InDeV: In-Depth understanding of accident causation for Vulnerable road users

HORIZON 2020 - the Framework Programme for Research and Innovation

Deliverable 1.1

Project Plan

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Dissemination Level		
PU	Public	X
PP	Restricted to other programme participants (including the Commission Services)	
RE	Restricted to a group specified by the consortium (including the Commission Services)	
CO	Confidential, only for members of the consortium (including the Commission Services)	

Document information

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Project funding

Revision and history chart

Version	Date	Comment
1	2015-12-15	pp. 38-39, 5.6 Video recordings, Data sharing and access.
		Changes regarding the rules for access of the video by the third parties. No free public access to the data (the condition about public dataset is removed)
2	2016-02-11	pp. 30-31. The routine for communication with the local authorities is described in detail
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Content

1. Introduction

1.1 Project aim

InDeV will contribute to the overall aim set out in the European policy objective of halving road deaths by 2020 by providing a toolbox for understanding accident causes for VRUs and by developing a framework for good practice for a comprehensive assessment of socio-economic costs related to road-accidents involving VRUs.

1.2 Project objectives

The main objective of the InDeV project is to contribute to the improvement of VRUs' safety in Europe, by developing an integrated methodology (compiled in a toolbox) for understanding accident causes for VRUs and a framework for good practice for a comprehensive assessment of socio-economic costs related to road-accidents involving VRUs.

The tool-box for in-depth analysis of accident causation for Vulnerable Road Users (VRU) is based on a combined use of accident databases, in-depth accident investigations, surrogate safety indicators, self-reported accidents and naturalistic behavioural data. The tool-box will help to link accident causation factors to VRUs' accident risk, and provide a solid basis for developing preventive countermeasures and a better input for socio-economic cost calculations of VRU accidents. The proposed approach is to reveal the causational factors by focusing on the process of accident development, thus overcoming the main weakness of the traditional accident data-based approach that might find correlations between various factors and accident frequency, but not show the causation chains. It will also employ, to a larger extent, observation of critical traffic events that are similar in process to real accidents, but are relatively more frequent and easier to collect in sufficient quantities. Thus, InDeV aims to further validate the use of surrogate safety indicators as a reliable substitute for crash data by comparing the results with findings from crash statistics and in-depth data from different countries. The tools developed in the project will be close to market-readiness and will be useful in any traffic context, i.e. will not be country-specific. The InDeV project includes the following steps: i) review of methods and identification of the critical sites and road user groups; ii) development of technical tools for automated behaviour data collection; iii) observation studies at the selected sites; iv) analysis of the socio-economical costs; v) compilation of the project results and development of the safety analyst toolbox. The project has a clear focus on VRUs and the course of events in accidents they get injured in. It will provide solid knowledge, help to avoid a skewed view on the problem of VRUs' safety, and facilitate the proposed tailor-made countermeasures for these groups. Moreover, with the use of surrogate safety indicators, there will be no need to wait for accidents to happen in order to learn how to prevent them from happening.

1.3 Key Performance Indicators (KPI) of the project

With reference to the Council Decision 2013/743/EU, the following KPIs are set up for InDeV:

1. **Share of publications which are among the top 1 % highly cited per field of science.** InDeV partners will publish 12 papers in peer-reviewed journals during the project period plus one year.

2. **Number of prototypes and testing activities.** InDeV will produce 3 prototypes of technical tools and carry out activities to test them.

3. **New products, processes, instruments, methods.** InDeV will develop:

- a unified methodology for using surrogate safety indicators with focus on VRU's accident risk;
- a mobile phone application for naturalistic cycling/walking study;
- an automated traffic conflict detection tool;
- a frame-work for accident cost calculation methods for the assessment of socio-economic costs for vulnerable road users.

2. Project work

2.1. Beneficiaries

	Name	Short name	Country
1	LUNDS UNIVERSITET	LU	Sweden
2	AALBORG UNIVERSITET	AAU	Denmark
3	UNIVERSITEIT HASSELT	UHasselt	Belgium
4	CORPORATION DE L ECOLE POLYTECHNIQUE DE MONTREAL ASSOCIATION	PM	Canada
5	BUNDESANSTALT FUER STRASSENWESEN	BASt	Germany
6	NEDERLANDSE ORGANISATIE VOOR TOEGEPAST NATUURWETENSCHAPPELIJK ONDERZOEK - TNO	TNO	Netherlands
7	INGENIERIA DE TRAFICO SL	INTRA	Spain
8	POLITECHNIKA WARSZAWSKA	WUT	Poland

All partners are involved in the project during the entire project life.

2.2. Work plan

Work packages

WP number	WP title	Lead beneficiary
WP1	Project Management	1 - LU
WP2	Review of study methods and identification of critical sites and situations for VRU safety	8 - WUT
WP3	Observational studies	1 - LU
WP4	Tools for automated data collection and analysis	2 - AAU
WP5	Socio-economic cost analysis	5 - BASt
WP6	VRU safety analysis toolbox	3 - UHasselt
WP7	Dissemination and exploitation	5 - BASt

Overall work plan

The overall structure of the project work plan is given in Figure 1.
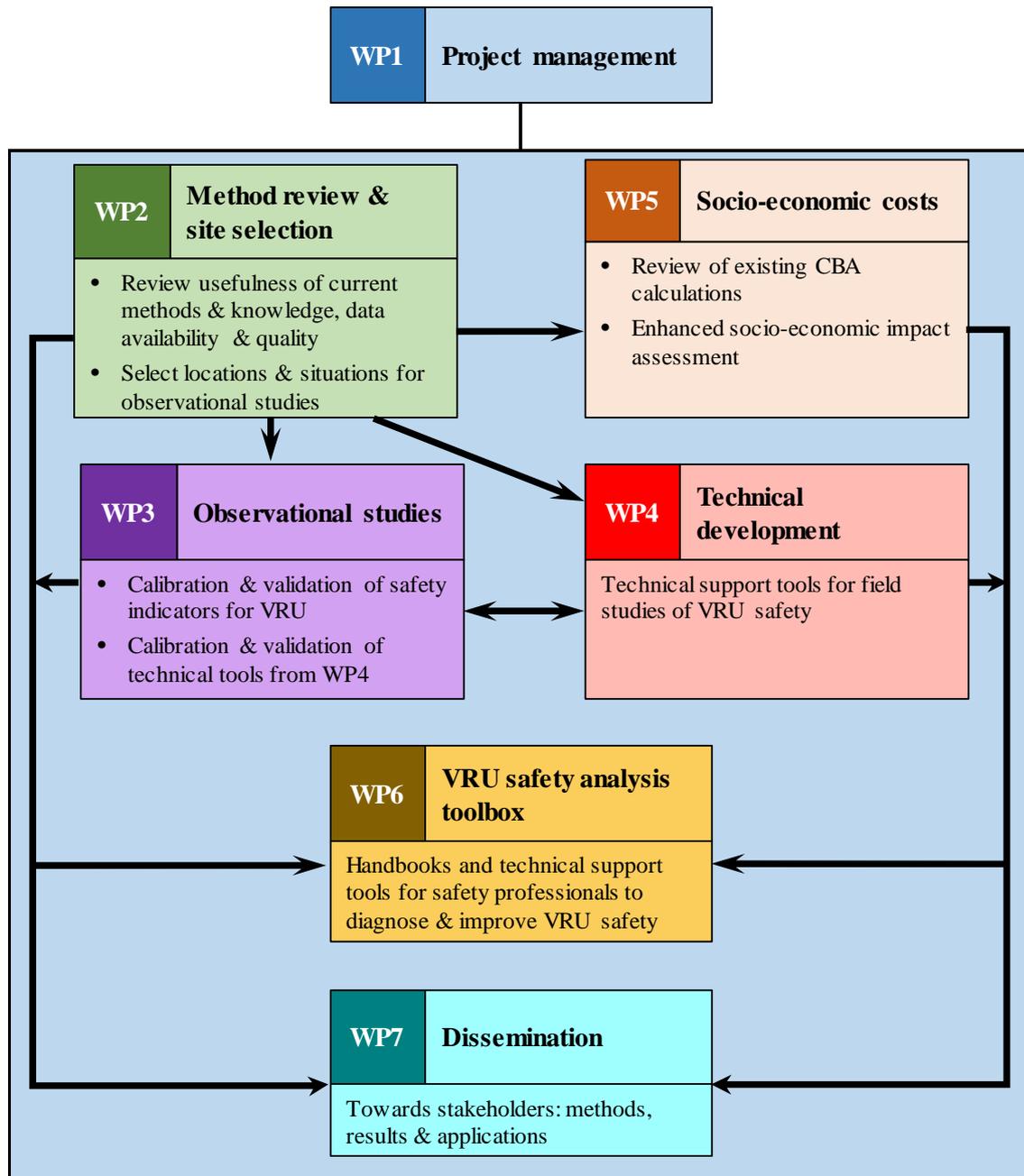
Figure 1. Overall structure of the InDeV project work plan.

WP1 "Project management" ensures efficient co-ordination of the project tasks, timely delivery of the results, their quality control and actions to mitigate the consequences of any unexpected obstacles.

