ISABELA

CEDR TRANSNATIONAL ROAD RESEARCH PROGRAMME

Call 2014

Integration of social aspects and benefits into life-cycle asset management

Investigation Report

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Table of contents

Table of figures

List of Tables

Executive Summary

The ISABELA project aims at identifying clear and repeatable social key performance indicators (S-KPI) in combination with existing technical parameters, described in projects like COST354, FORMAT, EVITA, SBAKPI, etc.

To achieve its objectives the project is subdivided into 5 technical work packages: WP1 Social benefits investigation, WP2 Social benefits indicators, WP3 Social benefits modelling, WP4 Social benefits implementation, and WP5 Social benefits in practice and dissemination. This report is the outcome of the work package WP1.

The objective of WP1 was to collect information on social key performance indicators (S-KPIs) and their use in asset management systems.

The review started with assessment of stakeholder requirements and expectations and included literature review on used social performance indicators, as well as interviews with experts from road directorates regarding their current practice and use of S-KPIs in order to check and complete stakeholders' expectations and requirements along with the inventory of available indicators, data, models and methods already available from existing groups/projects.

Five groups of stakeholders were identified: users, neighbours, road authorities (with subcategories road owners and road operators), financial institutions, and society.

Stakeholder requirements and expectations were grouped into four areas related to the following maintenance aspects:

- Availability and disturbance;
- Road safety;
- Environment;
- Socio-economy.

The project group found 30 single stakeholder requirements and expectations from the literature review. However, some of these expectations are related to more than one area, which was the reason that 63 expectations were finally obtained, of which 15 related to Users, 11 to Neighbours, 8 to Financial Institutions, 8 to Road Authorities, and 21 expectations related to Society.

The literature review has identified a high number of indicators related to four major maintenance aspects. For "Availability and disturbance" aspect 16 indicators were identified in five subcategories: accessibility, condition, congestion, restrictions, and travel time. For "Road safety" aspect a total of 23 indicators were identified in five subcategories: accidents, condition, overall safety, safety costs, and users' perception; most of these indicators are classified into the "accidents" sub-category. "Environment" aspect includes 18 indicators divided into five subcategories: air quality, CO_2 emission, natural resources, noise, and soil and water quality. Finally, for "Wider socio-economic" aspects 45 indicators were identified in the literature, divided into eight subcategories: asset value, condition, cost efficiency, environmental costs, safety costs, wider socio-economic costs, stakeholder satisfaction, and users' costs.

The indicators identified in the literature served as a base for interviews with experts from interested road authorities in order to identify indicators that are currently either used or there is interest for their use in development of authorities' asset management programs. Based on interviews, the list of indicators was complemented with additional social key performance indicators (S-KPIs) used by road authorities.

Most of identified S-KPIs are not used in a systematic way in development of asset maintenance programs, and very few of identified indicators are used by substantial number of road authorities. However, there is considerable interest to implement and use some of

these indicators in the future; especially those for which data are available in some form within road administrations.

The importance of consideration of the expectations in the area of road availability and disturbance in maintenance planning is recognized in all countries but with a varying extent. The indicators used mostly include some form of condition rating for pavements and bridges, while other indicators, related to accessibility, congestion, availability and travel time are used to a lesser extent.

All countries are using some of S-KPIs related to road safety. The indicators used are mostly related to number of fatalities, injuries, or simply to number of accidents. Based on these data more complex indicators related to safety cost, or to frequency of occurrence of accidents may be calculated. In addition, many administrations are using some of condition parameters in order to identify adequate maintenance treatments to achieve certain safety related levels of these parameters. The S-KPIs for overall safety, safety costs and user perception are currently not seen as significant to the most in maintenance planning.

The noise stands out as the most important environmental parameter that is used by most of road directorates as a result of implementation of European Noise Directive. Other parameters, such as air quality, CO_2-emission, environmental costs, natural resources, soil and water quality do not affect the planning at the moment, but are up to a point the integral part of a national legislation. Nevertheless, as the environmental impact is becoming a principal mission for all European societies, there is a large interest for the application of the related parameters in the future.

Among the parameters related to economy, cost efficiency, and particularly benefit/cost ratios of maintenance programs appear to be used by most of administrations in order to assess socio-economic impact of maintenance policy. All other parameters are used to a smaller extent.

Glossary of terms

ISABELA uses a number of terms that pertain to road asset management, social key performance indicators and performance indicators in general. The following words are used in line with the definitions given. Some of the definitions presented here were developed in previous projects EVITA [1] and COST 354 [2]. The complete list of definitions can be found in the deliverable D3.1 Terminology of social benefit modelling.

Expectation in societal areas

Anything that a stakeholder is expecting / desiring from the road infrastructure. It may be some services, some benefits, or it may be the reduction of some nuisances, risks.

Road Infrastructure / road asset

All constructions (pavements, bridges, drainage structures…) and equipment (safety barriers, signs, lights…), including all the land devoted to the highway corridor.

Road asset management

All studies, decision making processes and operations which are specifically concerned with, or required to, build, maintain and operate the road infrastructure/road asset.

Road performance

Generally, the ability of the road to meet expectations and to provide a stakeholder with what she / he is expecting from the road. More specifically, road performance is a measure of this ability to meet expectations, of the quality of the road regarding the expected service or characteristics or impacts.

Road Stakeholder

All people (physical or social person), all organisations, and more generally all bodies, which have some interactions with road infrastructure. The road network can provide benefits to stakeholders as well as imposing constraints upon them. Conversely, the needs of stakeholders may also impose constraints on, or determine the requirements of, the infrastructure.

Social benefits

A social benefit is defined as a (positive or negative) societal consequence of any intervention strategy on one or more stakeholders, which is related to disturbance and availability, safety, environment and socio-economy.

Social Performance Indicator (PI)

A comprehensive term which quantifies the impact of the road on the societal areas. It can be expressed in the form of a technical parameter (dimensional) and / or finally in form of an index (dimensionless) evaluating the performance indicator on a predefined scale

- S-KPI ……Key performance indicator related to social effects and benefits

Technical Parameter (TP)

A physical characteristic, derived from various measurements, or collected by other forms of investigation (for example, noise level).

1 Introduction

The main objective of ISABELA (**I**ntegration of **s**ocial **a**spects and **be**nefits into **l**ife-cycle **a**sset management) is the definition of a holistic asset management framework for social key performance indicators (S-KPIs) and social benefit modelling in form of social effects (monetary and non-monetary), social backlog and social risk. ISABELA provides an essential enhancement for the life-cycle-assessment of maintenance strategies and enables to incorporate social aspects and benefits into classical asset management.

ISABELA aims at identifying clear and repeatable social key performance indicators (S-KPI) in combination with existing technical parameters, described in projects like COST354, FORMAT, EVITA, SBAKPI, etc. The use of these new indicators in parallel to existing technical performance indicators will help to underline the necessity of road infrastructure maintenance and, of course, is the basis for a holistic definition of a new maintenance benefit taking into account maintenance aspects such as:

- Availability and disturbance (travel time, vehicle operating costs);
- Road safety (fatal and severe accidents related to asset condition);
- Environment (noise, air pollution, natural resources);
- Socio-economy (asset value, wider social effects).

To achieve the project goals and objectives, a close cooperation between the Consortium and the Roads Directorates (RD) is essential. Thus, the whole project is based on an intensified multi-party dialogue between interested RDs and the Consortium in the form of interviews. This approach will focus on the following main tasks:

- Identifying good practices of social benefit incorporation in the asset management processes;
- Defining a framework for social benefits;
- Development of procedures for the calculation and implementation of social key performance indicators (S-KPI);
- Applying the results from the investigations and the developments in practice.

The RDs of the PEB-countries were invited to participate in this multi-party dialogue and to provide the project consortium with the necessary initial information.

With regard to the objectives of ISABELA the following technical working groups (WG) were established:

- WP1 Social benefits investigation;
- WP2 Social benefits indicators;
- WP3 Social benefits modelling;
- WP4 Social benefits implementation;
- WP5 Social benefits in practice and dissemination.

The implementation packages of ISABELA, which will be carried out in close cooperation with interested Road Directorates, should clearly show how the theoretical approach, considered in earlier WPs, can be applied in practice under certain framework conditions. Using these results, an extended way of benchmarking on the social levels will be possible, taking actual needs and requirements of different stakeholders into account.

The main task of WP1 is the investigation on basics for the social benefit definition (monetary and non-monetary) and calculation in the context of asset management. This deliverable presents the basics for the social benefit definition and calculation, information that was gathered through an extensive survey by means of different activities.

2 General approach

The objective of WP1 activities has been to gather information on basics for the social benefit definition and calculation in the context of asset management. With basics it is meant to investigate stakeholder requirements and expectations from the social point of view. Based on these requirements and expectations further investigation has led to knowledge about available technical indicators for social benefit definition and data needed to calculate them.

Similar investigation about models and methods to calculate social benefits aimed to identify existing ones and point out the lacks. This will be covered in WP3 deliverables.

WP1 primary role has been in the application of the intensified dialogue approach between interested Road Directorates (RDs) and the project consortium. This approach is based on identification of stakeholders, their expectations and requirements, survey of literature and existing projects, and identification of good practices within three areas that correspond to the three WP tasks.

This work was complemented and rounded up with interviews with the targeted experts from main stakeholders (representatives from RDs). The aim of the interviews was to check and to complete the identified stakeholders' expectations and requirements along with the inventory of available indicators, data, models and methods already available from existing groups/projects. Additionaly, they would potentially show the "gaps", where new (social) indicators will be needed for further development. Annex 1 includes the complete list of references and literature that served as the initial sources for the work.

2.1 Stakeholders and expectations

Starting from the work done by the PIARC Technical Committee D1 on "Road Infrastructure Management" (cycle 2008-11), a list of main road infrastructure stakeholders was established. The expectations of each stakeholder from the social point of view were listed, analysed and complemented or extended with results of interviews with targeted experts and the work of other groups (EVITA, SBAKPI, etc.).

2.2 Technical indicators and data needed

The next task was to identify existing social indicators in combination with existing technical parameters. The efforts were put also on indicators identified through interviews with interested RDs and on the procedure and the technical means to calculate them with respect to the availability of necessary data and input information. The focus was on the following main fields of investigation:

- Availability and disturbance (travel time, vehicle operating costs);
- Road safety (fatal and severe accidents related to asset condition);
- Environment (noise, air pollution, natural resources);
- Socio-economy (asset value, wider social effects).

2.3 Models and methods

Expectations per se are of rather short-term use if not translated into a useful form. Technical indicators come well-timed in the recent years for this purpose and are one of the stepping stones on which different models and methods have built upon.

Both, models and methods that use different social indicators to calculate social benefits will be checked and discussed during the next round of interviews with the main stakeholders (see results of WP3).

2.4 Pavement performance

Social and economic (socio-economic) costs and benefits associated with the operation of a road network are directly and indirectly linked with its condition:

- Directly the pavement deterioration induces extra-costs and other inconveniences for the stakeholders; potholes generate lack of comfort and extra vehicle operating costs (VOC) for users, lack of skid resistance decreases road safety for users, neighbours and thus extra costs for the society, etc.
- Indirectly, the works to maintain the roads in good condition affect the road operations. Performing road works often requires lane closures affecting traffic flow and causing congestions, resulting in some unexpected delays for the users. Road works may generate excessive noise and/or vibrations or may temporary reduce accessibility for neighbours. Road works also lead to increased fuel consumption, CO_2 emission, air pollution due to working machines, the transport of material, etc.

From a perspective of a Road Directorate an overall reduction of socio-economic costs or increase of socio-economic benefits for the road stakeholders can only be efficiently obtained by a careful selection of maintenance operation and, more generally, of maintenance policy. Such policy should be characterized by two aspects:

- Applying the optimal balance between direct socio-economic benefits and indirect socio-economic costs; overabundance of maintenance will result in an “excessive” road condition, and generate high socio-economic indirect impacts (“costs” of works) unbalanced to low socio-economic direct benefits. For example, improving a pavement from good to very good condition will not significantly reduce the fuel consumption, travel time…. On the other hand, the associated works may generate significant congestion and extra fuel consumption which will overshadow the benefits.
- The balance between the direct and indirect socio-economic costs and benefits should be assessed on the long term (e.g. the pavement performance is planned and maintained for a decade).

3 Stakeholders, requirements & expectations, indicators

3.1 Stakeholders and expectations in literature

A decade ago a COST Action [3] sought to identify and propose indicators and indexes to quantify the condition of a road network. The COST 354 project has focused on technical indicators and indexes at the European level, as the first step towards a characterization of the relationship between the network condition, the operation - especially dysfunctions – of road infrastructure, the measures to overcome these dysfunctions, and the effects of both (dysfunctions and remedial measures) on the economy, society and the environment.

The COST 354 was followed by the work of the PIARC Technical Committee D1 (Management of Road Infrastructure) of the 2008-2011 cycle, whose report [4] is the cornerstone of the overall stakeholder-to-indicators analysis. This committee was mainly interested in identifying indices, called high level management indicators, to measure the social and environmental impacts of road activities. An approach by stakeholders was conducted, which allowed identifying the expectations of these stakeholders regarding the road network, both positive (the need to improve their living conditions) and negative (the fear of deterioration, even temporary, of those). This done, it was possible to propose, when not already existing, a scale for assessing the degree of satisfaction or dissatisfaction of each stakeholder, based on combinations of measurable quantities.

Who are the road stakeholders? As defined by the EVITA project [1][5], they are "*All people (physical or social person), all organisations, and more generally all bodies, which have some interactions with road infrastructure. The road network can provide benefits to stakeholders as well as imposing constraints upon them. Conversely, the needs of stakeholders may also impose constraints on, or determine the requirements of, the infrastructure.*"

Figure 3-1 shows the road stakeholders as identified by the PIARC TC D.1.

ROAD STAKEHOLDERS

USERS

Daily users: People who use road infrastructure very frequently (as a driver or passenger) to go to work, for education or business.
Truck & bus: Transport service operators including public or private companies, transport of goods or people.
Tourists: They use road infrastructure occasionally (as drivers or passengers).
Vulnerable users: Using the road infrastructure occasionally or frequently, and pedestrians.

NEIGHBOURS

Resident: Any person who lives along a road or a street.
Commercial business: Any shop, retail building located along a road or a street, with entrances and exits directly opened to the street.
Industries: Any industrial facility with a direct connection to the road network.
Users of public areas: Users of places like schools, hospitals, administrative buildings, and more generally buildings opened to the public.

FINANCIAL INSTITUTIONS

Development banks: Financial organisations which provide the (generally developing) countries with loans to develop their economy.
Shareholders: Stakeholders which gather financial resources and invest them in a (road)

Figure 3-1 Road stakeholders as identified by the PIARC TC D.1

3.2 The ISABELA list of stakeholders and expectations

Intensive investigation of other available literature and existing projects resulted in the final list of stakeholders with their requirements and expectations. The project group identified five groups of stakeholders, of which one can be divided into two subcategories:

- Users,
- Neighbours,
- Road Authorities (with subcategories Road Owners and Road Operators),
- Financial Institutions, and
- Society.

Both, the requirements and expectations, as proposed by ISABELA, were grouped into 4 areas related to the following maintenance aspects (see Figure 3-2):

- Availability and disturbance;
- Road safety;
- Environment;
- Socio-economy.

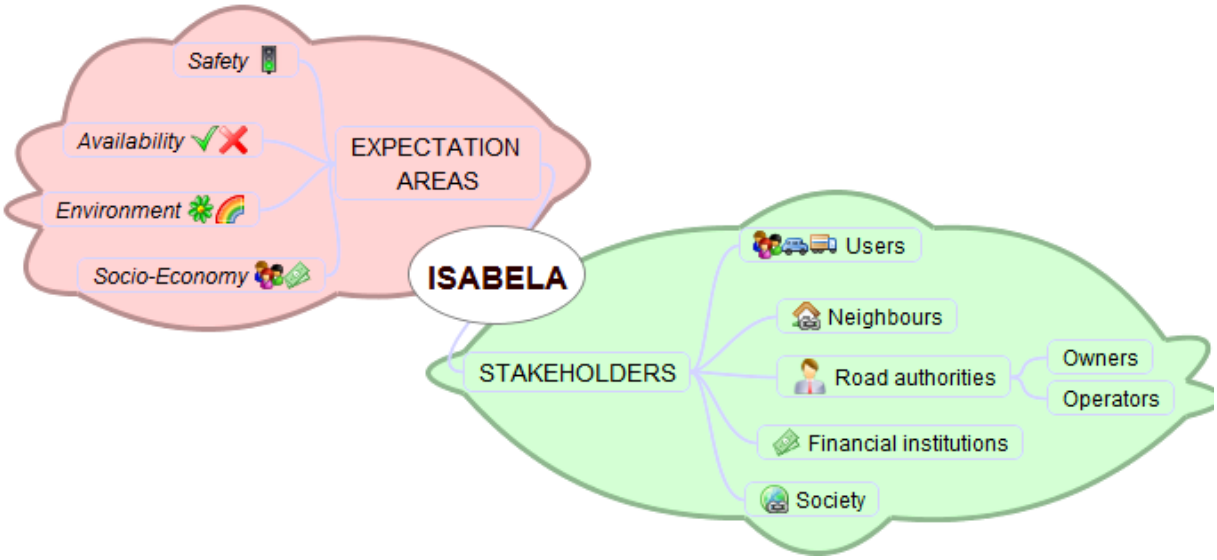

Figure 3-2 Stakeholders and expectation areas, identified by ISABELA

The list of gathered literature, which was relevant for the ISABELA project work, can be found in Annex 1.

The project group found 30 single requirements and expectations. However, some of these expectations are related to more than one area, which was the reason that we have finally obtained 63, of which:

- 15 expectations are related to Users,
- 11 to Neighbours,
- 8 to Financial Institutions,
- 8 to Road Authorities, and
- 21 expectations are related to Society.

Figure 3-3 shows how these expectations are further divided among 4 expectation areas. On the other hand, the complete lists of expectations in single areas are given in Table 3-1 to Table 3-4 below.

As explained above, the main part of stakeholders and their requirements/expectations were already identified by the PIARC Technical Committee D1 (Management of Road Infrastructure) of the 2008-2011 cycle. This committee has included in their report [4] a detailed identification and interpretation of socio-economic expectations.

The commentaries/interpretations are summarized in the ISABELA alphabetical list below.

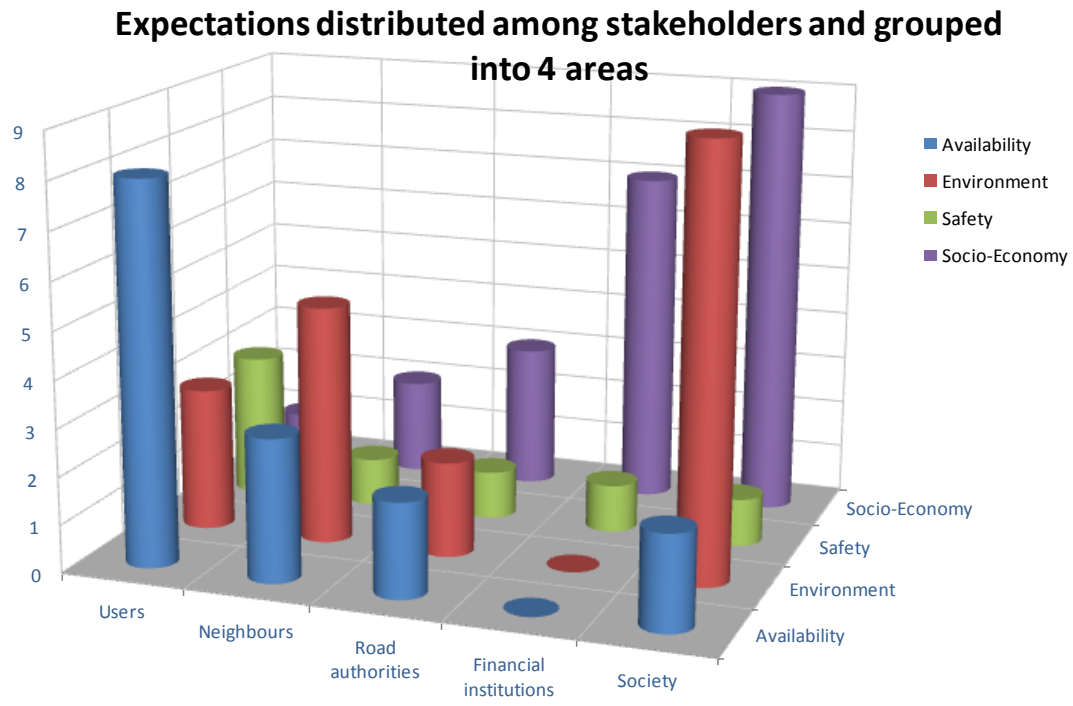

Figure 3-3 Expectation distribution among stakeholders and areas

List of expectations

The following list is mainly based on definitions given in [4] and/or [6].

Accessibility: Accessibility for road users refers to the ease of reaching zones away from momentary stay, or being reached from other zones. It also refers to the ease of accessing the road from private sites (homes, shops, industries) or reaching private sites from the road (for road neighbours). Accessibility by vehicles is influenced on one side by road characteristics, parking facilities, etc., and on the other side by roadwork.

- Parking facilities: Individual road neighbours or commercial offices which do not posses or posses too few parking facilities are expecting available public facilities to park own cars or their employee's and client's cars.
- Traffic flow: To comply with and answer to the accessibility expectations of users (and neighbours), road operators constantly seek for traffic management measures to traffic flow fluently in any place at any time (can also be measured through travel time).
- Travel time and reliability of travel time: Travel time is directly influenced by road characteristics (alignment, section pavement, etc.), motorized and non-motorized traffic volume, roadside friction (e.g. bus stop, access point, etc.). However, even more important than the travel time is the reliability of travel time: Users consider the road system reliable if expected travel times closely correspond to the actual times.

Aesthetics and cleanliness: This is the quality of road landscape / environment as perceived by road users, both motorized and non-motorized. It includes but is not limited to: quality of roadside amenity and vegetation, aesthetic and architectural look, integration of infrastructure in its environment, cleanness, and quality of street furniture. In towns, road

neighbours are sensitive to the aesthetic and cleanness of the street they travel through or see several times a day.

Asset value: Financial institutions that invest in the construction, maintenance and operation of road infrastructure, consider this investment as any other investment (financial or industrial), to which it is compared. The capital preservation is one of institutions' expectations raised besides (and sometimes before) the investment generates dividends

Business growth opportunity: Investing in road networks development and maintenance may generate direct financial income (tolls). Investment often generates more widely indirect returns, for instance due to a growth in the industrial business financed by the institution, or due to a more cost-effective industrial activity.

Community cohesion: Capability of the community members to easily meet and/or exchange ideas and goods. This is strongly related to accessibility to and from the networks and to regularity of traffic flow.

Consumption: The motorized vehicle operating costs (VOC) include the consumption of fuel, lubricating oil, tires, spare parts; they also include maintenance labour hours, capital cost (comprises depreciation and interest), crew hours, overheads. The operating costs of non-motorized vehicles are obtained from the cost of capital depreciation, repair and maintenance, crew (if any), energy costs and overheads.

Efficiency of owners/operators: The efficiency of operators, from the perspective of the investing financial institutions or the owner, is a measure of operators' ability to produce a higher ROI. This produces a higher value of the capital (the road condition) with the minimum expenses.

Environment preservation: Preserving the natural ambience means to avoid any negative and (quasi-) irreversible effect of road transport on air, water, noise, fauna, flora. In other words, it aims at limiting the direct and negative influence of human activity (in this case, road transport) on the environment.

Information: Travel information (weather forecast, congestion, accident, ongoing interventions, etc.) influences the perception of comfortable ride of drivers as well. Actuality, reliability, clarity and usefulness of information are important in this perception.

Land preservation: Refers to minimizing land uptake due to maintenance of infrastructure and other necessary facilities (gas stations, rest areas etc.), to minimizing the impact on natural and wildlife habitats and degradation of agricultural areas near infrastructure due to activities related to maintenance.

Natural resources preservation: Sustainable development meets the needs of the present without compromising the ability of future generations to meet their own needs. These in particular include the preservation of (natural) resources such as quality aggregate, bitumen, but also water.

No contribution to climate change: Climate change is defined as "alteration due to human activity, of the complex web of systems that allow life to thrive on earth, such as cloud cover, rainfall, wind patterns and ocean currents, also influencing the distribution of plant and animal species." (This is rather the indirect influence of human activity on the environment).

No disposal of vehicles: Related to the pollution which is caused by the act of non-controlled disposal of used vehicles. The act can have an adverse effect on ecosystems that becomes concern of future generations or can be threatening to human health.

Prevention of natural disaster: Road networks may have an active and passive role in natural disasters; on one hand anarchic development of infrastructure may destabilise natural equilibrium. Conversely, roads play a major part in rescue activities as they allow the means to arrive at affected areas.

Property values: Residents and businesses located in areas near proposed transportation facilities are often concerned about whether the transportation project would lead to changes

in desirability as places to live, work, and conduct business or to changes in the value of their property (both land and buildings).

Public parking facilities: see Accessibility

Quality of services: The frequency and quality of service areas along a route is increasingly integrated in users' perception of the level of service that a road network provides.

Reliability of travel time: see Accessibility

Respect for the cultural heritage: Expresses the new concerns of the current generation to transmit to the next generation a direct access to their historical assets including the local social and cultural patrimony. In other words, it expresses the expectation that the negative impacts of human activity on the patrimony generated by previous and current human generations will remain at an acceptable level.

Return of investment (ROI): Usually is calculated as the benefit (return) of an investment divided by the cost of the investment. In road management, the benefit would be proceeds, obtained from selling the investment. Proceeds are directly related to the asset value, which is in some cases related to the condition of the infrastructure as well.

Riding comfort: Refers to the effect of road infrastructure on the quality of traveling and is an important impact to road users who physically and psychologically experience the condition of a road. Travel comfort influences the drivers' perception regarding the quality of service. It is closely connected to level of service concept.

Risk on investment: Before the investment is carried out, the ROI is the result of a probabilistic estimate. The probability to get a certain level of ROI decreases as the level of risk increases. The risk of not getting to a certain level of ROI increases with the level itself. This risk depends upon the reliability of the traffic prediction, of infrastructure lifetime and of the occurrence of adverse natural events (earthquakes, flooding…).

Safety: A safe road is a riskless road. In fact, "road safety" is assessed through road risk: the number and the severity of road crashes which lead to deaths, injuries, and property damage. Road traffic safety deals exclusively with road crashes involving at least one vehicle.

Seamless public transportation: Public transportation network should incorporate several modes of transport for people and freight to be able to move from a starting point (station) to any other one representing the end of journey. Network should include some connecting points (linking public systems or transport modes) which allow change of transportation means without disruption.

Society's development: Roads contribute to the progress of social and economic activities, and aim to improve prosperity and overall satisfaction felt by all. Society primarily expects the road network to efficiently contribute to this outcome.

Socio-economic efficiency: Socio-economists focus on the social impact of some sort of economic change, in the present case the impact of road transport evolution. According to the PIARC dictionary, socio-economic efficiency in terms of social value (economics and finance) replaces individual value by aggregating the satisfaction and dissatisfaction felt by all people.

State budget income due to socio-economic efficiency: Efficient socio-economic activities generate taxes (on turn over, on added value, professional taxes…) which feed the state budget.

Taking care of public health: Care for the global level of health of the whole population. The impact of road transport on public health is explicitly mentioned as having important effect on society.

Transportation choice: Refers to the quantity and quality of transportation options available to residents of a particular area. The choice often focuses on the availability of alternatives (e.g., walking, bicycling, transit, ridesharing) to using a personal car.

Travel time: see Accessibility

Table 3-1 to Table 3-4 show the complete lists of expectations in four main areas, related to the maintenance aspects. The colour shaded expectations in tables show those expectations that are exclusively related to the specific area.

Table 3-1 Stakeholder expectations in the "Safety" area

Users	*Neighbours*	*Financial institutions*	*Owners/Operators*	*Society*
Safety	Safety (including accidents with release of dangerous goods)	Safety	Safety	Safety (including accidents with release of dangerous goods)
Riding comfort				
Information				

Table 3-2 Stakeholder expectations in the "Availability" area

Users	*Neighbours*	*Financial institutions*	*Owners/Operators*	*Society*
Travel time	Accessibility		Travel time	Seamless public transportation
Reliability of travel time	Public parking facilities		Reliability of travel time	Transportation choice
Accessibility	Information			
Public parking facilities				
Seamless public transportation				
Quality of services				
Information				
Transportation choice				

Table 3-3 Stakeholder expectations in the "Environment" area

Users	*Neighbours*	*Financial institutions*	*Owners/Operators*	*Society*
Consumption	Aesthetics and cleanliness		Consumption	Environment preservation
Riding comfort	Environment preservation		Aesthetics and cleanliness	Natural resources preservation
Aesthetics and cleanliness	Taking care of public health			No contribution to climate change
	Land preservation			Taking care of public health
	No disposal of vehicles			Prevention of natural disaster
				Land preservation
				Consumption
				No disposal of vehicles
				Aesthetics and cleanliness

Table 3-4 Stakeholder expectations in the "Socio-Economy" area

Users	*Neighbours*	*Financial institutions*	*Owners/Operators*	*Society*
Consumption	Community cohesion	Socio-economic efficiency	Socio-economic efficiency	Society's development
	Property values	Return on investment	Efficiency of owners/operators	Socio-economic efficiency
		Risk on investment	Asset value	Respect for the cultural heritage
		Business growth opportunity		State budget income due to socio-economic efficiency
		Efficiency of owners/operators		Land preservation
		Asset value		Consumption
		State budget income due to socio-economic efficiency		Transportation choice
				Community cohesion
				Property values

3.3 List of indicators from investigation

Within the investigation phase of ISABELA a high number of different indicators could be found. The full list of these (reviewed) indicators can be taken from ANNEX B.

