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CLEAN-ROADS

Action C1: Monitoring the impact on the target audience and local welfare

D.C1.1

Initial impact evaluation

Project Coordinating Beneficiary	Provincia di Trento (PAT)
Project Associated Beneficiary n.1	Famas System (FAM)
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PROVINCIA AUTONOMA DI TRENTO

FAMAS SYSTEM

TiS innovation park

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1. Introduction

Action C1 is one of the two project actions located within the action bundle C, which is responsible for the monitoring of the impact of the project actions. This action is focused on the monitoring of the impact on the target audience and the local welfare, i.e. in understanding how (and how much) the activities proposed in CLEAN-ROADS have a repercussion on the normal behavior and perspective of the reference target groups of the project, which have been assessed in the deliverable D.D2.1 - Dissemination Plan [1]. The action is complementary to Action C2, which is responsible for the monitoring of the environmental improvement of the project, and strongly connected to the activities carried out in action bundle D (communication and dissemination actions), and in particular with Action D2, which is focused on the organization of dedicated initiatives with the local target audience, and Action E3 (Project Progress Monitoring). The latter one, which is supervised by the Monitoring Committee, is responsible to periodically assess the technical and financial progress of the project and to compare it with respect to the original plan. By including information about the measured impact of the project, the Monitoring Committee can be in the condition to assess how much effective the time and budget investments have been.

This document aims to present the results of the initial impact evaluation concerning the task of monitoring the impact of the project actions over the target audience. In particular, the objective of this initial study is to (i) consolidate a list of reference indicators for each considered target group (Chapter 2), and (ii) identify operational procedures for the proper and periodic measurement of those indicators within the project life time (Chapter 3).

2. Target groups and monitoring indicators

This chapter presents the list of reference indicators which are going to be considered for each reference target group of the project. For completeness sake, the list of this target audience, already presented and introduced in [1], is briefly recalled in Table 1. The section concerning the potential impact is completed on top on the initial expectations, which are (in the case of road management operators and local travelers and drivers) assessed by preliminary studies carried out in the scope of Action A2 and D2, and the few indications collected from reference studies available in the international state-of-art.

Target Group	Expected impact	Impact potential
Road management operators	The operators are expected to intensively use the Maintenance Decision Support System (MDSS) introduced by CLEAN-ROADS in order to optimize their winter road maintenance operations and decisions, and to get a significant benefit in terms of stress reduction and quality of work improvement. Last but not least, the operators are asked to be more aware of the ecological impact that is caused by de-/anti-icing operations during the winter season, and thus to use only the minimum resources which are required for guaranteeing the today's standards of road safety in winter.	**Moderate**. The initial expectation was that this aspect would have been the most critical challenge, since an automatic DSS could have been seen negatively by road operators and an instrument for reducing the importance of (or worse, replacing) their work and their role. However, the Province of Trento has managed to find a road operators team which has very positively welcomed the idea of the project, so these kind of risks will be probably minimized during the demonstration phase of the project. Indeed, this relationship could change and be not as constructive when other teams will be involved (e.g. during the exploitation of CLEAN-ROADS after the project's end).
Local travelers and drivers	The local travelers are expected to show a more responsible attitude during the winter season, and to adapt their travel choices and patterns wisely as a function of the road weather conditions. In particular, travelers are requested to have a stronger awareness about the (ecological) impact and the complexity of the winter road maintenance service, and to lower their expectations towards it, in particular in correspondence of meteorological events such as snowfalls.	**Low**. As confirmed by the preliminary studies carried out in Action A2, the level of expectation of local travelers and drivers towards the winter maintenance service is very high, and this is in part motivated by the national legislation which obliges the road management service to guarantee everywhere the maximum level of safety in every meteorological conditions. So, considering even the fact that the dissemination plan cannot be addressed in large scale on the whole population but only on small focus groups, the expectation is that CLEAN-ROADS will just give an initial stimulus to a long-term process, which will need to be fostered and sustained even after the project's end.
Inter-regional stakeholders	The inter-regional stakeholders are expected to be informed and possibly	**Moderate**. Initial contacts with potentially interested stakeholders

