Deliverable D7.1.2: Cost-Benefit analysis report for the deployment of ITS in Austria

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**PROJECT PARTNERS**

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<td>ITS Bulgaria</td>
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<td>10% PP2</td>
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Abstract: This report includes a detailed cost benefit analysis of the integrated traffic & mobility management and traveller information systems that were developed in the framework of SEE-ITS. The overall benefits and costs from a future implementation of the aforementioned systems are being computed for Austria.
EXECUTIVE SUMMARY

This report includes a detailed cost benefit analysis of the integrated traffic & mobility management and traveller information systems that were developed in the framework of SEE-ITS. The overall benefits and costs from a future implementation of the aforementioned systems are calculated for Austria.

The adequate techniques for the transformation of qualitative criteria (environmental, social) are also being identified and applied for the computation of the external effects. The computation of costs and benefits follows the analytical CBA procedure, namely the analysis is composed by three different perspectives: the user perspective, the operator's perspective and the government's perspective. The overall welfare of the society for Austria is the sum of the three separate perspectives. The output of this activity is the analytical recording of all costs and benefits, along with the overall impact to social welfare for each demo case.
## CONTENTS

1. Cost-Benefit Analysis of ITS
   1.1. Overview of CBA in Transport
   1.2. Scope of the CBA
   1.3. Estimation of consumer’s surplus and travel time savings
   1.4. Estimation of Producer’s Surplus
   1.5. Investment Costs
   1.6. Maintenance and Operating Costs
   1.7. Safety related Benefits
   1.8. Environmental Impacts of a Transport Project
   1.9. Evaluation Criteria
2. Cost-Benefit Analysis of ATIS in Austria
   2.1. Costs
       2.1.1. Investment costs
       2.1.2. Operational costs
   2.2. Benefits
3. Cost-Benefit Analysis of Cooperative traffic management in Austria
   3.1. Costs
       3.1.1. Investment costs
       3.1.2. Operational costs
   3.2. Benefits
4. Cost-Benefit Analysis of ITS deployment for road networks in Austria
   4.1. Costs
       4.1.1. Investment costs
       4.1.2. Operational costs
   4.2. Benefits
5. Cost-Benefit Analysis of intermodal travel planning services in Austria
   5.1. Costs
       5.1.1. Investment costs
       5.1.2. Operational costs
   5.2. Benefits
6. Cost-Benefit Analysis of dangerous goods monitoring in Austria
   6.1. Costs

Deliverable D7.1.2: Cost-Benefit analysis report for the deployment of ITS in Austria
6.1.1. Investment costs
6.1.2. Operational costs
6.2. Benefits
7. Cost-Benefit Analysis of optimal use of traffic and travel data in Austria
7.1. Costs
7.1.1. Investment costs
7.1.2. Operational costs
7.2. Benefits
8. Conclusion
9. References
LIST OF FIGURES

Figure 1: Flowchart of Transport Economic Appraisal (Source: HEATCO D5 [1])_______ 9
LIST OF TABLES

Table 1: Development costs of ATIS in Austria ___________________________ 15
Table 2: Annual operational and maintenance costs of the Greek system in Austria _______ 16
Table 3: Total costs of the Greek system in Austria _________________________ 16
Table 4: Cost factors for the Greek system in Austria _________________________ 16
Table 5: Transport related statistical data of the Thessaloniki factors for Austria _______ 17
Table 6: Benefit of the ATIS demo system in Austria _________________________ 17
Table 7: Temporal benefits ___________________________ 17
Table 8: Development costs of Cooperative Traffic Management in Austria _______ 18
Table 9: Annual operational and maintenance costs of the Austrian system _______ 18
Table 10: Total costs of the Austrian system ___________________________ 18
Table 11: Development costs of ITS deployment for road networks in Austria _______ 20
Table 12: Annual operational and maintenance costs of the Romanian system in Austria _______ 21
Table 13: Total costs of the Romanian system in Austria _______________________ 21
Table 14: Development costs of intermodal travel planning services in Austria _______ 22
Table 15: Annual operational and maintenance costs of the Hungarian system in Austria _______ 22
Table 16: Total costs of the Hungarian system in Austria _______________________ 23
Table 17: Development costs of dangerous goods monitoring in Austria _______ 24
Table 18: Annual operational and maintenance costs of the Italian system in Austria _______ 24
Table 19: Total costs of the Italian system in Austria _______________________ 25
Table 20: Annual operational and maintenance costs of the Bulgarian system _______ 27
Table 21: Total costs of the Bulgarian system in Austria _______________________ 27
1. **Cost-Benefit Analysis of ITS**

The appraisal of a transportation project seeks to evaluate the value for money of this project. Investments on the transportation sector usually affect many different parties (i.e. public transport agencies, transport users, businesses, land owners etc.). Each of these parties is interested in quantifying the impacts of a transportation project from his/her viewpoint. However, an economic analysis that is conducted within the context of a transport project appraisal aims to identify the social benefit of the transport project.