The indicators are grouped into four main categories according to their anticipated use in the asset management systems:

- Availability and disturbance
    - Accessibility
    - Condition
    - Congestion
    - Restrictions
    - Travel time
- Road safety
    - Accidents
    - Condition
    - Overall safety
    - Safety costs
    - Users' perception
- Environment
    - Air quality
    - CO2 emission
    - Natural resources
    - Noise
    - Soil and Water quality
- Socio-economy
    - Asset value
    - Cost efficiency
    - Environmental costs
    - Safety costs
    - Wider socio-economic costs
    - Stakeholder satisfaction
    - User costs.

These four main groups reflect the principal maintenance aspects considered by the ISABELA project. Thus, the list is an essential basis for the following activities in WP3 to WP5.

4 Interviews with targeted experts

The desk study work of the ISABELA consortia was complemented by interviews with the targeted experts from main stakeholders (representatives from RDs). The project group have primarily contacted the experts that work for RDs in their own countries. However, there are a number of countries funding the CEDR call 2014 which are not represented in the project by the project partners. Representatives of these countries have also been contacted, forming the following complete group of interviewees:

- Austria – Christian Honeger (Asfinag, Austrian motorway company), Bernd Stigger (Amt der Tiroler Landesregierung, State road authority),
- Flanders, Belgium – Margo Briessinck (Agency for Roads and Traffic),
- France – Pascal Rossigny (CEREMA), (French Motorway Authority),
- Ireland – Tom Casey (Transport Infrastructure Ireland),
- Netherlands – Rob Hofman (RWS),
- Norway – Even Sund (NPRA),
- Portugal – Rui Coutinho (Infraestruturas de Portugal),
- Sebia - Momčilo Veljović (Roads of Serbia),
- Slovenia – Marjan Zavec, Andrej Zajec (DARS), Ljiljana Herga (DRSI)
- Sweden – Kenneth Natanaelsson, Åsa Lindgren (STA),
- Switzerland – Alain Jacot (DOT Canton Zurich), Luzia Seiler (ASTRA FEDRO).

4.1 Purpose of the interviews

The objective of the interviews was on the one hand to collect suitable parameters, which can be used as input information for the calculation of S-KPIs and on the other hand to review a list of parameters, which were collected from the actual literature/projects and which offer a high potential for the use as input information for the calculation of S-KPIs from the project team point of view.

Apart the general information about interviewee' organisation, their role and the road network of their countries, the main interest of the project group was in:

- The focus/vision of organisation from the socio-economic point of view, and
- Whether they take into account the socio-economic impacts in the process of making decisions or performing prioritization.

Related to this main part interviewees were presented the 4 expectation areas and were invited to provide information on the indicators that they used or would like to use in asset management associated with these. In some cases, the whole list of indicators was presented to the interviewees. One by one, the interviewees have given their feedback on indicators, including: whether these were already in use in a specific country or they thought indicators are interested enough to be used.

4.2 output Interviews overview

In total, 14 questionnaires are collected, 12 for national road networks, and two for regions (Tyrol in Austria and Zurich in Switzerland). Data for Slovenia are collected from road administration for motorways (DARS) and for main and regional roads (DRSI).

This section provides a summary of social indicators used in road administrations that provided response to the questionnaire. The indicators that are in use will be summarized by categories and subcategories.

4.2.1 Availability and disturbance

Availability and disturbance related indicators include five subcategories:

A. Accessibility
B. Condition
C. Congestion
D. Restrictions
E. Travel time

Table 4-1 provides the summary of indicators for subcategory “Accessibility”. The current use of “accessibility” indicators seems to be limited to 7 countries out of 11 (and to 9 out of 14 Road Agencies (RA)). “Road Density” and ‘”Road Availability” are two indicators that are used in three out of 14 road administrations. The other indicators are relatively specific and used in individual road directorates that provided response. None of “Accessibility” indicators are used in Belgium, Ireland, Norway, and Slovenia.

Table 4-1 Summary of indicators for subcategory “Accessibility”

Indicator	Number of RAs	
	Use it	Interested to use
Percent of population within 1km of surfaced road	1	-
Criteria for the accessibility to the state road network (distance less than 500m to a state road if more than 500 people living in this area)	1	-
Road density	3	-
Road availability	3	1
Accessibility of emergency phones along the motorways	1	-
Possibility of using other transport modes during maintenance closures	1	-
Importance of the road connection	1	-

Table 4-2 provides the summary of indicators for subcategory “Condition”. Two Road Agencies (Belgium – Flanders, and NSRA – Norway) do not use any of “Condition” related parameters. In addition, Serbia uses only IRI to represent condition in addition to five other road agencies that use IRI (Ireland, Portugal, Sweden, and two agencies from Slovenia). All other road agencies use some a form of composite “pavement condition rating” and “bridge condition rating” indicators in the context of “Availability and disturbance” of road network.

Table 4-2 Summary of indicators for subcategory "Condition"

Indicator	Number of RAs	
	Use it	Interested to use
International Roughness Index	6	-
Pavement		
Comfort and Safety Index Pavement (scale 1 very good to 5 very poor)	1	-
Safety index (combined index, based on skid resistance and rutting)	1	-
Comfort index (combined index, based on roughness and surface defects)	1	-
Pavement Condition Index (IQRN: Condition Index of National Highways Pavements)	1	-
Condition Rating	5	-
Road condition	1	-
Condition rating for pavement sections	2	-
Friction Index	2	-
Bearing capacity	1	-
Maintainability	1	-
Bridges		
Bridge condition rating (scale 1 very good to 5 very poor)	1	-
Bridge Condition Index (IQOA: Condition Index of the Bridges)	1	-
Bridge health index	1	-
Bridge Sufficiency Rating (Federal sufficiency rating)	4	-
Condition rating for structures	2	-
Deficiency Ranking	1	-
Key-object definition for structures (as a function of traffic, size of object, condition of object, available alternative routes)	1	-
Hydraulic Vulnerability Rating Score	1	1
Other assets		
Condition of electro-mechanical equipment in tunnels	1	-
Condition traffic lights (traffic lights calculator)	1	-

More specific indicators, like friction index and bearing capacity, or maintainability, are used only in Slovenia and the Netherlands, respectively. However, it is also indicated that condition rating for Slovenia includes friction.

In addition, Office of the Provincial Government of Tyrol, Austria uses two indicators for condition of electro-mechanical equipment in tunnels, and traffic lights.

Table 4-3 provides summary of indicators for "Congestion". Some form of these indicators are in use in five countries (Austria, the Netherlands, Slovenia, Sweden, and Switzerland), and three more countries are interested to use this type of indicator (Ireland, Portugal, Serbia). No "Congestion" related indicators are used in Belgium and France.

Table 4-3 Summary of indicators for subcategory "Congestion"

Indicator	Number of RAs	
	Use it	Interested to use
Congestion	2	5
Congestion time	1	-
Maximum total length of congestion between A and B (or on a network)	3	1
Loss of time due to construction sites (max. 5minutes per 100km)	1	
Nr. of congestions due to works	1	-

Some indicators related to restrictions are used in eight RAs in seven countries (Table 4-4). The evidence on closures is used in five RAs and two more are interested to use this type of indicator. Three more RAs use “Clearance and load restrictions” and “Number of days of snow and/or ice free surface“. All other indicators are used by individual RAs.

Table 4-4 Summary of indicators for subcategory “Restrictions”

Indicator	Number of RAs	
	Use it	Interested to use
Closures	5	2
Clearence and load restrictions	3	1
Restrictions for HGV due to snow (in hours)	1	-
No. of vehicles affected	1	-
Number of days of snow and/or ice free surface	3	-
No. of sections/locations prone to avalanches/rock slides that have been secured/improved last year (also relevant for safety)	1	-
No. of restrictions due to severe wind	2	-
Non-construction-site indicator (on network level)	1	-
Construction site length (max. length and loss of time)	1	-

Indicators related to “Travel time” are currently used only in five RAs, with five more RAs being interested in their use (Table 4-5). Two RAs use some indicator related to “Delays” (The Netherlands and Sweden), “Mean travel time“ and „Variability of travel time“ between A and B (Ireland, Sweden) and five more are interested to use “Delays” (Ireland, Portugal, DARS and DRSI, Slovenia, and DOT Zurich, Switzerland), while three RAs are interested to use indicator related to “Mean travel time“ (Portugal and two agencies in Slovenia). All other indicators are used by individual road agencies.

Table 4-5 Summary of indicators for subcategory “Travel time”

Indicator	Number of RAs	
	Use it	Interested to use
Delays	2	5
Mean travel time between A and B	2	3
Variability of travel time between A and B	2	-
Lost hours (passenger or goods)	1	-
Loss of time due to construction sites (max. 5minutes per 100km)	1	-
Loss of travel time (public transportation, in general)	1	-

4.2.2 Road safety

The Road safety category is subdivided into five subcategories:

A. Accidents
B. Condition
C. Overall safety
D. Safety costs
E. Users’ perception

The group on indicators related to “Accidents” includes 17 indicators presented in Table 4-6. Each RA that responded to the questionnaire uses at least one of these indicators.

One subgroup of seven indicators includes in some form number of casualties (fatalities and injured persons), either as an individual or combined number, or as a statistics of casualties

per million vehicle kilometers. Total number of fatalities is used in 8 countries as indicator, while number of killed or seriously injured persons is used in 6 countries. Number of casualties per one million vehicle kilometers is used in Slovenia and Sweden.

The second group of ten indicators includes total number of accidents or only accidents with vulnerable users, weighted number of accidents by type of accident, accident rate (per certain number of vehicle kilometers), accident density (per km and per year), number of critical locations or black spots, accidents with property damage only, higher than average occurrence for route segment, or number of accidents that caused queuing of vehicles. Number of accidents, or number of accidents involving vulnerable users, are used in four countries each. Number of accidents per certain vehicle kilometers is used in three RAs in Slovenia and Sweden, while all other indicators are used by individual road administrations.

Table 4-6 Summary of indicators for subcategory "Accidents"

Indicator	Number of RAs	
	Use it	Interested to use
Number of fatalties (involving two-wheels, cars, bus and trucks) per veh.km	7	-
User safety (accidents), death	2	3
Serious Casualty Crashes (Population) Area : Road System Performance – Technical Efficiency Purpose : Monitor incidents of major safety failures in road system	-	2
Safety KPI - People killed or seriously injured (KSI) in road traffic accidents.	2	1
Accident victims	5	-
User safety (accidents), injury	3	3
Number of fatalities and injuries per million vehicle kilometres	3	-
Number of accidents per million vehicle kilometers	3	1
Accidents rate: how many accidents per 100 000 000 km driven	1	-
Accidents density: how many accidents per km and per year	1	-
Number of accident involving vulnerable users	4	1
Sum of accidents weighted by type of accidents (light, severe, killed)	1	-
User safety (accidents), property damage	-	2
Accidents	4	-
Accident points/Black spots	1	1
Higher than average occurrence for route segment	1	-
Nr. of crashes/ impacts on queuing/stopped vehicles	1	

The condition of road assets is included in the category related to "Road safety" through 12 indicators, mostly related to pavements, five indicators related to bridges, and one indicator related to tunnels (Table 4-7).

Road Agencies in two countries (France and Switzerland) do not use any of "Condition" related parameters in the context of road safety. The Ireland uses Investigatory level (% above threshold) as general indicator.

For remaining countries the indicators can again be separated in two major groups, one related to pavement condition, and the other related to bridge condition. Pavement related indicators are either indices, or specific condition parameters that are mainly used in case of road safety, like skid resistance that is used by five RAs, and longitudinal and transverse roughness, that are both used by four RAs. The other pavement related indicators are used by individual agencies.

Four out of five indicators for bridges are used by individual agencies in the context of road safety, and two agencies in Slovenia and Sweden RA are interested to use Hydraulic Vulnerability Rating Score.

Finally, the Norwegian State Road Agency uses the number of existing tunnels that comply with the European Tunnel Safety Act.

Table 4-7 Summary of indicators for subcategory "Condition"

Indicator	Number of RAs	
	Use it	Interested to use
Pavement		
Condition rating	3	1
Comfort and Safety Index Pavement (scale 1 very good to 5 very poor)	1	-
Safety index (combined index, based on skid resistance and rutting)	1	-
Percentage of roads with satisfactory pavement condition	1	-
International Roughness Index	4	1
Rutting (technical parameter and index, scale 1 to 5)	1	-
Rutting	4	1
Skid resistance	5	
Friction Index	2	-
Ravelling	1	
Edge depth – weaknesses on secondary roads	1	1
Bearing capacity	1	
Bridges		
Bridge Sufficiency Rating (Federal sufficiency rating)	2	-
Bridge condition rating (scale 1 very good to 5 very poor)	1	-
Deficiency Ranking	1	-
Investigatory Level % above threshold	1	
Hydraulic Vulnerability Rating Score	-	2
Other assets		
No. of existing tunnels that comply with the European Tunnel Safety Act	1	-

The "Overall Safety" indicators are presented in Table 4-8. Road agencies in Ireland and Slovenia use Eurorap score, while four agencies in Austria, Ireland and Slovenia perform Road Safety Inspection. Agencies in Portugal and Sweden are interested to implement both Eurorap Score and Road Safety Inspections. The indicator used in Belgium and referenced in this subcategory is related to pavement condition.

Table 4-8 Summary of indicators for subcategory "Overall safety"

Indicator	Number of RAs	
	Use it	Interested to use
Eurorap Score	3	2
Road safety inspection (treatment in combination with the construction program)	4	2
Safety KPI - People killed or seriously injured (KSI) in road traffic accidents.	-	1
Minimum of rutting and skid resistance	1	-
Km of roads with milled sinusoidal grooves in connection with centre road marking	1	-

Table 4-9 provides information about indicators related to safety costs. It should be noted that these indicators are also referenced under "Socio-economic" category. Road agencies in France, Ireland, the Netherlands, and Sweden use some form of indicators related to

accident or road safety costs, while agencies in Portugal, Slovenia and Switzerland seem to be interested to implement some of these models.

Table 4-9 Summary of indicators for subcategory "Safety costs"

Indicator	Number of RAs	
	Use it	Interested to use
Accident costs	3	1
Annual accident costs	1	3
Safety costs	2	1
Fatality costs	1	-

The use of indicators related to "Users' perception" is quite limited, as presented in Table 4-10. The only indicator that is used from this group is CSI (Customer Satisfaction Index) used by ASFINAG, Austria. Road agencies in Portugal, Slovenia and Sweden are interested in use of some of these indicators. The questionnaire for the Netherlands indicated interest in use IRI that has been already discussed under condition subcategory.

Table 4-10 Summary of indicators for subcategory "Users perception"

Indicator	Number of RAs	
	Use it	Interested to use
Operation quality (Comfort), physical impact of travelling on the user	-	2
Operation quality (Comfort), psychological impact of travelling on the user	-	2
CSI (customer satisfaction index)	1	-
International roughness index (IRI)	-	1

4.2.3 Environment

The indicators for environmental impact are separated in the following subcategories:

A. Air quality
B. CO2 emission
C. Natural resources
D. Noise
E. Soil and Water quality

The indicators related to air quality are scarcely used in road agencies across Europe, as presented in Table 4-11. Two most interesting indicators are related to emission and exposure for Nitrogen oxides and Particulate matter. The indicators used in Norway are based on these emissions as well, but instead of indices, they use the number of cities or urban areas with higher than allowed values of concentrations. The Tyrolean road agency uses transport distance for material as proxy for air pollution.

Table 4-11 Summary of indicators for subcategory "Air quality"

Indicator	Number of RAs	
	Use it	Interested to use
Environmental index for Air Quality: Emission and Exposure EPI for Nox	2	3
Environmental index for Air Quality: Emission and Exposure EPI for PM10 and PM2.5	2	3
Direct toxicity of air pollutants (no models)	-	-
Air Quality KPI - Level 1 - Number of AQZAs /1000 km of NRA road network	-	1
Air Quality KPI - Level 2 - Lehgth of road network within AQZAs /1000 km of NRA road network	-	1
Environmental index for Air Quality: Emission and Exposure EPI for CO	-	1
Environmental index for Air Quality: Emission and Exposure Adehydes, sulphur dioxide, polycyclic aromatic, hydro-carbons	-	1
Environmental index for Air Quality: Emission of CO2	-	3
Distance material transport (in the context of maintenance treatments)	1	-
No. of cities/urban areas that exceed the permitted values for PM10 (max daily values or annual average values)	1	-
No. of cities/urban areas that exceed the permitted values for NO2 (max hourly values or annual average values)	-	-

The indicators related to CO_2 emissions are also used in few countries, as presented in Table 4-12. Most of them are used in Sweden and the Netherlands, but there is interest in other countries, like Slovenia, Ireland, Portugal, and Serbia. The Ireland is interested to implement indicators related to CO_2 emission cost, which should be included in the subcategory related to Environmental cost.

Table 4-12 Summary of indicators for subcategory "CO2 emission"

Indicator	Number of RAs	
	Use it	Interested to use
Environmental index for GHG – Emissions rate for CO2 emissions from vehicles: EPIemissons,CO2 Purpose : To assess the CO2 emission rate, taking into account the emissions model using traffic flow data and vehicle emission factors per km of road	2	3
Environmental index for embodied carbon reduction: EPIECR Purpose : To assess the difference in CO2 emissions for building and maintaining the infrastructure with different strategies	2	3
Environmental index for GHG – CO2 equivalent emissions during road construction and maintenance activities Purpose : To assess the difference in GHG emissions for building and maintaining the infrastructure with different strategies	-	-
Emissions of ozone precursors	-	1
Distance material transport (in the context of maintenance treatments)	-	1
CO2 emission cost	-	1

The Energy consumption is the indicator mostly used from the subcategory on "Natural resources", as presented in Table 4-13. All other indicators are more specific and mostly used in individual road agencies.

Table 4-13 Summary of indicators for subcategory "Natural resources"

Indicator	Number of RAs	
	Use it	Interested to use
Material Resource Efficiency Indicator (MREI): EPIResources	1	3
Energy consumption	5	1
Consumption of non-renewable raw materials and recycling of waste in construction	2	2
Use of fossil fuels/renewable energy	-	1
Amount of recycling-asphalt	1	-
Percentage of recycled material	1	-
Use of fossil fuels/renewable energy	2	

Most of road administrations use some type of indicator for "Noise" (Table 4-14). Only France does not use any indicator for noise, and Ireland is interested to use "Noise Maps" that are already used by most of other directorates as a result of implementation of the Environmental Noise Directive 2002/49/EC.

Table 4-14 Summary of indicators for subcategory "Noise"

Indicator	Number of RAs	
	Use it	Interested to use
Noise Maps, Vehicle Noise	9	1
Vibration Maps	1	1
Traffic Noise Exposure	6	-
Traffic Noise Exposure (number of people exposed to excessive noise) in sensitive areas, like schools, hospitals, etc	1	-
Noise annoyance to humans	1	3
Environment preservation (Noise)	2	1
Number of noise complaints	4	1
Number of dwellings exposed to excesive noise	5	-
Distance material transport (in the context of maintenance treatments)	1	-
Including CPX measurements	-	1
No of residential homes or institutions (hospitals, retirement homes etc) exposed to noise values above limit values	1	-
Change in no. of people exposed to indoor noise levels above 38 dB	1	-
Number of inhabitants protected against excessive noise	-	1

Table 4-15 presents the current use of indicators related to soil and water quality. EPIWater is used by two directorates, but there are four more interested to use it. EPISalt is currently not used (except maybe in Sweden), but there are also four directorates interested to implement it. In addition, concentration of pollutants in surface water is used by three directorates. Some indicators that can be found in literature, like Toxicity and Eutrophication, are not used by any administration.

Table 4-15 Summary of indicators for subcategory "Soil and Water Quality"

Indicator	Number of RAs	
	Use it	Interested to use
Environmental index for Water quality and drainage system: EPIWater, Purpose: To assess the capa-city of the drainage system to collect, transport and potentially treat the pollution before being finally discharged into the environment	2	4
Environmental index for Water Pollution from winter mainte-nance activities (salting): EPISalt Purpose : To compare salt loadings for the road section against the average for the network, weighted by local requirements (inten-sity of winter maintenance) and the sensitivity of the environment.	-	4
Emissions of substances that cause acidification and eutrophication	-	1
Concentration of pollutants in soils	1	-
Concentration of pollutants in surface water	3	-
Acidification	1	-
Toxicity	-	-
Eutrophication	-	-
Release of dangerous goods due to accidents	2	2
Pollution of the verge	1	-

4.2.4 Socio-economic indicators

The socio-economic indicators include the following sub-categories:

A. Asset value
B. Condition
C. Cost efficiency
D. Environmental costs
E. Safety costs
F. Wider socio-economic costs
G. Stakeholder satisfaction
H. User costs.

The asset value indicators are used in different forms by road administrations in two countries (Serbia and Slovenia) and some others (ASFINAG, Austria, Portugal, Sweden) intend to use some of indicators (Table 4-16).

Table 4-16 Summary of indicators for subcategory "Asset value"

Indicator	Number of RAs	
	Use it	Interested to use
Asset value	3	4
Mean residual life span of the asset	1	4
Loss of asset value (reconstruction value)	2	3
Salvage value	-	2
Preservation of road investment	1	4
Condition related asset value pavement	1	4
Bridge health index	-	2
Asset value per road section	-	2
Asset value per network per asset (pavements, bridges/viaducts, other structures including tunnels, furniture)	1	1

The “Condition” sub-category includes twelve indicators, equally split for pavement and bridge condition, as presented in Table 4-17. Condition rating and IRI are used by four road agencies for pavement condition, while Bridge sufficiency rating and Bridge Health Index are used by four and two agencies, respectively, for bridge condition. All other indicators are used by individual agencies.

Table 4-17 Summary of indicators for subcategory “Condition”

Indicator	Number of RAs	
	Use it	Interested to use
Pavement		
Condition rating	4	4
Percentage of national roads with Pavement Condition Index under 12	1	-
Maintenance backlog (in monetary value). Not a formal indicator, but has been estimated in preparation for the last two revisions of the National Transport Plan	1	-
International Roughness Index	4	-
Friction index	1	-
Bearing capacity	1	-
Bridges		**-**
Bridge sufficiency rating (Federal sufficency rating)	4	1
Bridge health index	2	1
Condition of engineering structures (scale from 1 very good to 5 very poor)	1	-
Structural condition of assets – structural condition index	1	-
Hydraulic Vulnerability Rating Score	1	1
Deficiency ranking	1	-

Sub-category on “Cost efficiency” includes 13 indicators, presented in Table 4-18. Some form of Benefit cost ratio is used by seven road agencies, and three more are interested to use it.

Table 4-18 Summary of indicators for subcategory “Cost Efficiency”

Indicator	Number of RAs	
	Use it	Interested to use
Return on Construction Expenditure Area : SRA Performance – Economic Effectiveness Purpose : Monitor the predicted community benefits from road transport and traffic authority programs	-	1
Preservation of road investment	1	3
Impact of executing the interventions	1	2
Road Maintenance Effectiveness RME	-	2
Return on investment (construction expenditure)	1	2
Program B/C or cost effectiveness	7	3
Network depreciation	-	3
Cost recovery	1	3
Asset Sustainability Index	-	3
Bridge sufficiency rating (Federal sufficency rating)	3	-
Deficiency ranking	-	1
Maintenance budget in relation to monetary maintenance needs	2	-
Aiming accuracy of investments (need due to others vs. need due to condition)	1	1

The indicators for “Environmental costs” appear to be used only in Sweden (Table 4-19). Road administrations in Ireland, Portugal, and Slovenia are interested to use some of these indicators.

Table 4-19 Summary of indicators for subcategory “Environmental costs”

Indicator	Number of RAs	
	Use it	Interested to use
Environment preservation (Noise)	1	1
Noise costs	1	3
CO_2 emission costs	1	1
Air pollution costs	1	1
Noise cost (affecting Users)	1	-
Particle emissions cost	1	-
Energy consumption cost	1	2
Material consumption cost	1	2
Land consumption cost	1	-
Emissions during maintenance periods	1	2

The indicators related to safety costs have already been discussed under category related to Road Safety (Table 4-9). The new indicator that papers in this subcategory here is related to health that is used in Ireland and Sweden (Table 4-20), and two more road agencies are interested (Portugal and DRSI, Slovenia). The other two indicators include Accident costs (that are used in Sweden, but according to Table 4-9 also in Ireland and the Netherlands) and Fatality cost that is used in France.

Table 4-20 Summary of indicators for subcategory “Safety costs”

Indicator	Number of RAs	
	Use it	Interested to use
Accident cost	1	1
Persons - Health	2	2
Fatality cost	1	-

The socio-economic indicators are not used by any of road administrations, except that the Tyrolean administration considers Maintenance budget to belong to this group of indicators (Table 4-21). Road administrations in Ireland, Portugal, Slovenia and Sweden are interested to use some of these indicators.

Table 4-21 Summary of indicators for subcategory “Social Economy”

Indicator	Number of RAs	
	Use it	Interested to use
Operation quality (Comfort), physical impact of travelling on the user	-	1
Operation quality (Comfort), psychological impact of travelling on the user	-	2
The contribution of the road operation to socio-economic development, Employment	-	3
Total costs/capita	-	2
Maintenance budget (in general)	1	-

Different indicators related to Stakeholder satisfaction are presented in Table 4-22. Some of indicators are used in Austria, Norway, Serbia, and Slovenia, and road administrations in Ireland, Portugal and Sweden are interested to use some of indicators.

Table 4-22 Summary of indicators for subcategory "Stakeholder satisfaction"

Indicator	Number of RAs	
	Use it	Interested to use
Stakeholder satisfaction KPI - Ind. 1- Number of complaints to NRA / km NRA road network	3	2
Stakeholder satisfaction KPI - Ind. 2- Number of responses from NRA / km NRA road network	1	2
Operation quality (Comfort), psychological impact of travelling on the user	-	1
CSI (customer satisfaction index)	1	-
Questionnaires to public regarding public satisfaction with condition of road network under summer and winter conditions (carried out as two separate surveys every 4 years) Not used as a formal indicator	1	-
Nr. of uses (clicks, phone calls, downloaded apps) of available means for traffic information (website, traffic info center, app)	1	-

Three different indicators related to users costs, presented in Table 4-23, include time and vehicle operating costs, and reliability of travel time. All three indicators are used in Sweden, and vehicle operating costs also in Serbia. Road administrations in Ireland, Portugal, and Slovenia are interested to use some of these indicators.

Table 4-23 Summary of indicators for subcategory "Users costs"

Indicator	Number of RAs	
	Use it	Interested to use
Time costs	1	2
Vehicle operating costs	2	3
Reliability of travel time	1	1

4.3 Feedback about S-KPI and usability of indicators

Based on the interviews, 14 questionnaires from 11 countries were collected. In all interviews it was expressed that most of S-KPIs are not used in a systematic way for maintenance planning. At the moment, the decision making process in maintenance is not directly affected by these indicators, but there is a considerable interest for their application in the future. In the most of the countries, some data for the expectation areas already exists in various departments of administrations and could be used if its significance is clearly stated.

The importance of consideration of the expectations in the area of road availability and disturbance in maintenance planning is recognized in all countries but with a varying extent. The S-KPIs related to a condition of road infrastructure objects are dominantly used and widely accepted. Other parameters, such as accessibility, congestion, availability or travel time, are used to a lesser extent. Nevertheless, the expectations in this area are set as the principal objectives in the maintenance strategies of road infrastructure in the most of the interviewed road administrations.

The provision of a safe road infrastructure is highlighted within every program of the road administrations. All countries are making use of S-KPI's related to the number of accidents. Besides that, many are trying to use the condition parameters as technical indicators for setting the safety levels which relate to adequate maintenance actions. The S-KPI`s for overall safety, safety costs and user perception are currently not seen as significant to the most in maintenance planning.

Regarding the expectation area of environment, the noise parameters directly or indirectly affect the maintenance planning in many cases. Other parameters, such as air quality, CO_2-emission, environmental costs, natural resources, soil and water quality do not affect the planning at the moment, but are up to a point the integral part of a national legislation. Nevertheless, as the environmental impact is becoming a principal mission for all European societies, there is a large interest for the application of the related parameters in the future.

There is a varying feedback from the interviews with regard to the expectation area of economy. In the most countries this area is assessed for socio-economic impact of maintenance policy, but there is no favoured parameter as stated for the other three expectation areas. Here, almost every country recognizes the overall benefit to the road infrastructure but still find it very hard to implement these important economy parameters in the maintenance planning.