	committed about the project activities carried out in CLEAN-ROADS, and when possible / applicable, they are requested to improve their winter maintenance procedures by following the experience and the recommendations gathered within the present project initiative.	have revealed how the topic covered by CLEAN-ROADS is of high interested, in particular if the proposed approach will demonstrate to obtain the expected benefits. However, there are a lot of limiting factors which can jeopardize the adoption of similar methods, e.g. (i) the reduced availability of resources caused by this period of negative , which could be necessary for the initial investments, (ii) personal preconceptions, which could be difficult to change, and probably most relevant (iii) the actual legislative limitations which practically assign all responsibility to the road management operators.
EU networks and stakeholders	The EU networks and the national and international stakeholders are expected to be informed and possibly committed about the project activities carried out in CLEAN-ROADS, and when possible / applicable, they are requested to support (i) the diffusion of the CLEAN-ROADS approaches and methods, (ii) the awareness of the targeted environmental problem and (iii) the proliferation of broader RWIS initiatives.	**High**. If dissemination activities carried out at national and international level are properly carried out and do not find any relevant issue or limitation, the possibility that the CLEAN-ROADS project can become a reference initiative in the RWIS community and can contribute in addressing "global" barriers and criticalities which are common between different realities is very high, and can bring to very important outcomes on the long-term period.
Secondary target groups	The secondary target groups are expected to be fully committed in the project vision and to cooperate with the CLEAN-ROADS consortium for the organization of dedicated actions towards specific target groups.	**High**. The local premises stated by past and present initiatives in the field of road safety offer enough guarantees to say that the potential impact potential on secondary target groups is very high. The only issue is related to the availability of time / budget for organizing joint awareness-raising activities, but if properly managed the risk for this can be considered very low.

Table 1: List of reference target groups of CLEAN-ROADS.

2.1 Monitoring indicators for local travelers

A reference list of monitoring indicators which is considered for target group "local travelers" is illustrated in Table 2.

Indicator Nr.	Monitoring Indicator	Direct / Indirect measurement
LT1	Number of users revealing a positive change towards their travel patterns in winter after having entered in contact with the CLEAN-ROADS project	Direct measurement
LT_2	Number of users expressing a better attitude towards the winter	Direct measurement

	maintenance service	
LT_3	Number of users confirming a high quality of service of the winter maintenance service	Direct measurement
LT_4	Number of accesses to the local traveler information system ("Viaggiare in Trentino")	Indirect measurement
LT_5	Number of accesses on the project website	Indirect measurement
LT_6	Number of comments and notifications received by the users on the on-line channels	Indirect measurement
LT_7	Number of accidents during the winter season	Indirect measurement
LT_8	Number of congestion phenomena during the winter season	Indirect measurement
LT_9	Average daily traffic during the winter season	Indirect measurement
LT_10	Average daily speed during the winter season	Indirect measurement

Table 2: Reference monitoring indicators list for target group "local travelers".

It is worth noting that an additional indicator could be considered for local travelers, i.e. roadside air pollutant levels, which can be actually considered even an indicator for road management operators since they can reveal the amount of deicers used during the road treatment operations. This indicator is however not considered here since it is already included in the list of indicators for the environmental monitoring process [2].

2.2 Monitoring indicators for road management operators

A reference list of monitoring indicators which is considered for target group "road management operators" is illustrated in Table 3.

Indicator Nr.	Monitoring Indicator	Direct / Indirect measurement
RMO_1	Number of road operators revealing that they have been in condition to work more efficiently and under a lower stress conditions thanks to CLEAN-ROADS	Direct measurement
RMO_2	Number of road operators revealing that their technical background has improved thanks to the educational activities of the project	Direct measurement
RMO_3	Number of vehicles kilometers traveled during the winter season	Indirect measurement
RMO_4	Amount of salt (and other deicers) used in the winter maintenance operations	Indirect measurement
RMO_5	Number of treatments carried out during the winter season	Indirect measurement
RMO_6	Total amount of time destined to winter road maintenance treatments (equal to the time in which maintenance vehicles were on the roads)	Indirect measurement

Table 3: Reference monitoring indicators list for target group "road management operators".

2.3 Monitoring indicators for inter-regional stakeholders

A reference list of monitoring indicators which is considered for target group “inter-regional stakeholders” is illustrated in Table 4.

Indicator Nr.	Monitoring Indicator	Direct / Indirect measurement
IRS_1	Number of stakeholders revealing that they have increased their attention to these topics and issues thanks to CLEAN-ROADS	Direct measurement
IRS_2	Number of stakeholders revealing that they have increased their knowledge about the potential of RWIS	Direct measurement
IRS_3	Amount, type and possibly economical investments in RWIS	Direct measurement

Table 4: Reference monitoring indicators list for target group “inter-regional stakeholders”.