In this present document a framework is proposed for the conduct of such an economic analysis. The proposed framework approach is a cost-benefit analysis (CBA). A CBA compares costs and benefits (in monetary units) of an application incurred in a specific time period and spatial dimension (e.g. highway corridor). As a comparative tool CBA assesses the difference between project alternatives (i.e. capital investment alternatives) and a Base Case Alternative (i.e. “Do minimum” alternative). A “Do minimum” alternative should be the most plausible yet efficient utilization of the stock of capital resources that is likely to be available over the life of the proposed project, without additional investment.

Transportation projects normally require large initial investments and are expected to generate benefits extending far into the future. Thus, a need is created to compare benefits and costs that occur at different points in time. Since money has a time value, the same amount of money at different times does not have the same value. Therefore, it is important to convert costs and benefits (i.e. “cash flows”) into equivalent values when conducting a CBA.

1.1. **Overview of CBA in Transport**

The primary goal of an economic assessment of a transport project is to quantify the magnitude of the economic impact resulting from an investment in the transportation sector. The cumulative economic impact is a function of the change in transport user benefits (i.e. consumer’s surplus), the change in system operating costs and revenues (i.e. producer surplus), the change in cost of externalities (i.e. environmental costs, accidents, etc.), and finally the investments costs.

Monetizing the abovementioned changes is a rather demanding task, since it is necessary to consider:

- The scope of the analysis in terms of mode, study area and range of impacts;
- The definition of the alternatives – particularly the “Do minimum” alternative;
- The estimation of transport user benefits (consumer surplus);
- The estimation of impacts on transport providers and the government (includes producer surplus and investment costs);
- Monetization of time and safety;
• Consideration of environmental impacts and other externalities;
• The mechanics of the process including inputs, project life, discounting, aggregation of benefits and costs, unit of account.

![Flowchart of Transport Economic Appraisal](source: HEATCO D5 [1])
1.2. Scope of the CBA

In order to define the scope of a CBA it is critical to delineate the study area, determine the modes of transports that should be considered in the analysis, and identify the impacts of the transport project. Regarding impacts, the estimation of changes in producer and consumer surplus demands the measurement of benefits, revenues and costs to transport operators and users. These should at least include the investment cost and changes in infrastructure and system maintenance and operating costs, travel times, safety, user charges and operator revenues. As far as the modes of transport are concerned, those should be considered that will use the new infrastructure, along with those from which demand may be abstracted. Finally, the study area should be small enough to facilitate the estimation of accurate results.

1.3. Estimation of consumer’s surplus and travel time savings

Monetization of transport user benefits requires the quantification of consumer’s surplus. Consumer’s surplus has been defined as the excess of consumer willingness to pay over the cost of a trip. Normally, what is of interest is the change in consumer surplus occurring from some change in the cost of travel incurred by an improvement in transport conditions. However, in the transportation field, money costs are only a part of the composite travel cost. In reality the cost of travel also encompasses the time spent by the users, access time to public transport, discomfort, perceived safety risk and other elements. Thus, price alone is not an accurate estimate of the cost of travel of the consumer’s willingness to pay, instead generalized cost is used.

Generalized cost is an amount of money representing the overall cost and inconvenience to the transport user of travelling between a particular origin and destination by a particular mode. In practice, generalized cost is usually limited to a number of impacts which when added constitute the components of user benefit:

1. Time costs (Time in minutes * Value of Time in €/minute);
2. User charges (e.g. fares/tolls); and
3. Operating costs for private vehicles.

It is critical though to mention that the components of generalized cost differ among the different transportation modes. Thus, there is a substantial difference in the reported user’s benefits for users of different modes. Moreover, it should be noted that Value of Time varies between individuals and even for the same individual, depending for example on the trip purpose. Thus, there is no unique willingness-to-pay for travel time savings.

Given the significance of the Value of Time in the estimation of the generalized cost of travel and in consequence the consumer’s surplus, it is recommended that local values should be used whenever possible, provided that they have been produced according to a coherent and well justified methodology. In the case that no such values exist, then default values obtained
from international analyses of value of time studies should be used (e.g. Developing Harmonized European Approaches for Transport Costing and Project Assessment [1]). In the abovementioned study different valuation methods of Value of Time have been used for different trip purposes.