5 References

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Annexes

ANNEX 1: Relevant literature

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ANNEX 2: Integral list of indicators

CORRESPONDING AREA(S)	GROUP	NAME OF INDICATOR	DESCRIPTION	BASED ON / INFLUENCING FACTORS	REFERENCE
Availability	Accessibility	Percent of population within 1km of surfaced road	Acessibility indicator that evaluates how close the population is from a surfaced road	Ratio of the population within 1km of surfaced road to the country's total population	Haas et al. (2009)
		Road availability	Number of road kilometers per people	Ratio of the length of the country's total road network to the country's total population	Haas et al. (2009)
		Road density	Number of road kilometers per area	Ratio of the length of the country's total road network to the country's land area	Haas et al. (2009)
	Congestion	Congestion	Effect of increasing traffic volumes (e.g. speed reduction, increasing road user costs, etc.)	Ratio of the actual traffic volume to the design capacity	Haas et al. (2009)
		Maximum total length of congestion between A and B (or on a network)	Maximum cumulated length of congestion on the selected route or network over the given period	Observed from road side	PIARC (2012)
	Restrictions to availability	Clearence and load restrictions	Restrictions on traffic movement	Number of load restricted roads and number of trucks detoured.	Haas et al. (2009)
		Closures	Period of time during which the road is closed	Unit of time (e.g. days, hours, etc.) that the road is closed	Haas et al. (2009)
		Number of days of snow and/or ice free surface			Haas et al. (2009)
	Travel time	Delays	Mobility quality indicator that measures the delays in travel times	Total hours of delay. Difference between travel time with delays and without delays.	OECD (2012)
		Mean travel time between A and B	Average value of travel times measured at different hours, on different days, on different weeks	Measured with probe vehicles	PIARC (2012)
		Variability of travel time between A and B	Standard deviation of travel times measured at different hours, on different days, on different weeks	Measured with probe vehicles	PIARC (2012)
Availability / Safety / Economy	Condition	International Roughness Index (IRI)			Haas et al. (2009)
Economy	Asset value	Asset value	Summation of asset components values	Size of the components and condition of the asset components	PIARC (2012)
		Bridge Health Index (BHI)	A single-number assessment of a bridge's condition based on the bridge's economic worth, determined from an element level inspection. The index makes it possible to ascertain the structural quality of a single bridge or a network of bridges and to make objective comparisons with other bridges or networks.	It is computed as that ratio of remaining value of the bridge structure by the initial value of the structure. Since it is expressed as a percentage value, the BHI could provide an intuitive measure for bridge engineers, legislators, and the public.	Shepard and Johnson (1999)

CORRESPONDING AREA(S)	GROUP	NAME OF INDICATOR	DESCRIPTION	BASED ON / INFLUENCING FACTORS	REFERENCE
Economy	Asset value	Condition related asset value pavement	Asset value of pavement construction based on Structural Condition Index (SCI). Index scale ranges between 1 (best condition) to 5 (worst condition). Unit costs for reconstruction/rebuilding are considered and a linear function, in which full unit costs will be used if SCI=1 and no costs are considered if SCI=5, is used. It can be calculated either for single sections or based on the SCI distribution over the whole network.	SCI as a function of pavement age, surface defects, cracking, weighted rutting and IRI; Unit costs for reconstruction/rebuilding; Pavement area of section or of whole network.	Litzka et.al. (2008)
		Loss of asset value (reconstruction value)	Loss of asset value, based on the net value (depreciated value of deteriorated pavement) and the gross value (current replacement value of the roadway and foundation)	Ratio of the net value to the gross value	Gáspár and Rosa (1994)
		Mean residual life span of the asset	The life span is the number of years before the value of asset has vanished	Calculated from the asset condition using deterioration models	PIARC (2012)
		Preservation of road investment	For evaluating the life-cycle costs of roads, two different methods can be used to determine the value of road investment costs. One method takes into account all of the investments made in the road from construction to the end of the analysis period (e.g., construction costs, routine and maintenance costs, structural maintenance costs); the other considers only the construction costs.	Condition indicators and construction costs	PAV-ECO (1999)

CORRESPONDING AREA(S)	GROUP	NAME OF INDICATOR	DESCRIPTION	BASED ON / INFLUENCING FACTORS	REFERENCE
Economy	Asset value	Salvage value	The monetary value of the residual life. Residual life or remaining life is the number of load applications or time to reach intervention level. The salvage value of the pavement at the end of the analysis period must depend on the condition of the pavement at that time, and hence, the type and timing of maintenance works carried out during the analysis period (e.g., a pavement in need of structural maintenance at the end of the analysis period will have a lower residual value than a pavement recently strengthened). There are several ways to relate the pavement condition and its value/cost of rehabilitation. The pavement salvage value is usually expressed in terms of the remaining value before the pavement fails completely and can no longer be trafficked (Option 1). In this case, the salvage value is equal to the proportion of the initial construction cost representing the remaining life to failure. This cannot be calculated directly as the residual life to zero value cannot be easily determined. The salvage value, in this case, can be estimated by using the formula (Option 1): Salvage value = Initial construction cost - Pavement preservation. Option 2: The salvage value is expressed in terms of the (residual) life to the next intervention. In this case the salvage value can be calculated using models that predict pavement behaviour to the intervention level. It is equal to the proportion (related to the intervention level being used) of the treatment cost representing the remaining life to the next intervention level. The time to next intervention level depends on the type and timing of the previous treatment and the performance of the pavement following that treatment. Salvage value to intervention level = Cost of last treatment * Residual life of the treatment / Design life of the treatment. Option 3: Pavement preservation (PP) is expressed as the cost of rehabilitation to bring the road into its initial condition. The cost of rehabilitation depends on the measures that need to be taken to restore pavement serviceability. If only maintenance works that affect the surface courses are required, the salvage value of the pavement will be higher and pavement preservation value will be lower. However, if the lower pavement layers have to be reconstructed, the salvage value of the pavement will be lower and pavement preservation value will be higher. Where the	Option 1: Salvage value = Initial construction cost - Pavement preservation (PP); Option 2: Salvage value to intervention level = Cost of last treatment * Residual life of the treatment / Design life of the treatment; Option 3: Pavement Preservation (PP) is expressed as the cost of rehabilitation to bring the road into its initial condition.	PAV-ECO (1999)

CORRESPONDING AREA(S)	GROUP	NAME OF INDICATOR	DESCRIPTION	BASED ON / INFLUENCING FACTORS	REFERENCE
Economy	Condition	Bridge Health Index (BHI)	A single-number assessment of a bridge's condition based on the bridge's economic worth, determined from an element level inspection. The index makes it possible to ascertain the structural quality of a single bridge or a network of bridges and to make objective comparisons with other bridges or networks.	It is computed as that ratio of remaining value of the bridge structure by the initial value of the structure. Since it is expressed as a percentage value, the BHI could provide an intuitive measure for bridge engineers, legislators, and the public.	Shepard and Johnson (1999)
	Cost efficiency	Asset Sustainability Index (ASI)	A composite metric computed by dividing the amount budgeted on infrastructure maintenance and preservation over time by the amount needed to achieve a specific infrastructure condition target over long term	Amount Budgeted / Amount Needed = ASI; Composite of three ratios: Pavement Sustainability Ratio, Bridge Sustainability Ratio and Maintenance Sustainability Ratio. When combined, they form an Asset Sustainability Index which is a composite of all three.	Proctor et al. (2012)
		Bridge sufficiency rating (Federal sufficency rating)	Method of evaluating highway bridge data by calculating four separate factors to obtain a numeric value which is indicative of bridge sufficiency to remain in service. The result of this method is a percentage in which 100 percent would represent an entirely sufficient bridge and zero percent would represent an entirely insufficient or deficient bridge.	Based on the NBI Items - 55% Structural; 30% Serviceability and Functional Obsolete; Essentiality for public use 15%; Special Reduction 6%.	FHWA (1995)
		Cost recovery	Indicators of institutional productivity and effectiveness	Revenues, ratio revenues/expenses or ratio revenue/maintenance expenditure	Haas et al. (2009)
		Deficiency ranking	Algorithm that compares certain characteristics for each bridge recorded in the state bridge database against performance criteria. Bridges not meeting the performance criteria are assigned "deficiency points." The output of the algorithm is a list of bridges ranked from most to least deficient. The bridge deficiency rankings were used to help select bridges for replacement.	Load, width, vertical clearence, structural condition inspection rating	Richardson et al. (2009)
		Impact of executing the interventions	Impact on the owner of the executing of interventions	Amount of labor, equipment and material to be used	SABARIS (2012)
		Network depreciation	Indicator of institutional productivity and effectiveness	Ratio: current value of roads/replacement cost	Haas et al. (2009)

CORRESPONDING AREA(S)	GROUP	NAME OF INDICATOR	DESCRIPTION	BASED ON / INFLUENCING FACTORS	REFERENCE
Economy	Cost efficiency	Preservation of road investment	Methodology for estimating Road Investment costs: For evaluating the life-cycle costs of roads, two different methods can be used to determine the value of road investment costs. One method takes into account all of the investments made in the road from construction to the end of the analysis period (e.g., construction costs, routine and maintenance costs, structural maintenance costs); the other considers only the construction costs.	Methodology for estimating the costs of Preservation of Road Investments: The state of deterioration of the whole road structure is determined using condition indicators. From the ranges and values of these condition indicators, a maintenance treatment is selected which will reinstate the existing pavement to its initial condition. The costs of preservation of road investment is then given by the updated cost of the maintenance treatment.	PAV-ECO (1999)
		Program B/C or cost effectiveness	Indicator of institutional productivity and effectiveness	Benefits or; Effectiveness or; Ratio: benefit/cost	Haas et al. (2009)
		Return on Construction Expenditure	The indicator is a graph showing percentage distribution of programmed expenditures by Benefit Cost Ratio (BCR) range. The indicator is a graph showing percentage distribution of programmed expenditures by BCR. The BCR used is one attributed to the project when the decision to fund it was made.	Projects BCRs	PIARC (2012)
		Return on investment (construction expenditure)	The indicator is based on a graph showing percentage distribution of programmed expenditure by benefitc cost ratio range (BCR). The BCR used is one attributed when the decision to fund the project was made.	BCR for single projects; Ranges for BCR (assessment); Expenditure of projects to be taken into account	PIARC (2012)
		Road Maintenance Effectiveness (RME)	The effectiveness by road network quality is being maintained to target conditions through expenditure on maintenance activity	RME=TME/L, where TME = 3 year average total maintenance expenditure, calculated for the current and the 2 previous year; and L = total carriageway kilometers for which quality targeted condition is met, as measured as a set point in time.	PIARC (2012)
	Environmental costs	Air pollution costs	The quantity of indirect air pollution is determined by applying the EWS (1997) speed emission functions, which determine the quantity of air pollution caused by different kinds of vehicle emissions (NOx, SO2, CO, HC, PA), and which depend upon the different vehicle types and their vehicle km of travel. These different kinds of vehicle emissions are transformed by applying toxicity factors into standardised units of nitrogen x-oxide.	The costs for one x-oxide unit is 850 €/tonne. The estimated amounts of x-oxide emitted are multiplied by 850€ to determine the total costs of air pollution resulting from vehicle exhaust emissions.	FGSV (1998)

CORRESPONDING AREA(S)	GROUP	NAME OF INDICATOR	DESCRIPTION	BASED ON / INFLUENCING FACTORS	REFERENCE
Economy	Environmental costs	CO2 emission costs	Determination of CO2 emission costs. CO2 emissions are direct emissions. These disperse readily and spread widely in the atmosphere creating damage that is independent of the distance from the sources of the emissions. Therefore they have to be distinguished from indirect air pollution by NOx, SO2, CO, HC, PA (in which the distance between the source of the pollutant output and the place of its registration is a main determinant). CO2-emissions per vehicle km are determined by the EWS (1997) fuel consumption. CO2-emission functions that are quantified separately for Diesel fuel and Petrol fuel.	CO2 emission costs result from the product of the CO2 emissions quantity by the costs per tonne (90 €/ tonne CO2). These costs are multiplied by the number of the relevant vehicle types, the road length and the number of days within the analysis period. The total sum of these costs represents the investment necessary to avoid the damages resulting from CO2 emissions. The values of these costs are estimated from the costs of those general measures that are necessary to cause a decrease of CO2 emissions (e.g. by more economic use of limited energy resources, or by substitution of limited energy resources by non-limited energy resources).	FGSV (1998)
		Emissions during maintenance periods	Part of the TRIMM project indirect action-related cost: models developed for heating costs, transport costs and traffic costs for maintenance works.	Reducing emissions within a maintenance strategy by minimizing environmental costs. A management strategy should enable reduction of the amount of motorized kilometres and influencing the traffic speed (by avoiding traffic congestions and slow driving traffic). Emissions during maintenance periods are caused by heating of materials, transport of materials related to asphalt concrete, traffic conditions during maintenance. Model developed.	TRIMM (2014)
		Energy consumption cost	The expected values concerning energy consumption for the indirectly affected public in the period between interventions and during intervention. f(t,x) and g(d,x) = functions in the impact hierarchy = BI(t) * c. It is assumed that the values of the two functions are transformed into monetary values.	c = unit cost for consuming an certain amount of energy source; BI = vector of impact indicators for each type of energy source	SABARIS (2012)
		Environment preservation (Noise)	The societal impact due to the user and neighbours coming in contract with sound emissions	The impact indicator is the amount of sound emissions, and the value can be determined through wilingness to pay	SABARIS (2012)
		Land consumption cost	The expected values concerning land consumption for the indirectly affected public in the period between interventions and during intervention. f(t,x) and g(d,x) = functions in the impact hierarchy = BI(t) * c. It is assumed that the values of the two functions are transformed into monetary values.	c = unit cost for converting 1 m2 of land from natural state to a built state; BI = is area (m2) of land that has been converted from natural state to a built state due to intervention	SABARIS (2012)

CORRESPONDING AREA(S)	GROUP	NAME OF INDICATOR	DESCRIPTION	BASED ON / INFLUENCING FACTORS	REFERENCE
Economy	Environmental costs	Material consumption cost	The expected values concerning material consumption for the indirectly affected public in the period between interventions and during intervention. f(t,x) and g(d,x) = functions in the impact hierarchy = BI(t) * c . It is assumed that the values of the two functions are transformed into monetary values.	c = unit cost for consuming an certain amount of material; BI = vector of impact indicators for each type of material	SABARIS (2012)
		Noise cost (affecting users)	Capturing the changes that occur in the interactions between people due to sound emissions (e.g. the inability to communicate between driver and passenger while driving). The impact indicator is the amount of sound emissions to which the users is exposed. The value of an amount of sound emissions can be determined through willingness to pay investigations. The expected values concerning noise reduction for the directly affected public in the period between interventions and during intervention. f(t,x) and g(d,x) = functions in the impact hierarchy = BI(t) * c . BI = impact indicator = t * dBA * U. It is assumed that the values of the two functions are transformed into monetary values.	c = unit costs in Person/dBA/day; t = number of days in between interventions and during intervention; dBA = expected increase unit of noise (in dBA) compared to a baseline; U = expected number of users within a specific period	SABARIS (2012)
		Noise costs	Exceeding legislated threshold sound levels (40 dB at night; 50 dB during the day), causes noise, which may be cost-equated. These threshold sound level exceedings (e.g. noise) are transformed into factors that are multiplied by the number of people (inhabitants) affected, to give Inhabitant coefficients (Ic).	Ic = noise intensity * number of people (inhabitants) affected by the noise, where Ic is the inhabitant coefficent. Each Inhabitant coefficient is valued at 42.5 euro. Total costs of noise per day = Ic * 42.5 euro	FGSV (1998)
		Particle emissions cost	The expected values concerning reduction of particle emissions for the indirectly affected public in the period between interventions and during intervention. f(t,x) and g(d,x) = functions in the impact hierarchy = BI(t) * c . BI = vector of impact indicators (CO2, PM10, NO, CO, NO2, ...). It is assumed that the values of the two functions are transformed into monetary values.	c = unit cost of particle emitted; BI = EF = the fleet-average emission factor = S(FVMT(EC)); FVMT = the fractional vehicle-mile travel; E, C = the basic emission rate and correction factor	SABARIS (2012)

CORRESPONDING AREA(S)	GROUP	NAME OF INDICATOR	DESCRIPTION	BASED ON / INFLUENCING FACTORS	REFERENCE
Economy	Safety costs	Accident cost	EWS (1997) accident quotas (accidents/106 heavy vehicle km) are used depending on the road type. Accidents can be separated into those affecting cars only and commercial vehicles only using these quotas, together with the input data of the model (traffic volume, road type, share of freight transport). Subcategories of accident costs in PAV-ECO are economic loss of earnings, loss of full health due to disablement, loss of spare time, medical treatment costs, repair costs, and the administration costs of insurance institutions, law institutions, and the fire, hospital and police services.	The accidents are multiplied by the EWS (1997) cost rates per accident (e.g. commercial vehicle accident with personal injuries = 8500 €/accident, commercial vehicle accident with property damage = 8100 €/accident)	FGSV (1998)
		Persons - Health	Indicator describing the health for the indirectly affected public in the period between mainenance interventions and during maintenance intervention. It is calculated by multiplying an impact indicator with unit costs including index for injury and death.	Impact indicator, which is measured as numbers of injuries and death incurred in a specific time interval; Index for injury and death; Unit cost (e.g. average wage)	SABARIS (2012)
	Social economy	Operation quality (Comfort), physical impact of travelling on the user	The societal impact of obtaining, for example, bruises from na extremely bumpy ride	The impact indicators are the amounts of physical and psychological impacts of travelling. The value of degrees of bumpiness could be determined through willingness to pay investigations.	SABARIS (2012)
		Operation quality (Comfort), psychological impact of travelling on the user	The societal impact of having for example, anxiety due to a perceived increase in the probability of being involved in an accident, or of seeing things while travelling.		SABARIS (2012)
		The contribution of the road operation to socio-economic development (employment)	The impact of interventions in terms of employing people	The impact indicator is the amount of work provided. The value can be estimated as using economic impact assessment models, using predictions of business output, value added, employment level, wages, salaries, and wealth.	SABARIS (2012)
		Total costs/capita	Maintenance costs per capita		Haas et al. (2009)
	Stakeholder satisfaction	Stakeholder satisfaction KPI - Ind. 1- Number of complaints to NRA / km NRA road network	Complaint - An enquiry related to the responsibilities and work of the NRA requesting some form of action or intervention that the NRA could conceivably act on.	Complaints / km road network	SBAKPI (2012)
		Stakeholder satisfaction KPI - Ind. 2- Number of responses from NRA / km NRA road network	Response - Direct responses to individuals and organizations e.g. personal reply, e-mails, telephone calls, letters. Plus other types of responses may be applicable e.g. website update, newsletter, press release.	Responses / km road network	SBAKPI (2012)

CORRESPONDING AREA(S)	GROUP	NAME OF INDICATOR	DESCRIPTION	BASED ON / INFLUENCING FACTORS	REFERENCE
Economy	User costs	Reliability of travel time	Change of reliability on expected travel time to destination	Assessment of congestion situation, section length, AADT (vehicle kilometer/year)	Walter et al. (2003)
		Time costs	The basis for the estimation of time costs are the EWS (1997) speed-volume functions. They specify the average speeds for cars and commercial vehicles, depending on average traffic volumes and share of freight transported on different types of road. The time costs are separated into the following subcategories: Freight transport (Labour costs and the drivers' expenses, Provision costs (interest charges for loans and depreciation of the capital invested, garaging, and other general costs)); Passenger transport (Time costs for working hours, Time costs for leisure hours, Provision costs (commercially-used cars only).	The travel time is multiplied by the EWS (1997) time costs for one hour, which are: Car: 5.5€; Commercial vehicle: 21€; Semi-trailer: 30€; Bus: 62.5€. The time costs per vehicle are multiplied by the number of vehicles of that type and by the number of days within the investigation period.	FGSV (1998)
		Vehicle Operating Costs (VOC)	The basis for the estimation of vehicle operating costs are the EWS (1997) speed-volume functions. They specify the average speeds for cars and commercial vehicles, depending on average traffic volumes and share of freight transported on different types of road.	Estimation of vehicle operating costs is based on two components. The first component is fixed for every vehicle type, and includes the basic costs of vehicle operation. This cost component is independent of vehicle kilometre travelled. The second term is the product of fuel consumption and fuel price. Fuel consumption is determined for different vehicle types by the EWS speed-fuel consumption functions (fuel consumption depends on average vehicle speed). The costs per vehicle are multiplied by the number of the relevant vehicle types and the number of days within the period of analysis.	FGSV (1998)
Environment	Air quality	Air Quality KPI - Level 1 - Number of AQZAs /1000 km of NRA road network	Number of road traffic related Air Quality Zones and Agglomerations (AQZAs) through which road network passes per 1000 km of road network. AQZAs are defined according to the Directive 2008/50/EU.	Number of AQZAs / 1000 km	SBAKPI (2012)
		Air Quality KPI - Level 2 - Lehgth of road network within AQZAs /1000 km of NRA road network	Length of road network within road traffic related AQZAs per 1000 km of road network	Length of road network within AQZAs / 1000 km	SBAKPI (2012)
		Direct toxicity of air pollutants	Short term mortality: all causes, non-accidental, cardiac, pulmonary; Hospital admission for: respiratory reason, cardio-vascular reason, acute bronchitis, children asthma attacks, adult acute asthma attacks; Long term mortality; Chronic bronchitis; Lung cancer	No models available	COST (2010)

CORRESPONDING AREA(S)	GROUP	NAME OF INDICATOR	DESCRIPTION	BASED ON / INFLUENCING FACTORS	REFERENCE
Environment	Air quality	Environmental index for Air Quality: Emission and Exposure Adehydes, sulphur dioxide, polycyclic aromatic, hydro-carbons	The impact on people due to the environment being impacted by particle emissions	See reference for more details	SABARIS (2012)
		Environmental index for Air Quality: Emission and Exposure EPI for CO	The impact on people due to the environment being impacted by particle emissions	See reference for more details	SABARIS (2012)
		Environmental index for Air Quality: Emission and Exposure EPI for Nox	An emissions rate indicator for each of NOx, based upon total modelled emissions using traffic data and vehicle emission factors per km of road	See reference for more details	EVITA (2012)
		Environmental index for Air Quality: Emission and Exposure EPI for PM10 and PM2.5	An exposure indicator for each PM, reflecting its health impact, based upon an assessment of the exposed population to concentrations above EU limit values	See reference for more details	EVITA (2012)
		Environmental index for Air Quality: Emission of CO2	The impact on people due to the environment being impacted by particle emissions	See reference for more details	SABARIS (2012)
	CO2	Emissions of ozone precursors	Ozone precursors aare chemical compounds that contribute to the formation of ground level (tropospheric) ozone. They are nitrogen oxides, carbon monoxide, methane and non-methane volatile organic compounds. Traffic is the main generator of nitrogen oxides (NOx) and carbon monoxide (CO).	NOx emissions and CO emissions.	Slovenia (2014)
		Environmental index for embodied carbon reduction (EPIECR)	The reduction in CO2 emissions for a maintenance strategy against a nominal strategy that demonstrates the maximum emissions of CO2	See reference for more details	EVITA (2012)
		Environmental index for GHG – CO2 equivalent emissions during road construction and maintenance activities	Comparison of GHG emissions for maintenance or construction strategies in terms of CO2 emissions	See reference for more details	EVITA (2012)
		Environmental index for GHG – Emissions rate for CO2 emissions from vehicles: EPI emissons, CO2	CO2 emission rate, taking into account the emissions model using traffic flow data and vehicle emission factors per km of road	See reference for more details	EVITA (2012)
	Natural resources	Consumption of non-renewable raw materials and recycling of waste in construction	Ratio of the amount of recycled material used in construction and the total used material. The Indicator method allows a choice from a number of optional weighting factors which enable the user to encourage certain behaviour from a project based on the local factors that affect natural resources.	Ton (Mg) or m3 of construction material and % of recycled materials in it.	Haas et al. (2009)

CORRESPONDING AREA(S)	GROUP	NAME OF INDICATOR	DESCRIPTION	BASED ON / INFLUENCING FACTORS	REFERENCE
Environment	Natural resources	Energy consumption	Energy consumption in transport is closely linked to the volume of transport, which is correlated with economic growth. The negative impacts of energy consumption in transport can be decreased through a reduction in the use of fossil fuels and transport demand, increased energy efficiency of the means of transport, and an increased proportion of energy generation via alternative or more sustainable energy sources (particularly biofuels), and increased use of public transport, cycling, and other sustainable modes. Accordingly, the quality of air will improve.	Energy consumption by modes of transport [MWh/year]	SABARIS (2012), Haas et al. (2009); Walter et al. (2003)
		Material Resource Efficiency Indicator (MREI): EPIResources	Ratio of the amount of recycled material used in construction and the total used material. The Indicator method allows a choice from a number of optional weighting factors which enable the user to encourage certain behaviour from a project based on the local factors that affect natural resources.	See reference for more details	EVITA (2012)
		Use of fossil fuels/renewable energy	Indicator varies with respect to data availability: Low: LoS and transport volume; Intermediate and High: Use of fossil fuels/renewable energy.	Fuel consumption and emissions for motor vehicles, method to calculate transport emissions and energy consumption.	COST (2009)
	Noise	Environment preservation (Noise)	The societal impact due to the user and neighbours coming in contract with sound emissions	The impact indicator is the amount of sound emissions, and the value can be determined through wilingness to pay	SABARIS (2012)
		Noise annoyance to humans	The percentage of the exposed population highly annoyed by the road traffic noise during the Day-Evening-Night period or Night-only period. Indicators: Equivalent Level Leq,Traffic Noise Index, Noise Pollution Level, Sound Exposure Level, Transit Exposure Level, Perceived Noice level, Effective perceived Noise Level, Noise Number Index, Noise Exposure Forecast, Weighted Noise Exposure Forecast, LVA Indicator, Day-Night Equivalent Level, Day-Evening-Nigh Equivalent Level.	A mathematical formula has been given for each indicator (13 in total). Based on the density of population, distance to settlements and sensitive areas, equivalent noise level ranges. Definition of Lday, Levening, Lnight, Lden level, number of affected people through models.	EVITA (2012)
		Noise Maps, Vehicle Noise	Maps of the level of noise generated by trafic along the roads	Used complex propagation models calibrated with road side measurements, also actual dBA vs. acceptable level	Haas et al. (2009)
		Number of dwellings exposed to excesive noise	The KPI will identify number of dwellings exposed to noise levels above 55 dBA during the night. Based on noise maps. Should be collected annualy.	Number of dwellings over 55 dBA threshold / km NRA road network (for roads with more than 6 million vehicles/year)	SBAKPI (2012)

CORRESPONDING AREA(S)	GROUP	NAME OF INDICATOR	DESCRIPTION	BASED ON / INFLUENCING FACTORS	REFERENCE
Environment	Noise	Number of noise complaints	The KPI provides indication of the level of nuisance from noise	Complaints per year /1000 km of road network	SBAKPI (2012)
		Traffic Noise Exposure	The percentage of people living in the area exposed to a noise level higher than the legal (or recommended) threshold during the day-evening-night period or only night period. L10,18h is the arithmetic average of the sound levels which are exceeded for 10% of each of the 18 hours between 6 a.m. and midnight on a normal working day. Leq-24h is the equivalent or steady state noise level which represents the varying noise levels throughout the normal working day.	TNE = log10 * mean (101st measure, 102nd, …), also number of affected people (day >55dBA / night >45 dBA)	PIARC (2012)
		Vibration Maps	Maps of the level of vibrations generated by trafic along the roads. Relevant in urban areas	Used complex models of propagation of vibration in soils	PIARC (2012)
	Soil and water quality	Acidification	Indicator varies with respect to data availability: Low: -; Intermediate and High: Emission of pollutants with acidification potential	Emissions computed with ARTEMIS or other model based on transport data and emission factors for NOx, NHy, SO2. Emission objective values relative to NEC directive given.	COST (2009)
		Concentration of pollutants in soils	Indicator varies with respect to data availability: Low: -; Intermediate: Risk of pollution of sensitive soils; High: Concentration of lead, PAH, pesticides, salt in soil	Pollutant production and levels of pollution figured out based on vehicle flows and emission characteristics as well as the meteorological conditions. Modelling on models for pollution.	COST (2009)
		Concentration of pollutants in surface water	Indicator varies with respect to data availability: Low: Risk of pollution of sensitive water; Intermediate and High: Concentration of oil derivates, pesticides and salt in water	Emission of pollutants in run-off water. Based on concentration of each pollutant in the run-off water and on distance to natural reservoirs from the road/railway axis.	COST (2009)
		Emissions of substances that cause acidification and eutrophication	Substances that cause acidification are sulphor oxides, nitrogen oxides and ammonia. Nitrogen oxides and ammonia also contribute to eutrophication. Traffic generates nitrogen oxides (NOx).	NOx emissions.	Slovenia (2014)
		Environmental index for Water Pollution from winter maintenance activities (salting): EPISalt	Average usage of salt for the section of road being considered in comparison to the whole network, weighted by the intensity of winter maintenance in the area and the sensitivity of the area	See reference for more details	EVITA (2012)
		Environmental index for Water quality and drainage system: EPIWater	An indicator that takes into account the pollution loading, the risk of spills, the drainage outfall, its design and location, the ability to handle the expected quantities of water without causing flooding and the functional condition of the drainage system	See reference for more details	EVITA (2012)

CORRESPONDING AREA(S)	GROUP	NAME OF INDICATOR	DESCRIPTION	BASED ON / INFLUENCING FACTORS	REFERENCE
Environment	Soil and water quality	Eutrophication	Indicator varies with respect to data availability: Low: -; Intermediate and High: Emission of pollutants with eutrophication potential	The indicator corresponds to the quantity of NOx emissions (t/year).	COST (2009)
		Release of dangerous goods due to accidents	Indicator varies with respect to data availability: Low: -; Intermediate: Probability of accidents causing ecological catastrophes; High: Probability of accidents causing ecological catastrophes within vulnerable areas	Probability of serious environmental catastrophes. % (counts using weights for different sensitivity of the environment in proximity). Sensitivity assessed using 5-grade scale (very low to very high). Different weights for different situations.	COST (2009)
		Toxicity	Indicator varies with respect to data availability: Low: Emission of toxic or ecotoxic gases; Intermediate: Risk of affecting highly populated areas or sensitive habitats; High: Nr of people or protected areas exposed to toxic or ecotoxic pollutant immission exceeding standards	Based on the measurement of toxic pollutants immission (heavy metals, POC, particulates, NOx, SOx etc.), identification of those above the limit values and on the number of people living in a highly populated area near the transport infrastructure.	COST (2009)
Safety	Accidents	Number of accident involving vulnerable users	Recense all road accidents involving pedestrian and/or two-wheelers, on (part of) a network	Directly calculated from police reports	ECMT (2000)
		Number of accidents per million vehicle kilometers		Clear from the name of indicator	Haas et al. (2009)
		Number of fatalities and injuries per million vehicle kilometres		Clear from the name of indicator	Haas et al. (2009)
		Number of fatalties (involving two-wheels, cars, bus and trucks) per veh.km	Recense all road accidents with fatalties, on (part of) a network	Directly calculated from police reports	PIARC (2012)
		Safety (Accidents), death	The societal impact due to death on the directly affected public due being involved in an accident		SABARIS (2012)
		Safety (Accidents), injury	The societal impact due to the injury on the directly affected public due being involved in an accident	The impact indicators are the number of injuries and deaths incurred in a specified time interval. The value of these impact types can be estimated by using willingness to pay to avoid injury or death.	SABARIS (2012)
		Safety KPI - People killed or seriously injured (KSI) in road traffic accidents.		The percentage change in the number of people killed or seriously injured based on a three year rolling average	SBAKPI (2012)
		Serious Casualty Crashes (Population)	The number of serious casualty crashes per year normalized per 100,000 head of population. Serious casualty crashes are crashes in which at least one person has been killed or hospitalized. The data supplied refers to crashes occurring within the road reserve.	SCC/P = CC / P, where CC = Crashes involving hospitalization or death; and P = Total population	PIARC (2012)

CORRESPONDING AREA(S)	GROUP	NAME OF INDICATOR	DESCRIPTION	BASED ON / INFLUENCING FACTORS	REFERENCE
Safety	Accidents	User safety (accidents), death	The societal impact due to death on the user due to the user being involved in an accident		SABARIS (2012)
		User safety (accidents), injury	The societal impact due to the injury on the user due to the user being involved in an accident	The impact indicators are the number of injuries and deaths incurred in a specified time interval. The value of these impact types can be estimated by using the user's willingness to pay to avoid injury or death.	SABARIS (2012)
		Accident victims	Number of injured and fatalities within a time frame	Accident statistics (persons/year)	Walter et al. (2003)
		Accidents	Number of accidents within a time frame	Accident statistics (accidents/year)	Walter et al. (2003)
	Overall safety	Eurorap Score			SAFETYNET (2005)
	Safety costs	Accident cost	Cost of accident per kilometer	Directly calculated from police reports	COST (1994)
		Annual accident costs			Haas et al. (2009)
		Safety costs	Safety costs	Safety costs are equivalent to the costs of traffic accidents caused during maintenance performance or due to the road condition.	TRIMM (2014)
	Users perception	Operation quality (Comfort), physical impact of travelling on the user	The societal impact of obtaining for example, bruises from an extremely bumpy ride	The impact indicators are the amounts of physical and psychological impacts of travelling. The value of degrees of bumpiness could be determined through willingness to pay investigations.	SABARIS (2012)
		Operation quality (Comfort), psychological impact of travelling on the user	The societal impact of having for example, anxiety due to a perceived increase in the probability of being involved in na accident, or of seeing things while travelling.		SABARIS (2012)
Safety/Availability/Economy	Condition	Condition rating	No specific condition indicators are identified		Haas et al. (2009)
		Bridge sufficiency rating (Federal sufficency rating)	Method of evaluating highway bridge data by calculating four separate factors to obtain a numeric value which is indicative of bridge sufficiency to remain in service. The result of this method is a percentage in which 100 percent would represent an entirely sufficient bridge and zero percent would represent an entirely insufficient or deficient bridge.	Based on the NBI Items - 55% Structural; 30% Serviceability&Functional Obsolete; Essentiality for public use 15%; Special Reduction 6%.	FHWA (1995)
		Deficiency ranking	The original deficiency algorithm was developed in 1991 (Richardson &Turner). The algorithm compared certain characteristics for each bridge recorded in the state bridge database against performance criteria. Bridges not meeting the performance criteria were assigned "deficiency points." The output of the algorithm was a list of bridges ranked from most to least deficient. The bridge deficiency rankings were used to help select bridges for replacement.	The deficiency algorithm consists of four factors (load, width, vertical clearance, structural condition inspection rating).	Richardson et al. (2009)

CORRESPONDING AREA(S)	GROUP	NAME OF INDICATOR	DESCRIPTION	BASED ON / INFLUENCING FACTORS	REFERENCE
Safety/Availability/Economy	Condition	Hydraulic Vulnerability Rating Score	The main goal of evaluation of this rating score is to identify the vulnerable bridges to failures caused by scour or related hydraulic forces	VRS = Likelyhood score + Consequence score (Failure type score, Exposure score(Traffic volume, Functional classification))	NYSDOT (2003)

ANNEX 3: Full information from questionnaires

1 AUSTRIA

1.1 ASFINAG

1.1.1 Interviewer

Name	Alfred Weninger-Vycudil	**Contact details**	office@pms-consult.at

1.1.2 Interviewee

Organisation	ASFINAG – Austrian motorway company	**Country**	Austria
		Date	6.6.2016
Participants			
Name	Christian Honeger	Tel	
Role in Organisation	Head Asset Management Department	Email	Christian.honeger@asfinag.at
Name	Mario Krmek	Tel	
Role in Organisation	Technical coordination ASFINAG Holding	Email	Mario.krmek@asfinag.at
Name	Christoph Antony	Tel	
Role in Organisation	Asset Management Department	Email	Christoph.antony@asfinag.at
Road network	☒ Motorways [km]: 2200 km ☐ Other primary roads [km]: _____ ☐ Secondary roads [km]: _____ ☐ Other roads [km]: _____ Please, give additional explanations about the road network if necessary:		

1.1.3 General questions about decision making

What is the focus, vision of your organisation from the socio-economic point of view (in general)?