2.4 Monitoring indicators for EU networks and stakeholders

A reference list of monitoring indicators which is considered for target group “EU networks and stakeholders” is illustrated in Table 5.

Indicator Nr.	Monitoring Indicator	Direct / Indirect measurement
ENS_1	Number of EU stakeholders revealing to have activated / increased their investments in RWIS	Indirect measurement
ENS_2	Number of EU stakeholders revealing to have optimized winter maintenance procedures	Indirect measurement
ENS_3	Number of R&D / pilot projects in the RWIS field	Indirect measurement
ENS_4	Number of directives / standards / reference publications at national and EU level concerning RWIS	Indirect measurement

Table 5: Reference monitoring indicators list for target group “EU networks and stakeholders”.

2.5 Monitoring indicators for secondary target groups

A reference list of monitoring indicators which is considered for secondary target groups is finally illustrated in Table 6.

Indicator Nr.	Monitoring Indicator	Direct / Indirect measurement
STG_1	Number of secondary target groups involved in the project	Indirect measurement
STG_2	Number of people belonging to secondary target groups that have been involved in the organization of some project activities	Indirect measurement
STG_3	Number of users that have been possible to involve thanks to the secondary target groups	Indirect measurement
STG_4	Number of independent initiatives complementary to the	Direct measurement

	project kicked-off by secondary target groups

Table 6: Reference monitoring indicators list for secondary target groups.

3. Monitoring indicators measurement

The aim of this chapter is to present the measurement methodology which is proposed in order to monitor and quantify the different indicator sets introduced in the previous chapter for each reference target group of the project. The basic approach, which is quite widespread within the behavior analytic research community [3], is to perform this assessment by means of a combined sets of methods, which rely from one side on direct feedbacks provided by target groups, and on the other side on indirect measurements in their habits' change.

It is worth noting that the proposed approach for the monitoring of the impact on the target audience is an element of significant novelty in the scientific literature which is available in this specific application domain. Until now, very little has been done to quantitatively evaluate the impact related to the introduction of advanced RWIS system on specific target groups. For instance, the involvement of road operators, which are going to actually be the primary users of the CLEAN-ROADS system, is an aspect that has had very little consideration in RWIS projects, both at a research level as well as in deployment initiatives.

Something more has been done concerning travelers driving during the winter season. One of the most interesting approaches, Takahashi et al. presented during the recent SIRWEC 2012 conference a very innovative approach for performing a Customer Satisfaction Analysis (CSA) for evaluating winter driving environment, which is based on the idea to interview the drivers immediately after they have driven a certain case study road and to relate their answers to the actual conditions of the road, which is continuously measured by means of a mobile probe [4]. The interesting aspect of this approach is that a precise and reliable BCG matrix [5] can be quantitatively produced, and give very useful indications to the road maintenance managers on the most important issues that they are recommended to cover in order to improve the overall level of quality of service. On the other side, the limitation of this methodology is that it can be very useful in order to assess the needs of the drivers' population, but it is inapplicable for performing an extended campaign of impact monitoring assessment, in which the goal is to consolidate the behavior changes on a long-term period.

Given all these premises, the methodology which is introduced in the CLEAN-ROADS project can not only satisfy the internal need to deeply understand and quantify the impact of the project within the local community, but can also represent an important element of novelty even within the scientific community, which could be used (and eventually improved) also for other present and future initiatives and allow a more precise comparison between different RWIS implementations measures.

3.1 Direct data collection methods

One side of the monitoring methodology is based on the idea to collect direct feedbacks from the identified target groups. In this way, reference users and stakeholders can provide an effective and objective statement which can be actively considered in order to determine the type and amount of impact that the project actions have had on their habits, perspectives and

daily activities. The main method with which this direct data collection process is going to take place is the questionnaire, which is a common and consolidated method to directly determine an ex-post evaluation concerning a specific user experience [6]. As proposed in [7], the proposed methodology aims to put in relationship the expectations and the perception of target groups towards the winter road maintenance service, and to evaluate how this overall attitude evolves in the time domain. The objective of this impact assessment activity would be exactly to verify a progressive decrease in the user expectations, and as a consequence a progressive increase in the positive perception on how the service is organized and maintained.