1.4. **Estimation of Producer’s Surplus**

Since CBA is concerned about the social welfare and not only the consumer’s surplus, the producer’s surplus should be estimated as well. Producer’s surplus is defined simply as the total revenue minus total costs. However, regarding producer’s surplus, it should be emphasized at this point that if the additional demand for this service is associated with reduced consumption of some other goods or services elsewhere in the economy, those goods and services are being priced at marginal cost, so that there is no offsetting or additional change in producer surplus elsewhere.

1.5. **Investment Costs**

The investment costs for transport infrastructure projects are normally dictated from engineering design studies and estimates. However, necessary adjustments have to be applied to these engineering cost estimates before they can be considered for the economic analysis. Adjustments should account for Inflation (between year of the engineering cost estimate and price base of the appraisal).

No adjustments are required for the method of the project financing. The investment costs are the same whether or not the project is financed directly by the government or through some form of private sector involvement (i.e. public private partnerships). Moreover, it is important that user benefits reflect any travel time and cost delays during construction, although they cannot be directly accounted as investment costs.

1.6. **Maintenance and Operating Costs**

Appropriate estimates are also necessary for the costs of infrastructure and services operation, which are mode and country-specific. The main costs are commonly:

- The costs of infrastructure operation;
- Maintenance costs;
- Changes in the vehicle operating costs of public transport services.

Additionally, any disruption to transport users that occurs during periods of routine maintenance should be reflected in the appraisal as a user benefit impact.
1.7. Safety related Benefits

Safety is not treated like the other components of user benefit. Instead of being considered as a component of generalized cost per trip, accidents and casualties are typically treated as random, occasional costs arising from the transport system. These costs are estimated by applying unit values per accident and per casualty. The calculation is a simple multiplication of forecasted accident numbers (by severity) with the costs of accidents (by severity). This approach is similar to that of externalities (e.g. the environment).

Accidents costs are comprised by direct economic costs, indirect economic costs, costs of material damage, and a value of safety per se:
- Value of safety per se: willingness to pay for protecting human life based on stated preference studies carried out in the country concerned.
- Direct and indirect economic costs (mainly medical and rehabilitation cost, administrative cost of legal system, and production losses).
- Material damage from accidents: cost values for the average damage caused by accidents in the country under assessment.

Estimates for the value of safety per se, direct and indirect economic costs, and material damage can be found in the following project report “Developing Harmonized European Approaches for Transport Costing and Project Assessment [1]” regarding EU member countries.

1.8. Environmental Impacts of a Transport Project

Investments on ITS technologies and infrastructure can possibly generate significant benefits regarding the surrounding environment (i.e. natural and man-made). Within the context of a CBA analysis attention is being placed on the assessment of environmental effects such as air pollution, noise and global warming. Monetary measures are proposed below for the valuation of these environmental impacts. In order to quantify the positive effects of the transport project on air pollution the following calculation procedure is recommended:

**Step 1:** quantification of change in pollutant emissions (NOx, SO2, NMVOC, PM2.5/PM10) due to a project, measured in tonnes, using state-of-the-art national or European emission factors.

**Step 2:** classification of emissions according to local environment (urban – outside built-up areas).

**Step 3:** preparation of the cost factor table by increasing the cost factor according to the assumed country-specific GDP per capita growth for each year of the analysis.
Step 4: calculation of impacts (multiplication of pollutant emissions by impact factor) and costs (multiplication of pollutant emissions by cost factor).

Step 5: reporting of impacts and costs.

The monetization of noise costs should be obtained according to the subsequent estimation procedure:

Step 1: quantification of the number of persons exposed to certain noise levels (should be available from noise calculations) for the Do-Minimum case and the Do-Something case.

Step 2: preparation of the cost factor table by increasing the cost factor according to the assumed country-specific GDP per capita growth for each year of the analysis.

Step 3: calculation of impacts (multiply percentage of highly annoyed persons by number of persons exposed) and costs (multiply cost per person by number of persons exposed) for both cases.

Step 4: subtraction of total costs for the Do-Something case from Do-Minimum case

Step 5: reporting of costs and impacts (change in number of people highly annoyed).

Accordingly, the estimation of costs due to the emission of greenhouse gases (usually expressed as CO2 equivalents) is conducted by multiplying the amount of CO2 equivalents emitted with a cost factor. The calculation steps are the following:

Step 1: quantification of change in greenhouse gas emissions (i.e. CO2) due to a project measured in tonnes.

Step 2: multiplication of CO2 equivalents with cost factor for year of emission.

Step 3: reporting of emissions and costs.

Values for the corresponding emission and noise cost factors can be obtained from the following project report “Developing Harmonized European Approaches for Transport Costing and Project Assessment [1]” regarding EU member countries.