Basic vision of ASFINAG: We work in harmony with our business, environmental and social responsibility, and also strengthen Austria as a business location.

Do you take into account the socio-economic impacts in the process of making a decision/prioritization? If "yes" how?

Yes, availability (central topic for coordination of construction sides) and traffic safety.

The infrastructure investment program (construction program) will be assessed subject to availability and traffic safety.

1.1.4 Indicators for availability and disturbance

Here is a list of different groups for indicators of availability and disturbance. Which parameters/indicators are used to measure the socio-economic impacts of maintenance policy in the context of availability and disturbance?			
#	**Parameter or indicator / Description**	**In use?**	**Interested to use?**
Accessibility			
1		☐	☐
2		☐	☐
3		☐	☐
4		☐	☐
Condition			
1	Safety index (combined index, based on skid resistance and rutting)	☒	☐
2	Comfort index (combined index, based on roughness and surface defects)	☒	☐
3	Key-object definition for structures (as a function of traffic, size of object, condition of object, available alternative routes)	☒	☐
4		☐	☐
Congestion			
1	Loss of time due to construction sites (max. 5minutes per 100km)	☒	☐
2		☐	☐
3		☐	☐
4		☐	☐
Restrictions to availability			
1	Non-construction-site indicator (on network level)	☒	☐
2	Construction site length (max. Length and loss of time)	☒	☐
3		☐	☐
4		☐	☐
Travel time			
1	Loss of time due to construction sites (max. 5minutes per 100km)	☒	☐
2		☐	☐
3		☐	☐
4		☐	☐

1.1.5 Indicators for road safety

Here is a list of different groups for indicators for road safety. Which parameters/indicators are used to measure the socio-economic impacts of maintenance policy in the context of road safety?			
#	**Parameter or indicator / Description**	**In use?**	**Interested to use?**
Accidents			
1	Accident reports of fatal accidents (including analysis)	☒	☐
2		☐	☐
3		☐	☐
4		☐	☐
Condition			
1	Skid resistance (friction coefficient)	☒	☐
2	Rutting	☒	☐
3	Safety index (combined index, based on skid resistance and rutting)	☒	☐
4		☐	☐
Overall safety			
1	Road safety inspection (treatment in combination with the construction program)	☒	☐
2		☐	☐
3		☐	☐
4		☐	☐
Safety costs			
1		☐	☐
2		☐	☐
3		☐	☐
4		☐	☐
User perception			
1	CSI (customer satisfaction index)	☒	☐
2		☐	☐
3		☐	☐
4		☐	☐

1.1.6 Indicators for environment

Here is a list of different groups for indicators for environment. Which parameters/indicators are used to measure the socio-economic impacts of maintenance policy in the context of environment?			
#	**Parameter or indicator / Description**	**In use?**	**Interested to use?**
Air quality			
1		☐	☐
2		☐	☐
3		☐	☐
CO_2			
1		☐	☐
2		☐	☐
3		☐	☐
Environmental costs			
1		☐	☐
2		☐	☐
3		☐	☐
Natural resources			
1	Percentage of recycled material	☒	☐
2		☐	☐
3		☐	☐
Noise			
1	Noise map (European noise directive)	☒	☐
2		☐	☐
3		☐	☐
Soil and water quality			
1		☐	☐
2		☐	☐
3		☐	☐

1.1.7 Indicators for economy

Here is a list of different groups for indicators for economy. Which parameters/indicators are used to measure the socio-economic impacts of maintenance policy in the context of economy?			
#	**Parameter or indicator / Description**	**In use?**	**Interested to use?**
Asset value			
1	Asset value (related to asset condition)	☐	☒
2		☐	☐
Condition			
1	Structural condition of assets – structural condition index	☒	☐
2		☐	☐
Cost efficiency			
1	Cost benefit ratio (PMS, BMS under implementation)	☒	☐
2	Maintenance budget in relation to monetary maintenance needs	☒	☐
3	Aiming accuracy of investments (need due to others vs. need due to condition)	☐	☒
Environmental Costs			
1		☐	☐
2		☐	☐
Safety Costs			
1		☐	☐
2		☐	☐
Social economy			
1		☐	☐
2		☐	☐
Stakeholder satisfaction			
1	CSI (customer satisfaction index)	☒	☐
2		☐	☐
User costs			
1		☐	☐
2		☐	☐

1.2 Tirol region

1.2.1 Interviewer

Name	Dr. A. Weninger-Vycudil	**Contact details**	office@pms-consult.at

1.2.2 Interviewee

Organisation	Amt der Tiroler Landesregierung	**Country**	Austria
		Date	25.5.2016
Participants			
Name	DI Bernd Stigger	Tel	++43 512 508 4180
Role in Organisation	Director Asset Management Department	Email	Bernd.stigger@tirol.gv.at
Name		Tel	
Role in Organisation		Email	
Name		Tel	
Role in Organisation		Email	
Road network	☐ Motorways [km]: _____ ☒ Other primary roads [km]: 2.200 km _____ ☐ Secondary roads [km]: _____ ☐ Other roads [km]: _____ Please, give additional explanations about the road network if necessary: State road network of Tirol		

1.2.3 General questions about decision making

What is the focus, vision of your organisation from the socio-economic point of view (in general)?

The vision is valid for the whole road infrastructure including maintenance, extension and new construction. The vision is related to the following main aspects:

- Traffic safety
- Accessibility of all parts of the state of Tirol
- Protection of neighbours against traffic efffects
- Provide a road infrastructure network with enough capability for the people and the economy

Additionally general goals and tasks for the maintenance of the road infrastructure are being defined in form of guidelines

Do you take into account the socio-economic impacts in the process of making a decision/prioritization? If "yes" how?

No impacts from this side will be taken into consideration at the moment. The main objective of the PMS is to keep the actual condition.

1.2.4 Indicators for availability and disturbance

Here is a list of different groups for indicators of availability and disturbance. Which parameters/indicators are used to measure the socio-economic impacts of maintenance policy in the context of availability and disturbance?			
#	**Parameter or indicator / Description**	**In use?**	**Interested to use?**
Accessibility			
1	Criteria for the accessibility to the state road network (distance less than 500m to a state road if more than 500 people living in this area)	☒	☐
2		☐	☐
3		☐	☐
4		☐	☐
Condition			
1	Comfort and Safety Index Pavement (scale 1 very good to 5 very poor)	☒	☐
2	Bridge condition rating (scale 1 very good to 5 very poor)	☒	☐
3	Condition of electro-mechanical equipment in tunnels	☒	☒
4	Condition traffic lights (traffic lights calculator)	☒	☐
Congestion			
1		☐	☐
2		☐	☐
3		☐	☐
4		☐	☐
Restrictions to availability			
1		☐	☐
2		☐	☐
3		☐	☐
4		☐	☐
Travel time			
1		☐	☐
2		☐	☐
3		☐	☐
4		☐	☐

1.2.5 Indicators for road safety

Here is a list of different groups for indicators for road safety. Which parameters/indicators are used to measure the socio-economic impacts of maintenance policy in the context of road safety?			
#	**Parameter or indicator / Description**	**In use?**	**Interested to use?**
Accidents			
1	Accident points	☒	☐
2		☐	☐
3		☐	☐
4		☐	☐
Condition			
1	Rutting (technical parameter and index, scale 1 to 5)	☒	☐
2	Condition bridge pavement (scale 1 very good to 5 very poor)	☒	☐
3	Comfort and Safety Index Pavement (scale 1 very good to 5 very poor)	☒	☐
4		☐	☐
Overall safety			
1		☐	☐
2		☐	☐
3		☐	☐
4		☐	☐
Safety costs			
1		☐	☐
2		☐	☐
3		☐	☐
4		☐	☐
User perception			
1		☐	☐
2		☐	☐
3		☐	☐
4		☐	☐

1.2.6 Indicators for environment

Here is a list of different groups for indicators for environment. Which parameters/indicators are used to measure the socio-economic impacts of maintenance policy in the context of environment?			
#	**Parameter or indicator / Description**	**In use?**	**Interested to use?**
Air quality			
1	Distance material transport (in the context of maintenance treatments)	☒	☐
2		☐	☐
3		☐	☐
CO_2			
1	Distance material transport (in the context of maintenance treatments)	☒	☐
2		☐	☐
3		☐	☐
Environmental costs			
1		☐	☐
2		☐	☐
3		☐	☐
Natural resources			
1	Amount of recycling-asphalt	☒	☐
2		☐	☐
3		☐	☐
Noise			
1	Distance material transport (in the context of maintenance treatments)	☒	☐
2		☐	☐
3		☐	☐
Soil and water quality			
1		☐	☐
2		☐	☐
3		☐	☐

1.2.7 Indicators for economy

Here is a list of different groups for indicators for economy. Which parameters/indicators are used to measure the socio-economic impacts of maintenance policy in the context of economy?			
#	**Parameter or indicator / Description**	**In use?**	**Interested to use?**
Asset value			
1	Asset value	☐	☒
2		☐	☐
3		☐	☐
Condition			
1	Condition of engineering structures (scale from 1 very good to 5 very poor)	☒	☐
2		☐	☐
3		☐	☐
Cost efficiency			
1	Benefit cost ratio (pavement, part of PMS)	☒	☐
2		☐	☐
3		☐	☐
Environmental Costs			
1		☐	☐
2		☐	☐
3		☐	☐
Safety Costs			
1		☐	☐
2		☐	☐
3		☐	☐
Social economy			
1	Maintenance budget (in general)	☒	☐
2		☐	☐
3		☐	☐
Stakeholder satisfaction			
1		☐	☐
2		☐	☐
3		☐	☐
User costs			
1		☐	☐
2		☐	☐
3		☐	☐

2 BELGIUM

2.1 Flanders

2.1.1 Interviewer

Name	Dr. A. Weninger-Vycudil	**Contact details**	office@pms-consult.at

2.1.2 Interviewee

Organisation	Agency for Roads and Traffic	**Country**	Belgium
		Date	27 May 2016
Participants			
Name	Margo Briessinck	Tel	+32 2 727 09 25
Role in Organisation	senior advisor road structures	Email	margo.briessinck@ mow.vlaanderen.be
Name		Tel	
Role in Organisation		Email	
Name		Tel	
Role in Organisation		Email	
Road network	☒ Motorways [km]: ca. 1000 km ☒ Other primary roads [km]: ca. 2500 km ☒ Secondary roads [km]: ca. 3000 km ☒ Other roads [km]: ca. 6700 km bicycle paths Please, give additional explanations about the road network if necessary:		

2.1.3 General questions about decision making

What is the focus, vision of your organisation from the socio-economic point of view (in general)?

The Agency wants to realise a safe, fluent and sustainable mobility for all road users in Flanders.

Strategic goals are:

- in a selective way ensuring the accessibility of economic nodes and ports
- offer everyone in Flanders the opportunity to move; everyone should be able to participate fully in society
- improve traffic safety in Flanders by reducing the number of road casualties
- despite the increasing mobility improve traffic liveability
- reduce the damage to nature and environment, even when mobility increases

Do you take into account the socio-economic impacts in the process of making a decision/prioritization? If "yes" how?

Safety / number of people killed (mainly used on primary and secondary) – light, severe, killed – indicator calculated from number of light, severe, killed

Noise – European noise directive (noise maps)

2.1.4 Indicators for availability and disturbance

Here is a list of different groups for indicators of availability and disturbance. Which parameters/indicators are used to measure the socio-economic impacts of maintenance policy in the context of availability and disturbance?			
#	**Parameter or indicator / Description**	**In use?**	**Interested to use?**
Accessibility			
1	Name	☐	☐
2	Name	☐	☐
3	Name	☐	☐
4	Name	☐	☐
Condition			
1	Name	☐	☐
2	Name	☐	☐
3	Name	☐	☐
4	Name	☐	☐
Congestion			
1	Name	☐	☐
2	Name	☐	☐
3	Name	☐	☐
4	Name	☐	☐
Restrictions to availability			
1	Name	☐	☐
2	Name	☐	☐
3	Name	☐	☐
4	Name	☐	☐
Travel time			
1	Loss of travel time (public transportation, in general)	☒	☐
2	Name	☐	☐
3	Name	☐	☐
4	Name	☐	☐

2.1.5 Indicators for road safety

Here is a list of different groups for indicators for road safety. Which parameters/indicators are used to measure the socio-economic impacts of maintenance policy in the context of road safety?			
#	**Parameter or indicator / Description**	**In use?**	**Interested to use?**
Accidents			
1	Sum of accidents weighted by type of accidents (light, severe, killed)	☒	☐
2	Name	☐	☐
3	Name	☐	☐
4	Name	☐	☐
Condition			
1	Skid resistance	☐	☐
2	Rutting	☐	☐
3	Name	☐	☐
4	Name	☐	☐
Overall safety			
1	Minimum of rutting and skid resistance	☐	☐
2	Name	☐	☐
3	Name	☐	☐
4	Name	☐	☐
Safety costs			
1	Name	☐	☐
2	Name	☐	☐
3	Name	☐	☐
4	Name	☐	☐
User perception			
1	Name	☐	☐
2	Name	☐	☐
3	Name	☐	☐
4	Name	☐	☐

2.1.6 Indicators for environment

Here is a list of different groups for indicators for environment. Which parameters/indicators are used to measure the socio-economic impacts of maintenance policy in the context of environment?			
#	**Parameter or indicator / Description**	**In use?**	**Interested to use?**
Air quality			
1	Name	☐	☐
2	Name	☐	☐
3	Name	☐	☐
CO_2			
1	Name	☐	☐
2	Name	☐	☐
3	Name	☐	☐
Environmental costs			
1	Name	☐	☐
2	Name	☐	☐
3	Name	☐	☐
Natural resources			
1	Name	☐	☐
2	Name	☐	☐
3	Name	☐	☐
Noise			
1	Noise map (European noise directive)	☒	☐
2	Including CPX measurements	☐	☒
3	Name	☐	☐
Soil and water quality			
1	Name	☐	☐
2	Name	☐	☐
3	Name	☐	☐

2.1.7 Indicators for economy

Here is a list of different groups for indicators for economy. Which parameters/indicators are used to measure the socio-economic impacts of maintenance policy in the context of economy?			
#	**Parameter or indicator / Description**	**In use?**	**Interested to use?**
Asset value			
1	Name	☐	☐
2	Name	☐	☐
3	Name	☐	☐
Condition			
1	Name	☐	☐
2	Name	☐	☐
3	Name	☐	☐
Cost efficiency			
1	Cost-benefit-ratio (PMS)	☐	☐
2	Name	☐	☐
3	Name	☐	☐
Environmental Costs			
1	Name	☐	☐
2	Name	☐	☐
3	Name	☐	☐
Safety Costs			
1	Name	☐	☐
2	Name	☐	☐
3	Name	☐	☐
Social economy			
1	Name	☐	☐
2	Name	☐	☐
3	Name	☐	☐
Stakeholder satisfaction			
1	Name	☐	☐
2	Name	☐	☐
3	Name	☐	☐
User costs			
1	Name	☐	☐
2	Name	☐	☐
3	Name	☐	☐

3 FRANCE

3.1 CEREMA

3.1.1 Interviewer

Name	Philippe LEPERT	**Contact details**	

3.1.2 Interviewee

Organisation	CEREMA (formerly CETE)	**Country**	FRANCE
		Date	23rd of May 2016
Participants			
Name	Pascal Rossigny	Tel	
Role in Organisation	Deputy technical director, in charge of infrastructure	Email	Pascal.rossigny@cerema.fr
Road network	☐ Motorways [km]: ____6000 km (free motorways, national roads)_____ ☐ Other primary roads [km]: _____6000 km (national roads)_____ ☐ Secondary roads [km]: _____ ☐ Other roads [km]: _____ Please, give additional explanations about the road network if necessary:		

3.1.3 General questions about decision making

What is the focus, vision of your organisation from the socio-economic point of view (in general)?

We write methodology to assess socio-economic impact of transportation infrastructures

Do you take into account the socio-economic impacts in the process of making a decision/prioritization? If "yes" how?

Yes, but mainly for new roads, not so well for roads maintenance

3.1.4 Indicators for availability and disturbance

Here is a list of different groups for indicators of availability and disturbance. Which parameters / indicators are used to measure the socio-economic impacts of maintenance policy in the context of availability and disturbance?

#	Parameter or indicator / Description	In use?	Interested to use?
Accessibility			
1	Accessibility of emergency phones along the motorways	☒	☐
Condition			
1	Pavement Condition Index (IQRN: Condition Index of National Highways Pavements)	☒	☐
2	Bridge Condition Index (IQOA: Condition Index of the Bridges)	☒	☐
Congestion			
1		☐	☐
Restrictions to availability			
1		☐	☐
Travel time			
1		☐	☐

3.1.5 Indicators for road safety

Here is a list of different groups for indicators for road safety. Which parameters / indicators are used to measure the socio-economic impacts of maintenance policy in the context of road safety?			
#	**Parameter or indicator / Description**	**In use?**	**Interested to use?**
Accidents			
1	Accidents rate: how many accidents per 100 000 000 km driven	☒	☐
2	Accidents density: how many accidents per km and per year	☒	☐
Condition			
1		☐	☐
Overall safety			
1		☐	☐
Safety costs			
1	Fatality cost	☒	☐
User perception			
1		☐	☐

3.1.6 Indicators for environment

Here is a list of different groups for indicators for environment. Which parameters / indicators are used to measure the socio-economic impacts of maintenance policy in the context of environment?			
#	**Parameter or indicator / Description**	**In use?**	**Interested to use?**
Air quality			
1		☐	☐
CO_2			
1		☐	☐
Environmental costs			
1		☐	☐
Natural resources			
1		☐	☐
Noise			
1		☐	☐

Here is a list of different groups for indicators for environment. Which parameters / indicators are used to measure the socio-economic impacts of maintenance policy in the context of environment?			
#	**Parameter or indicator / Description**	**In use?**	**Interested to use?**
Soil and water quality			
1		☐	☐

3.1.7 Indicators for economy

Here is a list of different groups for indicators for economy. Which parameters / indicators are used to measure the socio-economic impacts of maintenance policy in the context of economy?			
#	**Parameter or indicator / Description**	**In use?**	**Interested to use?**
Asset value			
1	Asset value of national roads = cost of brand new national roads minus cost of maintenance and reparation needs	☒	☐
Condition			
1	Percentage of national roads with Pavement Condition Index under 12	☒	☐
Cost efficiency			
1		☐	☐
Environmental Costs			
1		☐	☐
Safety Costs			
1	Fatality cost	☒	☐
Social economy			
1		☐	☐
Stakeholder satisfaction			
1		☐	☐
User costs			
1		☐	☐

3.2 French motorway authority

This note reflects some discussions with private motorway network maintenance services, conducted as a part of the project ISABELA. It should be notice that the services could not provide the project with an extensive information, as some aspects are strategic for their authorities and thus, confidential.

The discussion was centered on the assessment, by the road authorities, of the societal impact of maintenance operations. New constructions are not in the scope of the project, and were therefore not dealt with during the discussions.

3.2.1 General questions about decision making

Most of the societal impact of road networks and roadworks are considered and assessed before the construction phase. Especially, most socio-economic impacts are assessed when a new motorway section or a new connection (entrance / exit) is under project. This is illustrated in the following paragraphs.

Some socio-economic assessments are mandatory, at the new construction design phase, never at the maintenance phase.

3.2.2 Indicators for availability and disturbance

The main indicator used to quantify maintenance disturbances is the length of congestion (in kilometers) generated by maintenance works. It depends on one hand on daily and weekly traffic volume and distribution, on the other hand on the workshop organization. This indication, average over a certain period and sum over the whole network, is used to report about the maintenance work efficiency.

The accessibility of the network is considered, as a component of its socio-economic impact or efficiency at the design phase of new infrastructure, not at the maintenance phase.

Travel time is well known on motorway, and only governed by speed limits (130 km/h in most cases, sometime 110 km/h). It is only affected – increased – by roadworks, since speed limits are lowered along these roadworks, and sometime congestions occur (see above).

3.2.3 Indicators for road safety

Road safety is the main aspect taken into account in road maintenance decision, beside and often before asset preservation. Road safety is primarily governed by the behaviour and condition of drivers. However, and as far as infrastructure is considered, it is more or less linked with:

- Pavement skid resistance,
- Road geometry (curves…),
- Transverse slope, rutting (a cause of water accumulation),
- Speed limit

Generally, when accidents are accumulating on a road section, or at a given point, specific studies are conducted to evaluate whether the infrastructure may have contributed to this accumulation or not. These studies mainly consist in confronting the above indicators to identify eventual inconsistencies.

Finally, statistics on road accident, as well as accident cost for Society, are not under the responsibility of the road authorities.

3.2.4 Indicators for environment

As previously explained, the different impacts of road network on the environment are considered far upstream, at the new construction design phase. At this phase, different

studies are conducted, such as a carbon, carbon dioxide, NO_x, etc. balances of the new project. As a part of any new infrastructure studies, some hydraulic survey and analysis are conducted to determine the need for retention basin(s) with appropriate filtration disposals, in order to avoid water pollution. These studies must also assess the risk for the flora and/or fauna. Measures required to compensate the negative impacts will be proposed and their relevance and efficiency justified.

As far as maintenance operations are considered, the main factor which is taken into account is the noise generation in urban or populated areas. This potential disturbance may orientate the choice of wearing course (porous asphalt, for instance).

> *Note: Regarding winter maintenance, the need for salt spreading is always governed by safety considerations. Environment preservation cannot be put in balance with user safety requirements, even if the operators always try to contain the quantity of salt to the strict minimum.*

3.2.5 Indicators for economy

There is no assessment of the infrastructure residual value.

Again, most of the socio-economic impacts of a new infrastructure are assessed at the design phase. This determined the “Go / No Go” decision, or the choice between several construction options.

However, when a significant maintenance operation is decided, and if several strategies or techniques may be considered, the “efficiency” of the operation on medium term may be investigated to select the most suitable option. These investigations will be performed by the project team. There is no dedicated model(s), but a usual methodology which take into account different criteria such as the economic costs and benefits of the new infrastructure, the discount rate, the potential disturbances for users, etc. Note that there is no model to link the traffic disturbances and their impacts on surrounding economy.

3.2.6 User satisfaction

On toll motorways, there are periodic questionnaires and/or interviews to collect the user perception. In most case, the road infrastructure (pavement, bridges…) is considered as very satisfactory. Criticisms address more often the condition, cleanness, efficiency of the facilities (parking or service areas, for instance).

4 IRELAND

4.1 Transport Infrastructure Ireland

4.1.1 Interviewer

Name	Alfred Weninger-Vycudil	**Contact details**	office@pms-consult.at

4.1.2 Interviewee

Organisation	Transport Infrastructure Ireland	**Country**	Ireland
		Date	25.05.16
Participants			
Name	Tom Casey	Tel	00353872445461
Role in Organisation	Network Manager	Email	Tom.Casey@tii.ie
Name		Tel	
Role in Organisation		Email	
Name		Tel	
Role in Organisation		Email	

Road network

☐ Motorways [km]: __900_____

☐ Other primary roads [km]: ___1800_____

☐ Secondary roads [km]: _____1350_____

☐ Other roads [km]: ____1350_____

Our national network is the principal system for transportation of goods and people between important centres of population. It varies between routes servicing ports and airports to low volume routes for community access and tourism. Other primary hence consists of both dual carriageway and single carriageway with higher traffic (about 10-50,000 AADT). Secondary is more focused on principal regional towns and urban centres ; single carriageway and typically 5-10,000AADT whilst other is low volume single carriageway catering for local communities and tourism with volumes from 2 – 5,000 AADT.:

4.1.3 General questions about decision making

What is the focus, vision of your organisation from the socio-economic point of view (in general)?

In the recent past our focus was building the network of Major Interurban Routes (motorways and other primary routes) We are only beginning to develop strategic positions on the wider social aspect (apart from safety which always has been fundamental) and are strengthening the economic perspectives to ensure adequate funding to retain an effective and efficient network – safe and fit for its intended use

One important point to note is funding! – the more indices we measure and report the higher the expectation of the stakeholders BUT they also need to be aware that some KPI's are very cost sensitive – the more demanding the target the higher the cost eg noise reduction. Hence it would be useful to look at the funding implications / sensitivities of the matrix chosen

Do you take into account the socio-economic impacts in the process of making a decision/prioritization? If "yes" how?