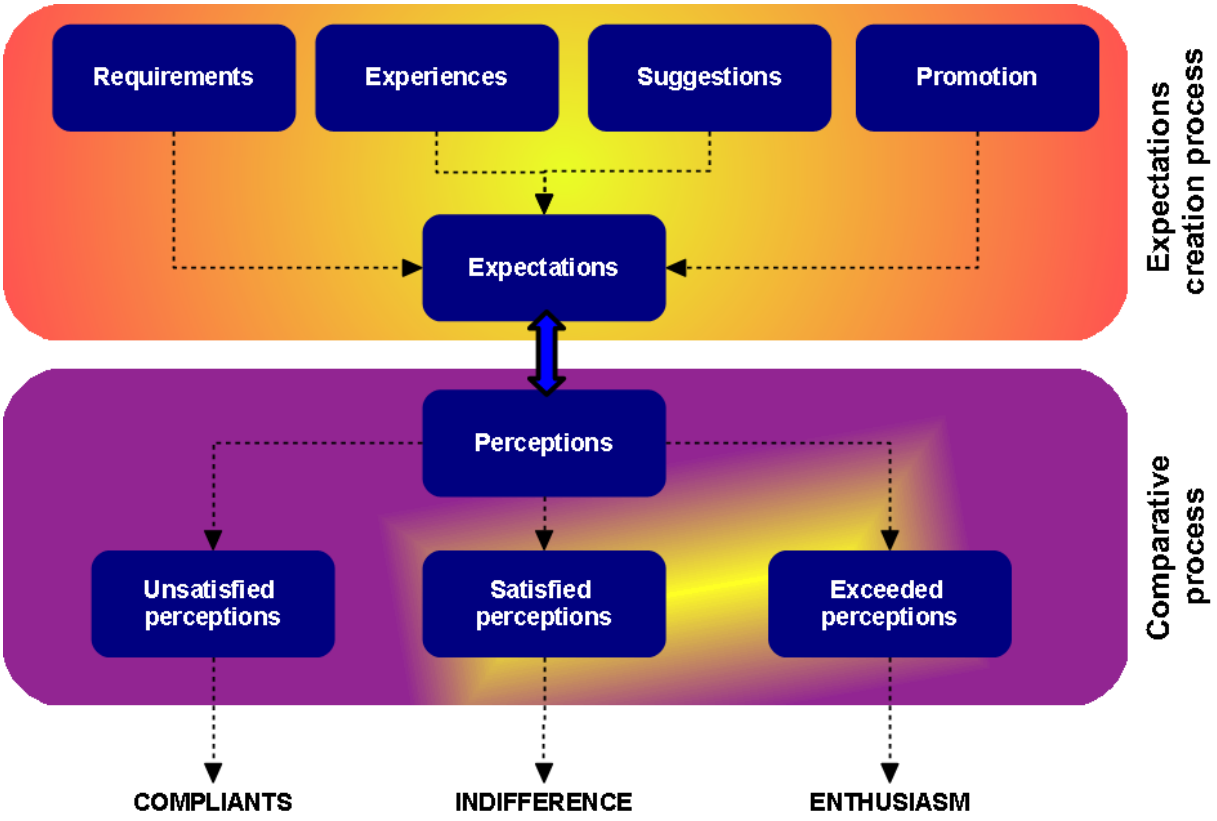

Figure 1: The reference cognitive model considered in the proposed methodology for the user experience assessment [7].

Table 7 illustrates how the method is going to be applied in practice towards the different target groups in order to quantitatively measure the aforementioned monitoring indicators. The detailed formulation of the set of questions as well as the measurement method for the received answers (which will probably follow the Likert methodology [8]) are going to be defined during the preparation activities of the ex-ante impact evaluation

Indicator Nr.	Target groups	Domain Type	Description
LT_1-LT_2	Local travelers	Expectations creation process	The local travelers are asked to reveal if (i) they have performed a change in their winter travel patterns and (ii) their perspective towards the winter maintenance service has changed .

LT_3	Local travelers	Comparative process	The local travelers are asked to reveal if the quality of service of the winter maintenance operations has increased.
RMO_1	Road management operators	Comparative process	The road management operators are asked to reveal if their work has become more efficient.
RMO_2	Road management operators	Expectations creation process	The road management operators are asked to reveal if they can recognize an improvement in their technical background and as a consequence a better attitude towards the procedures which are used for managing the winter maintenance service.
IRS_1-IRS_2	Inter-regional stakeholders	Expectations creation process	Inter-regional stakeholders are asked to reveal if they have increased their awareness concerning (i) topics and issues covered by CLEAN-ROADS and (ii) RWIS technological potentials.
IRS_3	Inter-regional stakeholders	Comparative process	Inter-regional stakeholders are asked to reveal if they have planned investments in the RWIS sector
STG_4	Secondary target groups	Comparative process	Secondary target groups are asked to reveal if they have planned complementary initiatives in the topics of interest covered by CLEAN-ROADS.