WP2 "Methods review & site selection" outlines the state-of-the-art knowledge in the field and provides the necessary theoretical and practical input (e.g. list of sites to be studied in WP3) to the other work packages.

WP3 "Observational studies" and WP4 "Technical support" are very closely inter-related. In WP3, data from the selected sites is collected and analysed. The results are used to validate not

just the suggested safety indicators, but also the overall methodology of studying accident causation.

WP4 "Technical support" provides the necessary technical tools to support the automated data analysis, while the performance of the developed tools is validated in WP3.

WP5 "Socio-economic costs" provides a review and recommendations on the methods for assessment of the costs related to VRU accidents.

WP6 "VRU safety analysis toolbox". The results of WP2, WP3, WP4 and WP5 serve as input for WP6, where the existing and new knowledge generated in the project is summarised in a set of tools in user-friendly and easily accessible form for traffic safety practitioners.

WP7 "Dissemination" organises work on the dissemination of project results to practitioner, stake holder and researcher communities through journal publications, conferences, seminars, etc.

Inter-relation of the components

The detailed inter-relation of the tasks of the project WPs is given in Figure 2. To improve the readability of the chart, WP1 ("Management") and WP7 ("Dissemination & Exploitation") are not shown – since they will go on during the entire project life-time and practically have an effect on each of the components.
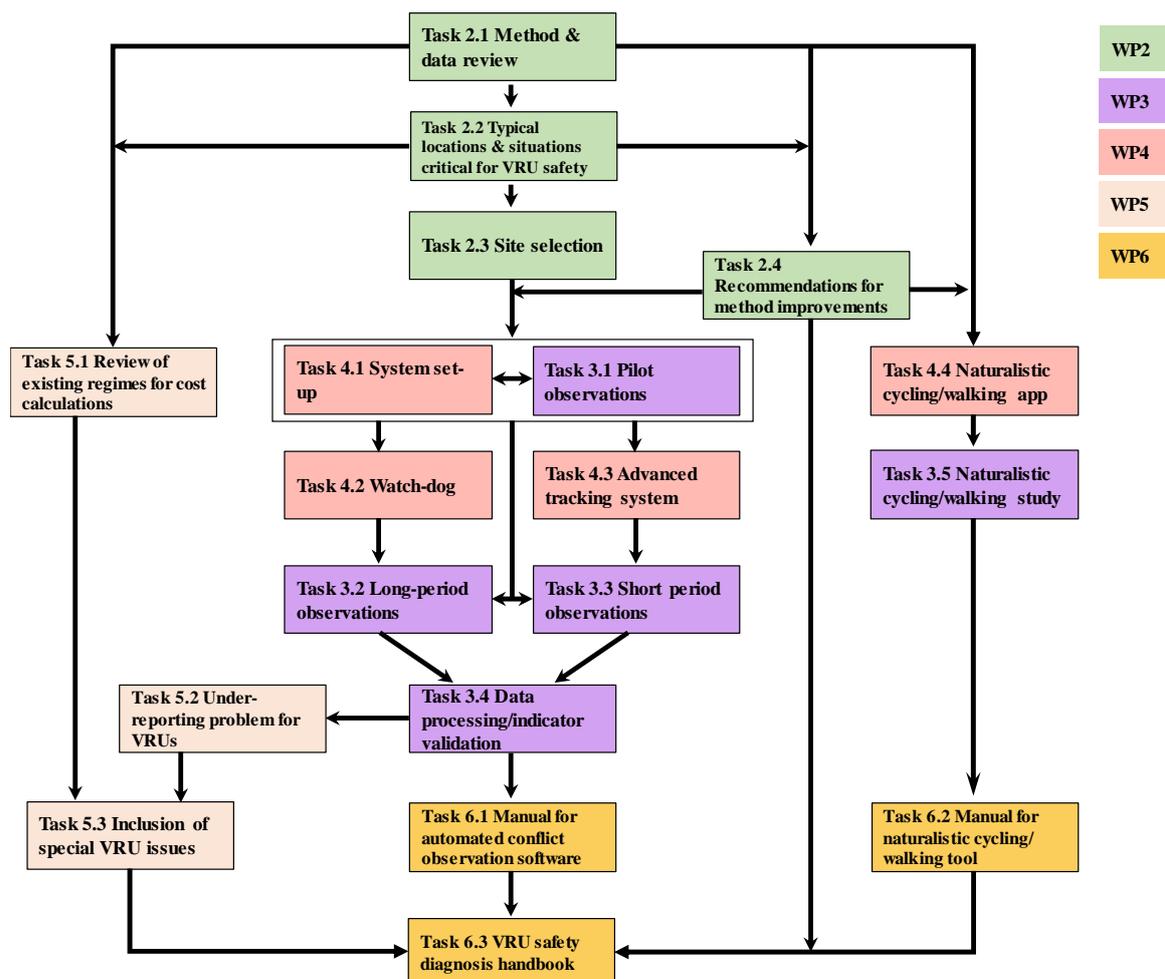
Figure 2. Inter-relation between the project components (except for WP1 and WP7).

In WP1, the main work of the management, co-ordination of the partners' work, reporting to the Commission, and dealing with risk and other issues will be done by the project co-ordinator (LU). This work is estimated to be 30 PMs for LU and 1 PM for each project partner. The project progress can be assessed by the Commission through the regular reports from the project. The entire consortium will meet at the beginning of the project and at the end of each project year (kick-off & annual meetings). In connection with these events, the consortium also has a meeting with the Advisory Board (the travel costs for the Advisory Board members are included in the WP1 budget). Additional meetings, necessary for co-ordinating particular project tasks, are included in the budget for the respective WPs.

WP2 "Review of study methods and identification of critical sites for VRU safety" consists of 4 distinct tasks. Task 2.1 will provide the review of the current methods for accident causation studies, availability of the data, methodological and data gaps. Based on the available data sources and combining the methods described in Task 2.1, Task 2.2 will produce a list of the most typical locations and situations critical for VRU safety. This will provide input for a large number of tasks in the project, as the specific properties of the locations/situations will have an effect on how the methods for VRU-safety analysis should be developed and applied. Task 2.3 will list the municipality locations which will be involved in the project and whose VRU-safety problems will be studied in detail in WP3. Task 2.4 will develop recommendations for improvements of the described methods, which will serve as input for WP3, WP4 and WP6. The main work in WP2 is to be done by WUT (40 PMs), while other partners will require 5 to 11 PMs depending on the amount of work contributed.

WP3 and WP4 ("Observational studies" and "Tools for automated data analysis") are intimately inter-related. In Tasks 3.1 and 4.1 the initial tests for the technical system set-up and its practical installation are performed. With this practical knowledge, the equipment for the long- and short-term observations is purchased and the data collection is performed in each European partner's country (Tasks 3.2 and 3.3). The planned number of sites is 3 for the long-term observations and 21 for the short-term observations (three sites per European partner country). The data is analysed in Task 3.4 partly manually (to provide ground truth) and automatically by the tools developed in Tasks 4.2 ("Watch-dog") and 4.3 ("Advanced tracking system"). The results of the analysis are used to validate both the technical tools and the suggested safety indicators. The methods for automated observational studies and the guidelines for technical tools use will be described in a manual developed in Task 6.1 (WP6, "VRU safety analysis toolbox").

A parallel track in the project is development (Task 4.4) and application (Task 3.5) of a mobile application and its support system, which can be used for naturalistic cycling/walking data collection. Based on this work and similar site-based observations, a manual for naturalistic VRU studies will be developed in Task 6.2.

The data collection and analysis in WP3 is to be done mainly by LU, AAU, UHasselt and WUT (30, 25, 25 and 18 PMs, respectively). The costs also include purchase of the equipment (9 sets to be moved around the sites) and the travel costs for the responsible partners. In WP4, the development is to be done by AAU, LU and TNO (78, 52 and 10 PMs), and the other costs include purchase of the equipment necessary for tests before finally deciding on what sensors are to be used, and in which combinations, for data collection in WP3.

WP5 "Socio-economic costs" consists of three tasks that review the current calculation regimes of economic costs of VRU accidents (Task 5.1), estimate the scale of under-reporting problem for VRUs (Task 5.2) and develop a framework for good practice that includes the special issues of VRU safety (Task 5.2). This work will be based on the input from WP2 and WP3. The work is to be done by BASt, LU and AAU (18, 8 and 8 PMs) with input of local country cost calculation procedures from other partners.

Finally, all the project "tracks" are to be joined together in Task 6.3 to develop the general VRU safety diagnosis handbook that will summarise the earlier existing and in InDeV methods for VRU safety analysis and calculation of the related socio-economic costs. The WP6 is to be driven by UHasselt (16 PMs), with input from the other partners involved in the development in the earlier stages. Some additional costs are involved in producing the handbook in Task 6.3, for which professional design and layout will be required.

In WP7 "Dissemination and exploitation", the results of the project work are to be presented in the form of a website, newsletters, publications in scientific journals, presentations at the conferences, and organisation of the final demonstration event. This work is to be organised by BASt (20PMs) with contributions from all the other partners.

