# EU EIP Activity 5: Evaluation

## Final Report

### Final

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## Preface

Since the launch of the European ITS Platform (EU EIP) in 2016, the EU EIP Evaluation Group (Activity 5) was collectively responsible for coordinating and overseeing the delivery of evaluation related EU EIP Milestones and supporting internal deliverables. The EU EIP Evaluation Group was also responsible for developing and promoting a suite of tools to support the ITS Corridors in their Evaluation Reporting and for bringing together the reported impacts, benefits and results from the ITS Corridors in a consistent and harmonised way.

This report provides an overview of the main outputs of the EU EIP Evaluation group during the EU EIP Action and presents the common methodology which was developed and adopted in order to calculate the overall benefits of the ITS investments undertaken within the scope of the ITS Corridors.

As reported below, the EU EIP Activity 5 Evaluation Expert Group fully achieved all of the planned Activity Milestones and, in so doing, successfully developed and promoted the common evaluation approach for ITS Corridors which ensured a harmonised approach to the evaluation of the main benefits and yielded consistent results. As such, the EU EIP A5 Evaluation Expert Group, in conjunction with the CEF-funded ITS Corridors, successfully demonstrated the significant impacts and benefits of ITS investments in terms of safety, environment and congestion.

The main ITS Corridor results are presented in sections 5 (phase 2) and section 6 (phase 3) of this report, along with global results of combined corridor investments in section 7.

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# 1. Scope and Composition of EU EIP Activity 5: Evaluation

## 1.1. Overview of Scope

Since the launch of the European ITS Platform (EU EIP) in 2016, the EU EIP Evaluation Group (Activity 5) was collectively responsible for coordinating and overseeing the delivery of evaluation related EU EIP Milestones and supporting internal deliverables. The EU EIP Evaluation Group was also responsible for developing and promoting a suite of tools to support the ITS Corridors in their Evaluation Reporting and for bringing together the reported impacts, benefits and results from the ITS Corridors in a consistent and harmonised way.

## 1.2. EU EIP Evaluation Group Structure

The EU EIP Evaluation Group was coordinated and led by the UK (National Highways), who took responsibility for the delivery of the identified milestones outlined in section 2.1 below. The group was co-led by Sweden (Swedish Transport Administration) who were responsible for the leadership and deliverables of Work Package 1, which relates more specifically to the assessment of the impacts of the ITS Directive Priority Actions and the related milestones.

The wider EU EIP Evaluation group was very well supported throughout its duration by experts from both the Member States and co-funded ITS Corridors. Representation was stable and consistent and the group worked effectively to deliver in accordance with the work programme and to exchange knowledge and best practices in the field of ITS Evaluation.

Corridor representatives played a crucial role in developing and promoting the common EU EIP Evaluation Group approach at the corridor level and, as such, were instrumental in the general adoption of the common approach defined by A5.

The EU EIP Evaluation Group held regular core group meetings for the duration of the EU EIP Action. These meetings were supplemented by ad hoc, Work Package or deliverable-specific web-conferences. Whilst the focus of each meeting varied in accordance with the pertinent issues and prevalent deliverables and milestones of the time, A5 core meetings regularly included updates in relation to each of the defined Work Packages as well as the monitoring of ITS Corridor progress and best practice exchange as standard agenda points.

# 2. General Achievements

## 2.1. Overview

Building on the content of the 1st Interim Report (EU EIP A5: D5 - 2019) and 2nd Interim Report (EU EIP A5: D7 - 2020), which provided a detailed overviews of Activity 5 planned activities and progress to the end of 2019 and 2020 respectively, this section provides an overview of the status of the Activity at the end of the Action (December 2021) and provides a summary of achievements in relation to the work packages and deliverables for which the Evaluation Activity group was responsible.

It should be noted that, in keeping with the other EU EIP Activities, the Evaluation Activity was extended as part of the general EU EIP Action extension. Consequently, selected Milestones relating to some Work Packages were eventually completed by the end of 2021 (rather than 2020, as originally planned), which ultimately provided better alignment to the revised ITS Corridor timeframes (the majority of which were also extended).

The EU EIP Evaluation Group, under this Activity, were responsible for delivering the following EU EIP Decision Milestones by the end of the extended eligibility period (December 2021). The table below provides an overview of the status of the planned EU EIP Activity 5 milestones at the end of the Action, and demonstrates that all planned Milestones were delivered as planned:

| | | |
|---|---|---|
| 64 | Draft evaluation plan: ITS Directive priority actions | Complete |
| 65 | Agreement and definition of Evaluation KPI for CEF ITS deployment | Complete |
| 66 | Provision of guidance and templates for CEF EIP Evaluation | Complete |
| 67 | Evaluation plan: ITS Directive priority actions | Complete |
| 68 | Development of an ITS decision making toolkit model based on collected Evaluation data and Best Practice | Complete |
| 69 | Interim Evaluation Report 1 (outcomes of first CEF call) | Complete |
| 70 | First update of ITS Decision Making Toolkit | Complete |
| 71 | Interim Evaluation Report 2 (outcomes of second CEF call) | Complete |
| 72 | Workshop: Results of the ITS Directive Priority Action assessment and proposals for priority service coverage | Complete |
| 73 | Second update of ITS Decision Making Toolkit | Complete |
| 74 | Final Evaluation Report (CEF overview) | Complete |
| 75 | Socio-economic assessment of ITS Directive priority actions | Complete |

## 2.2. General EU EIP Contributions and Outreach Activities

### 2.2.1. Reporting to EU EIP Coordination

Throughout the course of the action, the Activity 5 leader provided regular comprehensive updates on general activity progress, milestone achievement and presentation of major deliverables to the EU EIP coordination. As such, the Evaluation Activity was present at all EU EIP Member State Supervision Assemblies and Joint Technical Secretariat meetings throughout the EU EIP action.

### 2.2.2. EU EIP / Cross-Corridor Evaluation Workshop

The Cross-Corridor Cooperation Workshop, hosted by Arc Atlantique and EU EIP Activity took place on 5th and 6th February 2020 at ASFA (Paris, France).

The ITS Corridor Evaluation Workshop / Seminar was organised by Arc Atlantique and EU EIP Activity 5 – Evaluation. The purpose of the workshop was to educate delegates and to support the continual refinement of the approach to ITS Corridor evaluation. The workshop was deliberately timed to coincide with the ITS corridors preparing the latter stages of their deployment programmes and offered Corridors and experts from the wider community a platform to communicate their successes and benefits more widely and in a meaningful way to various stakeholders.

The event therefore aimed to facilitate cross corridor discussions concerning the evaluation process at the operational level (ITS corridors). It also assisted the dissemination of information relating to the EU EIP evaluation methodology and best practice, embedding the importance of evaluating ITS corridors using a harmonised approach by informing and educating participants. The workshop also served to identify a number of proposed actions which could enhance and consolidate the current approach.

The event covered the presentation of specific technical examples and results and was attended by 25 participants from 9 EU Member States, incorporating representation from all of the ITS Corridors and the majority of core A5 expert group members.

### 2.2.3. DIGITALIZATION OF ROAD TRANSPORT IN EUROPE

EU EIP A5 provided extensive support to the EU EIP Joint Technical Secretariat / Future Taskforce by contributing to the *Digitalization of Road Transport in Europe* report. This report was designed to promote the benefits of ITS investment in Europe based on results from the Corridor phase 2 investments and produced overall estimated minimum results in terms of safety and return on investment for the combined phase 2 ITS Corridor investments.

Based on available results from the 4 of the 5 ITS corridors, combined-corridor estimated "global" minimum 5-year safety benefits and return on investment (ROI) were calculated. In terms of minimum safety and socio-economical savings as a result of combined programme investments over a 5-year period, it was demonstrated that:

- A minimum of 75 lives would be saved
- A minimum of 2,166 injuries would be prevented

As a result of those safety impacts alone, it is apparent that the combined ITS Corridor investments also result in a significant financial benefit. Based on the combined investment of € 232 Million across the four phase 2 ITS corridors, the following minimum savings derived from those safety benefits were established as follows:

- A minimum annual safety socio-economical saving of € 55 Million
- A minimum overall Return on Investment (ROI) of about 4 years on average
- Assuming an average lifetime of at least 10 years for these infrastructure components, a simplified calculation would suggest benefit-cost ratios of around 3 and higher.

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# 3. Work Package Achievements

## 3.1. Work Plan

The EU EIP Evaluation Group (Activity 5) defined 5 separate but interrelated Work Packages against which all Activity related Milestones and deliverables were aligned. These can be briefly summarised as follows:

- WP1 - ITS Directive Evaluation
- WP2 - KPI Definition
- WP3 – Guidance and Reference
- WP4 - Evaluation Toolkit
- WP5 - ITS Evaluation Reporting

The Evaluation group established working groups / task forces to support the delivery of each specific work package and the related deliverables and / or milestones as required.

The following section of this report details achievements within each defined Work Package at the end of the EU EIP Action (2021).

## 3.2. WP1: ITS Directive Reporting

The WP1 focus was to develop a methodology and process to carry out an inventory of relevant projects in Europe. To support this, an Evaluation Plan to facilitate the assessment of ITS priority action service deployments (Milestone 64) was developed early in the programme to support robust estimates of the impacts, benefits and costs of ITS investments, expressed in European KPIs.

Following this, a WP1 workshop was held in Stockholm in September 2020 (Milestone 72) in order to present early results from the ITS directive priority actions assessment and proposals for service coverage, and to gather input to further develop the assessment for the Socio-economic assessment of ITS Directive priority actions report (Milestone 75).

For the assessment, a record of over 500 projects from 22 National progress reports was initially created in an excel tool, with a similar layout to the Evaluation toolkit. To aid with the selection of the most relevant projects for this evaluation, all partner countries were asked to select 2-3 of their most relevant projects. The initial results based on input received from 8 countries led to the identification of 22 selected projects with appropriate evaluation data.

The feedback from the workshop informed ongoing activities and, more importantly, clarified the best approach to completing the final WP1 Milestone - the *Socio- economic assessment of ITS Directive priority actions* (Milestone 75) .

In order to achieve Milestone 75, WP1 undertook to assess the deployment of services related to the priority actions defined in the ITS Directive 2010/40/EU. A further online workshop on ITS Directive Priority Action assessment and proposals for priority service coverage was held on 22nd September 2020. The goal of the workshop was to present early results from ITS directive priority actions assessment and proposals for service coverage and give input to further develop the assessment.

The final *Socio- economic assessment of ITS Directive priority actions* (Milestone 75) report was ultimately based on a review of twelve national reports which considered where the 5 Priority services had been deployed, the coverage for such services, and also identified the corresponding benefits of those services.

The final report includes an evaluation and impact valuation and presents a description of the services related to the ITS Directive priority actions in the context of the operating environments, as defined by the EasyWay program (precursor of EU EIP). Furthermore, relevant impacts and the KPIs recommended for evaluation of each service related to the ITS Directive priority actions were also presented in the report.

## 3.3. WP2: KPI Definitions

This work package related to the specification of a definitive list of practical ITS Deployment and Benefit KPIs for the evaluation of road based ITS services. A KPI taskforce, comprising ITS corridors and experts from the wider Evaluation expert group, developed and finalised the comprehensive KPI Definitions deliverable early in the programme.

The EU EIP KPI Definitions were developed on the basis of multiple sources, including the ITS KPI definitions developed by DG MOVE for the purpose of Member State Reporting. The DG MOVE KPI Definitions were necessarily more generic than the more detailed EU EIP KPI Definitions, which were developed for the purpose of ITS Corridor evaluation. Nonetheless, the two sets of KPIs were developed in parallel and are consistent with one another (Cf. KPI Definitions report for comparison).