Table 7: Target groups and application of reference direct data collections methods.

3.2 Indirect assessment procedures

In parallel to the direct data collection process, it is proposed to consider a set of indirect assessment procedures in order to have a more complete understanding of the type and amount of impact that the project actions have had on the target audience. In this way, it will be possible to overcome the natural limitations related to the statistical reliability and representitivity of the interviewed sample by externally observing its behavior in the application domain of the project. It is worth noting that this approach, which seems to be optimally in theory, has in reality to face different limitations when applied in practice. For example, the data related to the road operators are going to be recorded in a manual way, and not be acquired through standard and automatic tools, and therefore could be subjected to human errors and mistakes, both in the recording process as well as during the data evaluation phase. Moreover, reference data which is proposed in this monitoring method is provided by different sources and typically with different levels of detail and accuracy, thus increasing the complexity and the effort for a proper and consolidated impact assessment. These issues will be however properly compensated in the proposed monitoring methodology, since the aim is not primarily to determine an absolute assessment of the generated impact, but more to quantify a correspondent relative shift. This means, that it will be more important to guarantee that the heterogeneous data collection process is performed in the same way during the project life time, than to refine the process itself in order to maximize accuracy and reliability of the gathered datasets.

Table 8 illustrates the different data types (and sources) which are going to be considered in the proposed methodology for each target group.

Indicator Nr.	Target groups	Data type	Data source
LT_4	Local travelers	Number of accesses	Web portal “Viaggiare in Trentino” through on-line measurement instrument such as Google Analytics
LT_5-LT_6	Local travelers	Number of accesses / comments / notifications	Project website (and eventually other project on-line channels) administration panel, with possible use of on-line measurement instrument such as Google Analytics
LT_7	Local travelers	Number of accidents	Road Management Service through local police
LT_8	Local travelers	Number of congestion phenomena	Road Management Service through elaboration of a comprehensive traffic dataset collected by an extensive network of traffic detectors. The congestion phenomena will be identified by isolating low-speed profiles with respect to typical free-flow speed profiles
LT_9	Local travelers	Average Daily Traffic	Road Management Service (traffic data collected by static RWIS station(s) – traffic counts and vehicles classification)
LT_10	Local travelers	Average Speed Profile	Road Management Service (traffic data collected by static RWIS station(s) – vehicles speed)
RMO_3	Road management operators	Vehicles Kilometers Traveled	Estimated data provided by the road management operators, which are based on the description of the area where the road treatments are carried out.
RMO_4	Road management operators	Amount of salt used	Estimated data provided by the road management operators. More specifically, operators will record the initial configuration of the treatment and the one which is currently use in correspondence of the static RWIS station(s).
RMO_5	Road management operators	Number of treatments	Data provided by the road management operators. The data include type of treatment (e.g. use of sodium chloride) and motivation (e.g. imminent snowfall) as well.
RMO_6	Road management operators	Amount of time needed for the winter maintenance treatments	Estimated data provided by the road management operators.
ENS_1	EU networks and stakeholders	Number of investments in RWIS technologies	Analysis of proceedings of reference international conference (e.g. SIRWEC)
ENS_2	EU networks and stakeholders	Number of interventions concerning optimized winter maintenance procedures	Analysis of proceedings of reference international conference (e.g. SIRWEC)
ENS_3	EU networks	Number of R&D /	Analysis of proceedings of reference

	and stakeholders	pilot RWIS projects	international conference (e.g. SIRWEC)
ENS_4	EU networks and stakeholders	Number of directives / standards / reference publications	Analysis of activities and outputs produced a selected number of relevant organizations (e.g. DG Mobility and Transport, PIARC association, CEN TC 337, etc.)
STG_1	Secondary target groups	Number of secondary target groups involved	Analysis of documentation concerning secondary target groups involvement (minutes, intermediate outputs), etc.
STG_2	Secondary target groups	Number of employees belonging to secondary target groups involved	Analysis of documentation concerning secondary target groups involvement (minutes, intermediate outputs), etc.
STG_3	Secondary target groups	Number of final users involved in cooperation with secondary target groups	Analysis of documentation concerning local dissemination activities, which could also be enriched by information provided by secondary target groups.

Table 8: Target groups and application of reference indirect data collections methods.