1.9. Evaluation Criteria

Costs and benefits have to be converted into equivalent present values prior to the estimation of the evaluation criteria on which the project assessment will be based. Thus, the base year of the evaluation has to be initially determined. All past investment costs have to be
converted into present values (with respect to the base year of the valuation) according to the inflation rate of the corresponding country where the investment is taking place. All future costs (i.e. operation and maintenance) and benefits have to be converted into equivalent present values according to the present value formula:

$$P = F\times(1+r)^{-N}$$  \hspace{1cm} (Eq. 1)

where $P$ is the present value, $F$ is the future amount, $r$ is the social discount rate, and $N$ is the project lifetime.

The abovementioned conversions require the knowledge of the project lifetime (i.e. typically ranges between 5 – 10 years for ITS projects), the inflation rate as well as the social discount rate. The social discount rate represents the way money now is worth more than money later. It determines by how much any future amount is discounted or reduced, to make it correspond to an equivalent amount today. It is generally specified as a constant rate over time (i.e. reference social discount rate is 5.5% for EU transport projects [2]).

There are three evaluation criteria that can be used for the economic assessment of a transport project:

- Net Present Value (NPV);
- Benefit-Cost Ratio; and
- Internal Rate of Return (IRR)

The net present value is defined as the difference between benefits and costs. NPV focuses attention on quantity of money, which is what the evaluation is ultimately concerned with. However, it only provides a good comparison between projects when they are strictly comparable in terms of level of investment or total budgets. Benefit-cost ratio is a non-dimensional index of economic evaluation. It allows the comparison of projects on a common scale and provides an easy mean to rank objects in order of relative merit. However, since values changes depending on how costs and benefits are counted, there has been frequently observed a tendency to manipulate the data. Finally, the internal rate of return is the discount rate for which the net present value of a project is zero. The internal rate of return introduces the notion of “return on investment” and the project with the highest IRR is ranked as top. The advantages of the IRR is that it eliminates the need to argue about the appropriate discount rate and that rankings cannot be manipulated by the choice of the discount rate. On the other side, such an evaluation could possibly lead to two or more solutions; one cannot really tell what the IRR is.
2. **Cost-Benefit Analysis of ATIS in Austria**

## 2.1. Costs

### 2.1.1. Investment costs

In Thessaloniki, Greece, 25 Bluetooth devices were installed, amounting to 57,500 € in total. The system was integrated into the local mobility centre of Thessaloniki and therefore the information provision takes place also through roadside Variable Message Signs (VMS). Their installation costs will however not be included into the CBA, as the financing mechanisms of motorway operator ASFINAG exclude them to a different calculation. Moreover the development of the necessary software amounts to 60,000 € in total.

For transferring the results of the Greek demonstration to Austria it shall be assumed that the costs will be the same.

### Table 1: Development costs of ATIS in Austria

<table>
<thead>
<tr>
<th>Cost</th>
<th>Description</th>
<th>Cost / Unit</th>
<th>Units</th>
<th>Total cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>BT sensors</td>
<td>Purchase of equipment, cost of installation, other costs, guarantee for 3 years</td>
<td>2,300 €</td>
<td>25</td>
<td>57,500 €</td>
</tr>
<tr>
<td>Software</td>
<td>Development of data fusion software and information provision platform.</td>
<td>-</td>
<td></td>
<td>60,000 €</td>
</tr>
<tr>
<td>Total costs</td>
<td></td>
<td></td>
<td></td>
<td>117,500 €</td>
</tr>
</tbody>
</table>
2.1.2. Operational costs

These costs mainly consist of telecommunication and power supply costs, while no personnel costs are included since the system is integrated into the mobility centre of the area. For transferring the results of the Greek demonstration to Austria it shall be assumed that the costs will be the same.

**Table 2: Annual operational and maintenance costs of the Greek system in Austria**

<table>
<thead>
<tr>
<th>Cost</th>
<th>Description</th>
<th>Cost / Unit</th>
<th>Units</th>
<th>Total cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Operational costs</td>
<td>Telecommunications costs &amp; power supply</td>
<td>95 €</td>
<td>25 BT + 4 VMS</td>
<td>2.755 €</td>
</tr>
<tr>
<td></td>
<td>Personnel Costs</td>
<td>0,00 €</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Maintenance costs</td>
<td>Maintenance cost (after the first 3 years) including possible replacements</td>
<td>95 €</td>
<td>25 BT + 4 VMS</td>
<td>2.755 €</td>
</tr>
<tr>
<td></td>
<td>of various parts (batteries, wires etc.)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Personnel Costs</td>
<td>0,00</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

The following table will show the total costs for transferring the Greek demonstration to Austria.