The EU EIP KPI Definitions provide suggested methodologies for the calculation of benefits and took into account issues relating to country-specific data gathering / quality consistency issues. As such, the EU EIP KPI Definitions recommended a best practice methodology whilst allowing for the possibility of local variation in line with national standards, etc., through a 'Record and Explain' principle.

At the time of their original development, the EU EIP project team recognized the fact that over time the need may arise for additional KPIs to be added and, furthermore, that KPIs may require modification (or even removal) as the related technologies and guidance evolved throughout the course of the Action. As such, the EU EIP KPI Definitions was considered a living document throughout and when the EU EIP A5 Evaluation Group identified the need for a review of the KPI Definitions established at the beginning of the Action, review was undertaken to consider the possibility of the addition of any sufficiently mature KPIs in the newer or more emerging fields of ITS which were not necessarily covered at the time of original development. To this end a Guidance Review working group was established and taskforce meetings were held in order to consider possible updates to the existing KPI Definitions document, as well as to review and revalidate the guidance incorporated in the Evaluation Report Template (cf. section 3.3 – Work Package 3, below.

Within the EU EIP Action, no significant changes to the KPI Definitions were made due to the fact that additional KPIs were either not sufficiently mature at the time of consideration (particularly in emerging fields), or because the additional KPIs were not considered to be of value or relevance to the ITS Corridors in progress at the time. Nonetheless, the reviews undertaken served to successfully validate the appropriateness of the set of KPIs and related guidance provided for use by the Corridors. Furthermore, it is anticipated that the EU EIP KPI Definitions will provide a sound basis to be taken forward for use within any future Actions, which can adapt and update the definitions accordingly to fit the scope of future Actions.

## 3.4. WP3: Guidance and Reference

### 3.4.1. WEBSITE

The Evaluation website is an Activity sub-site of the EU EIP website. The Evaluation subsite includes highlights for all major Evaluation deliverables and Activity updates and was regularly updated throughout the duration of the Activity (https://evaluation.its-platform.eu/).

The evaluation website also provides direct links to the Evaluation Library (section 3.3.2 below) and the Evaluation Toolkit (section 3.4, below).

### 3.4.2. EVALUATION LIBRARY

The Evaluation Library (https://evaluation.its-platform.eu/EvalLib) is a repository which was developed in order to gather all available Evaluation Reports, guidance and source materials in one place. The Evaluation Library was regularly updated throughout the duration of the Activity. Here, all EU EIP compliant Evaluation Reports from the related ITS Corridors are stored in a single repository along with an archive of past and / or external evaluation reports from past programmes. The Library also stores all current EU EIP guidance materials (KPI Definitions, Report Templates, etc.) as well as historical guidance materials and sources from past programmes.

By the end of the EU EIP Action, 68 EU EIP compliant evaluation reports from the ITS Corridors were available via the EU EIP Evaluation Library. These are supplemented by an extensive archive of over 80 evaluation reports and guidance documents gathered from previous programmes.

### 3.4.3. EU EIP EVALUATION REPORT TEMPLATE

The EU EIP Evaluation Report Template was developed by the EU EIP Evaluation expert group in conjunction with the ITS Corridors early in the programme and was subsequently adopted as the standard report template for use by ITS Corridors. This template includes integral step by step guidance and helped to ensure, as far as possible, that the outputs and results extracted from the evaluation of ITS implementations within the ITS Corridors were both consistent and harmonized. This common format for presenting results helped to ensure that results of similar ITS implementations were comparable and, furthermore, was integral to supporting the provision of transferable results between projects, thereby providing European Added Value.

The EU EIP Evaluation Report Template is closely aligned to the KPI definitions (see section 3.3, above) as well as the EC ITS Directive Priority Actions and other

classificatory documents such as the Operating Environments. To ensure coherence, links are provided to all relevant reference material within the Template.

Full adoption of the Template by the ITS Corridors (phases 2 and 3) ultimately led to the provision of 68 compliant reports by the end of the EU EIP Action.

As above, during 2020 the EU EIP A5 group undertook to review the EU EIP Evaluation Report Template as part of the afore-mentioned general Guidance Review. The purpose of the review was to identify any possible need for adjustment, either within the timeframe of the current reporting cycle or for the purpose of a possible future reporting cycle / follow-on programme. As part of this exercise a survey was prepared in order to gather user feedback with a view to identifying any required updates to the current template on the basis of user feedback.

Within the EU EIP Action, no significant changes to the Evaluation were made as feedback from the ITS Corridors was positive and it was agreed that the Template and Guidance was working well in conjunction to with the KPI Definitions. Nonetheless, the reviews undertaken served to successfully validate the appropriateness of the Template for use by the Corridors and, moreover, it is anticipated that the EU EIP Evaluation Report template will provide a sound basis to be taken forward for use within any future Actions, which can adapt and update the Template accordingly to fit the scope of future Actions.

The EU EIP Evaluation Report Template can be found here.

## 3.5. WP4: ITS Toolkit

### 3.5.1. ITS TOOLKIT SPREADSHEET

The publicly accessible online EU EIP Evaluation Toolkit User Interface is under-pinned by an Excel-based database which compiles key meta-data from each of the available EU EIP compliant Evaluation Reports as provided by the Phase 2 and 3 ITS Corridors. Throughout the course of the EU EIP Action, the Toolkit inputs were periodically provided by the ITS Corridors and were then integrated and maintained in a Master version of the Spreadsheet by the lead coordinator of the group. The Toolkit spreadsheet was then directly linked to the online user-interface (see 3.5.2, below). Comprehensive updates to the spreadsheet were undertaken at periodic intervals throughout the course of EU EIP and data from 68 ITS implementation evaluation reports was integrated by the end of the Action.

### 3.5.2. USER INTERFACE

The EU EIP Evaluation Group launched the EU EIP ITS Toolkit in 2019. The Toolkit is a publicly accessible online resource which enables users to filter an extensive database of ITS Evaluation Reports using up to 6 criteria in order to identify key information (metadata) and access evaluation reports relating to projects of specific interest or relevance to them. The objectives of the EU EIP ITS Toolkit were to provide a platform which facilitated access to high quality evaluation reports which, in turn, support decision makers (e.g., by highlighting the benefits of investment in particular ITS services, etc.), as well as to support researchers and fellow ITS evaluators across the ITS Community who wish to access best practice examples or evaluate comparable projects.

Extensive effort was made by the EU EIP Activity 5 Evaluation Group in conjunction with the ITS Corridors in order to compile the ITS Toolkit and ensure that the outputs from it are as accessible, informative, consistent and useful as possible. The Toolkit grew over the course of the EU EIP programme and has been updated with all available ITS Corridor Evaluation Reports from phases 2 and 3 in response to the related periodic milestones. As such, it now incorporates data provided by 68 project evaluations from the CEF funded ITS corridors (Arc Atlantique, Crocodile, MedTIS, Next ITS, Ursa Major). The Toolkit UI also incorporates direct links to related reports in the Evaluation Library, making it very simple for Toolkit Users to directly access related literature. Each of the linked reports demonstrate the impacts and benefits of ITS investment on the European road network in a consistent way and in compliance with the defined EU EIP approach.

The EU EIP ITS Toolkit can be accessed via the following link: https://its-toolkit.csl-inn.co.uk.

## 3.6. WP5: Evaluation Reporting

### 3.6.1. Corridor Interaction

Throughout the Action, the EU EIP Evaluation group benefitted from regular reports and updates on evaluation planning, reporting and compliance from all of the ITS Corridors. The ITS corridors were in turn integral to the development of the core EU EIP Evaluation deliverables and the usage and application of them. This helped to ensure wider acceptance of / compliance with the EU EIP evaluation approach (i.e., KPI Definitions, Report Template and Guidance, Evaluation Toolkit, etc).

Throughout the duration of the Action, 3-4 core group meetings were held per year wherein corridors regularly provided best practice technical presentations to highlight specific achievements and results at both national and Corridor level.

### 3.6.2. Interim Reports

This report is preceded by two Interim Reports (2019 and 2020) (Milestone 71) which cumulatively built on the status of the group activities and the results yielded by summarising EU EIP A5 Achievements in terms of internal deliverables / related milestones throughout the relevant reporting periods.

### 3.6.3. Final Report

This document is the Final Report which summarises the EU EIP A5 achievements at the end of the programme as well as providing a summary of results and benefits of the ITS Corridor investments.

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# 4. Benefits: Outline Methodology

This section provides an overview of the common methodology employed to obtain the evaluation results from the ITS investments within the co-funded ITS Corridors.

## 4.1. Methodology for calculating minimum key benefits

Within EU EIP, a methodology has been developed by ASFA partners for estimating safety, congestion and environment benefits as a result of project deployments. This ex-ante methodology can be applied at corridor level as well as at the level of individual national schemes and relies on the condition that baseline data prior to deployment, is available (safety data in terms of accident victims, congestion data in term of lost hours, environment data in term of CO2 emissions).

In situations where the congestion and environment data, prior to deployment, are not available, which is often the case, the methodology is difficult to apply in a complete and precise way.

In order to solve that issue, ASFA has recently developed a tool providing a means of estimating, from limited traffic data, the baseline congestion and environment data in terms of vehicle hours lost (VHL) and CO2 emissions prior to deployment.

With this new tool, which is an upstream companion to the approach used for estimating benefits, one therefore masters the whole chain of program global evaluation (data collection, data process, estimation of evaluation results).

Due to the lack of available congestion data at that time, this methodology has been applied partly on MedTis 2, Arc Atlantique 2 and Ursa Major 2, in order to derive the minimum estimated Safety benefits generated by the program and these are presented in the *Digitalization of Road Transport in Europe* report (see section 2.2.2 above). Furthermore, this methodology provides a means to calculate a corresponding minimum estimated Return on Investment (ROI) and the ROI presented in the *Digitalization of Road Transport in Europe* report has been calculated with this methodology.

This methodology enables benefits to be estimated based on sound rationale and assumptions and, if necessary, using just elementary baseline traffic data. It also provides realistic and credible results, particularly in areas where data may be missing or problematic.

This approach can therefore deliver global-level results which can clearly and effectively demonstrate the key benefits of ITS investment for use at the political level. The methodology has already been successfully used to estimate the overall safety impact and ROI of the phase 2 corridor investments and, going forward, will be extremely useful as the

scope expands to include minimum estimated congestion and environmental benefit results for the phase 3 corridors.

## 4.2. Synthesis of Evaluation Results

Estimating impacts of ITS deployment on the related network is historically problematic. It is indeed very difficult to calculate the relevant metrics, such as kilometres or hours driven, etc., concretely and estimation of such results can also be complicated. One possible solution is to make an extensive literature search, and to synthetise the potential results by critically analysing earlier results and comparing those into the target environment and context.

This approach was previously applied by the Viking evaluation group when collecting the information on potential results of co-modal information and travel time information services. In this way both national and available international databases were included in the search for evaluation studies relating to the studied services. It is important to bear in mind that, in scientific databases, etc., not everything is available and, as such, it is beneficial to conduct searches of multiple sources. In this way sources such Academia and ResearchGate have proven to be very good additions, as here research scientists can share studies which would otherwise only be available through conference attendance or specific scientific journals, etc.