3.3 Monitoring operations plan

The monitoring activities of Action C1 are going to be carried in a systematic way over the whole project duration. Similarly as what is proposed for Action C2 [2], the main goal is to put in relationship the indicators quantified at the beginning of the project (ex-ante impact evaluation) and at the project end (ex-post impact evaluation), in order to get a comprehensive assessment of the impact on the target audience produced by the project activities. Together with these two main monitoring checkpoints, two other intermediate monitoring verifications will be performed in order to get a deeper overview of the current, measured impact and to eventually suggest recovery / optimization plans for improving the scope and outcome of awareness-raising activities foreseen in Action D2. A reference overall plan for monitoring activities foreseen in Action C1 is presented in Table 9.

Monitoring activity	Period	Reference deliverable	Winter season	Description
Ex-ante impact evaluation	M1-M12	D.C1.2	2012 – 2013	• an initial survey will be organized in order to quantify indicators LT_1, LT_2, LT_3 (referred to winter season 2012/2013); it is envisaged to give visibility to this activity in order to create a statistically significant community of final users; • the indicator s LT_5, and LT_7-LT_10 as well as RMO_3-RMO_6 (referred to the winter season 2012/2013) will be indirectly measured; • an initial survey will be organized with a selected number of inter-regional / national stakeholders in order to

				preliminary determine IRS_1, IRS_2 and IRS_3; the survey could be organized in occasion of the first project workshop; • an initial survey will be organized with a selected number of secondary target groups in order to preliminary determine STG_4; the survey could be organized even in this case in occasion of the first project workshop;
First process evaluation	M13-M24	D.C1.3	2013 – 2014	• a progress survey will be organized in order to update indicators LT_1, LT_2, LT_3 (referred to winter season 2013/2014); • the indicators LT_4 and LT_6 will be first quantified, and the indicator LT_5 updated; • the indicator s LT_7-LT_10 as well as RMO_3-RMO_6 (referred to the winter season 2013/2014) will be indirectly measured; • a progress survey will be organized with the identified inter-regional / national stakeholders in order to update indicators IRS_1, IRS_2 and IRS_3; the survey could be organized in occasion of the second project workshop; • an progress survey will be organized with the identified target groups in order to update indicator STG_4; the survey could be organized even in this case in occasion of the second project workshop; • the indicators STG_1-STG_3 will be initially quantified; • an initial survey will be carried out in order to quantify indicators ENS_1-ENS_4;
Second process evaluation	M25-M36	D.C1.4	2014 – 2015	• a progress survey will be organized in order to update indicators LT_1, LT_2, LT_3 (referred to winter season 2014/2015); • the indicators LT_4 -LT_10 as well as RMO_3-RMO_6 (referred to the winter season 2014/2015) will be indirectly measured; • a survey will be organized with road operators taking part to first training courses in order to quantify indicator RMO_2; road operators involved in the first validation activities on the road stretch will also provide a to quantitatively estimate indicator RMO_1; • the indicators STG_1-STG_3 will be updated; • a second survey will be carried out in order to quantify indicators ENS_1-

				ENS_4;
Ex-post impact evaluation	M37-40	D.C1.5	2015	• a final survey will be organized in order to finally determine indicators LT_1, LT_2, LT_3 (referred to winter season 2015); • the indicators LT_4 -LT_10 as well as RMO_3-RMO_6 (referred to the winter season 2015) will be finally measured; • a final survey will be organized with road operators taking part to second training courses (as well as final test and validation activities) in order to quantify indicators RMO_1 and RMO_2; • a final survey will be organized with the identified inter-regional / national stakeholders in order to finally quantify indicators IRS_1, IRS_2 and IRS_3; a progress survey will be organized with the identified inter-regional / national stakeholders in order to update indicators IRS_1, IRS_2 and IRS_3; the survey could be organized in occasion of the third and final project workshop; • a final survey will be organized with the identified target groups in order to finally quantify STG_4; the survey could be organized even in this case in occasion of the third and final project workshop;

Table 9: Actuation of the proposed methodology for the assessment of the impact on the target audience .

It is worth noting that during the activation of the effective monitoring activities it will be important to properly organize the data collection campaign and, where necessary, the proper measurement instruments (e.g. Google Analytics in order to keep trace of the visits on the project's website). Since not all data sources are directly managed and controlled by the project beneficiaries (e.g. the traveler information system "Viaggiare in Trentino"), the monitoring activities will be properly scaled and revised as a function of the available technical and organizational limits.

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