Yes – we need to demonstrate cost / benefits of our strategies this would include reduction in accident frequency / severity and lately CO_2 emissions. Environmentally we have produced noise mapping but no strategic programme to effect a network wide target has been developed. The lack of rail or waterways means roads are the principal method of enabling social / regional development. Whilst this has been recognised no specific target performance has been mandated. We are working to put these targets into effect and hence the interest in projects such as ISABELA

4.1.4 Indicators for availability and disturbance

Here is a list of different groups for indicators of availability and disturbance. Which parameters/indicators are used to measure the socio-economic impacts of maintenance policy in the context of availability and disturbance?			
#	**Parameter or indicator / Description**	**In use?**	**Interested to use?**
Accessibility			
1	Percentage of Population within 1km of surfaced roads	N	N
2	Road Density	N	N
3	Road Availability	N	N
4	Name	☐	☐
Condition			
1	Condition rating	Y	Y
2	International Roughness Index	Y	Y
3	Bridge health index	Y	Y
4	Deficiency Ranking	Y	Y
Congestion			
1	Congestion – (only on about 6 of busiest route sections)	N	Y
2	Maximum total length of congestion between A and B (or on a network)	N	Y
3	Name	☐	☐
4	Name	☐	☐
Restrictions to availability			
1	Closures (only on about 6 of busiest route sections)	N	Y
2	Name	☐	☐
3	Name	☐	☐
4	Name	☐	☐
Travel time			
1	Delays	N	Y
2	Mean travel time between A and B (as part of ITS pilot on selected routes)	Y	Y
3	Variability of travel time between A and B(as part of ITS pilot on selected routes)	Y	Y
4	Name	☐	☐

4.1.5 Indicators for road safety

Here is a list of different groups for indicators for road safety. Which parameters/indicators are used to measure the socio-economic impacts of maintenance policy in the context of road safety?			
#	**Parameter or indicator / Description**	**In use?**	**Interested to use?**
Accidents			
1	Number of fatalties (involving two-wheels, cars, bus and trucks) per veh.km	Y	Y
2	Number of accident involving vulnerable users	Y	Y
3	Accident victims	Y	Y
4	Higher than average occurrence for route segment	Y	Y
Condition			
1	Investigatory Level % above threshold	Y	Y
2	Name	☐	☐
3	Name	☐	☐
4	Name	☐	☐
Overall safety			
1	Safety KPI - People killed or seriously injured (KSI) in road traffic accidents.	N	Y
2	EuroRap score	Y	Y
3	Name	☐	☐
4	Name	☐	☐
Safety costs			
1	Accident Costs	Y	Y
2	Safety Costs	Y	Y
3	Name	☐	☐
4	Name	☐	☐
User perception			
1	Name	☐	☐
2	Name	☐	☐
3	Name	☐	☐
4	Name	☐	☐

4.1.6 Indicators for environment

Here is a list of different groups for indicators for environment. Which parameters/indicators are used to measure the socio-economic impacts of maintenance policy in the context of environment?			
#	**Parameter or indicator / Description**	**In use?**	**Interested to use?**
Air quality			
1	Name	☐	☐
2	Name	☐	☐
3	Name	☐	☐
CO_2			
1	Environmental index for GHG – Emissions rate for CO2 emissions from vehicles: EPIemissons,CO2	N	Y
2	CO2 emission costs	N	Y
3	Name	☐	☐
Environmental costs			
1	Name	☐	☐
2	Name	☐	☐
3	Name	☐	☐
Natural resources			
1	Name	☐	☐
2	Name	☐	☐
3	Name	☐	☐
Noise			
1	Noise Maps, Vehicle Noise	N	Y
2	Name	☐	☐
3	Name	☐	☐
Soil and water quality			
1	Name	☐	☐
2	Name	☐	☐
3	Name	☐	☐

4.1.7 Indicators for economy

Here is a list of different groups for indicators for economy. Which parameters/indicators are used to measure the socio-economic impacts of maintenance policy in the context of economy?			
#	**Parameter or indicator / Description**	**In use?**	**Interested to use?**
Asset value			
1	Mean residual life span of the asset	N	Y
2	Loss of asset value (reconstruction value)	N	Y
3	Preservation of road investment	N	Y
Condition			
1	Condition related asset value pavement	N	Y
2	Bridge health index	N	Y
3	Bridge sufficiency rating (Federal sufficency rating)	N	Y
Cost efficiency			
1	Program B/C or cost effectiveness	N	Y
2	Asset Sustainability Index	N	Y
3	Program B/C or cost effectiveness	N	Y
Environmental Costs			
1	Energy consumption cost	N	Y
2	Material consumption cost	N	Y
3	Name	☐	☐
Safety Costs			
1	Persons - Health	Y	Y
2	Name	☐	☐
3	Name	☐	☐
Social economy			
1	The contribution of the road operation to socio-economic development, Employment	N	Y
2	Name	☐	☐
Stakeholder satisfaction			
1	Stakeholder satisfaction KPI - Ind. 2- Number of responses from NRA / km NRA road network	N	Y
2	Stakeholder satisfaction KPI - Ind. 1- Number of complaints to NRA / km NRA road network	N	Y
3	Name	☐	☐
User costs			
1	Vehicle operating costs	N	Y
2	Time costs	N	Y
3	Name	☐	☐

5 The NETHERLANDS

5.1 RWS

5.1.1 Interviewer

Name	Maria de Lurdes Antunes & Pedro Marcelino	**Contact details**	mlantunes@lnec.pt

5.1.2 Interviewee

Organisation	RWS	**Country**	Netherlands
		Date	20-05-2016
Participants			
Name	Rob Hofman	Tel	
Role in Organisation	Responsible for validating innovations related to road pavements.	Email	rob.hofman@rws.nl
Name		Tel	
Role in Organisation		Email	
Name		Tel	
Role in Organisation		Email	
Road network	☒ Motorways [km]: 3100 ☐ Other primary roads [km]: _____ ☐ Secondary roads [km]: _____ ☐ Other roads [km]: _____ Please, give additional explanations about the road network if necessary:		

5.1.3 General questions about decision making

What is the focus, vision of your organisation from the socio-economic point of view (in general)?

Before starting any big projects on the road network (for example road widening), a Cost-Benefit Analysis (CBA) is performed. This CBA take into account some social effects.

Do you take into account the socio-economic impacts in the process of making a decision/prioritization? If "yes" how?

Yes, but normally this is taken into account in a qualitative way, not necessarily quantifying.

5.1.4 Indicators for availability and disturbance

Here is a list of different groups for indicators of availability and disturbance. Which parameters/indicators are used to measure the socio-economic impacts of maintenance policy in the context of availability and disturbance?			
#	**Parameter or indicator / Description**	**In use?**	**Interested to use?**
Accessibility			
1	Road availability	☒	☐
2	Possibility of using other transport modes during maintenance closures	☒	☐
3	Importance of the road connection	☒	☐
4		☐	☐
Condition			
1	Road condition	☒	☐
2	Maintainability	☒	☐
3		☐	☐
4		☐	☐
Congestion			
1	Total length of congestion	☒	☐
2	Congestion time	☒	☐
3		☐	☐
4		☐	☐
Notes	Congestion on working days or rush hours is given a higher rating then congestion on weekends or night time		
Restrictions to availability			
1	Closures	☒	☐
2	Number of vehicles affected	☒	☐
3		☐	☐
Notes	Road closures depend on traffic density No closures due to delay on winter maintenance, . Due to preventive maintenance. In extreme situations less driven lanes may be closed or a speed reduction is maintained at parts of the network		
Travel time			
1	Delays	☒	☐
2	Lost hours (passenger or goods)	☒	☐
3		☐	☐
Notes	Lost hours can have different ratings in the process, according to the importance of the connection		

5.1.5 Indicators for road safety

Here is a list of different groups for indicators for road safety. Which parameters/indicators are used to measure the socio-economic impacts of maintenance policy in the context of road safety?			
#	**Parameter or indicator / Description**	**In use?**	**Interested to use?**
Accidents			
1	Total number of accidents	☒	☐
2	Number of fatalities	☒	☐
3	Number of injuries	☒	☐
4		☐	☐
Condition			
1	Skid resistance	☒	☐
2	Rut depth	☒	☐
3	Ravelling	☒	☐
Notes	Technical parameters related to safety, such as skid resistance, act as triggers for immediate actions: repair within 24 h or 1 week, depending on the type of road and seriousness. Small defects repaired in weekend, other within 24 h.		
Overall safety			
1		☐	☐
2		☐	☐
3		☐	☐
4		☐	☐
Safety costs			
1	Accident costs	☒	☐
2		☐	☐
3		☐	☐
4		☐	☐
User perception			
1	Roughness (IRI)	☐	☐
2	Name	☐	☐
3	Name	☐	☐
4	Name	☐	☐

5.1.6 Indicators for environment

Here is a list of different groups for indicators for environment. Which parameters/indicators are used to measure the socio-economic impacts of maintenance policy in the context of environment?			
#	**Parameter or indicator / Description**	**In use?**	**Interested to use?**
Air quality			
1	Environmental index for Air Quality: Emission and Exposure EPI for Nox	☒	☐
2	Environmental index for Air Quality: Emission and Exposure EPI for PM10 and PM2.5	☒	☐
3	Emissions due to traffic are not easy to assess. However, traffic speed reductions are enforced when the atmosphere is too smoggy.	☐	☐
CO_2			
1	Environmental index for Air Quality: Emission of CO2	☐	☒
2	Environmental index for embodied carbon reduction for different strategies in building and maintaining the infrastructure	☒	☐
3	Environmental index for GHG – CO2 equivalent emissions during road construction and maintenance activities	☒	☐
Notes			
Environmental costs			
1	In the procurement process, a bonus is given to the proposals with less environmental impact	☒	☐
2		☐	☐
3		☐	☐
Natural resources			
1	Material Resource Efficiency Indicator	☒	☐
2	Energy consumption	☒	☐
3	Consumption of non-renewable raw materials and recycling of waste in construction	☒	☐
Noise			
1	Noise Maps, Vehicle Noise	☒	☐
2	Traffic Noise Exposure (number of people exposed to excessive noise)	☒	☐
3	Traffic Noise Exposure (number of people exposed to excessive noise) in sensitive areas, like schools, hospitals, etc	☒	☐
Notes	The choice of solutions for reduction of noise exposure (pavement type, noise barriers or insulation) is always based on cost/benefit analysis		
Soil and water quality			
1	Concentration of pollutants in surface water	☒	☐

Here is a list of different groups for indicators for environment. Which parameters/indicators are used to measure the socio-economic impacts of maintenance policy in the context of environment?			
#	**Parameter or indicator / Description**	**In use?**	**Interested to use?**
2	Acidification	☒	☐
3	Release of dangerous substances due to accidents	☒	☐
4	Pollution of the verge	☒	☐
Notes	Release of dangerous substances due to accidents is cleaned ASAP, using the Best Available Techinque		

5.1.7 Indicators for economy

Here is a list of different groups for indicators for economy. Which parameters/indicators are used to measure the socio-economic impacts of maintenance policy in the context of economy?			
#	**Parameter or indicator / Description**	**In use?**	**Interested to use?**
Asset value			
1	Benefit / Cost for 100 years period	☒	☐
2		☐	☐
3		☐	☐
Condition			
1		☐	☐
2		☐	☐
3		☐	☐
Cost efficiency			
1		☐	☐
2		☐	☐
3		☐	☐
Environmental Costs			
1		☐	☐
2		☐	☐
3		☐	☐
Safety Costs			
1		☐	☐
2		☐	☐
3		☐	☐
Social economy			
1		☐	☐
2		☐	☐
3		☐	☐
Stakeholder satisfaction			
1		☐	☐
2		☐	☐
3		☐	☐
User costs			
1		☐	☐
2		☐	☐
3		☐	☐

6 NORWAY

6.1 NPRA

6.1.1 Interviewer

Name	Philippe Lepert	**Contact details**	

6.1.2 Interviewee

Organisation	Norwegian Public Roads Administration	**Country**	Norway
		Date	June 7th 2016
Participants			
Name	Even K. Sund	Tel	+4793058635
Role in Organisation	Senior Principal Engineer, Road Management and Development Road Directorate, NPRA	Email	even.sund@vegvesen.no
Road network	☐ Motorways [km]: _____~500_____ ☐ Other primary roads [km]: _____~10000_____ ☐ Secondary roads [km]: _____44500_____ ☐ Other roads [km]: _____43100*_____ Please, give additional explanations about the road network if necessary: This is the road network managed by the NPRA. 10.500 km of “National roads” owned and financed by the national government, and 44.500 km owned and financed by 18 counties (regions). *There are 43100 km municipal roads in Norway. These are owned, financed and managed by each municipality (not by the NPRA)		

6.1.3 General questions about decision making

What is the focus, vision of your organisation from the socio-economic point of view (in general)?

The vision of the NPRA: "*On the road to a better society*"

Our vision signals that the Norwegian Public Roads Administration is an important contributor to, and participant in, society. We must develop good road systems available to all, where transport does not cause serious damage to human beings or the environment. This contributes to achieving goals such as developing industry, giving people more opportunity to participate in society, and increasing their quality of life.

Do you take into account the socio-economic impacts in the process of making a decision/prioritization? If "yes" how?

Yes, especially for the planning of new roads, or major improvements to the existing road network (investment-projects) - but I interpret this questionnaire to be focused on the maintenance phase. If not, further information can be provided on the procedures used in the planning phase of investment projects.

For the maintenance phase the socio-economic impacts have partially been taken into account when developing the Maintenance and Operations Standards, which are formalized for National roads in guidelines issued by the Road Directorate. The planning of maintenance works should comply with the requirements in the Maintenance Standards, which includes trigger-values for maintenance of e.g. pavements. Other than this socio-economic factors are not systematically taken into the day-to-day (or year-to-year) planning of maintenance works, where the decision processes of the actual maintenance programs are quite decentralized in our organisation. Therefore, the format of this questionnaire does not really comply well to the way maintenance activities are planned in the NPRA.

Additional information:

An overriding goal for maintenance and operations is that they should be carried out in a way that minimises delays and other inconveniences for all road users. The level of service (LOS) for different road assets and operational tasks (e.g. winter operations) is described in guidelines given through "*Maintenance and Operations Standard*" (handbook No. R610). The LOS for pavements and winter operations is partially based on socio-economic analysis including agency and user costs (time costs, vehicle costs, accident costs and delay costs). For other assets (e.g. structures, road furniture, drainage, etc.) the LOS is determined by specific factors like risk-assessments, traffic safety etc. based on the intended purpose for the asset. At present, the NPRA has not implemented any comprehensive methodology for cross-asset prioritization or optimization.

In the *Maintenance and Operations Standard (R610)* the following general goals are set for maintenance and operations.

Accessibility

- Low transport costs and short travel times for all road users, including pedestrians, cyclists, public transport and freight transport
- Good accessibility for all road users

- Maintenance and operations should be carried out in a way that minimises delays and other inconveniences for all road users

Traffic safety

- Limit the number of killed and seriously injured as well as material damages
- Maintenance and operations should be carried out in way that does not cause traffic accidents

Environment

- Limit negative environmental impacts of the road network and traffic, as well as the impacts of maintenance and operations regarding noise, pollution, cultural- and natural environment, landscape and land use.

Universal design

- Assets or road routes that have been designed for universal use (e.g. by road users with disabilities), should fulfil their intended function throughout the whole year (all seasons).

Road asset value

- Socio-economical optimal management of existing road assets.

The general strategy for maintenance and operations is to secure that the road network is suitable for all road users, and that the road network sustains its function over time. In addition, the physical infrastructure should be taken care of in accordance to the long term goals for its use. Maintenance and operations should be carried out according to a strategy that includes preventive or corrective action for each asset based on an assessment of the economically optimal solution (regarding the socio-economical aspects and the agency costs)

At project level there are many detailed condition parameters which are used in assessing both maintenance needs and timing/planning of maintenance. Not all the parameters are measured, and some are not measured for the whole network. Listed below are some of the parameters for pavements

  - Rutting (measured whole network)
  - Roughness IRI (measured whole network)
  - Friction (measured according to specific directives)
  - Cracks
  - Cross-fall (measured whole network)
  - Pot-holes
  - Edges /level differences

Other assets covered by the *Maintenance and Operations Standard (R610)* are:

- Gravel roads
- Pedestrian/cycle paths (incl. stairs)
- Drainage system
- Roadside areas
- Avalanche/landslide protection systems
- Bridges, ferry quays and other structures
- Tunnels (incl. tunnel equipment)
- Road furniture and equipment
- Vegetation
- Cleaning operations
- Winter operations

NB! Regarding the questionnaire itself, the indicators listed as “in use” are the ones that are included in our top-level “management by objectives” (MBO) system. The indicators and target values are indifferent to what kind of actions (major investments, rehabilitation/minor improvements or maintenance) that are needed to reach the targets. It is therefore not easy to identify only the ones that relate to maintenance, but I have included those I think may be relevant.

As you can see there are not very many indicators that are related to maintenance and operations in our top-level MBO-system.

Presently the NPRA has not identified other indicators (in top-level MBO-system) related to maintenance that we could be interested to use, but my personal opinion is that we should at least have indicators reflecting the overall condition for bridges, tunnels and drainage system. Maybe also some important road furniture (signs, guard rails, noise protection barriers, etc.). It could also be possible to develop some indicators related to accumulated delays for road users because of road/maintenance works?

6.1.4 Indicators for availability and disturbance

Here is a list of different groups for indicators of availability and disturbance. Which parameters / indicators are used to measure the socio-economic impacts of maintenance policy in the context of availability and disturbance?			
#	**Parameter or indicator / Description**	**In use?**	**Interested to use?**
Accessibility			
1	Name	☐	☐
2	Name	☐	☐
3	Name	☐	☐
4	Name	☐	☐
Condition			
1	Name	☐	☐
2	Name	☐	☐
3	Name	☐	☐
4	Name	☐	☐
Congestion			
1		☐	☐
2	Name	☐	☐
3	Name	☐	☐
4	Name	☐	☐
Restrictions to availability			
1	No. of sections/locations prone to avalanches/rock slides that have been secured/improved last year (also relevant for safety)	X	☐
2	Name	☐	☐
3	Name	☐	☐
4	Name	☐	☐
Travel time			
1	Name	☐	☐
2	Name	☐	☐
3	Name	☐	☐
4	Name	☐	☐

6.1.5 Indicators for road safety

Here is a list of different groups for indicators for road safety. Which parameters / indicators are used to measure the socio-economic impacts of maintenance policy in the context of road safety?			
#	**Parameter or indicator / Description**	**In use?**	**Interested to use?**
Accidents			
1	No of killed and seriously wounded	x	☐
2	Name	☐	☐
3	Name	☐	☐
4	Name	☐	☐
Condition			
1	Percentage of roads with satisfactory pavement condition	x	☐
2	No. of existing tunnels that comply with the European Tunnel Safety Act	x	☐
3	Name	☐	☐
4	Name	☐	☐
Overall safety			
1	Km of roads with milled sinusoidal grooves in connection with centre road marking	x	☐
2	Name	☐	☐
3	Name	☐	☐
4	Name	☐	☐
Safety costs			
1	Name	☐	☐
2	Name	☐	☐
3	Name	☐	☐
4	Name	☐	☐
User perception			
1	Name	☐	☐
2	Name	☐	☐
3	Name	☐	☐
4	Name	☐	☐

6.1.6 Indicators for environment

Here is a list of different groups for indicators for environment. Which parameters / indicators are used to measure the socio-economic impacts of maintenance policy in the context of environment?			
#	**Parameter or indicator / Description**	**In use?**	**Interested to use?**
Air quality			
1	No. of cities/urban areas that exceed the permitted values for PM10 (max daily values or annual average values)	x	☐
2	No. of cities/urban areas that exceed the permitted values for NO2 (max hourly values or annual average values)	☐	☐
3	Name	☐	☐
CO_2			
1	Name	☐	☐
2	Name	☐	☐
3	Name	☐	☐
Environmental costs			
1	Name	☐	☐
2	Name	☐	☐
3	Name	☐	☐
Natural resources			
1	Name	☐	☐
2	Name	☐	☐
3	Name	☐	☐
Noise			
1	No of residential homes or institutions (hospitals, retirement homes etc) exposed to noise values above limit values	x	☐
2	Change in no. of people exposed to indoor noise levels above 38 dB	x	☐
3	Name	☐	☐
Soil and water quality			
1	Name	☐	☐
2	Name	☐	☐
3	Name	☐	☐

6.1.7 Indicators for economy

Here is a list of different groups for indicators for economy. Which parameters / indicators are used to measure the socio-economic impacts of maintenance policy in the context of economy?			
#	**Parameter or indicator / Description**	**In use?**	**Interested to use?**
Asset value			
1	Name	☐	☐
2	Name	☐	☐
Condition			
1	Maintenance backlog (in monetary value). Not a formal indicator, but has been estimated in preparation for the last two revisions of the National Transport Plan	(x)	☐
2	Name	☐	☐
3	Name	☐	☐
Cost efficiency			
1	Name	☐	☐
2	Name	☐	☐
Environmental Costs			
1	Name	☐	☐
2	Name	☐	☐
Safety Costs			
1	Name	☐	☐
2	Name	☐	☐
Social economy			
1	Name	☐	☐
2	Name	☐	☐
Stakeholder satisfaction			
1	Questionnaires to public regarding public satisfaction with condition of road network under summer and winter conditions (carried out as two separate surveys every 4 years) Not used as a formal indicator	x	☐
2	Name	☐	☐
3	Name	☐	☐
User costs			
1	Name	☐	☐
2	Name	☐	☐
3	Name	☐	☐

7 PORTUGAL

7.1 Infraestruturas de Portugal

7.1.1 Interviewer

Name	Maria de Lurdes Antunes	**Contact details**	mlantunes@lnec.pt

7.1.2 Interviewee

Organisation	Infraestruturas de Portugal, S.A.	**Country**	Portugal
		Date	
Participants			
Name	Rui Miguel Alves de Oliveira Coutinho	Tel	211022476
Role in Organisation	Diretor de Asset Management	Email	rui.coutinho@infraestruturasdeportugal.pt
Name	Manuela Mesquita Trindade	Tel	211022281
Role in Organisation	Diretora do Departamento de Modelação e Planificação	Email	manuela.trindade@infraestruturasdeportugal.pt
Name	João Manuel Ribeiro Fonseca	Tel	211022885
Role in Organisation	Departamento de Modelação e Planificação	Email	
Road network	☒ Motorways [km]: _____ ☒ Other primary roads [km]: _____ ☒ Secondary roads [km]: _____ ☐ Other roads [km]: _____ Please, give additional explanations about the road network if necessary:		

7.1.3 General questions about decision making

What is the focus, vision of your organisation from the socio-economic point of view (in general)?

Vision: To position the *Infraestruturas de Portugal* as manager of multimodal mobility, enhancing the asset management, synergies and new revenues to ensure the provision of a sustainable service, safe and efficient

Do you take into account the socio-economic impacts in the process of making a decision/prioritization? If "yes" how?

Yes, we have.

Are considered the following criteria in the process of making a decision/prioritization:

- Environment;
- Investment;
- Being enhancer of investments made;
- It can be financed from European Union;
- It can be financed by EIB;
- Specific territorial impact;
- Municipal involvement (number of municipalities and population)

7.1.4 Indicators for availability and disturbance

Here is a list of different groups for indicators of availability and disturbance. Which parameters/indicators are used to measure the socio-economic impacts of maintenance policy in the context of availability and disturbance?			
#	**Parameter or indicator / Description**	**In use?**	**Interested to use?**
Accessibility			
1	Percent of population within 1km of surfaced road	☒	☐
2	Road density	☒	☐
3	Road availability	☐	☐
Notes			
Condition			
1	International Roughness Index	☒	☐
2	Pavement Condition rating / Quality index	☒	☐
3	Bridge sufficiency rating	☒	☐
Notes			
Congestion			
1	Congestion	☐	☒
2	Maximum total length of congestion between A and B (or on a network)	☐	☒
Notes			
Restrictions to availability			
1	Closures	☐	☒
2	Clearance and load restrictions	☐	☐
Notes			
Travel time			
1	Delays	☐	☒
2	Mean travel time between A and B	☐	☒
3	Variability of travel time between A and B	☐	☐
Notes			

7.1.5 Indicators for road safety

Here is a list of different groups for indicators for road safety. Which parameters/indicators are used to measure the socio-economic impacts of maintenance policy in the context of road safety?			
#	**Parameter or indicator / Description**	**In use?**	**Interested to use?**
Accidents			
1	Number of accidents	☐	☒
2	Number of injuries	☒	☐
3	Number of deaths	☒	☐
4	Number of accident involving vulnerable users	☐	☒
5	Number of fatalities per veh.km	☒	☐
6	Number of accidents per million vehicle kilometres	☒	☐
7	Number of accident victims	☒	☐
Notes			
Condition			
1	Skid resistance	☒	☐
2	Rut depth	☐	☐
3	International Roughness Index	☒	☐
4	Condition rating / Quality Index	☐	☐
Notes			
Overall safety			
1	Eurorap Score	☐	☒
Notes			
Safety costs			
1	Annual accident costs	☐	☒
2	Safety costs	☐	☒
Notes			
User perception			
1	Operation quality (Comfort), physical impact of travelling on the user	☐	☒
2	Operation quality (Comfort), psychological impact of travelling on the user	☐	☒
Notes			

7.1.6 Indicators for environment

Here is a list of different groups for indicators for environment. Which parameters/indicators are used to measure the socio-economic impacts of maintenance policy in the context of environment?			
#	**Parameter or indicator / Description**	**In use?**	**Interested to use?**
Air quality			
1	Environmental index for Air Quality: Emission and Exposure EPI for Nox	☐	☒
2	Environmental index for Air Quality: Emission and Exposure EPI for PM10 and PM2.5	☐	☐
3	Environmental index for Air Quality: Emission and Exposure EPI for CO	☐	☐
4	Environmental index for Air Quality: Emission and Exposure Aldehydes, sulphur dioxide, polycyclic aromatic, hydro-carbons	☐	☐
5	Environmental index for Air Quality: Emission of CO2	☐	☒
Notes			
CO_2			
1	Environmental index for GHG – Emissions rate for CO2 emissions from vehicles: EPI emissons	☐	☒
2	Environmental index for embodied carbon reduction: EPIECR	☐	☐
3	Environmental index for GHG – CO2 equivalent emissions during road construction and maintenance activities	☐	☒
3	Environmental index for GHG – CO2 equivalent emissions during road construction and maintenance activities	☐	☐
4	Emissions of ozone precursors	☐	☐
Notes			
Environmental costs			
1	Name	☐	☐
Natural resources			
1	Material Resource Efficiency Indicator (MREI): EPIResources	☐	☒
2	Energy consumption	☐	☒
3	Consumption of non-renewable raw materials and recycling of waste in construction	☒	☐
4	Use of fossil fuels/renewable energy	☒	☐
Notes			

Here is a list of different groups for indicators for environment. Which parameters/indicators are used to measure the socio-economic impacts of maintenance policy in the context of environment?			
#	**Parameter or indicator / Description**	**In use?**	**Interested to use?**
Noise			
1	Noise Maps, Vehicle Noise	☒	☐
2	Vibration Maps	☐	☐
3	Traffic Noise Exposure	☒	☐
4	Noise annoyance to humans	☐	☐
5	Environment preservation (Noise)	☒	☐
6	Number of noise complaints	☒	☐
7	Number of dwellings exposed to excessive noise	☒	☐
Notes			
Soil and water quality			
1	Environmental index for Water quality and drainage system: EPIWater	☐	☒
2	Environmental index for Water Pollution from winter maintenance activities (salting): EPISalt	☐	☒
3	Emissions of substances that cause acidification and eutrophication	☐	☐
3	Concentration of pollutants in soils	☐	☐
4	Concentration of pollutants in surface water	☐	☐
5	Acidification	☐	☐
6	Toxicity	☐	☐
7	Eutrophication	☐	☐

7.1.7 Indicators for economy

Here is a list of different groups for indicators for economy. Which parameters/indicators are used to measure the socio-economic impacts of maintenance policy in the context of economy?			
#	**Parameter or indicator / Description**	**In use?**	**Interested to use?**
Asset value			
1	Asset value	☐	☒
2	Mean residual life span of the asset	☐	☒
3	Loss of asset value (reconstruction value)	☐	☒
4	Salvage value	☐	☒
5	Preservation of road investment	☐	☒
6	Condition related asset value pavement	☐	☒
Notes			
Condition			
1	International Roughness Index	☒	☐
2	Pavement Condition rating / Quality index	☒	☐
3	Bridge Health Index	☒	☐
4	Bridge sufficiency rating	☒	☐
Notes			
Cost efficiency			
1	Return on Investment (Construction Expenditure)	☐	☒
2	Preservation of road investment	☐	☒
3	Impact of executing the interventions	☐	☒
4	Road Maintenance Effectiveness RME	☐	☒
5	Program B/C or cost effectiveness	☐	☒
6	Network depreciation	☐	☒
7	Cost recovery	☐	☒
8	Asset Sustainability Index	☐	☒
Notes			
Environmental Costs			
1	Environment preservation	☐	☒
2	Noise costs	☐	☒
3	CO2 emission costs	☐	☒
4	Air pollution costs	☐	☒
5	Noise cost (affecting Users)	☐	☐
6	Particle emissions cost	☐	☐
7	Energy consumption cost	☐	☒

Here is a list of different groups for indicators for economy. Which parameters/indicators are used to measure the socio-economic impacts of maintenance policy in the context of economy?			
#	**Parameter or indicator / Description**	**In use?**	**Interested to use?**
8	Material consumption cost	☐	☒
9	Land consumption cost	☐	☐
10	Emissions during maintenance periods	☐	☐
Notes			
Safety Costs			
1	Accident cost	☐	☒
2	Persons - Health	☐	☒
Notes			
Social economy			
1	Operation quality (Comfort), physical impact of travelling on the user	☐	☒
2	Operation quality (Comfort), psychological impact of travelling on the user	☐	☒
3	The contribution of the road operation to socio-economic development, Employment	☐	☒
4	Total maintenance costs per capita	☐	☐
Notes			
Stakeholder satisfaction			
1	Operation quality (Comfort), physical impact of travelling on the user	☐	☒
2	Operation quality (Comfort), psychological impact of travelling on the user	☐	☐
Notes			
User costs			
1	Time costs	☐	☒
2	Vehicle operating costs	☐	☒
3	Reliability of travel time	☐	☒
Notes			

8 SERBIA

8.1 Roads of Serbia

8.1.1 Interviewer

Name	Goran Mladenović Nikola Tanasić	**Contact details**	emladen@imk.grf.bg.ac.rs nikola@grf.bg.ac.rs

8.1.2 Interviewee

Organisation	Public Enterprise “Roads of Serbia”	**Country**	Serbia
		Date	June 14th 2016
Participants			
Name	Momčilo Veljović	Tel	+381 66 8665122
Role in Organisation	Senior Bridge Engineer, Sector for Traffic Control Information Systems	Email	momcilo.veljovic@putevi-srbije.rs
Name	Đorđe Mitrović	Tel	*381 66 8665406
Role in Organisation	Head of Department for Environmental Protection	Email	djordje.mitrovic@putevi-srbije.rs
Name	Vlado Rakočević	Tel	+381 64 1791510
Role in Organisation	Head of Department for Traffic Safety	Email	vlado.rakocevic@putevi-srbije.rs
Road network	☒ Motorways [km]: 669 ☒ Other primary roads [km]: 4109 ☒ Secondary roads [km]: 10240 ☐ Other roads [km]: _____ Please, give additional explanations about the road network if necessary:		

8.1.3 General questions about decision making

What is the focus, vision of your organisation from the socio-economic point of view (in general)?