Once such a search is completed, all of the found studies can then be analysed with the help of a specially created synthesis excel-tool. In the Viking approach the tool included fields for:

- description of the problem: where the service was deployed, and why? What was the problem to be solved with the deployment?
- description of the deployed system/service
- evaluation: timing and type; objectives of the evaluation; research questions; evaluation coverage (area); expected impacts/hypothesis; evaluation methods
- impacts: technical performance; impacts; reliability of the results; research questions answered
- Viking evaluation group expert assessment: overall assessment of the evaluation done; transferability of the results

Based on the above listed items, the overall synthesis of the impacts of the studied services can then be made, including the average impacts or impact ranges (if available/possible to summarise based on the studies) and also, last but not least, the overall expert assessment of the transferability of the results into the target environment and context.

# 5. Phase 2 CEF ITS Corridor Results

This section provides a summary of the impacts and benefits of ITS deployment in the phase 2 ITS Corridors (as previously reported in EU EIP A5 Interim Report 1, 2020).

As reported above, the EU EIP Activity 5 Evaluation Expert Group developed a framework to nurture a consistent approach to evaluation reporting by the ITS corridors which, in turn, was fully adopted by the corridors in their reporting.

The common adopted approach to evaluation reporting consequently yielded consistent results from the phase 2 ITS corridors which demonstrated the impact of the co-funded ITS investments in terms of safety, environment and congestion. Furthermore, it enabled the estimation of results in terms of key common KPIs at a global level.

## 5.1. Arc Atlantique

### 5.1.1. Overview of corridor

The purpose of the Arc Atlantique ITS Corridor is to accelerate the deployment of traditional and innovative Intelligent Transport Systems (ITS) systems and services on the Core and Comprehensive networks. This is with the key objectives of:

- Increasing the efficiency of the trans-European road network
- Improving safety
- Improving environmental performance

These objectives are consistent with the policy objectives of the EU, which is committed to reducing the overall cost of transport to the economic benefit of the Union, reducing societal impacts through improving the safety record of the network, delivering improved air quality, and contributing to the delivery of the Paris Agreement on climate change. Furthermore, through having a positive impact on congestion, particularly at bottlenecks, the ability for the Union to deliver goods and services more effectively supports transport cohesiveness, economic vitality and wellbeing.

To this end, the Arc Atlantique ITS corridor network is largely aligned with the North-Sea Mediterranean and Atlantic Core Network Corridors. Together, the corridors work towards improved multimodal transport links across the western reaches of the Union and for which the Arc Atlantique ITS corridor deploys technology and digital services on the road network.

Partner Member States comprise, Ireland, United Kingdom, the Netherlands, Belgium, France, Spain and Portugal and are supported and funded by the Connecting Europe

Facility. The partners are all public highway authorities or concessionaires operating on behalf of public authorities.

**Targeting Known Problems, Adopting a Harmonised Approach**

The Arc Atlantique works in conjunction with the European ITS Platform (EU EIP) and the other ITS Corridors to build a common approach to deployment and makes use of agreed common performance indicators to measure impacts and benefits on the network.

The Arc Atlantique Corridor technological focus is to deploy ITS enabled traffic management and safety solutions in known problem areas such as bottlenecks, and on routes with chronic and acute congestion which cause increased transport costs, pollution, and are often associated with an unsatisfactory safety record.

Furthermore, it extends and builds digital communications and cross-border cooperation through the implementation of harmonised systems and services such as Real Time Traffic Information and Safety Related Traffic Information whilst contributing to multimodal information via National Access Points. These are implemented in accordance with applicable European Regulations and assist Member States in meeting their obligations under the ITS Directive.

### 5.1.2. SHOWCASE RESULTS

The Arc Atlantique is being implemented over 3 phases and is due to complete its work in 2021. The Corridor has delivered and will continue to deliver a number of achievements over its lifetime. The following highlights some of these achievements.

For the period to end of 2017 the total number of Real Time Traffic Information schemes implemented on the corridor was 22. The length of corridor that benefited from this service was 19,000km. The work included upgrades to traffic management centres and new digital communications. For the same period, 19 projects concerning Safety Related Traffic Information were implemented benefiting 7,600km of the network. Furthermore, the network received new and improved services in co-modal information, truck- parking and the roll out of DATEXII.

The Arc Atlantique implemented a further 36 ITS projects designed to deliver enhancements in traffic and congestion management, safety and environmental improvement, amongst others, at specific locations on the network.

Throughout the length of the ITS corridor, the improvements delivered to users and operators during the current phase can be measured by the increase to the Level of ITS Services resulting from the deployment of ITS on the network.

- 31 projects aimed at improving management of traffic is leading to an increase to the Level of Services in Traffic Management up to Levels 4 and 5.

- 30 projects aimed at improving traffic information will lead to an increase in the Level of Services in Traffic Information to Levels 4 and 5.

This impacts 16,000km of the network. An additional 21,000km of the network will benefit from improved DATEX connectivity. Level of Service definitions can be found at https://www.its-platform.eu.

**A85, A10, A11 A63, A6 – Conceded Motorways - France Enhancement of the Traffic Management Systems.**

Traffic monitoring projects, Ghost Vehicle (wrong way) Detection project, and the On-board Emergency Call Post project, have been helping to shorten the alert time allowing faster response times and reduction of incident risk with wrong way vehicles.

ITS systems that shorten response times for events or accident, indicate a reduction in the number of accidents and congestion levels on the concerned motorway networks of 1.6%.

Over a 5-year period of the Arc Atlantique program, after deployment of the ITS services, expected minima potential savings on French conceded motorways are:

- 7 Fatalities, 17 seriously injured and 143 slightly injured for the safety figures
- 136 000 hours lost,
- 565 000 fuel litres
- 1,524 CO2 tons for the congestion volumes

The socio-economic benefits corresponding to these savings, amount to € 5,190,390 per year, giving a return on the investment program of French motorway companies of approximately 3 years.

**AG-64 Spain - Traffic Control and Traffic Management ITS deployment.**

Deployment of Variable Message Signs, digital communications, detection and monitoring systems and weather stations. Deployment KPI - 64km of network improved, Benefit KPI - reduction in accidents by 15% over two years, 450k€ saving.

**M25 United Kingdom - Traffic Control / ITS Enabled Hard-shoulder Running.**

Deployment of Lane control, detection and monitoring systems to enable hard-shoulder running. Benefit KPI – Vehicle Lost Hours reduction of 4,400 hours a day, reduction in Killed and Seriously Injured – 15%, reduction in collision rate of 20%.

**M70/M50 Ireland - Lane Control Systems.**

Installation of lane control signing with VMS to moderate speeds and increase compliance. Benefit KPI - reduction in speed to national limits with expected increase in safety, reduction in pollution and more consistent flow to reduce congestion.

### 5.1.3. IMPACT / ROI

Using modelling it is possible to estimate the impact of the new and improved ITS systems and services on the Arc Atlantique 2 network over a period of 5 years, after deployment. Expected savings are as follows:

- 236 slight injuries saved per year (1180 slight injuries over 5 years)
- 28 seriously injured saved per year (140 seriously injured over 5 years)
- 11 fatalities saved per year (55 fatalities over 5 years)

Applying these different realistic hypotheses and taking into account the level of investment, the Arc Atlantique 2 programme as a whole will deliver minimum safety socio-economic savings of 36 M€ per year and a projected ROI of about 3 years.

## 5.2. Crocodile

### 5.2.1. OVERVIEW OF CORRIDOR

In the past major traffic events have led to congestion and traffic breakdown in Central and East European cross-border areas repeatedly. This region comprises several smaller countries with different languages and lots of cross-border traffic. In order to enable harmonised and efficient traffic flows along European transport corridors, cooperation and harmonised information exchange is of vital importance.

As a continuation of the first CROCODILE corridor project, CROCODILE phase 2 has pushed the harmonised exchange of dynamic traffic data and information across borders. Partners have worked together to implement an infrastructure for providing road traffic information. Efforts are being pursued in accordance with the EU ITS Directive and its supplementing Delegated Regulations. This encompasses coordination on organisational level, technical implementation of standards as well as enhancement of management strategies and end-user services. The latter are being improved so that road users can obtain more and better information through channels (e.g. websites, apps) that they are used to, thereby adding to the continuity of services as defined in the EU ITS Directive.

**Focus topics**

- Foster cross-border coordination of motorway operators
- Implement European legislation (EU ITS Directive and supplementing Delegated Regulations)
- Deploy equipment for data collection (CCTV, sensors)
- Improve infrastructure for data processing (Upgrade traffic management centres)
- Establish mechanisms for data access (National Access Points, DATEX II nodes)
- Provide relevant information to end-users (safety-critical, real-time, truck parking)

### 5.2.2. SHOWCASE RESULTS

The results agreed upon within CROCODILE include infrastructural measures like increasing the coverage of motorways with data collection and processing equipment and building new or improving traffic management centres.

Parking places will be equipped with dynamic information on truck parking services and fixed monitoring stations will be built or upgrade along the CROCODILE corridor network.

Organisational aspects include data exchange agreements, national DATEX II nodes and cross-border traffic management plans.

Ultimately, at least one web service will be delivered, which includes relevant traffic information from neighbouring countries.

There was a common sense visible that a national body has to be part of the public administration in order to ensure impartiality and shall be attached to an already existing organisation. The role of national access points will mostly be taken by national road operators.

Furthermore, the discussion revealed the necessity of bilateral agreements between Member States on traffic data which should be exchanged, corresponding to the specifications of the ITS Directive.

### 5.2.3. IMPACT / ROI

Based on the first and second phase, CROCODILE 3 will further develop the results in discussions and technical workshops. In the background, this requires smooth processes along the whole value chain and effective coordination of actors. A CROCODILE strategy document will evaluate the data categories defined in the Delegated Regulation 2015/962 in respect of their relevance. It will also illustrate the possibilities for the application of standards and specifications (such as DATEX II, TN-ITS, …) to the cross-border exchange of traffic data from an overall corridor perspective.

The following issues are in the focus of the CROCODILE corridor:

- **National Access Points**
  All over the European Union National Access Points have been established in accordance with the Delegated Regulations.

- **Static road data**
  Road operators throughout the whole CROCODILE corridor have been coordinating their efforts and already agreed on a common minimum of static road data most relevant for exchange.

- **Traffic management plans**
  Further TMPs are being designed based on extensive coordination between different road operators all over Europe in order to close the gaps along the TEN-T network and relevant interfaces to urban areas.
  The second issue includes digitalisation of TMPs and a comprehensible structuring of cause and effect when triggering a traffic management plan.

## 5.3. MedTIS

### 5.3.1. OVERVIEW OF CORRIDOR

The MedTIS main objective is to foster the implementation of ITS (Intelligent Transport Systems) for better Traffic Management Service and better Traffic information Service on the Core and Comprehensive networks of the Mediterranean Corridor. By contributing to the evolution of local traffic management modes towards coordinated and cross-border management modes, MedTIS has a key role in improving corridor efficiency in terms of road safety and capacity of the trans-European road network.

By developing its actions over nearly 9,000 km and relying on a budget of more than 50 million euros, MedTIS project directly addresses the objectives of the ITS directive to smooth road traffic on major networks whilst improving user safety and environmental performance. MedTIS is therefore perfectly in line with the EU's objectives of decreasing societal costs by reducing the number of road victims and improving air quality. These objectives have been stressed in the new EU mobility package and its action plan.

Gathering almost thirty public and private road operators from the Members States of Italy, France and the Iberian Peninsula, MedTIS contributes to a better management of a strategic axis serving several major ports such as Venice, Genoa, Marseille, Barcelona and Valencia. As such it addresses areas where the traffic conditions are often difficult with high levels of traffic, especially during summer migration periods, heavy truck traffic, large international flows, but also, in some sectors, significant commuter traffic.