**Table 3: Total costs of the Greek system in Austria**

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Investment</td>
<td>309.500 €</td>
<td>0 €</td>
<td>0 €</td>
<td>0 €</td>
<td>0 €</td>
<td>0 €</td>
<td>0 €</td>
<td>0 €</td>
</tr>
<tr>
<td>Operational/maintenance</td>
<td>0 €</td>
<td>2.755 €</td>
<td>2.755 €</td>
<td>5.550 €</td>
<td>5.550 €</td>
<td>5.550 €</td>
<td>5.550 €</td>
<td>5.550 €</td>
</tr>
</tbody>
</table>

| Total costs | 342.760 € |

2.2. Benefits

For the Greek system the benefits that have been identified are those of travel-times reduction, fuel consumption reduction and CO₂ emissions reduction. The cost factors of the parameters defined for the Greek system have been transferred to Austrian values and are presented in the table below.

**Table 4: Cost factors for the Greek system in Austria**

<table>
<thead>
<tr>
<th>Value of Travel Time (€/hour)</th>
<th>Value of Fuel (€/litre)</th>
<th>Value of CO₂ Emissions (€/tonne)</th>
</tr>
</thead>
</table>

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The next step is related to the identification of the impact of the system on the transport-related characteristics of the area that is implemented. For this task the statistical data evaluated in activity 6.1 for an entire year are used, as provided in the table below.

### Table 5: Transport related statistical data of the Thessaloniki factors for Austria

<table>
<thead>
<tr>
<th>Total VHT</th>
<th>Total fuel consumption</th>
<th>Total CO₂ emissions</th>
</tr>
</thead>
<tbody>
<tr>
<td>27.995,535</td>
<td>N/A</td>
<td>N/A</td>
</tr>
</tbody>
</table>

* The necessary data for this task are not available for Austria

The benefits of the system are considered to appear one year after the installation of the system. These benefits are provided in the table below and are scaled to Austrian relation:

### Table 6: Benefit of the ATIS demo system in Austria

<table>
<thead>
<tr>
<th>VHT reduction</th>
<th>Fuel consumption reduction</th>
<th>CO₂ emissions reduction</th>
</tr>
</thead>
<tbody>
<tr>
<td>4%</td>
<td>Up to 5%</td>
<td>Up to 3%</td>
</tr>
</tbody>
</table>

Benefits are expected to occur at the first year of implementation, at their maximum value as they have been identified by previous project activities and are reduced gradually until 2020. The benefits that arise from the implementation of the project are provided in the table below:

### Table 7: Temporal benefits

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Travel times reduction (VHT)</td>
<td>0</td>
<td>1.119,821</td>
<td>425,222</td>
<td>198,956</td>
<td>33,525</td>
<td>18,376</td>
<td>7,797</td>
<td>1,480</td>
</tr>
<tr>
<td>VHT reduction benefit (€)</td>
<td>25,330.4</td>
<td>9,618.5</td>
<td>4,500.4</td>
<td>758.3</td>
<td>415,665</td>
<td>176,368</td>
<td>33,478</td>
<td></td>
</tr>
<tr>
<td>Total Benefit</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>40,833,114</td>
</tr>
</tbody>
</table>
3. **Cost-Benefit Analysis of Cooperative Traffic Management in Austria**

### 3.1 Costs

#### 3.1.1 Investment costs

There have been development costs of 52,000€ for the application, no additional infrastructure has been built or upgraded, therefore no costs have arisen from that.

<table>
<thead>
<tr>
<th>Cost</th>
<th>Description</th>
<th>Cost / Unit</th>
<th>Units</th>
<th>Total cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Software</td>
<td>Development of software and information platform.</td>
<td>-</td>
<td></td>
<td>52,000 €</td>
</tr>
<tr>
<td>Total costs</td>
<td></td>
<td></td>
<td></td>
<td>52,000 €</td>
</tr>
</tbody>
</table>

#### 3.1.2 Operational costs

Operational and maintenance costs consist of the costs necessary for the personnel carrying out these tasks. There are no additional equipment costs, as the system is integrated into existing hardware and software frameworks and all actual equipment (i.e. the smartphone) is operated by the end user.

<table>
<thead>
<tr>
<th>Cost</th>
<th>Description</th>
<th>Cost / Unit</th>
<th>Units</th>
<th>Total cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Personnel Costs</td>
<td>10,000 €/year</td>
<td>-</td>
<td></td>
<td>10,000 €</td>
</tr>
</tbody>
</table>

The following table will show the total costs for the Austrian demonstration.