PE "Roads of Serbia" is obliged to provide permanent, continuous and quality maintenance and protection of main and regional roads, as well as to enable safe and undisturbed traffic.

Do you take into account the socio-economic impacts in the process of making a decision/prioritization? If "yes" how?

The social indicators are not used systematically in the decision making process in the asset management. However, some groups of indicators or some indicators are used in the planning and design for interventions on the road network.

.

On the following pages:

Column "In use?": State if you use the specific indicator. Use green tick mark for yes or red cross mark for no.

Column "Interested to use?": State if the specific indicator sounds (is structured) interesting enough that you would possibly be willing to use it. Use green tick mark in combination with yes for you already use it (first column), yellow yes mark for "you don't use it yet but it sounds interesting enough to possibly use it", and red cross mark for no, no interest in the indicator.

Aditional comment: Short added info or comment for further explanation of answer written.

Empty lines: Place to add indicator which you possibly use but is not listed under specific group. If you type in the name of indicator it will show in blue. Add new lines if needed.

8.1.4 Indicators for availability and disturbance

Here is a list of different groups for indicators of availability and disturbance. Which parameters/indicators are used to measure the socio-economic impacts of maintenance policy in the context of availability and disturbance?				
#	**Parameter or indicator / Description**	**In use?**	**Interested to use?**	**Additional Comment**
Accessibility		☑ ☒	☑ ☑ ☒	
1	Percent of population within 1km of surfaced road	☒	☒	
2	Road density	☑	☑	
3	Road availability	☒	☒	
Condition				
1	International Roughness Index	☑	☑	
2	Condition rating	☒	☒	
3	Bridge sufficiency rating (Federal sufficiency rating)	☒	☒	
4	Deficiency ranking	☒	☒	
5	Hydraulic Vulnerability Rating Score	☒	☒	
Congestion				
1	Congestion	☐	☑	Taken into account for bypasses
2	Maximum total length of congestion between A and B (or on a network)	☐	☑	
Restrictions to availability				
1	Closures	☒	☒	
2	Clearance and load restrictions	☑	☑	
3	Nr of days of snow and/or ice free surface	☒	☒	
Travel time				
1	Delays	☒	☒	
2	Mean travel time between A and B	☒	☒	
3	Variability of travel time between A and B	☒	☒	
4		☐	☐	

8.1.5 Indicators for road safety

Here is a list of different groups for indicators for road safety. Which parameters/indicators are used to measure the socio-economic impacts of maintenance policy in the context of road safety?				
#	**Parameter or indicator / Description**	**In use?**	**Interested to use?**	**Additional Comment**
Accidents		☑ ☒	☑ ☑ ☒	
1	Number of fatalities (involving two-wheels, cars, bus and trucks) per veh.km	☑	☑	
2	Number of accident involving vulnerable users	☑	☑	
3	Serious Casualty Crashes (Population) Area: Road System Performance – Technical Efficiency Purpose: Monitor incidents of major safety failures in road system	☒	☒	
4	user safety (accidents), injury	☒	☒	
5	user safety (accidents), death	☑	☑	
6	Safety (Accidents), injury	☒	☒	
7	Safety (Accidents), death	☑	☑	
8	Safety KPI - People killed or seriously injured (KSI) in road traffic accidents	☒	☒	
9	Number of fatalities and injuries per million vehicle kilometres	☒	☒	
10	Number of accidents per million vehicle kilometres	☒	☒	
11	Accident victims	☒	☒	
12	Accidents	☒	☒	
13	Black spots	☐	☑	
14		☐	☐	
Condition				
1	International Roughness Index	☑	☑	
2	Condition rating (according to the HDM methodology)	☑	☑	
3	Bridge sufficiency rating (Federal sufficiency rating)	☒	☒	
4	Deficiency ranking	☑	☑	
5	Hydraulic Vulnerability Rating Score	☒	☒	
6	Skid resistance	☑	☑	
7	Rutting	☑	☑	

Here is a list of different groups for indicators for road safety. Which parameters/indicators are used to measure the socio-economic impacts of maintenance policy in the context of road safety?				
#	**Parameter or indicator / Description**	**In use?**	**Interested to use?**	**Additional Comment**
Overall safety				
1	Eurorap Score	☐	☑	Survey performed on part of the network (3000 km) with the intention to be expanded
2		☐	☐	
Safety costs				
1	Accident cost	☒	☒	
2	Annual accident costs	☒	☒	
3	Safety costs	☒	☒	
4		☐	☐	
User perception				
1	Operation quality (Comfort), physical impact of travelling on the user	☒	☒	
2	Operation quality (Comfort), psychological impact of travelling on the user	☒	☒	
3		☐	☐	

8.1.6 Indicators for environment

Here is a list of different groups for indicators for environment. Which parameters/indicators are used to measure the socio-economic impacts of maintenance policy in the context of environment?				
#	**Parameter or indicator / Description**	**In use?**	**Interested to use?**	**Additional Comment**
Air quality		☑ ☒	☑ ☑ ☒	
1	Environmental index for Air Quality: Emission and Exposure EPI for NOx	☐	☑	Some data available
2	Environmental index for Air Quality: Emission and Exposure EPI for PM10 and PM2.5	☐	☑	Some data available
3	Direct toxicity of air pollutants (no models)	☒	☒	
4	Air Quality KPI - Level 1 - Number of AQZAs /1000 km of NRA road network	☐	☑	Some data available
5	Air Quality KPI - Level 2 - Length of road network within AQZAs /1000 km of NRA road network	☐	☑	Some data available
6	Environmental index for Air Quality: Emission and Exposure EPI for CO	☐	☑	Some data available
7	Environmental index for Air Quality: Emission and Exposure Aldehydes, sulphur dioxide, polycyclic aromatic, hydro-carbons	☐	☑	Some data available
8	Environmental index for Air Quality: Emission of CO2	☐	☑	Some data available
CO_2				
1	Environmental index for GHG – Emissions rate for CO2 emissions from vehicles: EPIemissons,CO2 Purpose: To assess the CO2 emission rate, taking into account the emissions model using traffic flow data and vehicle emission factors per km of road	☐	☑	
2	Environmental index for embodied carbon reduction: EPIECR Purpose: To assess the difference in CO2 emissions for building and maintaining the infrastructure with different strategies	☐	☑	
3	Environmental index for GHG – CO2 equivalent emissions during road construction and maintenance activities Purpose: To assess the difference in GHG emissions for building and maintaining the infrastructure with different strategies	☐	☑	
4	Emissions of ozone precursors	☒	☒	
6		☐	☐	

Here is a list of different groups for indicators for environment. Which parameters/indicators are used to measure the socio-economic impacts of maintenance policy in the context of environment?				
#	**Parameter or indicator / Description**	**In use?**	**Interested to use?**	**Additional Comment**
Natural resources				
1	Material Resource Efficiency Indicator (MREI): EPIResources	☒	☒	
2	Energy consumption	☑	☑	
3	Consumption of non-renewable raw materials and recycling of waste in construction	☐	☑	
4	Use of fossil fuels/renewable energy	☐	☑	
Noise				
1	Noise Maps, Vehicle Noise	☑	☑	
2	Vibration Maps	☐	☑	
3	Traffic Noise Exposure	☑	☑	
4	Noise annoyance to humans	☐	☑	
5	Environment preservation (Noise)	☐	☑	
6	Number of noise complaints	☐	☑	
7	Number of dwellings exposed to excessive noise	☑	☑	
Soil and water quality				
1	Environmental index for Water quality and drainage system: EPIWater Purpose: To assess the capacity of the drainage system to collect, transport and potentially treat the pollution before being finally discharged into the environment	☐	☑	Some data available
2	Environmental index for Water Pollution from winter maintenance activities (salting): EPISalt Purpose: To compare salt loadings for the road section against the average for the network, weighted by local requirements (intensity of winter maintenance) and the sensitivity of the environment.	☐	☑	Some data available
3	Emissions of substances that cause acidification and eutrophication	☐	☑	Some data available
4	Concentration of pollutants in soils	☑	☑	
5	Concentration of pollutants in surface water	☑	☑	
6	Acidification	☒	☒	
7	Toxicity	☒	☒	

Here is a list of different groups for indicators for environment. Which parameters/indicators are used to measure the socio-economic impacts of maintenance policy in the context of environment?				
#	**Parameter or indicator / Description**	**In use?**	**Interested to use?**	**Additional Comment**
8	Eutrophication	☒	☒	
9	Release of dangerous goods due to accidents	☐	☑	
11		☐	☐	

8.1.7 Indicators for economy

Here is a list of different groups for indicators for economy. Which parameters/indicators are used to measure the socio-economic impacts of maintenance policy in the context of economy?				
#	**Parameter or indicator / Description**	**In use?**	**Interested to use?**	**Additional Comment**
Asset value		☑ ☒	☑ ☑ ☒	
1	Asset value	☑	☑	
2	Mean residual life span of the asset	☑	☑	
3	Loss of asset value (reconstruction value)	☒	☒	
4	Salvage value	☒	☒	
5	Preservation of road investment	☒	☒	
6	Condition related asset value pavement	☑	☑	
7	Bridge health index	☒	☒	
Condition				
1	Bridge health index	☒	☒	
2	International Roughness Index	☐	☐	
3	Condition rating	☐	☐	
4	Bridge sufficiency rating (Federal sufficiency rating)	☒	☒	
5	Deficiency ranking	☐	☐	
6	Hydraulic Vulnerability Rating Score	☒	☒	
Cost efficiency				
1	Return on Construction Expenditure Area: SRA Performance – Economic Effectiveness Purpose: Monitor the predicted community benefits from road transport and traffic authority programs	☒	☒	
2	Preservation of road investment	☒	☒	
3	Impact of executing the interventions	☒	☒	
4	Road Maintenance Effectiveness RME	☒	☒	
5	Return on investment (constr. expenditure)	☒	☒	
6	Program B/C or cost effectiveness	☑	☑	
7	Network depreciation	☒	☒	
8	Cost recovery	☒	☒	
9	Asset Sustainability Index	☒	☒	

Here is a list of different groups for indicators for economy. Which parameters/indicators are used to measure the socio-economic impacts of maintenance policy in the context of economy?				
#	**Parameter or indicator / Description**	**In use?**	**Interested to use?**	**Additional Comment**
10	Bridge sufficiency rating (Federal sufficiency rating)	☒	☒	
11	Deficiency ranking	☒	☒	
Environmental Costs				
1	Environment preservation (Noise)	☒	☒	
2	Noise costs	☒	☒	
3	CO2 emission costs	☒	☒	
4	Air pollution costs	☒	☒	
5	Noise cost (affecting Users)	☒	☒	
6	Particle emissions cost	☒	☒	
7	Energy consumption cost	☒	☒	
8	Material consumption cost	☒	☒	
9	Land consumption cost	☒	☒	
10	Emissions during maintenance periods	☒	☒	
Safety Costs				
1	Accident cost	☒	☒	
2	Persons - Health	☒	☒	
Social economy				
1	Operation quality (Comfort), physical impact of travelling on the user	☒	☒	
2	Operation quality (Comfort), psychological impact of travelling on the user	☒	☒	
3	The contribution of the road operation to socio-economic development, Employment	☒	☒	
4	Total maintenance costs per capita	☒	☒	
Stakeholder satisfaction				
1	Stakeholder satisfaction KPI - Ind. 1 - Number of complaints to NRA / km NRA road network	☑	☑	
2	Stakeholder satisfaction KPI - Ind. 2 - Number of responses from NRA / km NRA road network	☒	☒	
User costs				
1	Time costs	☒	☒	

Here is a list of different groups for indicators for economy. Which parameters/indicators are used to measure the socio-economic impacts of maintenance policy in the context of economy?				
#	**Parameter or indicator / Description**	**In use?**	**Interested to use?**	**Additional Comment**
2	Vehicle operating costs	☑	☑	
3	Reliability of travel time	☒	☒	
5		☐	☐	

9 SLOVENIA

9.1 DARS

9.1.1 Interviewer

Name	Darko Kokot (ZAG) Julijana Jamnik (CESTEL) Bajko Kulauzović (CESTEL)	**Contact details**	darko.kokot@zag.si, julijana.jamnik@cestel.si, bajko.kulauzovic@cestel.si

9.1.2 Interviewee

Organisation	Motorway Company in the Republic of Slovenia (DARS)	**Country**	Slovenia
		Date	16 May 2016
Participants			
Name	Marjan Zavec	Tel	+386 1 300 99 14
Role in Organisation	Head of the Road Infrastructure Unit	Email	Marjan.Zavec@DARS.si
Name	Andrej Zajec	Tel	+386 1 300 98 69
Role in Organisation	Road Infrastructure Unit, Specialist	Email	Andrej.Zajec@DARS.si
Name		Tel	
Role in Organisation		Email	
Road network	☐ Motorways [km]: 770 ☐ Other primary roads [km]: 0 ☐ Secondary roads [km]: 0 ☐ Other roads [km]: 0 Please, give additional explanations about the road network if necessary:		

9.1.3 General questions about decision making

What is the focus, vision of your organisation from the socio-economic point of view (in general)?

Mission: We ensure the socially responsible and efficient construction, management and maintenance of motorways and other infrastructure networks in the Republic of Slovenia and provide the conditions for their safe use.

Environmental Risk: In accordance with its role as a motorway and expressway management and maintenance company, DARS has implemented an environmental management system that it uses to consistently implement its environmental protection policy at all levels of its activity. The common thread is the assessment and analysis of environmental influences and aspects defined within the environmental aspect registry.

Risks related to environmental protection, including the risk of inappropriate waste disposal, risk of environmental pollution, and risks associated with protecting impact areas are becoming more and more important. The systematic management of these risks reflects the ecological awareness of employees. The likelihood of emergencies is also reduced through preventive measures. Training and drills aimed at learning appropriate reactions ensure that the impacts of any extraordinary events on the environment are kept at a minimum. By implementing appropriate activities within the scope of motorway maintenance, such as cleaning of retention basins, implementing the Annual Programme of Operational Monitoring of rainwater (APOM), etc., collecting, sorting and controlled disposal of waste, implementing measures to reduce light pollution, and by constantly controlling carbon monoxide concentrations and visibility in tunnels, we significantly contributed to reducing negative impacts on the environment and controlling the risks emerging in the environment.

Traffic and Safety Concerns: Traffic safety concerns are addressed through the coordinated action of everyone involved (DARS, Slovenian Traffic Safety Agency, police, Administration of the Republic of Slovenia for Civil Protection and Disaster Relief, media, etc.) in compliance with the annual traffic safety plan. Furthermore, we specifically address traffic safety of our field workers, where we note a large number of crashes into our maintenance technicians, causing injuries.

Noise: As part of the project entitled “Implementation of Operational Monitoring of Noise Pollution for the Network of Roads Operated by DARS”, we performed measurements of noise at 91 sites near motorways, made an inventory list of anti-noise protection devices and determined noise emission values for 327,000 buildings on motorway influence areas. On the basis of where the measured noise levels were over 65 dB during night time, we determined 14 locations for implementing protection against excessive noise pollution.

Waste Management: As part of its environmental protection policy in 2014, DARS focused on controlled waste management. All activities were aimed at proper waste management with consistent separation of waste already at its source. With this in mind, the Company purchased additional separate waste collection containers and reorganised some of its sites to allow for the separate collection of waste.

Waste can be divided into two groups: non-hazardous and hazardous waste. Among non-hazardous waste collected in 2014, the majority was collected during road cleaning; waste also came from de-sanding, from septic-tank water, from water used for cleaning tunnels, and from waste asphalt and waste plastics. The majority of hazardous waste consisted of waste oils, water containing oil, sludge, waste paints and varnishes, and absorbent papers (used to clean up roads after accidents).

Protection of Waters: Rainwater can be removed from motorways using two methods: with dispersed water drainage and controlled water drainage using retention basins. We thus perform the regular annual cleaning of all of the most burdened separators of oils (motorway bases and branches) and the basic maintenance of retention basins (grass cutting, repairing damaged parts and cleaning de-sanding areas). We also perform the

Annual Programme of Operational Monitoring (APOM) for waste water from rainfall, which measures the pollutant load of the drainage water from the retention basins. We conduct the controlled collection of tunnel waste water from washing that was handed over to waste disposal contractors as a specific kind of waste and then driven to waste-water treatment plants.

Gas Emissions: Tunnels longer than 500 metres are equipped with ventilation systems, where the automatic control of these systems enables us to monitor the gas emissions and visibility in the tunnels. Measurements are monitored by the control centres in charge of controlling traffic in individual tunnels. We reduce the number of traffic congestions by optimising traffic flow, thereby minimising gas emissions. This is achieved by forcing freight vehicles off motorways on time, through road diversions, additional variable message signs and coordination of all closures, as well as through the coordinated operation of control centres.

Environmental Impacts of Road Gritting: To prevent slippery roads and ensure safe road conditions in winter, roads are gritted using various gritting materials. These materials have a minimum impact on the ground, quality of surface and groundwater, flora, fauna, humans and animals, facilities (road lanes, bridges, viaducts and buildings), and on vehicles. The effect of spreading salt on the environment is also monitored during the implementation of the Annual Programme of Operational Monitoring (APOM) of rainwater from retention basins.

Communications with Motorway and Expressway Users: Users most often contact the Company with concrete questions, proposals, comments, complaints, and even praise relating to the use of motorways and expressways. Questions most frequently refer to reconstruction and maintenance works, traffic safety, and toll collection or vignettes. Persons residing in the vicinity of motorways are most interested in measures to reduce or eliminate the negative impacts of motorway traffic on the environment. We generally reply to most user queries within 24 hours.

Information on Public Road Conditions: By notifying users, we ensure added safety and a smoother flow of traffic on the motorways. The Traffic Information Centre (TIC) provides complete, quality, and up-to-date notifications to users regarding driving conditions on motorways and expressways. TIC operators also tune into various media outlets several times a day with live reports. Users can also obtain information via the toll-free telephone number, website, Twitter, text messages, smart mobile phone app or direct telephone conversations with operators.

Do you take into account the socio-economic impacts in the process of making a decision/prioritization? If "yes" how?

The EU Environment protection Act and based on it the National Environment Protection Strategy (NEPS) include guidance on: GHG reduction; air pollutants (NOx), particulate emissions, water and ground pollutants reduction; noise emission reduction; increase of energy efficiency.

Systematic collection of data on motorway network is put in place for:

- Noise; for all motorway sections (traffic above 3 mil of vehicles per year) there have been noise maps prepared,
- Monitoring of the surface run-off water,
- Retaining basins built for all new structures,
- In the planning phase: surveys to define animal passages (crossing points), green corridors are built there.
-
- According to the NEPS and when applicable the following applies:

- Water protection measures,
- Noise abating measures,
- Habitat protection (green corridors mainly for bears, hoofed animals and frogs).

Therefore, the usual use of the environment oriented data would include:

- Draining of the rainwater and surface run-off water,
- Introduction of low noise pavements,
- Pavement maintenance leading to smoother surfaces enabling lower energy consumption,
- Anti-noise barriers,
- Green corridors (over or below the road) for (mainly) bears, hoofed animals and frogs,
- Passive protection against noise on structures.

When planning works there are in general four aspects taken into account: economical, spatial (spatial planning), environmental and traffic/technical. Although they were initially meant equally important the prioritization is influenced very much by the environmental impacts (due to introducing some EU environmental acts into national legislation). This can have severe impact on budget of specific roads but there is usually some budget available to overcome this at the EU level (Cohesion funds etc.).

9.1.4 Indicators for availability and disturbance

Here is a list of different groups for indicators of availability and disturbance. Which parameters/indicators are used to measure the socio-economic impacts of maintenance policy in the context of availability and disturbance?				
#	**Parameter or indicator / Description**	**In use?**	**Interested to use?**	**Additional Comment**
Accessibility				
1	Percent of population within 1km of surfaced road	☒	☒	
2	Road density	☒	☒	
3	Road availability	☒	☒	
Condition				
1	International Roughness Index	☑	☑	
2	Condition rating	☑	☑	Including friction
3	Bridge sufficiency rating (Federal sufficiency rating)	☑	☑	
4	Deficiency ranking	☒	☒	
5	Hydraulic Vulnerability Rating Score	☒	☒	
6	Friction index	☑	☑	
Congestion				
1	Congestion	☐	☑	App already available
2	Maximum total length of congestion between A and B (or on a network)	☒	☒	
3	Nr. of congestions due to works	☑	☑	Congestion = queue length > 500m
Restrictions to availability				
1	Closures	☑	☑	
2	Clearance and load restrictions	☐	☑	Data available
3	Nr. of days of snow and/or ice free surface	☑	☑	
4	Nr. of restrictions due to severe wind	☑	☑	
5	Restrictions for HGV due to snow (in hours)	☑	☑	
Travel time				
1	Delays	☐	☑	Possible when info system upgraded
2	Mean travel time between A and B	☐	☑	App already available
3	Variability of travel time between A and B	☒	☒	

9.1.5 Indicators for road safety

Here is a list of different groups for indicators for road safety. Which parameters/indicators are used to measure the socio-economic impacts of maintenance policy in the context of road safety?				
#	**Parameter or indicator / Description**	**In use?**	**Interested to use?**	**Additional Comment**
Accidents				
1	Number of fatalities (involving two-wheels, cars, bus and trucks) per veh.km	☒	☒	Per network km available
2	Number of accident involving vulnerable users	☒	☒	Data available
3	Serious Casualty Crashes (Population) Area: Road System Performance – Technical Efficiency Purpose: Monitor incidents of major safety failures in road system	☒	☒	Data available
4	User safety (accidents), injury	☒	☒	
5	User safety (accidents), death	☒	☒	
6	Safety (Accidents), injury	☒	☒	
7	Safety (Accidents), death	☒	☒	
8	Safety KPI - People killed or seriously injured (KSI) in road traffic accidents	☒	☒	Data available
9	Number of fatalities and injuries per million vehicle kilometres	☑	☑	
10	Number of accidents per million vehicle kilometres	☑	☑	
11	Accident victims	☑	☑	
12	Accidents	☑	☑	
13	Nr. of crashes/impacts on queuing/stopped vehicles	☑	☑	
Condition				
1	International Roughness Index	☑	☑	
2	Condition rating	☑	☑	Including friction
3	Bridge sufficiency rating (Federal sufficiency rating)	☑	☑	
4	Deficiency ranking	☒	☒	
5	Hydraulic Vulnerability Rating Score	☒	☒	
6	Friction index	☑	☑	
Overall safety				
1	Eurorap Score	☑	☑	

Here is a list of different groups for indicators for road safety. Which parameters/indicators are used to measure the socio-economic impacts of maintenance policy in the context of road safety?				
#	**Parameter or indicator / Description**	**In use?**	**Interested to use?**	**Additional Comment**
Safety costs				
1	Accident cost	☒	☒	
2	Annual accident costs	☐	☑	Data available
3	Safety costs	☒	☒	
User perception				
1	Operation quality (Comfort), physical impact of travelling on the user	☒	☒	
2	Operation quality (Comfort), psychological impact of travelling on the user	☒	☒	

9.1.6 Indicators for environment

Here is a list of different groups for indicators for environment. Which parameters/indicators are used to measure the socio-economic impacts of maintenance policy in the context of environment?				
#	**Parameter or indicator / Description**	**In use?**	**Interested to use?**	**Additional Comment**
Air quality				
1	Environmental index for Air Quality: Emission and Exposure EPI for NOx	☑	☑	In tunnels only
2	Environmental index for Air Quality: Emission and Exposure EPI for PM10 and PM2.5	☑	☑	In tunnels only
3	Direct toxicity of air pollutants (no models)	☒	☒	
4	Air Quality KPI - Level 1 - Number of AQZAs /1000 km of NRA road network	☒	☒	
5	Air Quality KPI - Level 2 - Length of road network within AQZAs /1000 km of NRA road network	☒	☒	
6	Environmental index for Air Quality: Emission and Exposure EPI for CO	☒	☒	
7	Environmental index for Air Quality: Emission and Exposure Aldehydes, sulphur dioxide, polycyclic aromatic, hydro-carbons	☒	☒	
8	Environmental index for Air Quality: Emission of CO2	☒	☒	
CO_2				
1	Environmental index for GHG – Emissions rate for CO2 emissions from vehicles: $EPI_{emissons,CO2}$ Purpose: To assess the CO2 emission rate, taking into account the emissions model using traffic flow data and vehicle emission factors per km of road	☑	☑	In tunnels only
2	Environmental index for embodied carbon reduction: EPI_{ECR} Purpose: To assess the difference in CO2 emissions for building and maintaining the infrastructure with different strategies	☒	☒	
3	Environmental index for GHG – CO2 equivalent emissions during road construction and maintenance activities Purpose: To assess the difference in GHG emissions for building and maintaining the infrastructure with different strategies	☒	☒	
4	Emissions of ozone precursors	☒	☒	
Natural resources				
1	Material Resource Efficiency Indicator (MREI):	☐	☑	Data available

Here is a list of different groups for indicators for environment. Which parameters/indicators are used to measure the socio-economic impacts of maintenance policy in the context of environment?				
#	**Parameter or indicator / Description**	**In use?**	**Interested to use?**	**Additional Comment**
	$EPI_{Resources}$			
2	Energy consumption	☑	☑	Calculated at Ministry for whole network
3	Consumption of non-renewable raw materials and recycling of waste in construction	☒	☒	
4	Use of fossil fuels/renewable energy	☒	☒	
Noise				
1	Noise Maps, Vehicle Noise	☑	☑	
2	Vibration Maps	☒	☒	
3	Traffic Noise Exposure	☒	☒	
4	Noise annoyance to humans	☐	☑	
5	Environment preservation (Noise)	☒	☒	
6	Number of noise complaints	☑	☑	
7	Number of dwellings exposed to excessive noise	☑	☑	
8	Number of inhabitants protected against excessive noise	☐	☑	
Soil and water quality				
1	Environmental index for Water quality and drainage system: EPI_{Water} Purpose: To assess the capacity of the drainage system to collect, transport and potentially treat the pollution before being finally discharged into the environment	☐	☑	
2	Environmental index for Water Pollution from winter maintenance activities (salting): EPI_{Salt} Purpose: To compare salt loadings for the road section against the average for the network, weighted by local requirements (intensity of winter maintenance) and the sensitivity of the environment.	☐	☑	
3	Emissions of substances that cause acidification and eutrophication	☒	☒	
4	Concentration of pollutants in soils	☒	☒	
5	Concentration of pollutants in surface water	☑	☑	On part of network only
6	Acidification	☒	☒	

Here is a list of different groups for indicators for environment. Which parameters/indicators are used to measure the socio-economic impacts of maintenance policy in the context of environment?				
#	**Parameter or indicator / Description**	**In use?**	**Interested to use?**	**Additional Comment**
7	Toxicity	☒	☒	
8	Eutrophication	☒	☒	
9	Release of dangerous goods due to accidents	☒	☒	

9.1.7 Indicators for economy

Here is a list of different groups for indicators for economy. Which parameters/indicators are used to measure the socio-economic impacts of maintenance policy in the context of economy?				
#	**Parameter or indicator / Description**	**In use?**	**Interested to use?**	**Additional Comment**
Asset value				
1	Asset value	☑	☑	
2	Mean residual life span of the asset	☒	☒	
3	Loss of asset value (reconstruction value)	☑	☑	
4	Salvage value	☒	☒	
5	Preservation of road investment	☑	☑	
6	Condition related asset value pavement	☒	☒	
7	Bridge health index	☒	☒	
8	Asset value per road section	☑	☑	Road section as defined in road inventory or databank
9	Asset value per network per asset (pavements, bridges/viaducts, other structures including tunnels, furniture)	☐	☑	
Condition				
1	Bridge health index	☒	☒	
2	International Roughness Index	☑	☑	
3	Condition rating	☑	☑	Including friction
4	Bridge sufficiency rating (Federal sufficiency rating)	☑	☑	
5	Deficiency ranking	☒	☒	
6	Hydraulic Vulnerability Rating Score	☒	☒	
Cost efficiency				
1	Return on Construction Expenditure Area: SRA Performance – Economic Effectiveness Purpose: Monitor the predicted community benefits from road transport and traffic authority programs	☒	☒	
2	Preservation of road investment	☑	☑	
3	Impact of executing the interventions	☒	☒	
4	Road Maintenance Effectiveness RME	☒	☒	

Here is a list of different groups for indicators for economy. Which parameters/indicators are used to measure the socio-economic impacts of maintenance policy in the context of economy?				
#	**Parameter or indicator / Description**	**In use?**	**Interested to use?**	**Additional Comment**
5	Return on investment (constr. expenditure)	☒	☒	
6	Program B/C or cost effectiveness	☑	☑	
7	Network depreciation	☒	☒	
8	Cost recovery	☐	☑	Data available
9	Asset Sustainability Index	☒	☒	
10	Bridge sufficiency rating (Federal sufficiency rating)	☑	☑	
11	Deficiency ranking	☒	☒	
Environmental Costs				
1	Environment preservation (Noise)	☒	☒	
2	Noise costs	☐	☑	Data available
3	CO2 emission costs	☒	☒	
4	Air pollution costs	☒	☒	
5	Noise cost (affecting Users)	☒	☒	
6	Particle emissions cost	☒	☒	
7	Energy consumption cost	☒	☒	
8	Material consumption cost	☒	☒	
9	Land consumption cost	☒	☒	
10	Emissions during maintenance periods	☐	☑	
Safety Costs				
1	Accident cost	☒	☒	
2	Persons - Health	☒	☒	
Social economy				
1	Operation quality (Comfort), physical impact of travelling on the user	☒	☒	
2	Operation quality (Comfort), psychological impact of travelling on the user	☒	☒	
3	The contribution of the road operation to socio-economic development, Employment	☒	☒	
4	Total maintenance costs per capita	☐	☑	
Stakeholder satisfaction				

Here is a list of different groups for indicators for economy. Which parameters/indicators are used to measure the socio-economic impacts of maintenance policy in the context of economy?				
#	**Parameter or indicator / Description**	**In use?**	**Interested to use?**	**Additional Comment**
1	Stakeholder satisfaction KPI - Ind. 1 - Number of complaints to NRA / km NRA road network	☑	☑	
2	Stakeholder satisfaction KPI - Ind. 2 - Number of responses from NRA / km NRA road network	☒	☒	
3	Nr. of uses (clicks, phone calls, downloaded apps) of available means for traffic information (website, traffic info center, app)	☑	☑	
User costs				
1	Time costs	☒	☒	
2	Vehicle operating costs	☒	☒	
3	Reliability of travel time	☒	☒	

In blue – added according to interviewee responses

9.2 Slovenian Infrastructure Agency

9.2.1 Interviewer

Name	Julijana Jamnik CESTEL Ltd.	**Contact details**	+ 386 31 380 211 Julijana.Jamnik@cestel.si

9.2.2 Interviewee

Organisation	Ministry of Infrastructure, Slovenian Infrastructure Agency	**Country**	Slovenia
		Date	18 May 2016
Participants			
Name	Mrs. Ljiljana Herga	Tel	Tel. +386 1 47 88 060
Role in Organisation	Head of Sector for Road Management, Maintenance and Safety, Deputy Director	Email	Ljiljana.Herga@gov.si
Name		Tel	
Role in Organisation		Email	
Name		Tel	
Role in Organisation		Email	
Road network	☐ Motorways [km]: 0 ☐ Other primary roads [km]: 815 ☐ Secondary roads [km]: 5145 ☐ Other roads [km]: _____ Please, give additional explanations about the road network if necessary:		

9.2.3 General questions about decision making

What is the focus, vision of your organisation from the socio-economic point of view (in general)?