Priority and main actions to improve control, information and traffic management are the following:

- The deployment of automatic event detection equipment,
- The deployment of the first on-board information systems,
- The deployment of speed control systems,
- The displaying of truck parking occupancy information.

Moreover, one of the key actions of MedTIS was to develop a flagship project: «cross-border travel time project» that has significantly improved the operations efficiency and the level of service on France-Spain and France-Italy borders.

From a close collaboration between the 3 cross-border operators, who developed their exchanges of traffic information and traffic data and thanks to Datex2, new border traffic management plans and generalized travel time services have been deployed between Spain, France and Italy.

Overall, from the beginning of 2014 to end of 2018, MedTIS program actions have deployed 85 projects.

Ten of them where assessed, using ex-post or ex-ante evaluations, based on EU EIP indicators (Change in accident numbers and severity, Change in bottleneck congestion, Change in CO2 emissions)

These evaluations relate to individual emblematic deployments of MedTIS2 Action

These projects, of local impact, have been deployed to better respond to the specific issues encountered on MedTIS2 network:

- Improving traffic management and reducing congestion on critical spots, such as the approach of big cities, and cross-border areas;
- Improving safety on tunnels and their surroundings;
- Improving quality of traffic and event information to users, including travel times information.

The deployments chosen for individual evaluations cover different road configurations (cross border sections, inter-urban sections, urban sections, mountain areas with tunnels), and different levels of equipment. So, the impact on benefit KPIs is different from one deployment to another.

Regarding impact on congestion and on environment, the benefits of those local projects can go from a reduction of 2 to 10% of lost hours and $CO_2$-emissions volumes

Concerning safety, the benefits of those local projects can go from a reduction of 2 to 5% of accidents numbers

When comparing an individual deployment's costs and benefits, the results can be equally diverse, but all satisfactory: ROI are between 2 and 9 years, but most of them (8/10) are between 2 and 5 years.

New or enhanced traffic management services now covers more than 6,600 km of that corridor. New or enhanced Traffic information services now covers 2,300 km of that corridor.

This extension of proven traditional systems will bring significant benefits in the management and level of service of this ITS corridor and, through use of the most innovative telecommunication solutions, will facilitate the introduction of connected and automated vehicles. More precisely, on the 9,000 km of the MedTIS network:

- Nearly 100% of the network classified Level of Service 0 (no ITS service) switch to classification 1 (Basic travel information),

- Nearly 20% of the network classified Level of service 1 switch to classification 2 (Traffic information and traffic management per section),
- Nearly 10% of the network classified Level of service 2 switch to classification 3 (High level and sophisticated traffic management/information).

The general improvement in the level of congestion and road safety could therefore be significant and has to be highlighted with concrete figures.

For this purpose, and since a full evaluation of this type of program requires at least five years, it has become necessary to develop a methodology that can immediately and realistically extrapolate the full impact of this corridor programme. Overall, the operational and practical impact of most of the projects deployed in the program of motorway operators is to shorten response times in the case of an event or accident. These projects therefore make it possible to reduce the occurrence of secondary accidents. Founded on that basis, the methodology developed for this evaluation demonstrates that this ITS deployment programme potentially reduces both the number of accidents and congestion levels on the concerned motorway networks by 1.6%. This figure, which is well in line with those produced by other European reports delivered on the subject (e.g., OECD report: *Impact of new technologies on Road Safety*) leads to very significant impact results of the program.

### 5.3.2. IMPACT / ROI

On the whole MedTIS 2 network, and over a period of 5 years, after deployment of the programme, one can expect potential savings of:

- 8 fatalities,
- 53 seriously injured and 277 slightly injured for the safety figures
- 642,000 hours lost
- 2,700,000 fuel litres
- 7,200 CO2 tonnes for the congestion volumes

**The socio-economic benefits**

The socio-economic benefits corresponding to these savings, calculated from the figures presented in the "handbook on external costs of transport on road safety", amount to € 9,417,430 per year. For the investment program deployed in MedTIS, that leads to a ROI of roughly 5 years.

As these overall results come from projects that do not cover all the actions deployed in the programme, they must be considered as minima results. In practice, the result will therefore be even better.

In conclusion, these various projects and actions are fulfilling the objectives and goals for which they were targeted. They have thus contributed significantly to improving traffic safety and fluidity as well as the environmental performance and continuity of service on the MedTIS 2 networks.

## 5.4. Next ITS

### 5.4.1. Overview of corridor

The NEXT-ITS 2 corridor forms the Northern part of the Scandinavian–Mediterranean Corridor. The corridor connects Northern Europe with Western and Southern European transport networks. It offers the primary road transport connections between Western/Central Europe and Norway and the St. Petersburg region of Russia.

During the last decade increased traffic load and extensive presence of HGVs has made the NEXT-ITS corridor and core network vulnerable to disturbances. The road network of the sparsely populated areas of Northern Europe offers limited possibilities for alternative routes and large parts of the network is subject to recurring hard weather conditions, particularly in wintertime.

**Objective**

The main objective of the NEXT-ITS 2 has been to improve the network performance - in terms of efficiency, reliability, safety, and environmental impact - of the Northern part of the Scandinavian- Mediterranean CEF corridor from Oslo and the Finnish-Russian border in the north via Copenhagen, Hamburg, and Bremen to Hanover in Germany. Cross-border continuity of traffic management services have been targeted through coordinated deployment of Traffic Management services and major upgrades of Traffic Management centres.

The measures included in NEXT-ITS 2 have been chosen in order to fill the gaps concerning coverage, accessibility, dissemination, quality and content of the core traffic management services as well as to improve the cost-efficiency in the operation of traffic management. The following deployment projects were completed during NEXT-ITS2:

- Implementation and upgrade of Traffic Management Centres,
- Development and implementation of Traffic Management Plans,
- Update of roadside control software to enable service integration,
- Implementation and update of roadside information panels for driver information and control,
- Data fusion and data quality control at Traffic Management Centres.

As basic network for the assessment of the deployment KPIs of NEXT-ITS 2 measures, the comprehensive TEN-T Network has been used. The measures of NEXT-ITS 2

address mainly the Northern part of the Scandinavian-Mediterranean Corridor, but also influence the adjacent road network to the corridor and – in particular where general improvements and enhancements of traffic centres are carried out – larger parts of the main road network. Therefore NEXT-ITS 2 has estimated the impacts on the network which is influenced by the services deployed. The impacts are not limited to the NEXT-ITS Corridor but are the total estimated impacts on the affected network. The reason is that NEXT-ITS 2 contained a number of deployments in relation to central systems in traffic management centres and these system upgrades in reality affect a larger network than just the corridor itself. Thus, when including all the costs in relation to the deployments, one should also include all the benefits.

### 5.4.2. SHOWCASE RESULTS

NEXT-ITS 2 “showcase” project: **Network Control System/Traffic Management Plans Hannover-Braunschweig-Salzgitter (A2/A7/A39/391)**

The system is located in Niedersachsen on the motorways A2, A7, A39, A37, A391 and Federal Road B6 between the cities of Hannover, Braunschweig and Wolfsburg. The length of the network addressed is about 245 km. In the area where the system is implemented the important East-West connections (A2) between Western and Eastern Europe crosses the important North-South connection A7. In the vicinity of the cities of Hannover, Braunschweig and Wolfsburg several motorways around the cities are existing so that re-routing in case of congestion of incidents is possible to improve the traffic situation.

In total 10 large VMS have been installed at the motorway junctions. The system provides real-time on-trip information on congestion, traffic disruptions (problems, incidents) and re-routing recommendations via the VMS. It is being operated from the traffic centre and depending from the real-time traffic situation.

Re-routing recommendations are integrated so that the road users are informed about the possibly best routes in the case of congestion, incidents, accidents or other traffic problems on parts of the network.

By the information on congestion and possible alternative routes, the drivers can assess whether it is advantageous to choose another route. This may depend on the location of the congestion or incident and from the drivers’ final destination. As a result, parts of the traffic will choose the alternative route which leads to time saving for these drivers. Decreased congestion is expected on the original route, too. Safety (i.e. accidents with fatalities or injuries) might also be improved because end of queues are always critical points for accidents.

### 5.4.3. IMPACT / ROI

**Costs**

When calculating the costs, all the costs related to those measures, which were fully deployed during NEXT-ITS 2 are included. Overall, the costs are included into CBA calculations if and only if the respective benefits are included, too. This explains the inclusion of Norwegian costs into the total costs, even if they did not receive any EC funding for their deployment; Norwegian figures are also included into the benefit calculations.

For 5-year period, the estimated implementation costs of all NEXT-ITS 2 deployment measures are circa 33 million € (including VAT), and the annual operation and maintenance costs circa of 3 Million €, resulting 15 M€ for five years.

The five-year costs:

- Implementation 33M€
- Maintenance and operation 15 M€
- Total costs 48 M€

**Benefits**

The NEXT-ITS 2 evaluation has not determined a minimum benefit but was focused on estimating the "average" annual total benefits. The evaluation work did not include trying to estimate the level of minimum benefits, nor an interval of impacts. Instead the work was concentrated on performing a socio-economic assessment based on "average impact per year" and subsequent sensitivity analyses.

The following impact KPIs were included into CBA for NEXT-ITS2:

- Vehicle hours driven (h/year)
- Vehicle hours spent in congestion (h/year)
- Fatal accidents/Fatalities (number/year)
- Non-fatal injury accidents (number/year)
- CO2 emissions (tonnes/year)

Overall, the estimated main impacts of NEXT-ITS 2 measures are seen especially in improved traffic flow, indicated with the KPIs vehicle hours driven (reduced by 400,000 vehicle hours per year), and vehicle hours spent in congestion (reduced by 114,000 vehicle hours per year). This is a result of the deployed measures, which aims mostly at improving traffic and incident management, and supporting it with the improved traffic information.

In addition, nine thousand tons of CO2 emissions are avoided annually due to NEXT-ITS2 deployments. Moreover, the very conservative safety benefit estimate was an annual reduction of two severe accidents.

Even with these conservative estimates, the total value of the annual benefits in 2017 is calculated to be circa 12 Million €, which can be compared to the implementation costs of circa 33 million € (including VAT), and annual operation and maintenance costs 3 M€ (or 15 M€ for 5-year period), which leads to ROI of roughly 4 years.

The five-year benefits of NEXT-ITS2 deployments are the following:

- Vehicle hours driven - 2 035 000 h
- Vehicle hours spent in congestion - 571 000 h
- Fatalities/fatal accidents - 0.51
- Non-fatal injuries/injury accidents - 10.8
- CO2 emissions - 45 600 tonnes

## 5.5. Ursa Major

### 5.5.1. Overview of corridor

URSA MAJOR 2 targeted the deployment of ITS services to improve freight traffic on the TEN-T road network mainly along the RHINE-ALPINE and the Scandinavian Mediterranean Core network corridor, linking North-Sea ports, the Rhine and Ruhr area, metropolitan areas in southern Germany and in Italy. Parts of the Rhine-Danube core network corridor are also addressed due to important freight traffic routes linking these corridors in the middle of Europe.

International freight transport between EU Member States is one of the three main pillars for a Single Europe Economic Area. Improving services for international freight traffic along the mentioned corridors is the main European Added Value of URSA MAJOR 2.

Countries involved in the project are Germany, Italy and The Netherlands. Switzerland is an active partner without EU co-funding; Austria is included in its role of transit country, based on operational agreements for cross-border Traffic Management Plans.

**Evaluation, including GIS data tool support**

The main objective of the Evaluation activity is the assessment of the overall impact of Ursa Major Project on traffic efficiency, safety and environment, based on the results emerging from ex-post evaluation studies carried out by UM Partners. This means that

the evaluation studies will be based on measured real impacts on mobility. Moreover, the comprehensive usage of Floating Car Data will complement the project-wise evaluation.