<table>
<thead>
<tr>
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<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Investment</td>
<td>52,000€</td>
<td>0 €</td>
<td>0 €</td>
<td>0 €</td>
<td>0 €</td>
<td>0 €</td>
<td>0 €</td>
<td>0 €</td>
</tr>
<tr>
<td>Operational/maintenance</td>
<td>10,000€</td>
<td>10,000€</td>
<td>10,000€</td>
<td>10,000€</td>
<td>10,000€</td>
<td>10,000€</td>
<td>10,000€</td>
<td>10,000€</td>
</tr>
<tr>
<td><strong>Total costs</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>132,000€</td>
</tr>
</tbody>
</table>
3.2. Benefits

For the Austrian system the benefits that have been identified are those of the travel-times reduction and reduction of traffic casualties. The total benefits in Austria amount to 23,741 € from travel time savings and 78,848,825 € from the reduction of traffic casualties, amounting to a total saving of 78,872,566 €.

Taking into account the costs and the benefits of the project, then a cost benefit ratio of 597 occurs.
4. Cost-Benefit Analysis of ITS Deployment for Road Networks in Austria

4.1. Costs

4.1.1. Investment costs

The services that will be pilot implemented will follow a corridor approach starting from a location in Timisoara and ending at a location in Constanta, Romania. A web-based application has been developed, allowing the user to receive information about travel times on the selected corridor at any time, using different combinations of transport modes. The application was designed to provide real-time data, however if it is not available for a certain mode of transport, then static data are being used.

For transferring the results of the Romanian demonstration to Austria it shall be assumed that the costs will be 30% higher.

<table>
<thead>
<tr>
<th>Cost</th>
<th>Description</th>
<th>Cost / Unit</th>
<th>Units</th>
<th>Total cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hardware / Software</td>
<td>Cloud storage and hosting for 1 year and software development</td>
<td>-</td>
<td></td>
<td>15,000 €</td>
</tr>
<tr>
<td>Addition</td>
<td>Transferring the results to Austria</td>
<td>30%</td>
<td></td>
<td>4,500 €</td>
</tr>
<tr>
<td>Total costs</td>
<td></td>
<td></td>
<td></td>
<td>19,500 €</td>
</tr>
</tbody>
</table>
4.1.2. Operational costs

For transferring the results of the Romanian demonstration to Austria it shall be assumed that the personnel costs will be 30% higher. Costs for maintenance and operation are assumed to be the same.

Table 12: Annual operational and maintenance costs of the Romanian system in Austria

<table>
<thead>
<tr>
<th>Cost</th>
<th>Description</th>
<th>Cost / Unit</th>
<th>Units</th>
<th>Total cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Operational costs</td>
<td>Cloud storage and hosting, per year</td>
<td>2,100 €/year</td>
<td></td>
<td>2,100 €</td>
</tr>
<tr>
<td>Personnel Costs</td>
<td>Personnel Costs (0.1 man/month), per year</td>
<td>1,800 €/year</td>
<td></td>
<td>1,800 €</td>
</tr>
<tr>
<td></td>
<td>Transferring costs to Austria (+30%)</td>
<td>540 €/year</td>
<td></td>
<td>540 €</td>
</tr>
<tr>
<td>Maintenance costs</td>
<td>Software and/or OS updates, per year</td>
<td>750 €</td>
<td></td>
<td>750 €</td>
</tr>
<tr>
<td></td>
<td>Map and transport graph updates, per year</td>
<td>2,400 €</td>
<td></td>
<td>2,400 €</td>
</tr>
<tr>
<td>Total costs</td>
<td></td>
<td></td>
<td></td>
<td>7,590 €</td>
</tr>
</tbody>
</table>

The following table shows the total costs for the Romanian demonstration in Austria.

Table 13: Total costs of the Romanian system in Austria

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Investment</td>
<td>19,500 €</td>
<td>0 €</td>
<td>0 €</td>
<td>0 €</td>
<td>0 €</td>
<td>0 €</td>
<td>0 €</td>
<td>0 €</td>
</tr>
<tr>
<td>Operational/maintenance</td>
<td>7,590 €</td>
<td>7,590 €</td>
<td>7,590 €</td>
<td>7,590 €</td>
<td>7,590 €</td>
<td>7,590 €</td>
<td>7,590 €</td>
<td>7,590 €</td>
</tr>
<tr>
<td>Total costs</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>80,220 €</td>
</tr>
</tbody>
</table>

4.2. Benefits

In terms of impact and benefits the Romanian system cannot be transferred to Austria due to incompatibilities and missing numbers.
5. **COST-BENEFIT ANALYSIS OF INTERMODAL TRAVEL PLANNING SERVICES IN AUSTRIA**

5.1. **Costs**

5.1.1. **Investment costs**

The pilot service is a free end-user smartphone application. The purposes of the application are to assist bikers navigating in the pilot area and demonstrating the utility of the existing web services and databases.