The Slovene Infrastructure Agency is a body affiliated to the Ministry of Infrastructure of the Republic of Slovenia.

It undertakes technical, developmental, organizational and administrative tasks relating to the construction, maintenance and protection of main and regional roads and some dual carriageway sections, as well as tasks relating to freight and passenger road transport.

The tasks of the Slovene Infrastructure Agency also include the preparation of proposals for investment into national roads under its jurisdiction, as well as coordination relating to the designing, construction and reconstruction of roads and its facilities. The Agency collects and processes the various data required in the assessment of road investment decisions and performs tasks adopted by the National Assembly, the Government and the Ministry of Infrastructure.

Their mission is:

- to optimally manage and protect available sources,
- maintain and construct state roads so that they contribute to improving transportability, safety, accessibility, usability, the minimum burdening of the natural and living environment, and to harmonization with the economic and spatial development of regions.

Their vision is:

- to improve the condition of roads to the point where they can be compared with roads in similarly developed European countries,
- to raise the level of services for road users,
- to reduce their costs and the costs of work implementation and management.

The asset management strategy is to have less than 20% of the road network in poor or very poor condition until 2030. Cyclic monitoring of the level of service is performed since 1995. Levels of service are defined in Slovene Technical Specifications (TSC) for each pavement property. All properties are characterized by 5 condition classes from very good to very poor. Threshold values are defined for those 5 condition classes. Annual reports are issued for individual measurements stating the sections in poor and very poor condition.)

Monitored KPIs: Visual pavement condition assessment, Longitudinal evenness, Skid resistance, Texture depth, Periodic and main inspection of bridging objects. Apart these data also traffic information is collected with traffic counters (induction loops) in a form of AADT (for 8 vehicle categories), traffic loading is calculated and the use of bridge weigh-in-motion (B-WIM) system is used for real traffic loading measurements.

According to the National Environment Protection Strategy and when applicable the following applies:

- water protection measures,
- noise abating measures,
- habitat protection (green corridors mainly for bears, hoofed animals and frogs).

The EU Environment protection Act and based on it the National Environment Protection Strategy include guidance on:

- GHG reduction;
- air pollutants (NOx),
- particulate emissions,
- water and ground pollutants reduction;
- noise emission reduction;
- increase of energy efficiency.

Despite this document there is almost no systematic collection of data on network level, except for noise. For all national roads with traffic above 3 million of vehicles per year noise maps are being prepared.

How do you collect customer feedback?

Questionnaires, open e-mail contact for feedback of any kind, P.O. box for collecting mail, books for collecting proposals/commentaries/complaints at entrances of SRA's buildings. All complaints/proposals/commentaries need to be answered properly (including introducing appropriate measures when relevant), even when they are offensive.

Technical KPIs?

KPIs are in place mainly for pavements and bridges and are used for determining condition of both and for deterioration models. Visual condition, bearing capacity, longitudinal evenness, skid resistance each with own KPI are input data for calculation of Total Condition Index for pavements; "Condition rating" (Damage indicator) and "Rating factor" (Structural safety indicator) for bridges.

Societal KPIs?

- Environmental Risk: In accordance with its role they have implemented an environmental management system for consistent implementation of environmental protection policy at all activities. The common thread is the assessment and analysis of environmental influences and aspects defined within the environmental aspect registry.
- Risks related to environmental protection, including the risk of inappropriate waste disposal, risk of environmental pollution, and risks associated with protecting impact areas are becoming more and more important. The likelihood of emergencies is also reduced through preventive measures. Training and drills aimed at learning appropriate reactions ensure that the impacts of any extraordinary events on the environment are kept at a minimum.
- Traffic and Safety Concerns: Traffic safety concerns are addressed through the coordinated action of everyone involved (Slovenian Infrastructure Agency, Slovenian Traffic Safety Agency, police, Administration of the Republic of Slovenia for Civil Protection and Disaster Relief, media, etc.) in compliance with the annual traffic safety plan. Furthermore, we specifically address traffic safety of our field workers with their high exposure to the open traffic.
- Information to public on Road Conditions: By notifying users, we ensure added safety and a smoother flow of traffic on the motorways. The Traffic Information Centre (TIC) provides complete, qualitative, and up-to-date notifications to users regarding driving conditions on motorways and expressways. TIC operators also tune into various media outlets several times a day with live reports. Users can also obtain information via the toll-free telephone number, website, Twitter, text messages, smart mobile phone app or direct telephone conversations with operators.
- Gas Emissions: Where tunnels are equipped with ventilation systems, the gas emissions and visibility in the tunnels are monitored. Measurements are monitored by the control

centres in charge of controlling traffic in individual tunnels. They reduce the number of traffic congestions by optimising traffic flow, thereby minimising gas emissions. This is achieved by forcing freight vehicles off motorways on time, through road diversions, additional variable message signs and coordination of all closures, as well as through the coordinated operation of control centres.

- Environmental Impacts of Road Gritting: To prevent slippery roads and ensure safe road conditions in winter, roads are gritted using various gritting materials. These materials have a minimum impact on the ground, quality of surface and groundwater, flora, fauna, humans and animals, facilities (road lanes, bridges, viaducts and buildings), and on vehicles.

Do you take into account the socio-economic impacts in the process of making a decision/prioritization? If "yes" how?

How is the above information considered in the analysis phase?

When planning works there are in general four aspects taken into account: economical, spatial (spatial planning), environmental and traffic/technical. Although they were initially meant equally important the prioritization is influenced very much by the environmental impacts (due to introducing some EU environmental acts into national legislation). This can have severe impact on budget of specific roads.

Social benefit (stakeholders)?

Mainly cost of delays and benefits for re-establishing fluent traffic flow are calculated using dedicated software.

9.2.4 Indicators for availability and disturbance

Here is a list of different groups for indicators of availability and disturbance. Which parameters/indicators are used to measure the socio-economic impacts of maintenance policy in the context of availability and disturbance?				
#	**Parameter or indicator / Description**	**In use?**	**Interested to use?**	**Additional Comment**
Accessibility				
1	Percent of population within 1km of surfaced road	☒	☒	
2	Road density	☒	☒	
3	Road availability	☒	☒	
Condition				
1	International Roughness Index	☑	☑	
2	Condition rating	☑	☑	
3	Bridge sufficiency rating (Federal sufficiency rating)	☑	☑	
4	Deficiency ranking	☒	☒	
5	Hydraulic Vulnerability Rating Score	☐	☑	
6	Friction index	☑	☑	
7	Bearing capacity	☑	☑	
Congestion				
1	Congestion	☐	☑	Data available
2	Maximum total length of congestion between A and B (or on a network)	☒	☒	
Restrictions to availability				
1	Closures	☑	☑	
2	Clearance and load restrictions	☑	☑	
3	Number of days of snow and/or ice free surface	☑	☑	
4	Number of restrictions due to severe winds	☑	☑	
Travel time				
1	Delays	☐	☑	
2	Mean travel time between A and B	☐	☑	
3	Variability of travel time between A and B	☒	☒	

Column “In use?”: State if you use the specific indicator. Use green tick mark for yes or red cross mark for no.

Column “Interested to use?”: State if the specific indicator sounds (is structured) interesting enough that you would possibly be willing to use it. Use green tick mark in combination with

yes for you already use it (first column), yellow yes mark for “you don’t use it yet but it sounds interesting enough to possibly use it”, and red cross mark for no, no interest in the indicator.

Aditional comment: Short added info or comment for further explanation of answer written.

Empty lines: Place to add indicator which you possibly use but is not listed under specific group. If you type in the name of indicator it will show in blue. Add new lines if needed.

9.2.5 Indicators for road safety

Here is a list of different groups for indicators for road safety. Which parameters/indicators are used to measure the socio-economic impacts of maintenance policy in the context of road safety?				
#	**Parameter or indicator / Description**	**In use?**	**Interested to use?**	**Additional Comment**
Accidents				
1	Number of fatalities (involving two-wheels, cars, bus and trucks) per veh.km	☒	☒	
2	Number of accident involving vulnerable users	☒	☒	
3	Serious Casualty Crashes (Population) Area: Road System Performance – Technical Efficiency Purpose: Monitor incidents of major safety failures in road system	☒	☑	Data available
4	User safety (accidents), injury	☑	☑	
5	User safety (accidents), death	☑	☑	
6	Safety (Accidents), injury	☒	☑	Data available
7	Safety (Accidents), death	☒	☑	Data available
8	Safety KPI - People killed or seriously injured (KSI) in road traffic accidents	☒	☑	Data available
9	Number of fatalities and injuries per million vehicle kilometres	☑	☑	
10	Number of accidents per million vehicle kilometres	☑	☑	
11	Accident victims	☑	☑	
12	Accidents	☑	☑	
Condition				
1	International Roughness Index	☑	☑	
2	Condition rating	☑	☑	
3	Bridge sufficiency rating (Federal sufficiency rating)	☑	☑	
4	Deficiency ranking	☒	☒	
5	Hydraulic Vulnerability Rating Score	☒	☑	
6	Friction index	☑	☑	
7	Bearing capacity	☑	☑	
Overall safety				
1	Eurorap Score	☑	☑	
Safety costs				

Here is a list of different groups for indicators for road safety. Which parameters/indicators are used to measure the socio-economic impacts of maintenance policy in the context of road safety?				
#	**Parameter or indicator / Description**	**In use?**	**Interested to use?**	**Additional Comment**
1	Accident cost	☒	☒	
2	Annual accident costs	☒	☒	
3	Safety costs	☒	☒	
User perception				
1	Operation quality (Comfort), physical impact of travelling on the user	☒	☒	
2	Operation quality (Comfort), psychological impact of travelling on the user	☒	☒	

9.2.6 Indicators for environment

Here is a list of different groups for indicators for environment. Which parameters/indicators are used to measure the socio-economic impacts of maintenance policy in the context of environment?				
#	**Parameter or indicator / Description**	**In use?**	**Interested to use?**	**Additional Comment**
Air quality				
1	Environmental index for Air Quality: Emission and Exposure EPI for NOx	☒	☒	
2	Environmental index for Air Quality: Emission and Exposure EPI for PM10 and PM2.5	☒	☒	
3	Direct toxicity of air pollutants (no models)	☒	☒	
4	Air Quality KPI - Level 1 - Number of AQZAs /1000 km of NRA road network	☒	☒	
5	Air Quality KPI - Level 2 - Length of road network within AQZAs /1000 km of NRA road network	☒	☒	
6	Environmental index for Air Quality: Emission and Exposure EPI for CO	☒	☒	
7	Environmental index for Air Quality: Emission and Exposure Aldehydes, sulphur dioxide, polycyclic aromatic, hydro-carbons	☒	☒	
8	Environmental index for Air Quality: Emission of CO2	☒	☒	
CO_2				
1	Environmental index for GHG – Emissions rate for CO2 emissions from vehicles: EPIemissons,CO2 Purpose: To assess the CO2 emission rate, taking into account the emissions model using traffic flow data and vehicle emission factors per km of road	☒	☒	
2	Environmental index for embodied carbon reduction: EPIECR Purpose: To assess the difference in CO2 emissions for building and maintaining the infrastructure with different strategies	☒	☑	
3	Environmental index for GHG – CO2 equivalent emissions during road construction and maintenance activities Purpose: To assess the difference in GHG emissions for building and maintaining the infrastructure with different strategies	☒	☑	
4	Emissions of ozone precursors	☒	☒	
Natural resources				
1	Material Resource Efficiency Indicator (MREI): $EPI_{Resources}$	☐	☑	Data available
2	Energy consumption	☑	☑	Calculated at Ministry for

Here is a list of different groups for indicators for environment. Which parameters/indicators are used to measure the socio-economic impacts of maintenance policy in the context of environment?				
#	**Parameter or indicator / Description**	**In use?**	**Interested to use?**	**Additional Comment**
				whole network
3	Consumption of non-renewable raw materials and recycling of waste in construction	☒	☑	Data available
4	Use of fossil fuels/renewable energy	☒	☒	
Noise				
1	Noise Maps, Vehicle Noise	☑	☑	
2	Vibration Maps	☒	☑	
3	Traffic Noise Exposure	☒	☒	
4	Noise annoyance to humans	☐	☑	
5	Environment preservation (Noise)	☒	☒	
6	Number of noise complaints	☑	☑	In complaints per year
7	Number of dwellings exposed to excessive noise	☑	☑	
Soil and water quality				
1	Environmental index for Water quality and drainage system: EPI_{Water} Purpose: To assess the capacity of the drainage system to collect, transport and potentially treat the pollution before being finally discharged into the environment	☐	☑	
2	Environmental index for Water Pollution from winter maintenance activities (salting): EPI_{Salt} Purpose: To compare salt loadings for the road section against the average for the network, weighted by local requirements (intensity of winter maintenance) and the sensitivity of the environment.	☐	☑	Data available
3	Emissions of substances that cause acidification and eutrophication	☒	☒	
4	Concentration of pollutants in soils	☒	☒	
5	Concentration of pollutants in surface water	☒	☒	
6	Acidification	☒	☒	
7	Toxicity	☒	☒	
8	Eutrophication	☒	☒	
9	Release of dangerous goods due to accidents	☒	☑	Data available

9.2.7 Indicators for economy

Here is a list of different groups for indicators for economy. Which parameters/indicators are used to measure the socio-economic impacts of maintenance policy in the context of economy?				
#	**Parameter or indicator / Description**	**In use?**	**Interested to use?**	**Additional Comment**
Asset value				
1	Asset value	☑	☑	
2	Mean residual life span of the asset	☒	☑	
3	Loss of asset value (reconstruction value)	☑	☑	
4	Salvage value	☒	☒	
5	Preservation of road investment	☒	☑	Data available
6	Condition related asset value pavement	☒	☑	Data available
7	Bridge health index	☒	☑	
8	Asset value per road section	☑	☑	Road section as defined in road inventory or databank
9	Asset value per network per asset (pavements, bridges/viaducts, other structures-including tunnels, furniture)	☑	☑	
Condition				
1	Bridge health index	☒	☒	
2	International Roughness Index	☑	☑	
3	Condition rating	☑	☑	
4	Bridge sufficiency rating (Federal sufficiency rating)	☑	☑	
5	Deficiency ranking	☒	☒	
6	Hydraulic Vulnerability Rating Score	☒	☑	
7	Friction index	☑	☑	
8	Bearing capacity	☑	☑	
Cost efficiency				
1	Return on Construction Expenditure Area: SRA Performance – Economic Effectiveness Purpose: Monitor the predicted community benefits from road transport and traffic authority programs	☒	☒	
2	Preservation of road investment	☒	☑	
3	Impact of executing the interventions	☑	☑	

Here is a list of different groups for indicators for economy. Which parameters/indicators are used to measure the socio-economic impacts of maintenance policy in the context of economy?				
#	**Parameter or indicator / Description**	**In use?**	**Interested to use?**	**Additional Comment**
4	Road Maintenance Effectiveness RME	☒	☒	
5	Return on investment (constr. expenditure)	☒	☑	
6	Program B/C or cost effectiveness	☒	☑	
7	Network depreciation	☒	☑	
8	Cost recovery	☒	☑	
9	Asset Sustainability Index	☒	☒	
10	Bridge sufficiency rating (Federal sufficiency rating)	☑	☑	
11	Deficiency ranking	☒	☒	
Environmental Costs				
1	Environment preservation (Noise)	☒	☒	
2	Noise costs	☐	☑	Data available
3	CO2 emission costs	☒	☒	
4	Air pollution costs	☒	☒	
5	Noise cost (affecting Users)	☒	☒	
6	Particle emissions cost	☒	☒	
7	Energy consumption cost	☒	☒	
8	Material consumption cost	☒	☒	
9	Land consumption cost	☒	☒	
10	Emissions during maintenance periods	☐	☑	
Safety Costs				
1	Accident cost	☐	☑	Data available
2	Persons - Health	☐	☑	
Social economy				
1	Operation quality (Comfort), physical impact of travelling on the user	☒	☒	
2	Operation quality (Comfort), psychological impact of travelling on the user	☒	☒	
3	The contribution of the road operation to socio-economic development, Employment	☒	☒	
4	Total maintenance costs per capita	☐	☑	

Here is a list of different groups for indicators for economy. Which parameters/indicators are used to measure the socio-economic impacts of maintenance policy in the context of economy?				
#	**Parameter or indicator / Description**	**In use?**	**Interested to use?**	**Additional Comment**
Stakeholder satisfaction				
1	Stakeholder satisfaction KPI - Ind. 1 - Number of complaints to NRA / km NRA road network	☑	☑	
2	Stakeholder satisfaction KPI - Ind. 2 - Number of responses from NRA / km NRA road network	☑	☑	
User costs				
1	Time costs	☒	☒	
2	Vehicle operating costs	☐	☑	
3	Reliability of travel time	☒	☒	

In blue – added according to interviewee responses

10 SWEDEN

10.1 STA

10.1.1 Interviewer

Name	Goran Mladenović	**Contact details**	

10.1.2 Interviewee

Organisation	Swedish Transport Administration	**Country**	Sweden
		Date	2016.05.27
Participants			
Name	Kenneth Natanaelsson	Tel	+4610 123 58 45
Role in Organisation	Strategic Planner	Email	Kenneth.natanaelsson@trafikverket.se
Name		Tel	
Role in Organisation		Email	
Name		Tel	
Role in Organisation		Email	
Road network	☐ Motorways [km]: _____ ☐ Other primary roads [km]: _____ ☐ Secondary roads [km]: _____ ☐ Other roads [km]: _____ Please, give additional explanations about the road network if necessary:		

10.1.3 General questions about decision making

What is the focus, vision of your organisation from the socio-economic point of view (in general)?

Swedish Transport Administration vision is to use the tax payer's money as efficient as possible within the transport system. In that perspective the socio-economic values or impacts from different actions plays an important role.

Do you take into account the socio-economic impacts in the process of making a decision/prioritization? If "yes" how?

Yes, we are using socio-economic impacts as a criteria, among others, for all levels of decision making from strategic analysis on network level to decision making regarding different action plans.

Column “In use?”: State if you use the specific indicator. Use green tick mark for yes or red cross mark for no.

Column “Interested to use?”: State if the specific indicator sounds (is structured) interesting enough that you would possibly be willing to use it. Use green tick mark in combination with yes for you already use it (first column), yellow yes mark for “you don’t use it yet but it sounds interesting enough to possibly use it”, and red cross mark for no, no interest in the indicator.

Aditional comment: Short added info or comment for further explanation of answer written.

Empty lines: Place to add indicator which you possibly use but is not listed under specific group. If you type in the name of indicator it will show in blue. Add new lines if needed.

10.1.4 Indicators for availability and disturbance

Here is a list of different groups for indicators of availability and disturbance. Which parameters/indicators are used to measure the socio-economic impacts of maintenance policy in the context of availability and disturbance?				
#	**Parameter or indicator / Description**	**In use?**	**Interested to use?**	**Additional Comment**
Accessibility		☑ ☒	☑ ☑ ☒	
1	Percent of population within 1km of surfaced road	☐	■	
2	Road density	☐	■	
3	Road availability	☐	■	for secondary roads
4	Restrictions to availability - closure	■	☐	
5	Restrictions to availability – load restrictions	■	☐	
Condition				
1	International Roughness Index	■	☐	
2	Condition rating	■	☐	
3	Bridge sufficiency rating (Federal sufficiency rating)	■	☐	Measuring something similar
4	Deficiency ranking	■	☐	Measuring something similar
5	Hydraulic Vulnerability Rating Score	■	☐	We are measuring for routes with an identified risk
Congestion				
1	Congestion	■	☐	In urban areas
2	Maximum total length of congestion between A and B (or on a network)	☐	■	Certain parts of the network

Here is a list of different groups for indicators of availability and disturbance. Which parameters/indicators are used to measure the socio-economic impacts of maintenance policy in the context of availability and disturbance?				
#	**Parameter or indicator / Description**	**In use?**	**Interested to use?**	**Additional Comment**
Restrictions to availability				
1	Closures	☐	☐	See above
2	Clearance and load restrictions	☐	☐	See above
3	Nr of days of snow and/or ice free surface	☑	☐	Based on indicators from a weather information system
Travel time				
1	Delays	☐	☑	
2	Mean travel time between A and B	☐	☑	
3	Variability of travel time between A and B	☐	☑	

10.1.5 Indicators for road safety

Here is a list of different groups for indicators for road safety. Which parameters/indicators are used to measure the socio-economic impacts of maintenance policy in the context of road safety?

#	Parameter or indicator / Description	In use?	Interested to use?	Additional Comment
Accidents		☑ ☒	☑ ☑ ☒	
1	Number of fatalities (involving two-wheels, cars, bus and trucks) per veh.km	■	☐	
2	Number of accident involving vulnerable users	■	☐	
3	Serious Casualty Crashes (Population) Area: Road System Performance – Technical Efficiency Purpose: Monitor incidents of major safety failures in road system	☐	■	
4	user safety (accidents), injury	☐	■	
5	user safety (accidents), death	☐	■	
6	Safety (Accidents), injury	☐	■	
7	Safety (Accidents), death	☐	■	
8	Safety KPI - People killed or seriously injured (KSI) in road traffic accidents	■	☐	
9	Number of fatalities and injuries per million vehicle kilometres	■	☐	Can be derived from other measures
10	Number of accidents per million vehicle kilometres	■	☐	Can be derived from other measures
11	Accident victims	■	☐	
12	Accidents	■	☐	
Condition				
1	International Roughness Index	☐	■	We have tried to measure it but failed
2	Condition rating	☐	■	We have tried to measure it but failed
3	Bridge sufficiency rating (Federal sufficiency rating)	☐	■	Not regarded as a safety issue in Sweden
4	Deficiency ranking	☐	■	Not regarded as a safety issue in Sweden
5	Hydraulic Vulnerability Rating Score	☐	■	Might be of interest
6	Edge depth – weaknesses on secondary roads	☐	■	

Here is a list of different groups for indicators for road safety. Which parameters/indicators are used to measure the socio-economic impacts of maintenance policy in the context of road safety?				
#	**Parameter or indicator / Description**	**In use?**	**Interested to use?**	**Additional Comment**
7	Rut depth – With water accumulation	☐	■	Not so easy to capture
Overall safety				
1	Eurorap Score	☐	■	In some cases to general for Swedish roads
Safety costs				
1	Accident cost	■	☐	
2	Annual accident costs	■	☐	
3	Safety costs	■	☐	
User perception				
1	Operation quality (Comfort), physical impact of travelling on the user	☐	■	At least in Sweden you won't find so many observations
2	Operation quality (Comfort), psychological impact of travelling on the user	☐	■	Done some work regarding this

10.1.6 Indicators for environment

Here is a list of different groups for indicators for environment. Which parameters/indicators are used to measure the socio-economic impacts of maintenance policy in the context of environment?				
#	**Parameter or indicator / Description**	**In use?**	**Interested to use?**	**Additional Comment**
Air quality		☑ ☒	☑ ☑ ☒	
1	Environmental index for Air Quality: Emission and Exposure EPI for Nox	☒	☑	
2	Environmental index for Air Quality: Emission and Exposure EPI for PM10 and PM2.5	☒	☑	Only PM10.
3	Direct toxicity of air pollutants (no models)	☒	☐	
4	Air Quality KPI - Level 1 - Number of AQZAs /1000 km of NRA road network	☒	☐	
5	Air Quality KPI - Level 2 - Lehgth of road network within AQZAs /1000 km of NRA road network	☒	☐	
6	Environmental index for Air Quality: Emission and Exposure EPI for CO	☒	☐	
7	Environmental index for Air Quality: Emission and Exposure Aldehydes, sulphur dioxide, polycyclic aromatic, hydro-carbons	☒	☐	
8	Environmental index for Air Quality: Emission of CO2	☒	☐	
9		☐	☐	
10		☐	☐	
CO_2				
1	Environmental index for GHG – Emissions rate for CO2 emissions from vehicles: EPIemissons,CO2 Purpose: To assess the CO2 emission rate, taking into account the emissions model using traffic flow data and vehicle emission factors per km of road	☑	☐	Swedish Transport Administration assesses the CO2 emissions from road traffic with a model called HBEFA http://www.hbefa.net/e/index.html
2	Environmental index for embodied carbon reduction: EPIECR Purpose: To assess the difference in CO2 emissions for building and maintaining the infrastructure with different strategies	☑	☐	Embodied carbon is included in STA´s model for assessing CO2 emissions from construction and maintenance of rail and road infrastructure. The model is called Klimatkalkyl and there is a describing report in English of an older version of the model which can be e-mailed on demand.

Here is a list of different groups for indicators for environment. Which parameters/indicators are used to measure the socio-economic impacts of maintenance policy in the context of environment?				
#	**Parameter or indicator / Description**	**In use?**	**Interested to use?**	**Additional Comment**
3	Environmental index for GHG – CO2 equivalent emissions during road construction and maintenance activities Purpose: To assess the difference in GHG emissions for building and maintaining the infrastructure with different strategies	☑	☐	CO2 equivalents is included in STA´s model for assessing CO2 emissions from construction and maintenance of rail and road infrastructure. The model is called Klimatkalkyl and there is a describing report in English of an older version of the model which can be e-mailed on demand.
4	Emissions of ozone precursors	☐	☐	
5		☐	☐	
6		☐	☐	
Natural resources				
1	Material Resource Efficiency Indicator (MREI): EPIResources	☒	☐	
2	Energy consumption	☑	☐	In use but in small scale, only a few projects. CO2e and energy.
3	Consumption of non-renewable raw materials and recycling of waste in construction	☒	☐	Asphalt recycling is almost 100 %. We also allow crushed concrete and blast furnace slag.
4	Use of fossil fuels/renewable energy	☒	☐	General environmental requirements on working machines.
5		☐	☐	
6		☐	☐	
Noise				
1	Noise Maps, Vehicle Noise	☑	☐	
2	Vibration Maps	☐☑	☐	Yes for railways
3	Traffic Noise Exposure	☑	☐	
4	Noise annoyance to humans	☑	☐	And birds.
5	Environment preservation (Noise)	☑	☐	
6	Number of noise complaints	☑?	☐	Not sure, complaints are registered but don't know of any statistics.
7	Number of dwellings exposed to excessive noise	☑?	☐	
8		☐	☐	
9		☐	☐	
Soil and water quality				
1	Environmental index for Water	☑	☐	Yes, for some projects where relevant and according to

Here is a list of different groups for indicators for environment. Which parameters/indicators are used to measure the socio-economic impacts of maintenance policy in the context of environment?				
#	**Parameter or indicator / Description**	**In use?**	**Interested to use?**	**Additional Comment**
	quality and drainage system: EPIWater Purpose: To assess the capacity of the drainage system to collect, transport and potentially treat the pollution before being finally discharged into the environment			permits.
2	Environmental index for Water Pollution from winter maintenance activities (salting): EPISalt Purpose: To compare salt loadings for the road section against the average for the network, weighted by local requirements (intensity of winter maintenance) and the sensitivity of the environment.	☐	☐	Salt loads are known on all roads. There are restrictions on sensitive stretches (protection areas etc.)
3	Emissions of substances that cause acidification and eutrophication	☐	☐	Monitoring is done by the county boards.
4	Concentration of pollutants in soils	☐	☐	Yes when applicable. National guidelines for inventory and remediation of contaminated land. Transport Adm has own guidelines for handling och road ditch soils etc.
5	Concentration of pollutants in surface water	☐	☐	Monitoring is done by the county boards.
6	Acidification	☐	☐	Monitoring is done by the county boards.
7	Toxicity	☐	☐	
8	Eutrophication	☐	☐	Monitoring is done by the county boards.
9	Release of dangerous goods due to accidents	☑	☐	
10		☐	☐	
11		☐	☐	

10.1.7 Indicators for economy

Here is a list of different groups for indicators for economy. Which parameters/indicators are used to measure the socio-economic impacts of maintenance policy in the context of economy?				
#	**Parameter or indicator / Description**	**In use?**	**Interested to use?**	**Additional Comment**
Asset value		☑ ☒	☑ ☑ ☒	
1	Asset value	☐	☐	
2	Mean residual life span of the asset	☐	☐	
3	Loss of asset value (reconstruction value)	☐	☐	
4	Salvage value	☐	☐	
5	Preservation of road investment	☐	☐	
6	Condition related asset value pavement	☐	☐	
7	Bridge health index	☐	☐	
Condition				
1	Bridge health index	☐	☐	
2	International Roughness Index	☐	☐	
3	Condition rating	☐	☐	
4	Bridge sufficiency rating (Federal sufficiency rating)	☐	☐	
5	Deficiency ranking	☐	☐	
6	Hydraulic Vulnerability Rating Score	☐	☐	
Cost efficiency				
1	Return on Construction Expenditure Area: SRA Performance – Economic Effectiveness Purpose: Monitor the predicted community benefits from road transport and traffic authority programs	☐	☐	
2	Preservation of road investment	☐	☐	
3	Impact of executing the interventions	☐	☐	
4	Road Maintenance Effectiveness RME	☐	☐	
5	Return on investment (constr. expenditure)	☐	☐	
6	Program B/C or cost effectiveness	☐	☐	
7	Network depreciation	☐	☐	
8	Cost recovery	☐	☐	
9	Asset Sustainability Index	☐	☐	
10	Bridge sufficiency rating (Federal sufficiency rating)	☐	☐	

Here is a list of different groups for indicators for economy. Which parameters/indicators are used to measure the socio-economic impacts of maintenance policy in the context of economy?				
#	**Parameter or indicator / Description**	**In use?**	**Interested to use?**	**Additional Comment**
11	Deficiency ranking	☐	■	
Environmental Costs				
1	Environment preservation (Noise)	■	☐	In some parts can be more complete
2	Noise costs	■	☐	In some parts can be more complete
3	CO2 emission costs	■	☐	From traffic
4	Air pollution costs	■	☐	In some parts can be more complete
5	Noise cost (affecting Users)	■	☐	In some parts can be more complete
6	Particle emissions cost	■	☐	
7	Energy consumption cost	■	☐	
8	Material consumption cost	■	☐	In some parts can be more complete
9	Land consumption cost	■	☐	In some parts can be more complete
10	Emissions during maintenance periods	■	☐	In some parts can be more complete
Safety Costs				
1	Accident cost	■	☐	
2	Persons - Health	■	■	We are working on it.
Social economy				
1	Operation quality (Comfort), physical impact of travelling on the user	☐	■	
2	Operation quality (Comfort), psychological impact of travelling on the user	☐	■	
3	The contribution of the road operation to socio-economic development, Employment	☐	■	Some measures in place
4	Total maintenance costs per capita	☐	■	Easy to calculate for NRAs
Stakeholder satisfaction				
1	Stakeholder satisfaction KPI - Ind. 1 - Number of complaints to NRA / km NRA road network	☐	■	
2	Stakeholder satisfaction KPI - Ind. 2 - Number of responses from NRA / km NRA road	☐	■	

Here is a list of different groups for indicators for economy. Which parameters/indicators are used to measure the socio-economic impacts of maintenance policy in the context of economy?				
#	**Parameter or indicator / Description**	**In use?**	**Interested to use?**	**Additional Comment**
	network			
User costs				
1	Time costs	☐	☐	
2	Vehicle operating costs	☐	☐	
3	Reliability of travel time	☐	☐	

11 SWITZERLAND

11.1 DOT Canton Zürich

11.1.1 Interviewer

Name	Frank Schiffmann	**Contact details**	

11.1.2 Interviewee

Organisation	DOT Canton Zurich	**Country**	Switzerland
		Date	27.05.2016
Participants			
Name	Alain Jacot	Tel	+41 43 259 55 92
Role in Organisation	Road asset manager	Email	alain.jacot@bd.zh.ch
Name		Tel	
Role in Organisation		Email	
Name		Tel	
Role in Organisation		Email	
Road network	☐ Motorways [km]: 100 ☐ Other primary roads [km]: 0 ☐ Secondary roads [km]: 1310 (state roads) ☐ Other roads [km]: 0 Please, give additional explanations about the road network if necessary: Road drainage 1250 structures		

11.1.3 General questions about decision making

What is the focus, vision of your organisation from the socio-economic point of view (in general)?