WP1 – Project Management

Duration: Months: 1-36

Partners: LU (lead), AAU, UHasselt, PM, BAST, TNO, INTRA, WUT

Objectives:

The main objective of this work package is to provide an efficient, flexible and active project management of InDeV, with a clear distribution of responsibilities that is transparent to all partners.

The main objectives are to:

- Achieve the contracted results, including handling the project reporting and accounting;
- Ensure an effective daily management of the project both administrative and technical;
- Ensure a consistent high quality of work in the project and the reports produced;
- Efficiently deal with risk and other issues as they arise;
- Ensure proper communication within the consortium and with the European Commission;
- Ensure co-ordination of project-related activities both internally between the WPs and externally with the Advisory Board and other stakeholders.

Task 1.1: Technical Management – Scientific leadership (LU)

Lund University (LU) will fulfil the coordination responsibilities, as described in the contract with the European Commission. It will supervise the reporting of all activities, which is crucial for the overall progress of the project. As the Coordinator, LU is responsible for the overall project coordination, which includes research content leadership, strategic management tasks and supervision of the overall technical progress. In cooperation with the General Assembly and the European Commission (EC), the Coordinator may decide on critical strategic issues. In addition to regular meetings once a year, the General Assembly may hold extraordinary meetings for addressing major decisions requiring immediate attention. The project co-ordinator will act as chairman of the project Executive Board consisting of WP leaders. These meetings may be physical meetings or e-meetings (including video conferences).

Task 1.2: Communication Management (LU)

LU will constitute and act as the main contact for all inquiries concerning InDeV, as well as be responsible for communication between the consortium and the Commission. Further tasks include:

- Co-ordination of deliverable submission to the Commission and communicating requirements for modifications to the partners involved.

- Quality assurance of scientific and technical results. Peer reviews, which will be an important internal evaluation method, will be supported by partners' experts on a case-to-case basis. Upon request from the Coordinator, partners will provide the experts necessary for reviewing the specific deliverables.
- Compilation of the key findings from the other work packages into a condensed final report.

Furthermore, the purpose of this activity is to foster and ensure an appropriate level of communication within the project for scientific exchange and collaboration, as well as for matters related to project management and administration. The Project Management Team will define the project's overall communication infrastructure, but select and subcontract to a suitable agency for setting up and maintaining this infrastructure when it comes to such matters as handling of intellectual property rights (IPR). This part of the task ensures that IPR is properly handled according to the rights set out in the consortium agreement, and that patents are filed where and when necessary. If required, the necessary legal advice will be given to the partners as part of this task.

For regular conference calls among partners, already existing phone conference and virtual meeting tools at LU will be used.

Representatives of the participating municipalities, as well as private companies working on the relevant technology and method development will be invited to take part in an Advisory Board to discuss implementation issues. The Advisory Board will have regular meetings once a year. The current Advisory Board consists of:

- Andrew Tarko, University of Purdue (USA)
- Paul Schepers, Ministry of Infrastructure and the Environment (Netherlands)
- Christer Hyden, professor emeritus (Sweden)
- Michael Sørensen, TØI (Norway)
- Oliver Carsten, University of Leeds (UK)
- Veerle Schoutteet, Flanders Roads and Traffic Agency (Belgium)
- Lars Ekman, Swedish Transport Administration (Sweden)
- Lars Hultkrantz, Örebro university (Sweden)
- Ilona Buttler, Motor Transport Institute (Poland)
- Risto Kulmala, Finnish Transport Agency (Finland)
- Oscar Llatje Hierro, Catalan Traffic Institute (Spain)
- Ulf Görman, Jönköping University, professor in ethics (Sweden)

Task 1.3: Administrative Project Management (LU)

In order to allow the Project Coordinator to focus on strategy, leadership and scientific coordination, her/his administrative project management burden will be shared by the Administrative Project Management Team.

The operational management will define and implement processes, such as contract amendments, and provide appropriate tools and templates for their realization. The different work package leaders will be assisted in fulfilling their obligations. These supportive activities include resource monitoring and control, cost and related communication, and activities associated with work packages and tasks.

Task 1.4: Risk Management (LU)

The European Commission will receive regular reports on the project progress. These will be provided at work package and task levels. Adherence to EC guidelines will be monitored in

order to guarantee transparency not only in dealings within the project, but also with the European Commission and other stakeholders. After collecting and aggregating the technical and financial data from the partners, the processed information will serve as a basis for the risk analysis and quality check by the Coordinator.

The main tasks for Risk Management are:

- Progress management and risk contingency planning for the project;
- Any minor deviations from the plan will be reported to the Project Coordinator, who will consider the problems and, where appropriate, make recommendations for implementing the contingency plan(s) associated with the work package(s) in question;
- In the event of serious problems, the Project Coordinator will convene the GA to determine the best route forward and will advise the EC's Project Officer of the problem and seek approval for the proposed solution.

The main sources of risks have already been identified during the project preparation phase, however, unexpected risks may arise during the project lifetime.

Time plan for WP1 is presented in Figure 3.
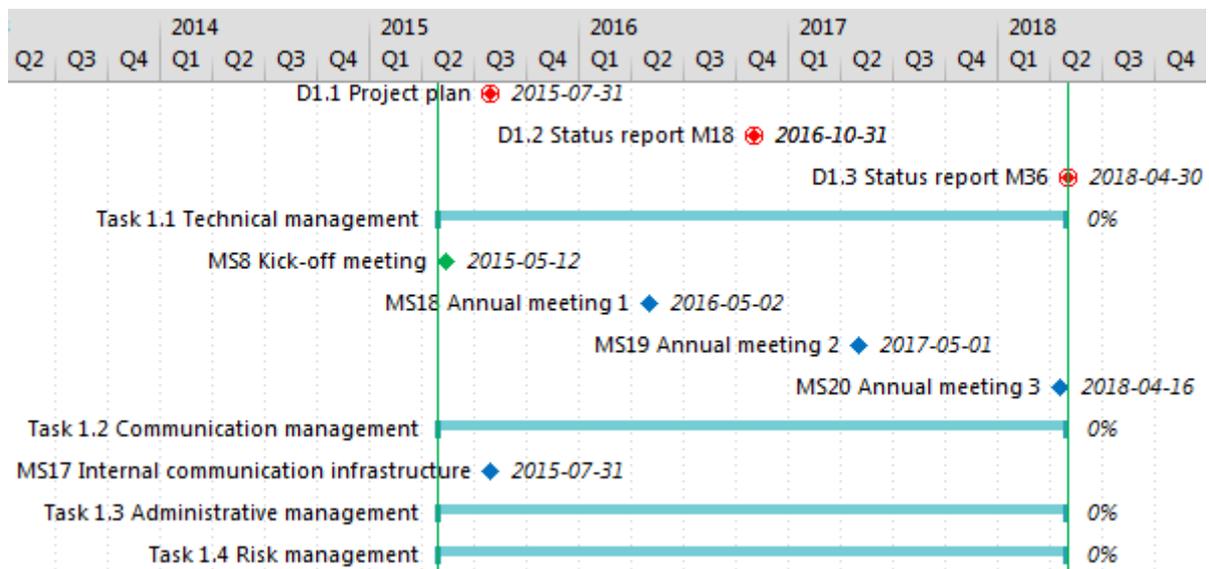
Figure 3. WP1 time-plan (note that when a milestone and a deliverable coincide only the deliverable is shown in the time-plan).

WP2 – Review of study methods and identification of critical sites and situations

Duration: Months 1-16

Partners: WUT (lead), LU, AAU, UHasselt, PM, BAST, TNO, INTRA.

Objectives:

- To critically review the usefulness of the currently used methods for accident causation studies with relevance to VRUs;
- To assess the quality and availability of data with relevance to VRU safety problems;
- To identify typical locations and situations where most VRU accidents occur;
- To select sites and situations for observational studies;
- To identify gaps in the currently used study methods and recommend improvements.

Task 2.1: Review of the current accident causation study methods and data

This task will first critically review the quality and usefulness of methods for accident causation studies used today, with the aim of linking accident causation factors to VRU accident risk. The quality and availability of data with relevance to VRU safety problems will then be documented and critically assessed (all partners will be involved). National and regional differences in study methods and data will be taken into account. The following current study methods will be reviewed (leaders are shown in bold):

- Epidemiological studies based on accident and injury data (**WUT**, all);
- In-depth accident investigations (**BASt**);
- Naturalistic driving studies (**AAU**, LU);
- Behavioural observations (**UHasselt**, INTRA, TNO, LU, BASt);
- Traffic Conflict studies (**LU**, UHasselt, TNO, WUT);
- Self-reported accidents (**AAU**, LU).

The review will examine international data sources (CARE, IRTAD, WHO) and national databases of accident and injury data, risk exposure data as well as safety performance indicators. It will build upon results of previous projects (SafetyNet, DaCoTA), focusing on issues specific to VRUs. During this task a workshop on indirect safety measures will be organised so that all partners can exchange knowledge of current study methods and their shortcomings as well as data availability and quality. LU and TNO will present their conflict techniques, including field training sessions. It is expected that the outcome of this task will be used in Tasks 2.2, 2.3 and 2.4.