For transferring the results of the Hungarian demonstration to Austria it shall be assumed that the costs will be 20% higher.

<table>
<thead>
<tr>
<th>Cost</th>
<th>Description</th>
<th>Cost / Unit</th>
<th>Units</th>
<th>Total cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Software</td>
<td>Software development costs</td>
<td>-</td>
<td></td>
<td>43,200 €</td>
</tr>
<tr>
<td>Addition</td>
<td>Transferring the results to Austria</td>
<td>20%</td>
<td></td>
<td>8,640 €</td>
</tr>
<tr>
<td><strong>Total costs</strong></td>
<td></td>
<td></td>
<td></td>
<td><strong>51,840 €</strong></td>
</tr>
</tbody>
</table>

5.1.2. **Operational costs**

For transferring the results of the Hungarian demonstration to Austria it shall be assumed that the personnel costs will be 30% higher.

<table>
<thead>
<tr>
<th>Cost</th>
<th>Description</th>
<th>Cost / Unit</th>
<th>Units</th>
<th>Total cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Personnel Costs</td>
<td>Database download, editing, testing, upload, handling questions, helpdesk operation; per year</td>
<td>1,320 €/year</td>
<td>-</td>
<td>1,320 €</td>
</tr>
<tr>
<td></td>
<td>Transferring costs to Austria (+ 30%)</td>
<td>396 €/year</td>
<td></td>
<td>396 €</td>
</tr>
<tr>
<td><strong>Total costs</strong></td>
<td></td>
<td></td>
<td></td>
<td><strong>1,716 €</strong></td>
</tr>
</tbody>
</table>

The following table will show the total costs for the Hungarian demonstration in Austria.
5.2. Benefits

In terms of impact and benefits the Hungarian system cannot be transferred to Austria due to incompatibilities and missing numbers.
6. Cost-Benefit Analysis of Dangerous Goods Monitoring in Austria

6.1. Costs

In Austria the European Agreement on international transport of dangerous goods has been applied in Austria for more than 40 years. Responsible handling of dangerous goods along the whole service chain has resulted in a reduction of 26.5% in dangerous goods accidents in 2012. Since 1998 there has been not a single fatality from an accident with dangerous goods transports. In 2013 the dangerous goods transport accidents only made 0.05% of all accidents.

However these numbers are very positive, a common understanding is still important and necessary along the whole service chain. Many safety standards originate from the dangerous goods field and are later applied to transport in general. Thus it is important constantly pursue improvements in order to increase the overall safety of transport.

6.1.1. Investment costs

In Austria 42 peripheral points will be established and installed, amounting to 10,000 € each. For transferring the results of the Italian demonstration to Austria it shall be assumed that the costs will be the same.

| Table 17: Development costs of dangerous goods monitoring in Austria |
|----------------------------------|-----------------|----------|----------|----------|
| Cost                        | Description                                      | Cost / Unit | Units | Total cost |
| Software                   | Operational Management and diagnostic system       | -          | 50,000 € |
| Hardware                   | Costs for each peripheral point                    | 10,000     | 42     | 420,000 € |
| Total costs                |                                                   |            |        | 470,000 € |

6.1.2. Operational costs

For transferring the results of the Italian demonstration to Austria it shall be assumed that the personnel costs will be the same.

| Table 18: Annual operational and maintenance costs of the Italian system in Austria |
|----------------------------------|--------------------------|----------|----------|----------|
| Cost                        | Description                                      | Cost / Unit | Units | Total cost |
| Personnel Costs             | Maintenance of central peripheral stations, data bases | 20,000 €/year | -     | 20,000 €  |
The following table will show the total costs for the Italian demonstration in Austria.

<table>
<thead>
<tr>
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<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Investment</td>
<td>470,000 €</td>
<td>0 €</td>
<td>0 €</td>
<td>0 €</td>
<td>0 €</td>
<td>0 €</td>
<td>0 €</td>
<td>0 €</td>
</tr>
<tr>
<td>Operational</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total costs</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>674,480 €</td>
</tr>
</tbody>
</table>

6.2. Benefits

Deploying this system in Austria would have the potential of further reducing the currently very low number of accidents with dangerous goods transports. Here the difficulty becomes visible as it is always harder to further improve an already positive status quo. Furthermore in the Austrian traffic planning dangerous goods monitoring play a rather inferior role, therefore no numbers on accident follow-up costs are available.