Vision:

We keep mobility high in the economic region canton Zurich.

Mission:

We ensure mobility on roads of canton Zurich for people and economy. This is our contribution to an attractive location for living and business location canton Zurich.

Mission statement:

We provide a high availability of roads.

We built and maintain with foresight transport infrastructure.

We set standards in road and working safety.

We are a decent partner.

Strategy:

With our dedicated and competent staff, we ensure highest possible availability of roads in the canton Zurich. Sustainability, economic efficiency and innovation form our action, considering all aspects such as safety, operation, preservation, extension, ecology as well as neighbours and society needs.

Do you take into account the socio-economic impacts in the process of making a decision/prioritization? If "yes" how?

Yes. We try to connect different road data for decision process.

11.1.4 Indicators for availability and disturbance

Here is a list of different groups for indicators of availability and disturbance. Which parameters/indicators are used to measure the socio-economic impacts of maintenance policy in the context of availability and disturbance?				
#	**Parameter or indicator / Description**	**In use?**	**Interested to use?**	**Additional Comment**
Accessibility		☑ ☒	☑ ☑ ☒	
1	Percent of population within 1km of surfaced road	☒	☒	
2	Road density	☒	☒	
3	Road availability	☑	☐	At the moment qualitative assessment, decision making because of experiences
4		☐	☐	
5		☐	☐	
Condition				
1	International Roughness Index	☒	☒	
2a	Condition rating for pavement sections	☑	☐	classical pavement management
2b	Condition rating for structures	☑	☐	classical bridge management
3	Bridge sufficiency rating (Federal sufficiency rating)	☒	☒	
4	Deficiency ranking	☒	☒	
5	Hydraulic Vulnerability Rating Score	☒	☒	
6		☐	☐	
7		☐	☐	
Congestion				
1	Congestion	☒	☒	
2	Maximum total length of congestion between A and B (or on a network)	☒	☒	
3		☐	☐	
		☐	☐	
Restrictions to availability				
1	Closures	☒	☒	
2	Clearance and load restrictions	☒	☒	
3	Nr of days of snow and/or ice free surface	☒	☒	

Here is a list of different groups for indicators of availability and disturbance. Which parameters/indicators are used to measure the socio-economic impacts of maintenance policy in the context of availability and disturbance?				
#	**Parameter or indicator / Description**	**In use?**	**Interested to use?**	**Additional Comment**
4		☐	☐	
5		☐	☐	
Travel time				
1	Delays	☐	☑	in progress, -information will be used for decision making: network wide user time delay for each (treatment) section, if it will be becoming a work zone, calculated from macroscopic traffic simulation
2	Mean travel time between A and B	☒	☒	
3	Variability of travel time between A and B	☒	☒	
4		☐	☐	
5		☐	☐	

11.1.5 Indicators for road safety

Here is a list of different groups for indicators for road safety. Which parameters/indicators are used to measure the socio-economic impacts of maintenance policy in the context of road safety?				
#	**Parameter or indicator / Description**	**In use?**	**Interested to use?**	**Additional Comment**
Accidents		☑ ☒	☑ ☑ ☒	
1	Number of fatalities (involving two-wheels, cars, bus and trucks) per veh.km	☒	☒	
2	Number of accident involving vulnerable users	☒	☒	
3	Serious Casualty Crashes (Population) Area: Road System Performance – Technical Efficiency Purpose: Monitor incidents of major safety failures in road system	☒	☒	
4a	user safety (accidents), property damage	☐	☑	Low level indicator (for accident cost calculation)
4b	user safety (accidents), light casualty	☐	☑	Low level indicator (for accident cost calculation)
4c	user safety (accidents), seriously injured	☐	☑	Low level indicator (for accident cost calculation)
5	user safety (accidents), death	☐	☑	Low level indicator (for accident cost calculation)
6	Safety (Accidents), injury	☒	☒	
7	Safety (Accidents), death	☒	☒	
8	Safety KPI - People killed or seriously injured (KSI) in road traffic accidents	☒	☒	
9	Number of fatalities and injuries per million vehicle kilometres	☒	☒	
10	Number of accidents per million vehicle kilometres	☒	☒	
11	Accident victims	☒	☒	
12	Accidents	☒	☒	
13		☐	☐	
14		☐	☐	
Condition				
1	International Roughness Index	☒	☒	
2	Condition rating	☒	☒	

Here is a list of different groups for indicators for road safety. Which parameters/indicators are used to measure the socio-economic impacts of maintenance policy in the context of road safety?				
#	**Parameter or indicator / Description**	**In use?**	**Interested to use?**	**Additional Comment**
3	Bridge sufficiency rating (Federal sufficiency rating)	☒	☒	
4	Deficiency ranking	☒	☒	
5	Hydraulic Vulnerability Rating Score	☒	☒	
6		☐	☐	
7		☐	☐	
Overall safety				
1	Eurorap Score	☒	☒	
2		☐	☐	
3		☐	☐	
Safety costs				
1	Accident cost	☒	☒	
2	Annual accident costs	☐	☑	in progress calculated from low level indicators property damage, slightly casualty, seriously injured, death; infrastructure potential of avoidable accident costs
3	Safety costs	☒	☒	
4		☐	☐	
5		☐	☐	
User perception				
1	Operation quality (Comfort), physical impact of travelling on the user	☒	☒	
2	Operation quality (Comfort), psychological impact of travelling on the user	☒	☒	
3		☐	☐	
4		☐	☐	

11.1.6 Indicators for environment

Here is a list of different groups for indicators for environment. Which parameters/indicators are used to measure the socio-economic impacts of maintenance policy in the context of environment?				
#	**Parameter or indicator / Description**	**In use?**	**Interested to use?**	**Additional Comment**
Air quality		☑ ☒	☑ ☑ ☒	
1	Environmental index for Air Quality: Emission and Exposure EPI for Nox	☒	☒	
2	Environmental index for Air Quality: Emission and Exposure EPI for PM10 and PM2.5	☒	☒	
3	Direct toxicity of air pollutants (no models)	☒	☒	
4	Air Quality KPI - Level 1 - Number of AQZAs /1000 km of NRA road network	☒	☒	
5	Air Quality KPI - Level 2 - Lehgth of road network within AQZAs /1000 km of NRA road network	☒	☒	
6	Environmental index for Air Quality: Emission and Exposure EPI for CO	☒	☒	
7	Environmental index for Air Quality: Emission and Exposure Aldehydes, sulphur dioxide, polycyclic aromatic, hydro-carbons	☒	☒	
8	Environmental index for Air Quality: Emission of CO2	☒	☒	
9		☐	☐	
10		☐	☐	
CO_2				
1	Environmental index for GHG – Emissions rate for CO2 emissions from vehicles: EPIemissons,CO2 Purpose: To assess the CO2 emission rate, taking into account the emissions model using traffic flow data and vehicle emission factors per km of road	☒	☒	
2	Environmental index for embodied carbon reduction: EPIECR Purpose: To assess the difference in CO2 emissions for building and maintaining the infrastructure with different strategies	☒	☒	
3	Environmental index for GHG – CO2 equivalent emissions during road construction and maintenance activities Purpose: To assess the difference in GHG emissions for building and maintaining the infrastructure with different strategies	☒	☒	

Here is a list of different groups for indicators for environment. Which parameters/indicators are used to measure the socio-economic impacts of maintenance policy in the context of environment?				
#	**Parameter or indicator / Description**	**In use?**	**Interested to use?**	**Additional Comment**
4	Emissions of ozone precursors	☒	☒	
5		☐	☐	
6		☐	☐	
Natural resources				
1	Material Resource Efficiency Indicator (MREI): EPIResources	☒	☒	
2	Energy consumption	☒	☒	
3	Consumption of non-renewable raw materials and recycling of waste in construction	☒	☒	
4	Use of fossil fuels/renewable energy	☒	☒	
5		☐	☐	
6		☐	☐	
Noise				
1	Noise Maps, Vehicle Noise	☒	☒	
2	Vibration Maps	☒	☒	
3	Traffic Noise Exposure	☑	☐	If legal limit has been exceeded [dB], decision e.g. about application of noise reducing porous asphalt
4	Noise annoyance to humans	☒	☒	
5	Environment preservation (Noise)	☒	☒	
6	Number of noise complaints	☒	☒	
7	Number of dwellings exposed to excessive noise	☒	☒	
8		☐	☐	
9		☐	☐	
Soil and water quality				
1	Environmental index for Water quality and drainage system: EPIWater Purpose: To assess the capacity of the drainage system to collect, transport and potentially treat the pollution before being finally discharged into the environment	☒	☒	
2	Environmental index for Water Pollution from winter maintenance activities (salting): EPISalt	☒	☒	

Here is a list of different groups for indicators for environment. Which parameters/indicators are used to measure the socio-economic impacts of maintenance policy in the context of environment?				
#	**Parameter or indicator / Description**	**In use?**	**Interested to use?**	**Additional Comment**
	Purpose: To compare salt loadings for the road section against the average for the network, weighted by local requirements (intensity of winter maintenance) and the sensitivity of the environment.			
3	Emissions of substances that cause acidification and eutrophication	☒	☒	
4	Concentration of pollutants in soils	☒	☒	
5	Concentration of pollutants in surface water	☒	☒	
6	Acidification	☒	☒	
7	Toxicity	☒	☒	
8	Eutrophication	☒	☒	
9	Release of dangerous goods due to accidents	☒	☒	
10		☐	☐	
11		☐	☐	

11.1.7 Indicators for economy

Here is a list of different groups for indicators for economy. Which parameters/indicators are used to measure the socio-economic impacts of maintenance policy in the context of economy?				
#	**Parameter or indicator / Description**	**In use?**	**Interested to use?**	**Additional Comment**
Asset value		☑ ☒	☑ ☑ ☒	
1	Asset value	☒	☒	
2	Mean residual life span of the asset	☒	☒	
3	Loss of asset value (reconstruction value)	☒	☒	
4	Salvage value	☒	☒	
5	Preservation of road investment	☒	☒	
6	Condition related asset value pavement	☒	☒	
7	Bridge health index	☒	☒	
8		☐	☐	
9		☐	☐	
Condition				
1	Bridge health index	☒	☒	
2	International Roughness Index	☒	☒	
3	Condition rating	☒	☒	
4	Bridge sufficiency rating (Federal sufficiency rating)	☒	☒	
5	Deficiency ranking	☒	☒	
6	Hydraulic Vulnerability Rating Score	☒	☒	
7		☐	☐	
8		☐	☐	
Cost efficiency				
1	Return on Construction Expenditure Area: SRA Performance – Economic Effectiveness Purpose: Monitor the predicted community benefits from road transport and traffic authority programs	☒	☒	
2	Preservation of road investment	☒	☒	
3	Impact of executing the interventions	☒	☒	
4	Road Maintenance Effectiveness RME	☒	☒	
5	Return on investment (constr. expenditure)	☒	☒	

Here is a list of different groups for indicators for economy. Which parameters/indicators are used to measure the socio-economic impacts of maintenance policy in the context of economy?				
#	**Parameter or indicator / Description**	**In use?**	**Interested to use?**	**Additional Comment**
6	Program B/C or cost effectiveness	☒	☒	
7	Network depreciation	☒	☒	
8	Cost recovery	☒	☒	
9	Asset Sustainability Index	☒	☒	
10	Bridge sufficiency rating (Federal sufficiency rating)	☒	☒	
11	Deficiency ranking	☒	☒	
12		☐	☐	
13		☐	☐	
Environmental Costs				
1	Environment preservation (Noise)	☒	☒	
2	Noise costs	☒	☒	
3	CO2 emission costs	☒	☒	
4	Air pollution costs	☒	☒	
5	Noise cost (affecting Users)	☒	☒	
6	Particle emissions cost	☒	☒	
7	Energy consumption cost	☒	☒	
8	Material consumption cost	☒	☒	
9	Land consumption cost	☒	☒	
10	Emissions during maintenance periods	☒	☒	
11		☐	☐	
12		☐	☐	
Safety Costs				
1	Accident cost	☒	☒	
2	Persons - Health	☒	☒	
3		☐	☐	
4		☐	☐	
Social economy				
1	Operation quality (Comfort), physical impact of travelling on the user	☒	☒	
2	Operation quality (Comfort), psychological	☒	☒	

Here is a list of different groups for indicators for economy. Which parameters/indicators are used to measure the socio-economic impacts of maintenance policy in the context of economy?				
#	**Parameter or indicator / Description**	**In use?**	**Interested to use?**	**Additional Comment**
	impact of travelling on the user			
3	The contribution of the road operation to socio-economic development, Employment	☒	☒	
4	Total maintenance costs per capita	☒	☒	
5		☐	☐	
6		☐	☐	
Stakeholder satisfaction				
1	Stakeholder satisfaction KPI - Ind. 1 - Number of complaints to NRA / km NRA road network	☒	☐	
2	Stakeholder satisfaction KPI - Ind. 2 - Number of responses from NRA / km NRA road network	☒	☐	
3		☐	☐	
4		☐	☐	
User costs				
1	Time costs	☒	☐	
2	Vehicle operating costs	☒	☐	
3	Reliability of travel time	☒	☐	
4		☐	☐	
5		☐	☐	

11.2 ASTRA FEDRO

11.2.1 Interviewer

Name	Frank Schiffmann	**Contact details**	

11.2.2 Interviewee

Organisation	FEDRO	**Country**	Switzerland
		Date	.06.2016
Participants			
Name	Luzia Seiler	Tel	+41 58 462 94 43
Role in Organisation	Divisional head of Road asset management	Email	luzia.seiler@astra.admin.ch
Name		Tel	
Role in Organisation		Email	
Name		Tel	
Role in Organisation		Email	
Road network	☐ Motorways [km]: 1431 ☐ Other primary roads [km]: 281 ☐ Secondary roads [km]: 112 ☐ Other roads [km]: _____ Please, give additional explanations about the road network if necessary:		

11.2.3 General questions about decision making

What is the focus, vision of your organisation from the socio-economic point of view (in general)?

The FEDRO is responsible for further development, heavy and routine maintenance as well as traffic management on the national highway network.

We provide highest possible availability and safety on our highway network and there we ensure a functional as well as ecologically and spatially compatible road infrastructure.

Do you take into account the socio-economic impacts in the process of making a decision/prioritization? If "yes" how?

Yes. We try to connect different road data for decision process.

On the following pages:

Column "In use?": State if you use the specific indicator. Use green tick mark for yes or red cross mark for no.

Column "Interested to use?": State if the specific indicator sounds (is structured) interesting enough that you would possibly be willing to use it. Use green tick mark in combination with yes for you already use it (first column), yellow yes mark for "you don't use it yet but it sounds interesting enough to possibly use it", and red cross mark for no, no interest in the indicator.

Aditional comment: Short added info or comment for further explanation of answer written.

Empty lines: Place to add indicator which you possibly use but is not listed under specific group. If you type in the name of indicator it will show in blue. Add new lines if needed.

11.2.4 Indicators for availability and disturbance

Here is a list of different groups for indicators of availability and disturbance. Which parameters/indicators are used to measure the socio-economic impacts of maintenance policy in the context of availability and disturbance?				
#	**Parameter or indicator / Description**	**In use?**	**Interested to use?**	**Additional Comment**
Accessibility		☑ ☒	☑ ☑ ☒	
1	Percent of population within 1km of surfaced road	☒	☒	
2	Road density	☒	☒	
3	Road availability	☑	☑	% of scheduled length of finished maintenance intervention in the network
4		☐	☐	
5		☐	☐	
Condition				
1	International Roughness Index	☒	☒	Considering of a separate longitudinal index
2a	Condition rating for pavement sections	☑	☑	classical pavement management requirements for condition distribution
2b	Condition rating for structures	☑	☑	classical bridge management requirements for condition distribution
3	Bridge sufficiency rating (Federal sufficiency rating)	☒	☒	
4	Deficiency ranking	☒	☒	
5	Hydraulic Vulnerability Rating Score	☒	☒	
6		☐	☐	
7		☐	☐	
Congestion				
1	Congestion	☑	☑	Hours/(vehicle km)
2	Maximum total length of congestion between A and B (or on a network)	☒	☒	
3		☐	☐	
		☐	☐	

Here is a list of different groups for indicators of availability and disturbance. Which parameters/indicators are used to measure the socio-economic impacts of maintenance policy in the context of availability and disturbance?				
#	**Parameter or indicator / Description**	**In use?**	**Interested to use?**	**Additional Comment**
Restrictions to availability				
1	Closures	☑	☑	No closures of roads, but lane closures. [h]
2	Clearance and load restrictions	☒	☒	
3	Nr of days of snow and/or ice free surface	☒	☒	
4		☐	☐	
5		☐	☐	
Travel time				
1	Delays	☒	☒	
2	Mean travel time between A and B	☒	☒	
3	Variability of travel time between A and B	☒	☒	
4		☐	☐	
5		☐	☐	

11.2.5 Indicators for road safety

Here is a list of different groups for indicators for road safety. Which parameters/indicators are used to measure the socio-economic impacts of maintenance policy in the context of road safety?				
#	**Parameter or indicator / Description**	**In use?**	**Interested to use?**	**Additional Comment**
Accidents		☑ ☒	☑ ☑ ☒	
1	Number of fatalities (involving two-wheels, cars, bus and trucks) per veh.km	☑	☑	Annual accident statistics to access actual situation
2	Number of accident involving vulnerable users	☑	☑	Annual accident statistics to access actual situation
3	Serious Casualty Crashes (Population) Area: Road System Performance – Technical Efficiency Purpose: Monitor incidents of major safety failures in road system	☒	☒	
4a	user safety (accidents), property damage	☐	☑	in progress, Low level indicator (for accident cost calculation)
4b	user safety (accidents), light casualty	☐	☑	in progress, Low level indicator (for accident cost calculation)
4c	user safety (accidents), seriously injured	☐	☑	in progress, Low level indicator (for accident cost calculation)
5	user safety (accidents), death	☐	☑	in progress, Low level indicator (for accident cost calculation)
6	Safety (Accidents), injury	☒	☒	
7	Safety (Accidents), death	☒	☒	
8	Safety KPI - People killed or seriously injured (KSI) in road traffic accidents	☒	☒	
9	Number of fatalities and injuries per million vehicle kilometres	☒	☒	
10	Number of accidents per million vehicle kilometres	☒	☒	
11	Accident victims	☒	☒	
12	Accidents	☒	☒	

Here is a list of different groups for indicators for road safety. Which parameters/indicators are used to measure the socio-economic impacts of maintenance policy in the context of road safety?				
#	**Parameter or indicator / Description**	**In use?**	**Interested to use?**	**Additional Comment**
13		☐	☐	
Condition				
1	International Roughness Index	☒	☒	
2	Condition rating	☒	☒	
3	Bridge sufficiency rating (Federal sufficiency rating)	☒	☒	
4	Deficiency ranking	☒	☒	
5	Hydraulic Vulnerability Rating Score	☒	☒	
6		☐	☐	
Overall safety				
1	Eurorap Score	☒	☒	
2		☐	☐	
Safety costs				
1	Accident cost	☒	☒	
2	Annual accident costs	☐	☑	in progress calculated from low level indicators property damage, slightly casualty, seriously injured, death; infrastructure potential of avoidable accident costs
3	Safety costs	☒	☒	
4		☐	☐	
5		☐	☐	
User perception				
1	Operation quality (Comfort), physical impact of travelling on the user	☒	☒	
2	Operation quality (Comfort), psychological impact of travelling on the user	☒	☒	
3		☐	☐	

11.2.6 Indicators for environment

Here is a list of different groups for indicators for environment. Which parameters/indicators are used to measure the socio-economic impacts of maintenance policy in the context of environment?				
#	**Parameter or indicator / Description**	**In use?**	**Interested to use?**	**Additional Comment**
Air quality		☑ ☒	☑ ☑ ☒	
1	Environmental index for Air Quality: Emission and Exposure EPI for Nox	☒	☒	
2	Environmental index for Air Quality: Emission and Exposure EPI for PM10 and PM2.5	☒	☒	
3	Direct toxicity of air pollutants (no models)	☒	☒	
4	Air Quality KPI - Level 1 - Number of AQZAs /1000 km of NRA road network	☒	☒	
5	Air Quality KPI - Level 2 - Lehgth of road network within AQZAs /1000 km of NRA road network	☒	☒	
6	Environmental index for Air Quality: Emission and Exposure EPI for CO	☒	☒	
7	Environmental index for Air Quality: Emission and Exposure Aldehydes, sulphur dioxide, polycyclic aromatic, hydro-carbons	☒	☒	
8	Environmental index for Air Quality: Emission of CO2	☒	☒	
CO_2				
1	Environmental index for GHG – Emissions rate for CO2 emissions from vehicles: EPIemissons,CO2 Purpose: To assess the CO2 emission rate, taking into account the emissions model using traffic flow data and vehicle emission factors per km of road	☒	☒	
2	Environmental index for embodied carbon reduction: EPIECR Purpose: To assess the difference in CO2 emissions for building and maintaining the infrastructure with different strategies	☒	☒	
3	Environmental index for GHG – CO2 equivalent emissions during road construction and maintenance activities Purpose: To assess the difference in GHG emissions for building and maintaining the infrastructure with different strategies	☒	☒	
4	Emissions of ozone precursors	☒	☒	
5		☐	☐	

Here is a list of different groups for indicators for environment. Which parameters/indicators are used to measure the socio-economic impacts of maintenance policy in the context of environment?				
#	**Parameter or indicator / Description**	**In use?**	**Interested to use?**	**Additional Comment**
Natural resources				
1	Material Resource Efficiency Indicator (MREI): EPIResources	☒	☒	
2	Energy consumption	☒	☒	
3	Consumption of non-renewable raw materials and recycling of waste in construction	☒	☒	
4	Use of fossil fuels/renewable energy	☒	☒	
Noise				
1	Noise Maps, Vehicle Noise	☑	☑	
2	Vibration Maps	☒	☒	
3	Traffic Noise Exposure	☑	☑	If legal limit has been exceeded [dB], decision e.g. about application of noise reducing porous asphalt or noise barrier
4	Noise annoyance to humans	☒	☒	
5	Environment preservation (Noise)	☒	☒	
6	Number of noise complaints	☒	☒	
7	Number of dwellings exposed to excessive noise	☒	☒	
Soil and water quality				
1	Environmental index for Water quality and drainage system: EPIWater Purpose: To assess the capacity of the drainage system to collect, transport and potentially treat the pollution before being finally discharged into the environment	☑	☑	Requirements for water treatment from FOEN
2	Environmental index for Water Pollution from winter maintenance activities (salting): EPISalt Purpose: To compare salt loadings for the road section against the average for the network, weighted by local requirements (intensity of winter maintenance) and the sensitivity of the environment.	☒	☒	
3	Emissions of substances that cause acidification and eutrophication	☒	☒	

Here is a list of different groups for indicators for environment. Which parameters/indicators are used to measure the socio-economic impacts of maintenance policy in the context of environment?				
#	**Parameter or indicator / Description**	**In use?**	**Interested to use?**	**Additional Comment**
4	Concentration of pollutants in soils	☒	☒	
5	Concentration of pollutants in surface water	☒	☒	
6	Acidification	☒	☒	
7	Toxicity	☒	☒	
8	Eutrophication	☒	☒	
9	Release of dangerous goods due to accidents	☒	☒	
10		☐	☐	
11		☐	☐	

11.2.7 Indicators for economy

Here is a list of different groups for indicators for economy. Which parameters/indicators are used to measure the socio-economic impacts of maintenance policy in the context of economy?				
#	**Parameter or indicator / Description**	**In use?**	**Interested to use?**	**Additional Comment**
Asset value		☑ ☒	☑ ☑ ☒	
1	Asset value	☒	☒	
2	Mean residual life span of the asset	☒	☒	
3	Loss of asset value (reconstruction value)	☒	☒	
4	Salvage value	☒	☒	
5	Preservation of road investment	☒	☒	
6	Condition related asset value pavement	☒	☒	
7	Bridge health index	☒	☒	
Condition				
1	Bridge health index	☒	☒	
2	International Roughness Index	☒	☒	
3	Condition rating	☒	☒	
4	Bridge sufficiency rating (Federal sufficiency rating)	☒	☒	
5	Deficiency ranking	☒	☒	
6	Hydraulic Vulnerability Rating Score	☒	☒	
Cost efficiency				
1	Return on Construction Expenditure Area: SRA Performance – Economic Effectiveness Purpose: Monitor the predicted community benefits from road transport and traffic authority programs	☒	☒	
2	Preservation of road investment	☒	☒	
3	Impact of executing the interventions	☒	☒	
4	Road Maintenance Effectiveness RME	☒	☒	
5	Return on investment (constr. expenditure)	☒	☒	
6	Program B/C or cost effectiveness	☒	☒	
7	Network depreciation	☒	☒	
8	Cost recovery	☒	☒	

Here is a list of different groups for indicators for economy. Which parameters/indicators are used to measure the socio-economic impacts of maintenance policy in the context of economy?				
#	**Parameter or indicator / Description**	**In use?**	**Interested to use?**	**Additional Comment**
9	Asset Sustainability Index	☒	☒	
10	Bridge sufficiency rating (Federal sufficiency rating)	☒	☒	
11	Deficiency ranking	☒	☒	
Environmental Costs				
1	Environment preservation (Noise)	☒	☒	
2	Noise costs	☒	☒	
3	CO2 emission costs	☒	☒	
4	Air pollution costs	☒	☒	
5	Noise cost (affecting Users)	☒	☒	
6	Particle emissions cost	☒	☒	
7	Energy consumption cost	☒	☒	
8	Material consumption cost	☒	☒	
9	Land consumption cost	☒	☒	
10	Emissions during maintenance periods	☒	☒	
Safety Costs				
1	Accident cost	☒	☒	
2	Persons - Health	☒	☒	
Social economy				
1	Operation quality (Comfort), physical impact of travelling on the user	☒	☒	
2	Operation quality (Comfort), psychological impact of travelling on the user	☒	☒	
3	The contribution of the road operation to socio-economic development, Employment	☒	☒	
4	Total maintenance costs per capita	☒	☒	
Stakeholder satisfaction				
1	Stakeholder satisfaction KPI - Ind. 1 - Number of complaints to NRA / km NRA road network	☒	☒	
2	Stakeholder satisfaction KPI - Ind. 2 - Number of responses from NRA / km NRA road network	☒	☒	
3		☐	☐	

Here is a list of different groups for indicators for economy. Which parameters/indicators are used to measure the socio-economic impacts of maintenance policy in the context of economy?				
#	**Parameter or indicator / Description**	**In use?**	**Interested to use?**	**Additional Comment**
User costs				
1	Time costs	☒	☒	
2	Vehicle operating costs	☒	☒	
3	Reliability of travel time	☒	☒	
4		☐	☐	
5		☐	☐	