The study is performed within “SA 1.7 – Evaluation, including GIS data/tool support” led by Italy with contributions from European implementing bodies of URSA MAJOR 2.

**Most significant results emerging from the evaluated projects**

Below are the most significant results that emerged from the evaluation studies of the individual projects implemented in URSA MAJOR 2 (18 studies), divided by impact area.

- Impact on Traffic Efficiency: With regard to evaluated Ursa Major projects, the more remarkable impacts are the increase of traffic flow, intended as throughput, with Dynamic Line Management (DLM, +17%/+23%), the reduction of travel time with Dynamic Rerouting (DR) and DLM (-770,000 hours per year and -8%/-50%), a good percentage of rerouted users with DR (10%/43%), the reduction of Vehicle Hour Lost thanks to Traffic Monitoring and Management (TMM, -48%/-86%) and a good result in congestion cost savings with DR and TMM (-26 M€ per year and -6,000 €/-55,000 € for 4 events).
- Impact on Safety: The analysis on safety reported in evaluated UM projects shows few results related to this area, where the most relevant indicator is the change in ratio between the number of accident and the change in traffic flow, which results as -7% in a TMM implementation. Moreover, a safety campaign on VMS obtained 91% user satisfaction.
- Impact on Environment: The ITS service that presents more results within evaluated UM projects is the DLM, with a reduction in fuel consumption of -28%/-55% and a change in fine particle emissions equal to -75%. In a DR application, a reduction of -3,650 tons of CO2 per year was calculated.
- Other results: Other results presented in the analysed projects are different for each type of ITS; this makes it complex to compare data and to provide a final judgment on overall results. There is one result that must be mentioned, and is the improvement of the event detection time, which is reduced by -93%/-97% in one Ursa Major implementation.

### 5.5.2. SHOWCASE RESULTS

| Project | Regiodesk: Improve accessibility with traffic management scenarios |
|---|---|
| **Project reference (sub-activity)** | 4.1 |
| **Site** | The Netherlands, in the South-Holland area around Rotterdam and The Hague |
| **Short description** | The system is composed of elements such as VMS, ramp metering and traffic signal control that are already operating on the road network. By using them in a better way, these ITS allow for the optimised management of traffic and emergencies thanks to the combination of regional and municipal coordination centres |
| **BKPI** | Change in traffic flow (EUEIP-BKPI-N1)<br>Change in bottleneck congestion (EUEIP-BKPI-N3) |
| **Impact on traffic efficiency** | Considering 4 incidents investigated:<br>Vehicle Hours Lost (VHL): between -468 and 4.207 (reduction between 42% and 86%), in average -838 VHL<br>During a rush hour estimated reduction of 6 - 11 VHL<br>Cost savings: between 6.000 € and 55.000 € |
| **Impact on safety** | The reduction of traffic and emergency management time increases safety |
| **Impact on environment** | Limiting delays and congestion leads to emissions that are more similar to those of regular traffic |
| **Other results** | No other results |
| **Costs** | 1,5 M€ per year for the 2012-2015 period |
| **Benefits** | 43,82 M€ in 4 years |
| **Benefit-cost ratio** | 7,3 |
| **Transferability of the results** | The procedures and techniques used for optimization are very useful and easily transferable to regions of other countries |

### 5.5.3. IMPACT / ROI

Overall impact of the project through EC Key Performance Indicators

The overall impact of UM is based on a combination of the results of UM evaluated ITS implementations and impact data available in literature (and similar to ITS realized in UM), in order to have more solid statistical basis.

The results are expressed through the Key Performance Indicators defined by DG MOVE, using only those applicable and pertinent to UM implementations.

The first step is the calculation of KPIs for each type of ITS service, using combined data from the UM evaluation studies and from literature.

After that, the impact results are extended to the whole UM corridor using a weighted average of the indicators over the number of implemented projects for each ITS service type.

The following table represents the assessed average impact along routes where the ITS systems included in the UM Project have been implemented.

| Impact area | Benefit KPI along routes where UM - ITS has been implemented | Value |
|---|---|---|
| Traffic efficiency | Change in journey time | -13% |
| | Change in traffic flow | +9% |
| Safety | Change in number of accidents | -34% |
| Environment | Change in annual CO2 emissions | -22% |

**5 year estimated minimum benefit**

The estimation model applied only to the Italian and German Projects allows to estimate the following annual savings:

- Less 71 accidents with victims,
- Less 79 slightly injured people,
- Less 22 seriously injured people,
- Less 2 fatalities,

By transforming these benefits into economic value, it can be estimated a gain of 11,5 M€. For the estimation of the ROI the following basic calculation can be applied: Project Investment (€) / Annual savings (€) = Number of Years. As such, ROI = 45,878 M€ / 11,5 = 4 years.

## 5.6. Conclusions (Phase 2 ITS Corridor Results)

### 5.6.1. Summary of Key Global Results

Based on available results from the 4 of the 5 phase 2 ITS corridors, pan-corridor estimated global minimum 5-year safety benefits and return on investment (ROI) were calculated.

In terms of minimum safety and socio-economical savings as a result of combined programme investments over a 5-year period, it can be concluded that:

- A minimum of 75 lives will be saved
- A minimum of 2,166 injuries will be prevented

### 5.6.2. Impact / RoI

In conclusion, as a result of these safety impacts alone, it is apparent that the combined ITS Corridor investments also result in a high financial benefit. Based on the combined investment of € 232 Million across the 4 ITS corridors, the following minimum savings based on safety benefits alone can be established:

- A minimum annual safety socio-economical saving of € 55 Million
- A minimum overall Return on Investment (ROI) of about 4 years on average
- Assuming an average lifetime of at least 10 years for these infrastructure components, a simplified calculation would suggest benefit-cost ratios of around 3 and higher.

# 6. Phase 3 Corridor Results

This section provides a summary of the impacts and benefits of ITS deployment in the phase 3 ITS Corridors as calculated at the end of the 2021 reporting period.

As with the phase 2 results (see above), the EU EIP Activity 5 Evaluation Expert Group developed a framework to nurture a consistent approach to evaluation reporting by the ITS corridors which, in turn, was fully adopted by the corridors in their reporting.

The common adopted approach to evaluation reporting again yielded consistent results from the phase 3 ITS corridors which demonstrated the impact of the co-funded ITS investments in terms of safety, environment and congestion. Furthermore, it enabled the estimation of results in terms of key common KPIs at a global level.

## 6.1. Arc Atlantique 3

The goal of the evaluation undertaken within AA3 was to verify that the programme fully responds to the objectives assigned in terms of:

- Network efficiency – operational performance
- Safety and Environmental performance (Congestion and CO2 emissions reduction)
- Financial profitability of investments (ROI)

This is demonstrated by using indicators and delivering concrete figures, for the whole programme, which must be significant and meaningful.

Some of the AA3 ITS projects were deployed at specific critical spots on corridor routes, whereas some of the ITS projects were more widespread projects which, in some cases applied to large parts of the whole network. This means it is not possible to sum up all of those partial results in order to deliver a global evaluation.

For this purpose, and since a full ex-post evaluation of this type of programme requires at least five years to be meaningful, it is necessary to use a sound methodology that can immediately and realistically extrapolate the full impact of this corridor programme.

Overall, the operational and practical impact of most of the projects deployed in the AA3 programme is to shorten response times in the case of an event or accident (70% of the total number of projects). These projects therefore make it possible to reduce the occurrence of secondary accidents.

Founded on that basis, a methodology already developed for the AA2 evaluation demonstrated that the ITS deployment programme has potentially reduced both the number of accidents and congestion levels on the relevant motorway networks by **1.6%**.

Taking into account the previous positive impacts of the previous AA2 deployments, the improvement rate for AA3 should reasonably be expected to be lower, on average. As a sound working assumption, one can therefore estimate the AA3 improvement rate at 1.2%, on average, on the basis of the following calculation:

- One assumes that the project aims to reduce potentially response times by 1 minute
- If the response times before deployment was 5 minutes, the potential reduction in the number of secondary accidents is: 1/5 = 20%
- Since secondary accidents account for 6% of total accidents (see ASFA accident database for such a network) the potential reduction, due to the project, in the total number of motorway accidents is as follows:
    - **6% X 20% = 1.2%**

This figure, which is well in line with those already produced by other European reports delivered on the subject (e.g., *OECD report: Impact of new technologies on Road Safety*), leads to very significant impact results of the programme.

Applying this improvement rate to the safety figures and congestion figures, before deployment (i.e., year 2017) and considering the calculations already made for AA2:

- 1 km congested traffic for 1 hour on 1 lane, running 50 km/h in average = 20 hours lost, 83.125 litres of fuel over-consumption, 0.224 T of CO2 over-emissions
- 1 hour congestion = 83.125 / 20 litres fuel over-consumption = 0.224 / 20 Tonnes of CO2 over-emissions

One can then calculate the socio-economic savings due to the AA3 Programme by the following means:

- Using the social costs of the « *Handbook of external costs of Transport 2019* » for safety figures,
- Using national costs of beneficiaries for congestion costs,
- Using Market prices for Fuel and CO2.

One can then calculate the value of socio-economic savings and the ROI of the overall AA3 Programme as is shown below in the following table:

| AA3 Estimation of Impacts and Results (-1.2%) | |
|---|---|
| Congestion Volume (vl) Year 2017 | |
| **Vehicle Hours Lost (number)** | **19,645,233.00** |
| Congestion vl reduction due to project (-1.2 %) | |
| **Hours lost number reduction** | **235,742.796** |
| **Fuel over-consumption reduction (Liters)** | **979,805.996** |
| **CO2 over-emissions reduction (Tons)** | **2,640.31932** |
| Accident Number Year 2017 | 6,363 |
| Slightly injured number | 8,330 |
| Seriously injured | 1,077 |
| Fatalities | 249 |
| Slightly injured number per accident | 1.30913091 |
| Seriously injured per accident | 0.16925978 |
| Fatalities per accident | 0.03913248 |
| **Accident Nb reduction due to project (-1.2 %)** | **76.356** |
| **Slightly injured number reduction** | **99.96** |
| **Seriously injured number reduction** | **12.924** |
| **Fatalities number reduction** | **2.988** |
| **Social costs savings** | |
| 1 Hour lost cost (€) | |
| **Vehicle Hours Lost savings (€)** | **5,604,185.77** |
| 1 fuel Liter cost (out of tax) (€) | |
| **Fuel over-consumption reduction savings (€)** | **783,844.80** |
| 1 C02 Ton cost(€) | |
| **CO2 over-emissions savings (€)** | **105,612.77** |
| 1 slightly injured cost (€) | |
| **Sligthly injured savings (€)** | **3,746,309.60** |
| 1 seriously injured cost (€) | |
| **Seriously injured savings(€)** | **6,264,718.22** |
| 1 fatality cost (€) | |
| **Fatalities savings(€)** | **9,344,208.10** |
| **Total Savings** | **25,848,879.30** |

As the total project cost is 65 M€, the ROI of the project is less than 3 Years.

As these overall results come from projects that do not cover all the actions deployed in the programme, they must be considered as minima results. In practice, the result would therefore be even better.

As a complement to this, and from the results above, which are yearly savings, we can expect for the whole AA3 programme, over a 5-year period, to result in the following benefits:

**Safety**:

- Fatalities: 15
- Seriously injured: 65
- Slightly injured: 500

**Congestion**:

- Hours lost: 1,180,000 h

**Environment**:

- Fuel: 4,900,000 L
- CO2: 13,200 T

In conclusion, the various projects and measures under the AA3 Programme are fulfilling the objectives and goals for which they were intended. They have thus contributed significantly to improving traffic safety and fluidity as well as the environmental performance and continuity of service on the AA3 networks.