Task 2.2: Identification of typical locations and situations critical for VRU safety

In the second task, typical locations and situations where most VRU accidents occur (by location, facility type, geometry, regulations, traffic flow, timing, conditions, etc.) will be identified using statistical analysis. This will be done with respect to different VRU groups: pedestrians, children, elderly, disabled, cyclists and riders of Powered Two Wheelers (PTWs). The analysis will be based on data from:

- International (CARE, IRTAD), national and local accident databases;
- In-depth accident investigations (e.g. GIDAS) and other databases;
- Naturalistic driving data.

This task will enable the identification of conditions and factors that have a negative impact on VRU safety. In addition, a list of criteria and recommendations will be drawn up for site selection in Task 2.3.

Task 2.3: Selection of sites for observational studies

In the third task, actual sites and locations in the participating municipalities will be identified and selected for subsequent field observations in WP3 and WP4. The selection will be based on data from regional accident databases, site characteristics and local knowledge in each partner city, as well as on naturalistic driving data (in Ålborg). The partner-countries where observational studies are planned will propose a list of feasible locations. The characteristics of these locations will be examined and sites selected in the municipalities involved.

Task 2.4: Recommendations for improvements of methods for VRU safety analysis

Following the work done in Task 2.1, this task will identify gaps and problems in the currently used study methods for VRU road safety analysis and recommend improvements. Recommendations will also concern deficiencies in the current data sets and data collection methods. The outcome will be applied and further developed in WP3, and then used in WP6 to

develop an integrated approach to VRU road safety analysis, based on surrogate safety indicators obtained from different data sources.

Time plan for WP2 is presented in Figure 4.
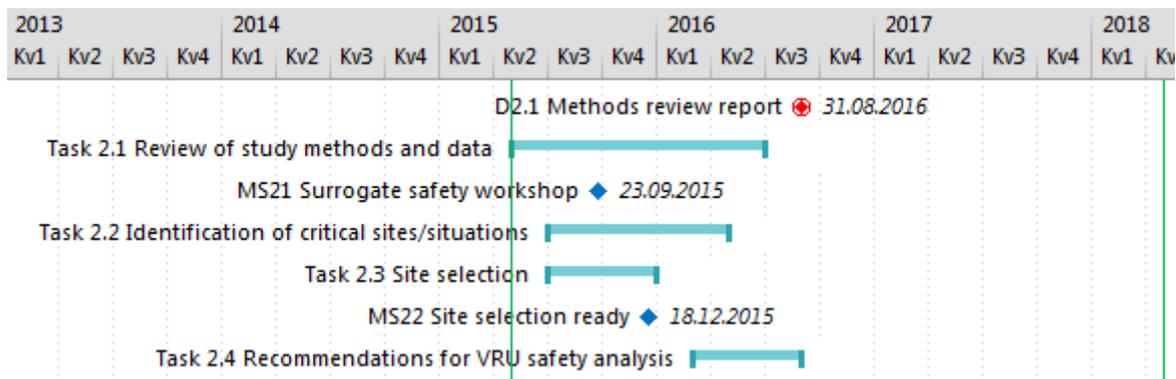
Figure 4. WP2 time-plan (note that when a Milestone and a Deliverable coincide only the Deliverable is shown in the time-plan).

WP3 – Observational studies

Duration: Months 3-30

Partners: LU (lead), AAU, UHasselt, PM, BAST, TNO, INTRA, WUT.

Objectives:

The main objective of this WP is to collect and analyse sufficient amounts of field data on the sites with VRU accident accumulation in order to:

- Work out an optimal strategy for observational field studies for VRU-safety in terms of duration, equipment, set-up, etc.,
- Calibrate and validate safety surrogates and behavioural indicators against accident statistics and in-depth accidents investigations based on new data.
- Calibrate and validate the technical tools developed in WP4.
- Demonstrate the usefulness of the method and identify the most prone VRU safety problems.

Task 3.1 Pilot set-ups (LU)

In this stage, data from a limited number of sites selected in WP2 will be collected during a short period using different camera/sensor set-ups and combinations. This will provide test data for technical development in WP4 and practical experience for planning data collection in Tasks 3.2 and 3.3. The pilots are to be done by LU and AAU with input from technical experts from other partners.

Task 3.2 Long-period observations (UHasselt)

At three sites with high VRU accident frequency (selected in WP2), the data collection will be performed continuously during a longer period of time, at least 1-1.5 years. This data will be used for:

- Testing the hypothesis of continuous severity dimension of traffic events at the same site. The longer period will cover the whole range of traffic events – from regular interactions to conflicts and, possibly, real accidents. This will be one of the most important theoretical contributions of the project, as until now most surrogate safety

indicators have been tested on very limited observation time periods, and the continuity of the severity is only postulated without real proof.

- Testing the watch-dog developed in WP4 on real-life long-period data covering different traffic, weather, light conditions, odd situations, etc. Again, this will be quite unique as most of the advanced video applications in traffic are tested on short sequences (from a few days to only few minutes) and the system performance in the long run is often uncertain.

Three sets of identical cameras/sensors will be administrated by UHasselt, which will take the main responsibility for the installation of equipment and data management. The local partners will take care of equipment maintenance, such as periodic checks of the functionality, cleaning lenses, changing the hard drives, etc.

Task 3.3 Short-period observations (LU)

In this task the sites selected in WP2 (at least three sites in each European partner country) will be video recorded (in combination with other sensor data collection) during 1-4 week periods. The data will be used:

- To test the consistency of the safety indicators in between-site comparison.
- To test the reliability of the technical tools from WP4 with regard to hit rate, etc., i.e. that the differences in the automated analysis results can be attributed to the differences in safety level at the sites and not to the peculiarities of the equipment installations and differences in scene, light, atmospheric, etc. conditions.

The final phase of the data collection will be taken as a trade-off between the number of sites, availability of the equipment, feasibility of the data processing within the project lifetime and the theoretical indications obtained from long-term observations (Task 3.2). A large number of identical sets of sensor equipment will be administrated by LU and AAU, which will take the responsibility for technical installations at each site. Each local partner will contribute to establishing contacts with local authorities, obtaining necessary permits and checking equipment during the data collection. Simultaneously, the interview/questionnaire studies will be performed in order to get background information on road user perception of the safety situation, their understanding and interpretation of the traffic rules, existing informal rules, etc. This is also to be done by the local partner in each country.

Task 3.4 Data processing and validation of safety indicators (LU)

In this stage, the data collected in Tasks 3.2 and 3.3 will be processed manually, using the tools developed in WP4. The manual processing of a certain part of the data, even though it is very laborious, is necessary in order to provide the ground truth for the validation of the automated tool. Also, in case of the automated watchdog (Task 4.1 in WP4), the final classification of the situations still has to be done by an expert. The most severe situations are usually few in number, in which case their manual processing is feasible, especially as it ensures the highest possible accuracy of the measurements. For this purpose, the semi-automated software tool T-Analyst, developed at LU, will be used. The software allows for manual tracking of road users in one or several camera views, calculation of various safety indicators (Time-to-Collision, Time Advantage, T2, relative speed, deltaV, etc.) and is very convenient for dealing with a large number of detections in one database.

Another important goal of this task is to validate the retrieved safety and behavioural indicators against accident data, both in their ability to estimate the expected number of accidents and to reveal the accident causation factors ("product" and "process" validity). The long-period observations will allow for connecting the temporal fluctuation of conflict frequency with the

risk of an accident at the site, while shorter observations at many locations will statistically link conflicts and accidents under more heterogeneous conditions.

The data processing and validation of the indicators will be done by LU, AAU, UHasselt and TNO, i.e. the partners with long experience of behavioural observation analysis, using surrogate safety measures and software tools to extract the necessary indicators from the videos.

Task 3.5 Naturalistic cycling/walking study (AAU)

The mobile application developed in WP4 will be distributed through the communication channels of the municipalities participating in the project. The app will register abnormal sensor readings that might indicate a fall or any other critical safety situation. After receiving the alarm, a questionnaire will be sent to the participant asking about the details of the incident. With this method we hope, first of all, to capture single VRU accidents/incidents, which are otherwise heavily under-reported, and for which the scale and circumstances are very much unknown. The data may be used for identifying not only the locations with a higher single-accident risk (that might be quite different from car-VRU accidents), but also the most risky/vulnerable VRU groups, or other special conditions (light, atmospheric and road surface conditions) that imply higher risks for VRU.

The data will be collected in Sweden, Denmark and Spain and analysed performed by LU, AAU and INTRA.