These costs are also difficult to even estimate as each accident bears highly individual catastrophic potential that depends heavily on the respective situation and consequently is impossible to estimate as this could range from simple car body damage to e.g. long-term contamination of the drinking water supply in large areas or massive damage to infrastructure with lots of casualties.

Taking this into account, it would not be possible to calculate verifiable numbers for benefits resulting from implementation of this system. It can however be stated that, given the very high implementation and operational costs compared to the very low number of accidents with dangerous goods transports in Austria, that the cost-benefit ratio would be very low.
7. **COST-BENEFIT ANALYSIS OF OPTIMAL USE OF TRAFFIC AND TRAVEL DATA IN AUSTRIA**

7.1. **Costs**

The demo activities in Bulgaria are focused on the installation and the implementation of Bluetooth Information System (BTiS). The provided services are based on real-time traffic data captured by six Bluetooth sensors. This Pilot BTiS serves the following basic information:

- Journey Time and
- Origin/destination matrix data

So far, in Bulgaria there were no pre-installed ITS infrastructure, services and applications. Since previous installations did not exist, there was no need for additional integration effort.

7.1.1. **Investment costs**

Given the high equipment rate of the Austrian ITS infrastructure in combination with substantial differences to the Bulgarian infrastructure, the system would be applied to existing sensor infrastructure and therefore no investment costs would arise.

7.1.2. **Operational costs**

Operational and maintenance costs consist of the costs necessary for the personnel carrying out these tasks, there are no additional equipment costs, as the system is integrated into existing hardware and software frameworks and all actual equipment (i.e. the smartphone) is operated by the end user.
### Table 20: Annual operational and maintenance costs of the Bulgarian system

<table>
<thead>
<tr>
<th>Cost</th>
<th>Description</th>
<th>Cost / Unit</th>
<th>Units</th>
<th>Total cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Personnel Costs</td>
<td></td>
<td>10,000 €/year</td>
<td>-</td>
<td>10,000 €</td>
</tr>
</tbody>
</table>

The following table shows the total costs for the Bulgarian demonstration in Austria.

### Table 21: Total costs of the Bulgarian system in Austria

<table>
<thead>
<tr>
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<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Investment</td>
<td>0 €</td>
<td>0 €</td>
<td>0 €</td>
<td>0 €</td>
<td>0 €</td>
<td>0 €</td>
<td>0 €</td>
<td>0 €</td>
</tr>
<tr>
<td>Operational/maintenance</td>
<td>10,000 €</td>
<td>10,000 €</td>
<td>10,000 €</td>
<td>10,000 €</td>
<td>10,000 €</td>
<td>10,000 €</td>
<td>10,000 €</td>
<td>10,000 €</td>
</tr>
<tr>
<td><strong>Total costs</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>80,000 €</td>
</tr>
</tbody>
</table>

### 7.2. Benefits

For the BTiS system the benefits that have been identified are those of travel-times reduction and reduction of traffic casualties. The total benefits in Austria amount to 23,741 € from travel time savings and 78,848,825 € from the reduction of traffic casualties, amounting to a total saving of 78,872,566 €.

Taking into account the costs and the benefits of the project, then a cost benefit ratio of 986 occurs.
8. CONCLUSION

The impacts detected at pilot level thanks to the implementation of SEE-ITS Demonstration Activities show the benefits originating from the deployment of ITS applications. Thousands of travelling hours could be avoided using the already available (from a technological point of view) systems for traffic management, for example. The natural consequence would be a reduction of accidents, of social costs, and an increase of safety levels, accompanied by significant potential for financial savings due to a massive reduction of economic damage from inefficiencies in transport.

The difficulties in transferring results and actual values between single Member States have once more indicated the heterogeneous nature of those countries participating in SEE-ITS yet also the necessity of a common and consolidated approach in terms improving safety, efficiency and environmental aspects in transport.

Standards are necessary in order to address interoperability at various levels of the whole ITS architecture as well as dealing with issues of data compatibility across ITS applications and services. They also facilitate the joining of local and regional systems into a coherent national application and enable the integration of its components on European and international level. To achieve cross-border interoperability it is crucial to consolidate the country-specific structures on all levels. Consequently it is important both to increasingly initiate transnational projects and to foster the national development of Intelligent Transport Systems.

Up to now, ITS have been regarded primarily from a technological point of view. In this way, ITS applications and services turned out to have much less impact than they could have had. Consequently a preceded political vision of a measurable, visible and perceptible benefit for the citizens is needed. Benefits and impacts for users and the transport system have to be emphasised and technological innovation must not be an end unto itself. The significant potential for savings that arises from very little investment costs can help raising the awareness for the importance of deploying ITS services and applications in due time as long as their impact can be utilised properly.
9. REFERENCES