## 6.2. MedTIS III

**Benefits at Corridor level**

As already noted in MedTIS II, and since MedTIS III is composed of multiple and sometimes interdependent projects, the results of which cannot simply be summed up, the benefits' evaluation of the entire Corridor Program needs to be addressed using a methodology that aggregates the effects of the deployment of each of the actions of this program.

Given the time constraints that require evaluation results to be delivered at the end of the project, road operators have developed an ex-ante evaluation method. This innovative method, successfully used in MedTIS II, seeks to respond to the commitment of verifying, by a socio-economic analysis, that the MedTIS III program fully responds to the objectives assigned in terms of congestion reduction, environmental impact, and safety improvement; and with a good level of economic balance of investments. The results must be concrete, significant and meaningful for decision-makers and stakeholders.

Moreover, the methodology should rely on as many individual deployments as possible, and allow the measurement of impacts common to all of them and significant for the entire program.

Overall and considering individual deployments of MedTIS III Action, the operational and practical impact of most of the projects deployed in the MedTIS III program is to shorten response times in the case of an event or accident (70% of the total number of projects).

This is due to:

- Better and Faster detection (CCTV, incident detection system …)
- Better and Faster information (VMS, on board information …)
- Better and Faster intervention (on site protection)

These projects therefore make it possible to reduce the occurrence of secondary accidents.

Indeed, by alerting drivers approaching the primary accident, these ITS systems contribute to better prepare them to avoid a secondary accident

In fact, and to summarize, the operational goal sought by the operators in deploying these projects is to improve the alert time and the response time in case of incident or accident, and thus reduce the occurrence of secondary accidents.

**Impact on safety (Benefit KPI: change in accident number and severity)**

Given the above, impact on safety is estimated by calculating the potential reduction of secondary accidents, which can be induced by reducing alert and response times.

Founded on that basis, the methodology already developed for the MedTIS II evaluation, demonstrated that the ITS deployment programme has potentially reduced the number of accidents on the concerned motorway networks by 1.6%.

Taking into account the previous positive effects of MedTIS II deployments, that improvement rate should be lower, on average, on MedTIS III; as assumption, one can estimate it, at 1.2%, in average:

- One assumes that the project aims to reduce potentially response times by 1 min.
- If the response times before deployment was 5 min on average on such networks, the potential reduction in the number of secondary accidents is: 1/5 = 20%
- Since secondary accidents account for 6% of total accidents (see French Concessionaires Association accident database for such networks) the potential reduction, due to the project, in the total number of motorway accidents is:
    - **6% X 20% = 1.2%**

This figure, which is well in line with those already produced by other European reports delivered on the subject (e.g., OECD report: *Impact of new technologies on Road Safety*), leads to very significant impact results of the program.

Using that figure of accident reduction percentage, the methodology developed allows to estimate the potential savings on safety due to MedTIS III program implementation

**Impact on congestion (Benefit KPI: change in bottleneck congestion)**

One assumes that there is a straight relation between congestion volumes and accidents.

One assumes that inter-urban highway congestion is mainly related to accidents that occur there: a potential reduction of 1.2% in the number of accidents leads to a potential reduction of 1.2% in congestion volumes

That hypothesis leads to a congestion reduction volume calculation to be considered as a minima result. In practice, the congestion volume reduction should be more favourable. Thus, our hypothesis should be rather conservative.

According to that hypothesis and using that same reduction rate of 1.2%, the methodology developed below allows to estimate the potential savings on congestion volumes due to MedTIS III program implementation.

**Impact on CO2 emissions (Benefit KPI: change in CO2 emissions)**

One assumes that there is a straight relation between congestion volumes (expressed in lost hours) and fuel over-consumption (expressed in fuel litres) and therefore CO2 over-emissions (expressed in CO2 Tons).

Applying that 1.2% improvement rate to the safety figures and congestion figures, before deployment (year 2018) and considering the calculations already made for MedTIS II:

- 1 km congested traffic for 1 hour on 1 lane, running 50 km/h in average =
    - 20 hours lost, 83.125 l of fuel over-consumption, 0.224 T of CO2 over-emissions

Thus, 1 hour congestion = 83.125 / 20 l fuel over-consumption, = 0.224 / 20 T of CO2 over-emissions.

One can calculate the socio-economic savings due to MedTIS III Program.

- Using the social costs of « Handbook of external costs of Transport 2019 » for safety figures,
- Using national costs of beneficiaries for congestion costs,
- Using Market prices for Fuel and CO2.

One can calculate the value of socio-economic savings and the ROI of the MedTIS III Program, with the following tables:

**Consolidated Figures for Year 2018** (year before project, figures for All MedTIS III beneficiaries):

| **Accidents** | **Congestion volumes** |
|---|---|
| Accident number: 4 111<br>Slight injured number: 5 632<br>Seriously injured number: 542<br>Fatalities: 140 | Hours lost: 10 827 857 |

**Social costs according to the different countries:**

| **Accidents** | **Congestion** |
|---|---|
| Slight injured: from 29 815 € to 38 735 €<br>Seriously injured: from 385 934 € to 501 498 €<br>Fatality: from 2 541 032 € to 3 122 354 €<br>(source: Handbook of external costs of transport) | Hour lost: from 18.34 € to 22.54€ (source: DOT of beneficiaries)<br>Fuel liter: 0.8 € (out of tax) (source: market price)<br>CO2 Ton: 40 € (source: market price) |

Applying the social costs, used in the different beneficiaries' networks, related to each of the savings, and summing those savings, it is possible to monetarize the gains of the whole project.

MedTIS III  Estimation of Impact and Results (summary version):

| **MedTIS III: Estimation of Impacts and Results** | |
|---|---|
| Congestion Volume Year 2018 | |
| **Hours lost number** | **10 827 857.00** |
| Congestion volume reduction due to project (-1,2 %) | |
| **Hours lost number reduction** | **129 934.28** |
| **Fuel  over-consumption reduction (Liters)** | **540 039.37** |
| **CO2 over-emissions reduction (Tons)** | **1 455.26** |
| Accident Number Year 2018 | 4 111.00 |
| Slightly injured number | 5 632.00 |
| Seriously injured | 542.00 |
| Fatalities | 140.00 |
| Slightly injured number per accident | 1.37 |
| Seriously injured per accident | 0.13 |
| Fatalities per accident | 0.03 |
| **Accident Number reduction due to project (-1,2 %)** | **49.33** |
| **Slightly injured number reduction** | **67.58** |
| **Seriously injured number reduction** | **6.50** |
| **Fatalities number reduction** | **1.68** |
| **Social costs savings** | |
| 1 Hour lost cost (€) | |
| **Hour lost savings (€)** | 2 830 966.64 |
| 1 fuel Liter cost (out of tax) (€) | |
| **Fuel over-consumption reduction savings (€)** | 432 031.49 |
| 1 C02 Ton cost(€) | |
| **CO2 over-emissions savings (€)** | 58 210.56 |
| 1 Slightly injured cost (€) | |
| **Slightly injured savings (€)** | 2 401 818.02 |
| 1 seriously injured cost (€) | |
| **Seriously injured savings(€)** | 3 062 927.42 |
| 1 fatality cost (€) | |
| **Fatalities savings(€)** | 5 059 772.06 |
| **Total savings (€)** | **13 845 726.21** |

***Potential savings on MedTIS III main network***

This table therefore makes it possible to draw the following overall potential results per year after MedTIS III implementation:

| Safety | Congestion | Environment |
|---|---|---|
| Potential Reduction: about 50 accidents, 75 injured, 2 fatalities | Potential reduction: about 130 000 Hours | Potential reduction: about 540 000 fuel liters, 1 460 CO2 Tons emissions |

These savings account for a total of roughly **13.8 million € per year.**

Comparing this with MedTIS III total deployment cost of about 66 million €, **the return on investment of the whole Action is less than 5 years.**

**Considering a five-year period, after deployments, the benefits should be close to:**

- **9 fatalities**
- **400 injured**
- **650 000 lost hours**
- **2 700 000 fuel liters**
- **7 300 CO2 Tons**

Insofar as the hypotheses retained are very conservative, as indicated above, these results, to be considered as minima, are therefore very positive and well demonstrate the significant impact of the MedTIS III implementation.

In the line of those of MedTIS II, they confirm the efficiency of the program.

## 6.3. NEXT-ITS 3

The NEXT-ITS 3 project covers implementations in Sweden, Finland, Denmark, Norway and Northern and Eastern Germany.

During the last decade the traffic load has increased considerably on the corridor and core network, especially the presence of heavy goods vehicles. The increased traffic load and extensive presence of heavy goods vehicles make the corridor and core network vulnerable to disturbances. Further, the road network of the sparsely populated areas of Northern Europe offers limited possibilities for alternative routes and large parts of the network is subject to recurring hard weather conditions, particularly in wintertime.

Based on this background, NEXT-ITS 3 aims to enhance the core network performance in terms of efficiency, reliability, safety and environmental impact. Enhanced corridor and core network performance will be achieved through deployment of ITS services such as vital upgrades of traffic management centres and new services with improved data quality and extended coverage. The objective of is to improve the quality of data and services provided by the road operators and increase the cost-efficiency.

The NEXT-ITS 3 project contains a variety of measures deployed on the NEXT-ITS 3 corridor, core and/or comprehensive network and in traffic management centres.

The evaluation performed has covered the systems and services deployed or enhanced by the road authorities involved during the period 2018-2021, also including some deployments which will be completed fully in early 2022. The objective has primarily been to evaluate the impacts, costs and benefits of the systems and services deployed i.e., how much the deployments contribute to reduction in travel time and delays, accidents and CO2 emissions from road transport.

This evaluation includes estimated impacts for Key Performance Indicators on vehicle hours driven, vehicle hours lost due to congestion, accidents in terms or fatalities and injury accidents, and CO2 emissions. In addition, costs and benefits of the systems and services deployed as well as Key Performance Indicators for deployment.

The total length of the NEXT-ITS corridor itself is about 3 000 km, but the impacts of the NEXT-ITS 3 deployments cover a much larger road network due to the fact that many implementations focus on improving the effectiveness and quality of traffic centre operations. In the participating countries, the traffic management centres of the road authorities provide their services on the whole comprehensive TEN-T network, and even wider for some services, on the whole main road network including e.g. arterials to the bigger cities. Hence, in order to cover all benefits of the measures in a fair way, also the contribution of the NEXT-ITS 3 deployments to solving transport problems outside the actual corridor have been taken into account.

As the contribution of the deployments to the effectiveness of existing ITS systems and services varies by type of measure and type of service, the road network affected had to be separated in several different sub-networks in some countries to be able to estimate the impacts of NEXT-ITS 3 as correctly as possible. In these cases, the impacts were first calculated separately for each sub-network and then summed up for all networks impacted by the measures in the country.

Due to the nature of the deployments, especially the central traffic management centre upgrades, and the fact that many of them were finalised close to the end of the project period (2018 to 2021), it has not been possible to carry out an ex-post evaluation for all the deployed measures. One Danish project evaluation has been conducted and for all other deployments an ex-ante evaluation has been performed.

The ex-ante evaluation is taking the estimated impacts of the deployments into account. The estimated impacts of the deployed services on the corridor and networks are based on experience from impact assessment studies available for the traffic management and information services deployed and enhanced. While taking into account the results from existing studies, especially from regions outside NEXT-ITS, the results were adapted somewhat in order to consider the differences in traffic and environmental conditions between the ones in the impact studies and the ones prevailing on the NEXT-ITS 3 networks.