Time plan for WP3 is presented in Figure 5.
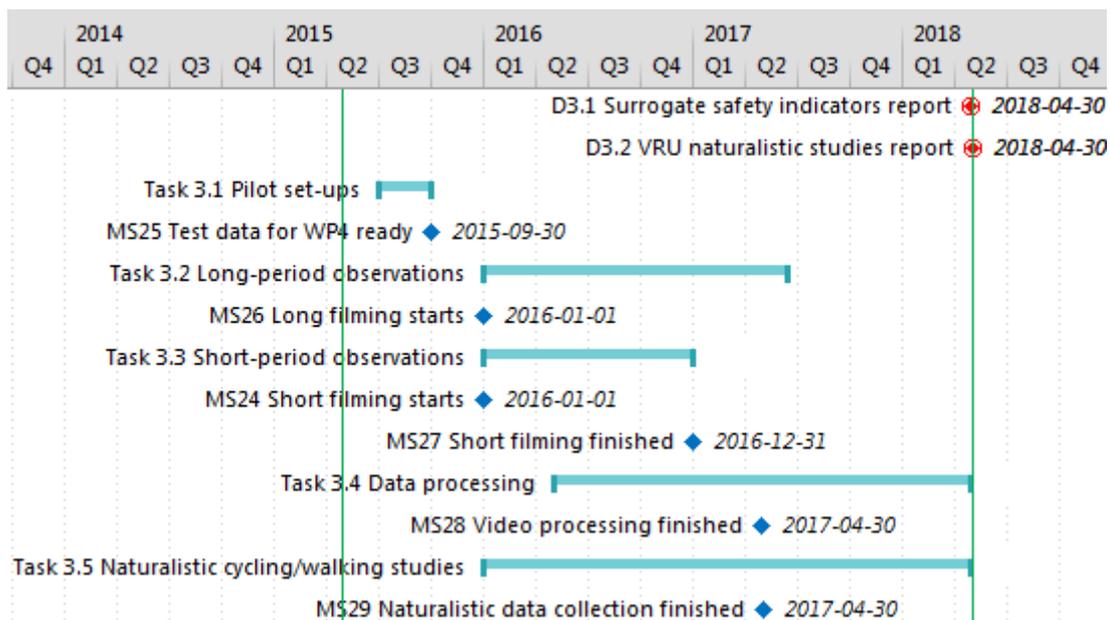
Figure 5. WP3 time-plan (note that when a Milestone and a Deliverable coincide only the Deliverable is shown in the time-plan).

WP4 – Tools for automated data collection and analysis

Duration: Months 1-30

Partners: AAU (lead), LU, PM, TNO.

Objectives:

The main objective is to develop and provide tools for automatic analysis of traffic data. Concretely the goals are to:

- provide technical support for system setup;

- develop an automatic watchdog system that identifies time intervals in a video sequence where possible safety critical events occur;
- develop a fully automatic tracking system that extracts and analyses trajectories of all objects in a scene in safety terms;
- develop a system that collects data from naturalistic VRU data.

WP4 is motivated by the need for an automatic system that can ease the task of annotating massive amounts of traffic data. This is highly relevant for WP3, but also for the analysis of traffic data in general. Three systems are to be developed in this WP. The first system is a watchdog system that aims at removing huge chunks of video data where no events/interactions are occurring. This reduces the amount of video data that has to be manually annotated.

The second system is a fully automated (next generation) tracking system that keeps track of all objects in the scene and automatically detects traffic events by analysing the trajectories. Lastly, a data collection system (an APP) is developed which automatically detects e.g. walking/cycling accidents that normally not are reported.

The systems will be developed and tested in close collaboration with WP3. These three systems are explained below, but first a subtask dealing with system setup is defined.

Task 4.1 System setup (LU)

This task will support WP3 in terms of technical aspects when finding the proper relationship between different locations and different setups (number of sensors and placements). Some types of setup may seem appealing from a data capturing point of view, but not from an algorithmic point of view, and vice versa. The mounting of sensors will be done on artefacts already present in the environment, e.g. buildings and poles. To this end, a graphical tool will be developed to allow for easy 3D modelling of an environment, e.g. an intersection, and to simulate placement of sensors and field-of-views in order to rapidly evaluate the effect of different placements in terms of coverage and occlusion issues.

Different types of sensors have been used for capturing data for traffic analysis - colour cameras, thermal cameras, lidar and radar. They all have their pros and cons. For example, colour cameras capture many details, but are sensitive to changes in lighting, it is the opposite for thermal cameras. While both provide data in 2D, lidar and radar can provide 3D data, but only limited appearance data like colour. Also, colour cameras, and recently also thermal cameras, are relatively cheap, while lidar and radar systems tend to be more expensive. For limited areas, such as specific bicycle or pedestrian paths, the recently released Kinect for windows v2 might provide additional 3D data at a low cost. No matter which sensor is applied, no research or commercial system has so far been able to produce a system that can capture and analyse year round traffic data. In this project, we will strive to attain this goal by applying a multi sensor approach. A calibration across different sensors will be based on existing work done at InDeV partners.

While the above will be aimed at a practical solution, this task will also include a more explorative approach to sensor setup. If the sensors are mounted so that a zenith view is provided, then the data capturing will be more comparable from site to site, and, more importantly, the occlusion issues will be reduced significantly. To this end we will experiment with data capturing from a small UAV (unmanned aerial vehicle), which will receive power directly from a cable attached to a light pole. In theory, this allows for continuous data capturing for very long time periods. Of course this needs to be done in a controlled environment as UAVs are still not reliable enough to allow for such a setup in practice. However, this experiment will provide valuable insights for future setups.

Task 4.2 Watchdog system (AAU)

Manually annotating vast amounts of traffic data – for example those collected in WP3 – is a huge task. There is therefore a need for a practical software tool that automatically pre-processes such video data and identifies time intervals where possible interactions occur. Developing this system needs a clear definition of events, thus, input from manual labelling produced in WP3 from recordings within the project is needed. Results from an InDeV partner indicate that traffic videos can be reduced significantly using such a watchdog system (Madsen, et al., 2014). The focus of a watchdog system is not on detecting trajectories of objects, but rather on an event-driven (feature-based) system that detects activities (events) in preselected regions of interest, it then uses predefined logic, for example machine learning, to determine whether the system should raise a flag or not.

The purpose of this task is to further develop this work along two directions. Firstly, by adapting the event detection system to allow for multi sensor input data, which will make it more robust, and secondly, by designing and implementing an intuitive interface, making the system useful for non-technical experts.

Task 4.3 Automated tracking system (LU)

The system developed in Task 4.2 will be a powerful tool, but limited to predefined scenarios. Moreover, human intervention is required to classify the exact events detected by the watchdog system. The purpose of this task is to develop a fully automated, general-purpose system that avoids these two drawbacks and is capable of tracking all objects in a scene. The resulting output will be trajectories of each object and interpretation of the trajectories' relation to each other and the (un-)safety level of this relation. These are analysed automatically so that near accident events etc. can be registered. Tracking of objects requires three problems to be solved robustly, object detection, prediction of movement and data association where predictions and detections are associated and hence trajectories formed. Object detection is a challenging task in real life conditions due to occlusions and changes in lighting, appearance and size. State-of-the-art object detection systems are still vulnerable to these challenges. Still, as mentioned above, utilizing several sensor modalities is a promising direction. Hence, working on various sensor representations and extracting robust features from such representations will be among the research goals of this task, as will exploring suitable classifiers like support vector machines or elastic net regularized logistic regression.

Predicting object movement is in general problematic, but the motion patterns of road users are strongly correlated with the layout of the particular environment, e.g. an intersection, and the layout can therefore act as a strong prior for the predictor. Thus, tracking approaches should be adopted, for example offline processing and looking both forward and backward in time, or exploring tracking techniques.

To this end, we suggest developing an easy-to-use user interface, where a practitioner quickly can indicate the layout of the particular environment, and from this the system infers predictive models. For data association we will adapt an optimization framework, since this has been shown to be robust towards noise, e.g. poor detections.

A key issue in this system is that the tracking framework needs to be robust enough to work over very long time intervals (ultimately a permanent setup), and hence in different lighting and weather conditions. Furthermore, evaluation of the system should follow current guidelines for video data in traffic. We aim at an automatic system, but stress that it is important for the system to perceive when there is doubt and is able to report this.

Task 4.4 Mobile application for naturalistic walking/cycling data collection (AAU)

In this task, a system will be developed for risk factor determination for VRU (pedestrians, cyclists, moped riders, and motorcycles). This will be used for, among other things, detecting traffic accidents that are not formally registered as accidents, but still are related to the road condition, such as pedestrian falling accidents.

This system will be in the form of a downloadable APP for smartphones, which monitors the movements of its users (via the accelerometers in the smartphones) and logs events that trigger an abnormal acceleration or jerk signature. Here we need to define the right triggers for the different types of events like braking, falling, swerving, etc.

Via an online-based questionnaire, users can afterwards describe what happened when the system was triggered. In a test phase (in WP3), the data collected by the APP will be analysed to see what types of situations may lead to risky circumstances.

