	0,33	0,33	0,34	0,24	0,17	0,37
Economic growth	0,66	0,36	0,18	0,82	0,32	0,28	0,11	0,41
Congestion	0,86	0,14	0,62	0,38	0,33	0,26	0,28	0,14
Emissions	0,86	0,15	0,75	0,25	0,30	0,24	0,25	0,21
Transport sustainability	0,86	0,14	0,65	0,35	0,28	0,26	0,23	0,23
Creativity	0,83	0,17	0,45	0,55	0,26	0,33	0,32	0,09
Cultural heritage	0,56	0,44	0,39	0,61	0,10	0,31	0,32	0,28
Landscape fragmentation	0,16	0,84	0,26	0,74	0,21	0,27	0,24	0,29

Table 2.7. VUlnerability of impacts for specific European regions (TEQUILA1)

	Urban	Rural	Advanced	Developing	Northern	Southern	Western	Eastern
Internal connectivity	0,61	0,39	0,39	0,61	0,11	0,20	0,29	0,40
External accessibility	0,44	0,75	0,39	0,61	0,10	0,20	0,22	0,44
Economic growth	0,50	0,39	0,18	0,82	0,11	0,24	0,08	0,57
Congestion	0,67	0,33	0,58	0,42	0,09	0,33	0,30	0,28
Emissions	0,52	0,48	0,59	0,41	0,09	0,32	0,34	0,24
Transport sustainability	0,60	0,40	0,45	0,55	0,10	0,28	0,35	0,26
Creativity	0,51	0,49	0,25	0,75	0,19	0,23	0,33	0,25
Cultural heritage	0,58	0,42	0,36	0,64	0,07	0,38	0,23	0,32
Landscape fragmentation	0,14	0,86	0,35	0,65	0,06	0,40	0,23	0,31

ANNEX 3

Milestones in the process towards Community Transport Policy (CTP):

- 1957: TREATY OF ROME provides for CTP
- 1961: Schauss Memo: coordination of investment
- 1985: ECJ ruling: momentum into CTP
- 1986: SINGLE EUROPEAN ACT provides basis for TENs
- 1991: Directive 1991/440 Right of access
- 1992: White Paper: opening-up of the transport market
- 1992: TENs Guidelines
- 1992: TREATY OF MAASTRICHT reinforces the political, institutional and budgetary foundations of transport policy and introduces concept of TEN. Basis for infrastructure policy and network integration.
- 1993: Essen priority projects (Christophersen Group)
- 1996: A Strategy for revitalising railways
- 2001: White Paper on Transport Policy
- 2003: Revision of TENs Guidelines and priority projects (Van Miert)
- 2003: LISBON COUNCIL: Rail infrastructure package (liberalisation of international freight)
- 2003: Growth Action Plan
- 2006: Revision of the White paper on Transport Policy
- 2007: Second Rail infrastructure package (access for the entire networks)