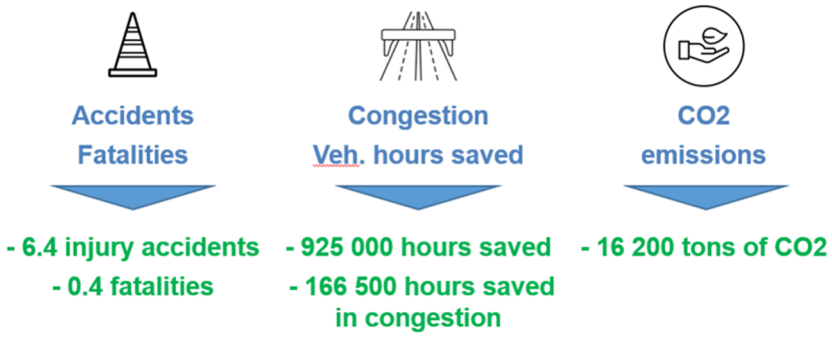
The total estimated impacts of the services are considerable. Overall, the estimated main impacts are seen in improved traffic flow, indicated with the KPIs vehicle hours driven, reduced by approximately 925 000 vehicle hours per year, and vehicle hours spent in congestion reduced by 166 500 vehicle hours per year. This is a result of the nature of the deployments of which the majority aims mostly at improving traffic management and incident management and supporting it with the improved traffic information.

The impacts from the Danish ex-post project evaluation should be added to these impacts. (The Danish ex-post impact results are not included in the figures stated as they were reported as totals for the evaluation period and not as annual impacts).

Fatalities and injury accidents are reduced by 0.37 and 6.36 per year respectively and in total 16 200 tonnes CO2 emissions are saved annually due to the deployments.

The relatively low reductions in fatalities and injury accidents are due to the modest effect estimates for these which follows from the majority of the NEXT-ITS networks had very good traffic safety circumstances before the implementations and especially in some of the Nordic countries also rather low traffic volumes and already low accident numbers. Further, the review of ex-post evaluation reports has shown a tendency to provide very cautious conclusions for accidents and fatalities, among others due to the fact that often the evaluations are performed e.g. half a year after the implementations, hence too short a time period to draw firm conclusions on safety effects.

Further, the “Effect enhanced” estimates are also cautious. Effect enhanced is the “additional” improvement of the service e.g., based on the additional users benefitting from the service.




**Annual impacts due to NEXT-ITS 3 services**

The total monetary benefits are estimated to 26.55 million Euros per year. The total costs are estimated to 6.90 million Euros per year, if using a 10-year lifetime. The estimated yearly benefits of 26.55 million Euros per year are without the Danish ex-post evaluation, where the total (not yearly) benefits were 3.6 million Euros.

If looking at the deployment (investment) costs only, these are in total 36 million Euros excl. VAT.

When comparing the benefits with the costs, the VAT should be included in the costs which gives an investment cost estimate of approximately 43.3 million Euros incl. VAT (when applying the different VAT in each country).

The operation and maintenance costs are estimated to approximately 3.30 million Euros per year excl. VAT and to 3.97 million Euros per year incl. VAT.

A simple comparison between the estimated benefits and costs indicates that the costs will be offset by the benefits in already about two years. However, these costs are without interest rates, Net Tax Factor etc. which would have to be included in a full socio-economic analysis of the benefit cost ratio. A rough estimate is therefore that the NEXT-ITS 3 deployments altogether will be beneficial within maximum 3 years.

It should be noted that this rough estimate is based on generally cautious and conservative estimates of the input parameters for the benefit analysis, namely effect enhanced by the services and impact estimates as well, and that the variation across deployments is not reflected in this overall conclusion for the entire NEXT-ITS 3.

The benefit results of the ex-ante model used naturally depend on the assumptions made and therefore some sensitivity analyses have been performed.

The sensitivity analysis shows that even with the effect enhanced estimates being only half of what is considered as the most realistic estimates, the total annual benefits are 13.28 M€. Hence, even with very conservative and cautious estimates of effect enhanced, NEXT-ITS 3 will be socio-economically feasible.

## 6.4. Ursa Major

URSA MAJOR neo is a project focused on the implementation of ITS services in order to improve freight traffic on the TEN-T road network in particular the connection between the North Sea ports, the Rhine and Ruhr area, the metropolitan areas of southern Germany, of Northern Italy and the Mediterranean ports down to Sicily. The members are road and maritime operators from Germany, Italy and the Netherlands.

Improving services for international road freight traffic along the corridors is one of the three main pillars of the European Economic Space and is the main European added value of UMneo. Dissemination of data allows the UMneo road operators to better adapt ITS services to the needs of the freight sector, the real-time traffic information (RTTI) services to inform truck drivers about accidents on their route (original) and with Floating Car data to estimate congestion in real time for the entire corridor and its daily and seasonal variability.

***One of the main objectives is the evaluation*** of the overall impact of the Ursa Major Project on traffic efficiency, safety and the environment. For some UMneo projects an ex-post Evaluation was performed. In the following table are listed the projects and the benefits calculated and obtained from the ex-post Evaluations, having a numerical result.

| Beneficiary | Partner | Sub-Act. No | Activity Title | Sub-Activity Name | Expected impacts: Safety, Traffic Efficiency, Environment | Benefits (k€) |
|---|---|---|---|---|---|---|
| Germany | RP | 5.4 | Activity 5: Improve safety for freight transport | DE (RP) - Road works information and management system | Reduced impact of roadworks on traffic efficiency, safety and the environment due to better coordination and improved planning of roadworks. Better information and educated decision by the road user due to improved pre-trip and on-trip information. | 2.000 |
| Netherlands | RWS | 6.3 | Activity 6: Real life pilots (Studies) | NL (RWS) - Real Life Pilot on Tyre Pressure System for trucks | 1. cost savings for truck companies: a total of € 9,000 per year.<br>2. societal benefits: € 21.000 per year. | 30 |

In order to have an estimation of the overall benefits for the UMneo Project, the benefits of all other ITS implementations planned in UMneo were assessed with a simplified methodology.

The method is agreed at EU EIP level and based on the indicators provided by MedTIS Corridor.

The basic assumption is a 1.2% reduction of accidents due to the implementation of traveler information service on the road.

The consequent reduction of accidents has produced indirect benefits in terms of less hours lost in traffic (traffic efficiency) and less emissions (environment).

Furthermore, some other considerations and assumptions are made and listed below:

**Impact on safety**:

The reductions in terms of *accidents, fatalities, injuries (slightly and seriously)* were determined by considering as baseline data set the UNECE - 2019 database, and the percentage subdivision among slightly (93%) and seriously (7%) injured people based on Italian statistics (Incidenti-stradali_2020 - A.C.I. – ISTAT). The monetary benefits (€) were assessed thanks to the cost information of the Handbook on the external costs of transport 2019.

**Impact on traffic efficiency**:

The ***direct*** *reduction in lost vehicle hours* was determined thanks to the C-Roads values and methods (C-Roads - Traffic Efficiency Impact in Italy HLN-SV), while the ***indirect*** *reduction* is a consequence of the above-mentioned accident reduction (1,2%); finally thanks to the costs released by the Handbook on the external costs of transport 2019 the economic benefits (€) were calculated.

**Environment**:

The impacts were determined with the same approach used for traffic efficiency for the determination of direct and indirect costs using parameters and approaches from C-Roads and from MedTIS. Finally, the impacts relating to the *fuel over-consumption reduction* (in liters) and *CO2 over-emissions reduction* (tons) are transformed in economic benefits.

The following table shows the various activities implemented by each of the three Member States which were considered in this simplified assessment based on the EU EIP and MedTIS approaches.

| Beneficiary | Partner | Activity No | Sub-Activity No | Activity Title | Sub-Activity Name | Network (Km) |
|---|---|---|---|---|---|---|
| Italy | ASPI | 3 | 3.4 | Activity 3: Improved traffic and traveller information | IT (ASPI) - A1/A4/A8 /A9/A11/A13/A14 - Variable Message Signs on motorways | 1995 |
| Germany | BW | 4 | 4.1 | Activity 4: Remove Bottlenecks | DE (BW) - A5/A8 - Dynamic traffic management and hard shoulder running at triangle Karlsruhe | 26,5 |
| Germany | RP | 4 | 4.2 | Activity 4: Remove Bottlenecks | DE (RP) A61, A48, A3, Cologne - Frankfurt dynamic rerouting | 8 |
| Germany | BW | 4 | 4.3 | Activity 4: Remove Bottlenecks | DE (BW) - A8 - Extension of dynamic traffic management system | 11 |
| Germany | BY | 4 | 4.4 | Activity 4: Remove Bottlenecks | DE (BY) - Extension of the traffic management system and TCC update in Bavaria | 108 |
| Germany | HE | 4 | 4.5 | Activity 4: Remove Bottlenecks | DE (HE) - A5 - Dynamic traffic management system for Corridor Link Frankfurt Rhein-Main – Berlin | 32 |
| Germany | HE | 4 | 4.7 | Activity 4: Remove Bottlenecks | DE (HE) - A4/A7/A44/A49 - Dynamic rerouting for Corridor Link Frankfurt Rhein - Berlin | 120 |
| Germany | NRW | 4 | 4.8 | Activity 4: Remove Bottlenecks | DE (NRW) - A3/A45 - Dynamic rerouting from and to Oberhausen | 355 |
| Germany | NRW | 4 | 4.9 | Activity 4: Remove Bottlenecks | DE (NRW) - A3 - Dynamic traffic management system Leverkusen – Hilden/Breitscheid – Oberhausen | 48 |
| Germany | RP | 4 | 4.10 | Activity 4: Remove Bottlenecks | DE (RP) - A6/A61 - Dynamic rerouting in the Rhine-Neckar network | 29 |
| Italy | ASPI | 4 | 4.11 | Activity 4: Remove Bottlenecks | IT (ASPI) - A4 Milano - Dynamic traffic management | 12 |
| Netherlands | RWS | 4 | 4.12 | Activity 4: Remove Bottlenecks | NL (RWS) - Traffic management on core road network Rotterdam | 20 |
| Italy | Autovie Venete | 4 | 4.13 | Activity 4: Remove Bottlenecks | IT (Autovie Venete) - A4 - ITS for freight transport Venice - Trieste | 55 |
| Italy | Brennero | 4 | 4.19 | Activity 4: Remove Bottlenecks | IT (Brennero) - A22 - Installation of new VMS at 6 motorway entrances | 313 |
| Germany | BW | 5 | 5.1 | Activity 5: Improve safety for freight transport | DE (BW) - Road works planning and coordination software incl. Web-based client for public (BIS 2.0) | 1138 |
| Germany | BY, BW, HE, NRW, RP | 5 | 5.2 | Activity 5: Improve safety for freight transport | DE - Upgrade of Safety Trailers towards cooperative systems | 830 |
| Germany | RP | 5 | 5.5 | Activity 5: Improve safety for freight transport | DE (RP) - Traffic and Tunnel Control Centre Rheinland-Pfalz | 96 |
| Italy | ANAS | 5 | 5.6 | Activity 5: Improve safety for freight transport | IT (ANAS) - A19 - Smart Roads | 200 |