Time plan for WP4 is presented in Figure 6.
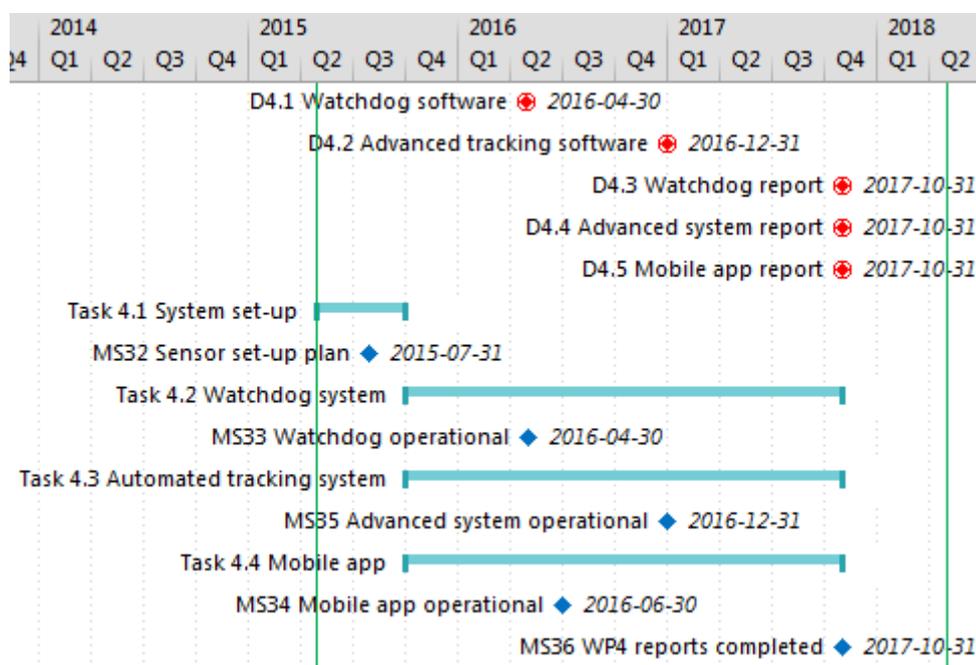
Figure 6. WP4 time-plan (note that when a Milestone and a Deliverable coincide only the Deliverable is shown in the time-plan).

WP5 – Socio-economic cost analysis

Duration: Months 12-30

Partners: BASt (lead), LU, AAU, UHasselt, TNO, INTRA, WUT.

Objectives:

- To review calculation regimes of socio-economic costs of traffic accidents
- To develop an enhanced assessment of socio-economic costs of traffic accidents involving VRUs

Task 5.1 Review of existing calculation regimes of socio-economic costs of traffic accidents (BASt)

In this task, the different accident cost calculation regimes, as used in the EU countries and other countries, will be critically reviewed in detail. In a first step, relevant literature from the

countries will be analysed. In addition, national experts will be contacted (via FERSI/CARE) if necessary, in order to get a comprehensive picture of the national accident cost calculation regimes.

The different cost calculation regimes will be compared regarding their methodology. Special emphasis will be put on the comprehensiveness of the approaches and the inclusion of special issues regarding VRUs. This will include, but not be limited to the following issues:

- The inclusion of indirect and immaterial accident costs;
- The inclusion of other costs, e.g. environmental costs, costs of delays;
- The type of method used for the different components of the calculation;
- The impact of underreporting for VRUs;
- The inclusion of methods using different accident costs depending on accident situation and opponent combination.

The diverging structure of VRU accidents from motor vehicle accidents

- Specific non-methodological differences between countries (resulting e.g. from the infrastructure, traffic regulations or culture);
- Different definitions of road accidents and casualties in Europe (e.g. the exclusion of single pedestrian accidents, definition of severity).

Results from this task will be compiled in a public deliverable (D5.1).

Task 5.2 Estimation of the amount of underreporting for VRUs (AAU)

The results from the study of critical events at the sites will be used to gain knowledge on the amount of underreporting of VRU accidents in specific sites and situations for specific VRUs.

This information will be complemented by an examination of self-reporting of accidents of VRUs. For this, a survey will be conducted in partner countries with volunteers that are VRUs (e.g. cyclists, pedestrians). During the one-year survey volunteers will be asked on a monthly basis on their involvement in accidents. If there has been an involvement a short survey will be send out to gather information on the nature of the accident and if the police had attended to it.

One of the purposes here is to investigate whether existing knowledge of how the underreported accidents differ from the reported accidents – in relation to the seriousness, the accident situation and the involved road user groups – and thus if the socioeconomic valuation of the police recorded accidents is correct. The study will be an input into a new method for pricing the socio-economic costs of different accident types.

Based on the estimation of underreporting a situation-specific correction value for the accident cost assessment will be generated.

Task 5.3 Development of options for the inclusion of special issues regarding VRUs (BASt)

This task aims at developing a framework of good practice for the adjustment of existing cost calculation methods of assessing the socio-economic costs of VRU accidents. Not only the costs directly related to the accident, but also secondary costs (e.g. delays, loss of production) will be taken into consideration.

The work in this WP will be based on results from task 5.1, the information gathered in WP2 and results from the studies at selected sites in WP3.

The results from the observed sites will be analysed with regard to the number of fatalities, injuries and property damage.

The observed figures will be used to calculate the accident costs for the different accident types based on the identified average accident cost rates from Task 5.1.

Furthermore, the resulting cost figures will be compared with average accident cost figures from other sites and situations as well as the overall aggregated accident cost unit rates for all accidents/accident types. In association with this comparison, a qualitative assessment of the accident cost rates, with regard to aspects such as severity of the injury, age distribution etc., will be conducted.

Additionally, the number of critical events recorded at the sites will be used to ascertain the amount of underreporting of VRU accidents at specific sites and situations for specific VRUs. This information will be complemented by an examination of the self-reporting of accidents in order to arrive at an estimation of the number of underreported accidents and casualties. Based on the estimation of underreporting, a situation-specific correction value for the accident cost assessment will be generated.

The effects of the different issues on the accident cost calculation regimes and results will be analysed with special emphasis on VRUs. Situation-specific recommendations for the handling of special issues regarding VRU accident cost calculation will be made based on the site and situation comparison and the estimation of underreporting. Furthermore, these recommendations will be supplemented by recommendations regarding the inclusion of other general issues identified in Task 5.1. The recommendations will be included in the InDeV handbook.

Results from this task will be compiled in a public deliverable (D5.3).

Time plan for WP5 is presented in Figure 7.
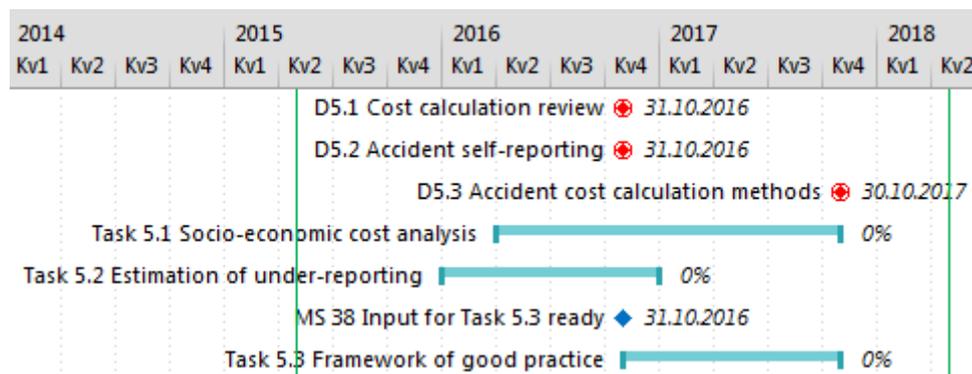
Figure 7. WP5 time-plan (note that when a Milestone and a Deliverable coincide only the Deliverable is shown in the time-plan).

WP6 – VRU safety analysis toolbox

Duration: Months 12-36

Partners: Uhasselt (lead), LU, AAU, PM, BASt, TNO, INTRA, WUT.

Objectives:

- To provide hands-on instructions for the use of the developed surrogate safety measures tool and the naturalistic cycling tool;
- To compile methods for in-depth understanding of causal factors contributing to VRU unsafety in a practically oriented handbook for a wide target group of traffic safety professionals. The handbook will describe various combinations of methods depending on the available data.

Task 6.1: Hands-on manual for surrogate safety measures software (LU)

A first subtask in this work package is the creation of a hands-on manual for using the surrogate safety measures observation tool that is developed in WP4. Apart from technical reports about system design, performance etc., this manual will be almost entirely focused on the use of the tool by practitioners and analysts. It will provide a step-by-step guide through the different steps of data collection, cleaning, analysis and hypothesis testing. This will strongly contribute to making the tool accessible to a wide range of end users in the road safety work field. The manual will be developed by LU and AAU.

Task 6.2: Hands-on manual for naturalistic cycling/walking study tool (AAU)

The second subtask of this work package is to write a hands-on manual for using the naturalistic cycling/walking study tool that is developed in WP4. The manual will be written by LU and AAU.

Task 6.3: VRU safety diagnosis handbook (UHasselt)

The final task of this work package is to create a handbook describing the toolbox for improved diagnosis of the road safety problems of VRUs. The handbook is aimed at a wide target group of road safety practitioners (including local government, police departments, and road designers) and describes the different methods for VRU safety diagnosis and techniques to combine and integrate different types of data to overcome their individual limitations.

Since the ambition of the handbook is to become the main reference document for VRU safety diagnosis by practitioners, usability by a large group of end users will be the key aspect here. The handbook will therefore focus on applying state-of-the-art but accessible techniques that make optimal use of existing data and/or data that is relatively easy and cheap to collect. The handbook will also clearly indicate the strengths and limitations of the different techniques, and offer suggestions to overcome the limitations of the technique by supplementing them with other techniques and data sources. In other words, the handbook will be a guide to practitioners and analysts, and allow them to identify specifics, at both local and higher levels.

The approach of this handbook will be unique in its aim to offer practitioners and analysts a complete and accessible overview of methods for the diagnosis of VRU safety issues. Other important reference documents such as the Highway Safety Manual and the Handbook of Road Safety Measures mainly focus on offering roadway design guidelines and recommendations. Methods for safety issue diagnosis are, at best, included in a rather general non-practice-ready way. Also, these documents often fail to include the special points of attention that are of importance when focusing on VRU safety. On the other hand, the handbook developed in this work package will allow practitioners to collect and analyse data that is specifically related to the safety issues at hand. As such, this handbook will supplement other existing documents, allowing practitioners to apply such guidelines and recommendations in a better informed way. This is expected to have a significant impact on VRU safety in the medium and long term.

An overview of the methods that will be included in the manual is listed below. For each of these methods, the handbook will provide an accessible step-by-step overview of the different steps that need to be taken to identify VRU safety issues.

The handbook will also elaborate on the strengths and limitations of the different techniques, and offer suggestions to overcome the limitations of the techniques by supplementing them with other techniques and data sources. Aspects such as validity, reliability and transferability of the results will be discussed as well. Optimization issues (such as minimal recommended observation lengths, data sample size, etc.) will be addressed, since these are often of great importance for practitioners. For many of these techniques (including surrogate safety studies, naturalistic cycling/walking studies, and socio-economic cost assessment), significant steps

forward regarding validity and feasibility will be made in the various work packages, and these findings will be made accessible to the general public in this handbook.

Techniques that will be included in the handbook are the following:

1. Methods for accident data collection and analysis at different levels:

- Macro level: road safety indicators (identifying general trends in VRU safety), accident prediction models, black spot management, network safety management,
- Meso level: identifying problems at the level of a specific location (e.g. collision diagram analysis),
- Micro level: in-depth analysis on the level of individual accidents,

2. Self-reported accidents: use of self-reported accidents to address single VRU accidents and to mitigate issues of underreported or missing accident data.

3. Traffic conflict and behavioural observations using automated surrogate safety measure tools: focus on the collection of data on serious conflicts and/or road user interactions, using on-site observations to identify VRU safety issues at specific locations. The content of the chapter will be tailored to the surrogate safety measures tool that is developed in WP4. UHasselt, LU and WUT will write this section.

4. Naturalistic cycling/walking studies. Part of this chapter will focus on the tool developed in WP4. This is straightforward, since most naturalistic cycling/driving studies are extremely specialized and expensive, and therefore out of reach of the traffic safety professional. The tool developed in WP4, on the other hand, will focus on using smartphone data, making the technique accessible for a larger group of end users to analyse specific VRU safety issues. AAU and LU will take care of this section.

5. Socio-economic cost assessment. This will be largely based on the improved SEC methodology developed in WP5, and can help the road safety professional to assess the socio-economic costs that are related to specific VRU safety problems, and to prioritize measures that need to be taken. This section will be written by BASt, AAU and LU.

Time plan for WP6 is presented in Figure 8.

Figure 8. WP6 time-plan (note that when a Milestone and a Deliverable coincide only the Deliverable is shown in the time-plan).

WP7 – Dissemination and exploitation

Duration: Months 1-36

Partners: BASt, LU, AAU, Uhasselt, PM, TNO, INTRA, WUT.

Objectives:

- To disseminate information and results from the project and to inform relevant key actors about the possible benefits of InDeV toolbox for safety analysis of VRUs, using adequate channels for different stakeholder groups
- To enable mutual knowledge exchange and interaction between project partners and stakeholders during the project's lifetime to improve its outcome.

Task 7.1 Dissemination plan / target group management (BASt)

At the beginning of the project, a dissemination plan will be set up, describing the objectives of the dissemination and all dissemination activities and target groups in detail, and providing detailed timelines and responsibilities for the project's dissemination. A first draft of the dissemination plan will be available in M4.

The main target groups to be addressed consist of authoritative bodies (i.e. policy makers from the EC and European countries), international organizations (e.g. WHO, ITF-OECD), municipality officers, road safety analysts and researchers, non-governmental organisations, companies, consultants, the general public, participating cities and municipalities and other interested stake holders. It is necessary to follow different information strategies depending on the type of target group and/or country. Therefore, a dissemination database matrix will be developed combining the different target groups with adequate dissemination strategies. Relevant persons/bodies for each target group will be identified and compiled in a stakeholder list which will be available from M5 as an integral part of the dissemination plan. Stakeholders will be identified from national and international institutions of partner countries and through the networks in which partners are involved (e.g. CARE, ICTCT, NTSA). The stakeholder list will be available for use by all project partners, and will be extended whenever necessary during the lifetime of the project.

Task 7.2 Dissemination tools (BASt)

A project website will be implemented shortly after the start of the project (M3). The website will be designed and hosted by BASt and will act as the main point of reference for up-to-date information on the project activities and results. The website will contain general information on the project, its contents, aims and the consortium. Documents such as public deliverables, green open access publications or newsletters will be uploaded there. Information on InDeV events will be included, as will contacts and links to related projects and networks, publications or project-related events. The website will also contain an internal sub-site which can only be accessed by partners. It will act as an information exchange platform and as a repository for restricted working documents, reports, presentations and other information which will be shared between partners. In this way a location-independent instant availability of documents and information for all partners will be ensured. The website will be updated continuously during the project's lifetime and thereafter if necessary.

A project leaflet, which will contain general information on the project, will be designed close to the start of the project.

The aim of the leaflet is to give interested parties a quick overview of InDeV. It will be published in printed form (complemented by the project information on the website) and made available to all partners as promotional material to be used at external dissemination activities (task 7.4), or to give away to any of the dissemination target groups where appropriate.

Apart from the distribution of general project information the progress of the project will be published via regular newsletters. The newsletters will be used to distribute this information to, and up-date, a large readership. It will raise and keep up public awareness of the project during the project's lifetime. WP leaders will provide input to the newsletters, which will be published twice a year, starting in M6 and adding up to 6 issues. In contrast to the general project leaflet,

the newsletters will be electronically distributed via email, and also be made available on the project's website.

Press releases and targeted articles will be proposed to the technical press at each key milestone of the project, including the final event around which a press campaign will be organized.

Another means for the project to reach public interest will be to make use of the social media (e.g. FACEBOOK, TWITTER, LinkedIn). One aim here is to reach a different audience, as some social media are mainly used by young people who represent a high proportion of VRUs. By making use of the social media (mainly FACEBOOK and TWITTER) the project will be able to have an easy exchange of opinion with this group. Other social media (e.g. LinkedIn) will be used to specifically reach out to persons who are connected to road safety and especially VRUs.

Furthermore, a regular dissemination bulletin (informal activity report) will inform partners about the dissemination activities of the project. It will give brief information about all dissemination activities and will be set up whenever necessary (e.g. when reaching a milestone, before/after a conference or workshop).

All dissemination tools require a certain format. Templates will be designed for all dissemination tools to allow all partners easy dissemination, and to give the project a project identity. Towards the end of the project the final report will be prepared by the WP leader, aided by the other WP leaders who will deliver input to the final report.

Task 7.3 Exploitation strategy (LU)

The overall exploitation strategy will be developed during the project's lifetime. To facilitate effective transformation of the developed systems into marketable products, exploitation activities will be planned, which will last for the entire duration of the project and thereafter. A stepwise approach in exploitation activities is proposed:

- Investigation of relevant market segments, taking into account marketing studies and socio-economic research.;
- Analysis of related, complementary, and competing products and services in the market and wider community;
- Setting up of deployment scenarios, market and business models for individual as well as for joint exploitation, specifying collaboration roles, costs and revenue flows;
- Validation of business models and deployment scenarios within the consortium, identifying benefits, obstacles and possible risks;
- Organization, planning and execution of communication activities to create full awareness of InDeV goals, approach and results within various target groups: road authorities, municipalities, ITS product vendors, engineering tools developers and transport research communities;
- Regular revision and refinement of partner-specific exploitation strategies and joint collaborative business plans in the light of interim project results, as well as formalization of appropriate agreements for joint exploitation among partners and third parties, including possible creation of new legal entities (joint ventures);
- Specification of needs for further research.

Exploitable products and services of InDeV:

- Watchdog system for safety critical event detection.
- Advanced tracking system for safety critical event detection.
- A smartphone APP for registering safety critical event for cyclists.

A preliminary exploitation plan will be delivered halfway through the project. It will be updated according to the progress of the project and a final exploitation plan will be delivered towards the end of the project. In addition to the consortium level exploitation strategy, each partner will have its own exploitation strategy, which will be included in the exploitation plan. The exploitation plan will also contain information on the status of realized, on-going and planned exploitation activities.

Task 7.4 Final event and showcase (BASt)

All results of the project will be presented at the final event and showcase, which will be held in M36 of the project's lifetime. The event will be used to create awareness and increase interest in InDeV methodology.