The following table represents the assessed average impact estimated, both by the three Member States and by Ursa Major neo totals:

| Italy | | | | | |
|---|---|---|---|---|---|
| **SAFETY** | | **TRAFFIC EFFICIENCY** | | **ENVIRONMENT** | |
| Accident Number reduction | 48 | Hours lost number reduction | 218589,7728 | Fuel over-consumption reduction (Liters) | 54781 |
| Injured number reduction | 80 | Benefits per year (€) | 3.650.449 | CO2 over-emissions reduction (Tons) | 300 |
| Fatalities number reduction | 2 | Benefits for UMneo duration 2017-2022 (€) | 21.902.695 | Benefits per year (€) | 68.355 |
| Slightly Injured number reduction | 74,3 | | | Benefits for UMneo duration 2017-2022 (€) | 410.131 |
| Seriously Injured number reduction | 5,9 | | | | |
| Benefits per year (€) | 10.202.119 | | | | |
| Benefits for UMneo duration 2017-2022 (€) | 61.212.717 | | | | |

| Germany | | | | | |
|---|---|---|---|---|---|
| **SAFETY** | | **TRAFFIC EFFICIENCY** | | **ENVIRONMENT** | |
| Accident Number reduction | 51 | Hours lost number reduction | 221587,6388 | Fuel over-consumption reduction (Liters) | 40647 |
| Injured number reduction | 82 | Benefits per year (€) | 4.609.451 | CO2 over-emissions reduction (Tons) | 316 |
| Fatalities number reduction | 1 | Benefits for UMneo duration 2017-2022 (€) | 27.656.704 | Benefits per year (€) | 72.071 |
| Slightly Injured number reduction | 75,7 | | | Benefits for UMneo duration 2017-2022 (€) | 432.426 |
| Seriously Injured number reduction | 6 | | | | |
| Benefits per year (€) | 8.726.925 | | | | |
| Benefits for UMneo duration 2017-2022 (€) | 52.361.551 | | | | |

| The Netherlands | | | | | |
|---|---|---|---|---|---|
| **SAFETY** | | **TRAFFIC EFFICIENCY** | | **ENVIRONMENT** | |
| Accident Number reduction | 0,1 | Hours lost number reduction | 467,8569231 | Fuel over-consumption reduction (Liters) | 117 |
| Injured number reduction | 0,1 | Benefits per year (€) | 10.386 | CO2 over-emissions reduction (Tons) | 1 |
| Fatalities number reduction | 0,01 | Benefits for UMneo duration 2017-2022 (€) | 62.319 | Benefits per year (€) | 146 |
| Slightly Injured number reduction | 0,1 | | | Benefits for UMneo duration 2017-2022 (€) | 878 |
| Seriously Injured number reduction | 0 | | | | |
| Benefits per year (€) | 29.833 | | | | |
| Benefits for UMneo duration 2017-2022 (€) | 178.999 | | | | |

| UMneo | | | | | |
|---|---|---|---|---|---|
| **SAFETY** | | **TRAFFIC EFFICIENCY** | | **ENVIRONMENT** | |
| Accident Number reduction | 99,7 | Hours lost number reduction | 440.645,27 | Fuel over-consumption reduction (Liters) | 95.546 |
| Injured number reduction | 162,0 | Benefits per year (€) | 8.270.286 | CO2 over-emissions reduction (Tons) | 617 |
| Fatalities number reduction | 2,57 | Benefits for UMneo duration 2017-2022 (€) | 49.621.718 | Benefits per year (€) | 140.572 |
| Slightly Injured number reduction | 150,1 | | | Benefits for UMneo duration 2017-2022 (€) | 843.435 |
| Seriously Injured number reduction | 11,8 | | | | |
| Benefits per year (€) | 18.958.878 | | | | |
| Benefits for UMneo duration 2017-2022 (€) | 113.753.267 | | | | |

From the last table, referred to the total benefit of the three countries, we can see that the estimation model allows to determine the following annual savings for *safety*: less 100 accidents with victims, less 150 slightly injured people, less 12 seriously injured people, less 2,5 fatalities.

For what concern *traffic efficiency*, 440.645 hours are saved and in terms of *environment benefits* a reduction of 95.546 liters of fuel and of 617 tons of $CO_2$ is estimated.

Moreover, through the model applied it's possible to estimate the following annual and six-year savings of the project, respectively referring to the three countries and totals of UMneo:

| | | | | |
|---|---|---|---|---|
| **Italy** | **Total Benefits in Italy per year (€)** | 13.920.924 | **Total Benefits in Italy (€) - duration UMneo (6 years)** | 83.525.543 |
| **Germany** | **Total Benefits in Germany per year (€)** | 13.408.447 | **Total Benefits in Germany (€) - duration UMneo (6 years)** | 80.450.681 |
| **The Netherlands** | **Total Benefits in The Netherlands per year (€)** | 40.366 | **Total Benefits in The Netherlands (€) – duration UMneo (6 years)** | 242.196 |

| | | | | |
|---|---|---|---|---|
| **UMneo – EU-EIP approach** | **Total Benefits for UMneo per year (€)** | **27.369.737** | **Total Benefits for UMneo (6 years ) - €** | **164.218.420** |
| **UMneo – ex post** | **Total Benefits for UMneo per year (€)** | **2.030.000** | **Total Benefits for UMneo (6 years ) - €** | **12.180.000** |
| **UMneo - Total** | **Total Benefits for UMneo per year (€)** | **29.399.737** | **Total Benefits for UMneo (6 years ) - €** | **176.398.420** |

The total gain of UMneo is around 29.4 M€ per year and of around 176.4 M€ over 6 years.

Therefore, ROI was estimated with the following calculation:

- Project Investment (€) / Annual savings (€) = Return on Investment (Number of Years).
- **ROI = 150 M€ / 29.4 M€ = 5.1 years**.

# 7. Global Results (Phase 3 ITS Corridors)

## 7.1. Rationale and Assumptions

Based on available results from the phase 3 ITS corridors, pan-corridor estimated global minimum 5-year benefits and return on investment (ROI) were calculated.

The calculation was made on the basis of available data from 4 ITS Corridors (MedTIS3, Arc Atlantique 3, Ursa Major neo and Next ITS3) with extrapolated results for 1 corridor (Crocodile), where due to the relative similarity of the measures within the Action, it can be reasonably assumed that Corridor results would be in line with the data from the other ITS Corridors and that, therefore, the same rationale can be applied in relation to the relatively limited costs of the Action.

The savings were calculated based on safety savings and congestion savings. Congestion savings include KPI such as vehicle lost hours, fuel over-consumption (litres) and CO2 over-emissions. The congestion indicator did not take into account the hours driven (which were only available for Next-ITS3), and therefore they should be considered as *minimum* savings.

Furthermore, the Return on Investment (RoI) calculations were based on investment costs only, as maintenance costs were only available for the Next ITS3 Corridor.

## 7.2. Impacts and Return on Investment

Based on the combined investment of € 360 Million across the Phase 3 ITS Corridor Actions, this section presents a summary of the overall calculated benefits and demonstrates that the combined Phase 3 ITS Corridor investments will result in a significant financial benefit.

In terms of minimum safety and socio-economical savings as a result of combined programme investments within the 5 Corridors over a 5-year period, it can be concluded that:

Safety-related socio-economic minimum savings over a 5-year period (annual savings x5) will be:

- **A minimum of 40 lives saved**
- **A minimum of 1846 injuries prevented**
    - Comprising the prevention of a minimum of 195 serious injuries, and
    - The prevention of a minimum of 1651 slight injuries.

Congestion related socio-economic savings due to the combined ITS Corridor investments over a 5-year period (annual savings x5) will be:

- **A minimum saving of 5,057.475 vehicle hours lost**
- **A minimum saving of 11,995,830 litres of fuel**
- **A minimum saving of 34,190 tons of CO2**

Based on these results, the combined Phase 3 corridor investments demonstrate a high overall financial profitability in terms of Return on Investment (RoI), calculated as follows:

- **A consolidated investment cost of 360 Million €**
- **A minimum annual safety socio-economic saving of 79 Million €**
- **A minimum RoI of about 4.5 years**

# 8. Conclusions / Summary

During the EU EIP programme, the EU EIP Evaluation Group (Activity 5) fully completed all planned milestones.

The Evaluation Group comprised experts from the EU EIP Member States and all CEF funded ITS Corridors and, throughout the EU EIP, benefitted from a strong active representation from its membership to build on the work undertaken in preceding programmes in order to develop a suite of tools and support materials to enable a harmonised approach to ITS evaluation reporting which, in turn, produced consistent results from the ITS Corridors.

Integral to the EU EIP evaluation approach are the common KPI Definitions. These were developed through extensive consultation with Member State experts, ITS Corridors and DG MOVE with the intent of providing a single convenient and practical reference point for evaluators. The KPI Definitions document comprises agreed deployment and impact KPI definitions along with "best practice" estimation methods for calculation which were drawn from various sources and work on the subject.

The common Evaluation Report Template developed by EU EIP incorporated guidance was consistent with, and structured in line with, the KPI Definitions for the purpose of ensuring that a common approach to evaluation reporting was adopted. The KPI Definitions and Evaluation Report Template have been widely promoted and both have been publicly available and downloadable from the Evaluation Library throughout the EU EIP Action (https://www.its-platform.eu/EvalLib).

The European ITS Platform ITS Toolkit (https://its-toolkit.csl-inn.co.uk) is an extensive database of key meta-data from Corridor Evaluation Reports. The Toolkit is a "live" publicly accessible online tool for filtering ITS Evaluation results by 6 key criteria (Deployment KPI, Benefit KPI, Location, Corridor, ITS Directive Priority Area and ITS Directive Priority Action) and enables users to directly locate relevant Evaluation Reports.

The EU EIP Evaluation website (https://evaluation.its-platform.eu/), which promotes the results of the Activity, also incorporates an extensive Evaluation Library (https://www.its-platform.eu/EvalLib), which serves as an access point for all EU EIP Evaluation reference and guidance materials, as well being a repository for Evaluation Reports from the ITS Corridors and an archive of pre-CEF ITS Evaluation Reports and support materials.

The EU EIP Evaluation Group has benefitted from strong, regular, direct Corridor engagement throughout the programme, and ITS Corridors were, in turn, integral to the development of the common approach defined in the European ITS Platform support materials. Indeed, the ITS Corridors fully adopted the harmonised European ITS Platform approach by aligning to the KPI definitions, using the report template and transferring their results into the ITS Toolkit.

The suite of interrelated EU EIP Evaluation Tools elaborated above were developed for the purpose of harmonizing the approach to ITS Corridor Evaluation and ensuring consistency of the results generated. The EU EIP tools were also developed with the intention of being transferable beyond the frame of the EU EIP, and therefore should inform the basis of any evaluation activity under future ITS platform programmes as the scope evolves beyond the current EU EIP.

As demonstrated in detail in sections 5-7 above, the EU EIP Evaluation methodology demonstrated that, as a minimum, combined estimated benefits of the Phase 2 ITS Corridor investments over a 5-year period would result in a minimum of 75 lives saved and over 2,000 injuries reduced, equating to a minimum overall ROI of about four years.

Similarly, for the Phase 3 ITS corridors, the same methodology demonstrated that a further 40 lives would be saved, and 1,845 injuries prevented over a 5-year period. In addition to this, the combined Phase 3 ITS Corridor investments will result in a reduction of over 5 million vehicle lost hours, a saving of almost 12 million litres of fuel and a reduction of almost 35,000 tonnes of CO2. As such, the combined phase 3 ITS Corridors equate to a minimum ROI of 4.5 years.

These results were obtained by the EU EIP Evaluation methodology – a methodology which is now successfully proven on a large scale and well-mastered for assessing the benefits of such projects. The final results therefore successfully demonstrate the key socio-economic benefits of ITS investment in Europe and have proven the high level of return on investment that such investments generate.