The final event will target the research community as well as stakeholders. Special attention will be given to inviting end users, practitioners and political decision makers. Results will be presented via presentations and a poster exhibition.

The final event will also contain a large number of demonstrations of the tools to make potential end users aware of the possibilities for implementation of the tools in their work. End users will be given the opportunity to get hands-on experience with the toolbox.

The consortium will seek to combine this event with the final event of another project, with a similar topic and a similar audience, to create synergy effects and to keep it economical.

Task 7.5 Clustering and liaising with RDI projects (BASt)

All project partners will actively seek opportunities for clustering and liaising with other relevant RDI projects by using their known contacts. The partners will be assisted by the task leader who will coordinate and keep track of all activities.

Furthermore, the task leader will identify additional suitable RDI projects, establish contact and determine clustering and liaising opportunities. Besides, RDI projects will be kept informed on the progress of InDeV by appropriate dissemination tools which have been developed in Task 7.2.

Contact has already been made to projects from the same call (PROSPECT, SENIORS, XCYCLE and SafetyCube) and agreement reached to co-ordinate the dissemination activities and keep each other updated on the research status and results.

Task 7.6 External dissemination actions (BASt)

Apart from the project's own dissemination actions, external activities such as conferences, workshops or seminars will be used to distribute information on the InDeV project. Results as well as information on the ongoing work of the project will be presented to give the conference participants insights into the project. Those actions will also be used to expand the network with possible stakeholders and get feedback which will enhance the project further.

In this task, relevant conferences, workshops and seminars will be identified and the information distributed among the partners. The participation of partners in external activities will be coordinated and they will be assisted in the preparation of contributions for relevant actions. The project's aim is to take part in at least two relevant actions per year during the project's lifetime (e.g. EUROBIKE, ICTCT, NTSA, Velocity, Walk21). Each of the project partners will actively contribute to identifying national opportunities to disseminate information and demonstrate the project tools and results.

Another important dissemination channel will be the publication of results in scientific journals. Partners will actively seek to publish articles in relevant journals to raise awareness of the project and spread results. Publishing will comply with the Open Access requirements in Horizon 2020.

A dissemination workflow will be designed and implemented to allow efficient tracking of the project's participation in external dissemination actions. The task leader will act as coordinator and monitor the evolvement of such participation. He/she will also collect the outputs and include them in the internal part of the website for further use by other partners where appropriate. The dissemination workflow will also provide an information basis for the dissemination bulletin.

Time plan for WP7 is presented in Figure 9.
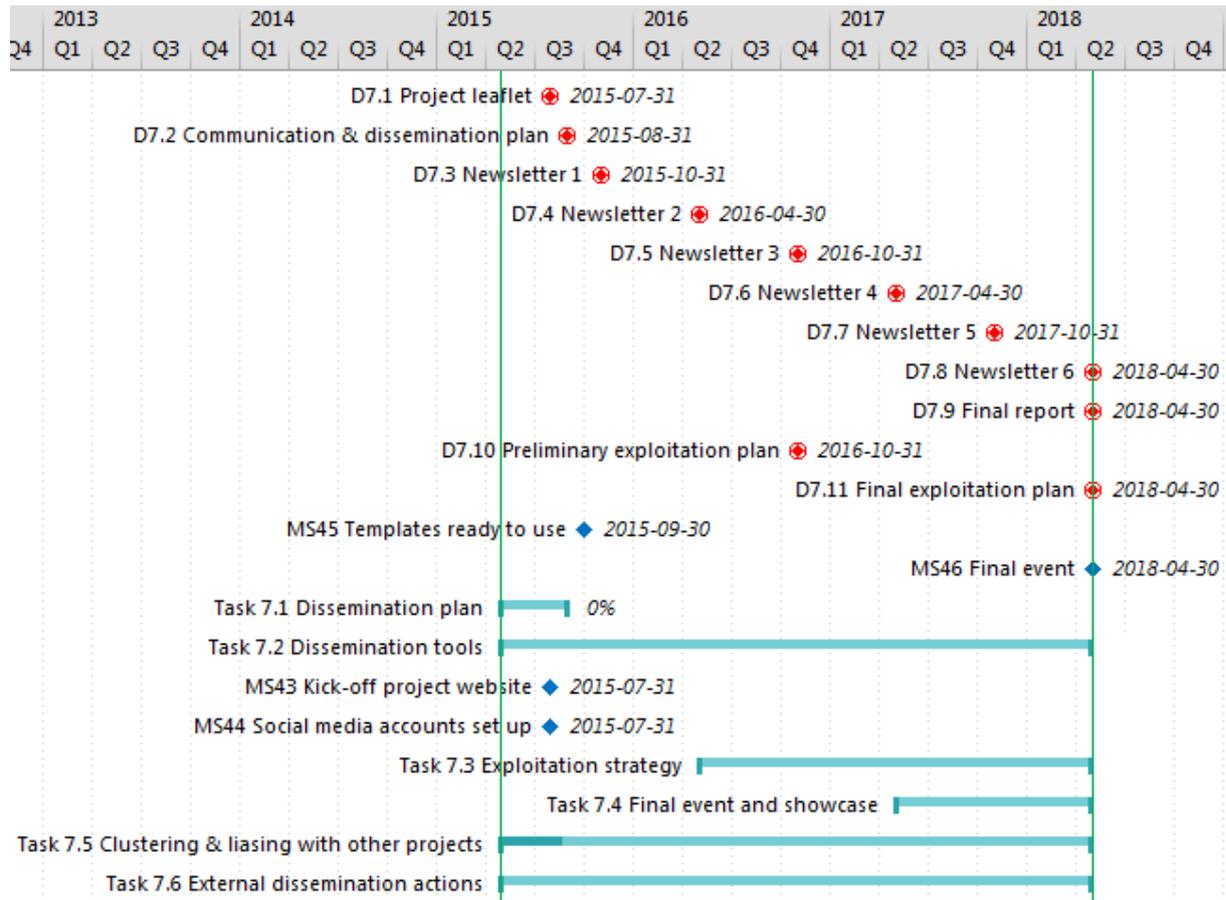
Figure 9. WP7 time-plan (note that when a Milestone and a Deliverable coincide only the Deliverable is shown in the time-plan).

2.3 Milestones and deliverables

Table 1. List of Milestones

Milestone	Title	WP	Due date	Means of verification
MS1	WP1 start	WP1	5/2015	WP1 start
MS2	WP2 start	WP1	5/2015	WP2 start
MS3	WP3 start	WP1	8/2015	WP3 start
MS4	WP4 start	WP1	5/2015	WP4 start
MS5	WP5 start	WP1	4/2016	WP5 start
MS6	WP6 start	WP1	4/2016	WP6 start
MS7	WP7 start	WP1	5/2015	WP7 start
MS8	Kick-off meeting	WP1	5/2015	Project kick-off meeting

MS9	WP1 completed	WP1	4/2018	WP1 completed
MS10	WP2 completed	WP1	8/2016	WP2 completed
MS11	WP3 completed	WP1	10/2017	WP3 completed
MS12	WP4 completed	WP1	10/2017	WP4 completed
MS13	WP5 completed	WP1	10/2017	WP5 completed
MS14	WP6 completed	WP1	4/2018	WP6 completed
MS15	WP7 completed	WP1	4/2018	WP7 completed
MS16	Project plan ready	WP1	8/2015	Project Work, Data Management & Protection and Quality Assurance plans are ready
MS17	Internal communication infrastructure	WP1	8/2015	Project-internal communication infrastructure is up and running
MS18	Annual Meeting 1	WP1	4/2016	Annual Meeting 1
MS19	Annual Meeting 2	WP1	4/2017	Annual Meeting 2
MS20	Annual Meeting 3	WP1	2/2018	Annual Meeting 3
MS21	Surrogate safety measures workshop	WP2	9/2015	Workshop on indirect safety measures
MS22	Site selection ready	WP2	12/2015	List of sites for observational studies ready
MS23	Method review ready	WP2	8/2016	Report D2.1 Review of methods for VRU safety studies ready
MS24	Short filming starts	WP3	1/2016	Observational equipment is up & running
MS25	Test data for WP4 ready	WP3, WP4	9/2015	Test data for WP4 is collected
MS26	Long filming starts	WP3	1/2016	Long-period data collection starts
MS27	Short filming finished	WP3	12/2016	Short period data collection finished
MS28	Video processing finished	WP3	4/2017	Video data processing and validation of safety indicators finished
MS29	Naturalistic study finished	WP3	4/2017	Data collection and processing of naturalistic cycling/walking study finished
MS30	Surrogate safety report finished	WP3	10/2017	Report D3.1 Surrogate safety indicators for VRUs ready
MS31	Naturalistic study report finished	WP3	10/2017	Report D3.2 VRUs' safety problems based on a naturalistic cycling/walking study ready
MS32	Sensor set-up plan	WP4	9/2015	A unified generic plan for sensor fusion and setup finished
MS33	Watch-dog operational	WP4	4/2016	Watch-dog software system is operational
MS34	Mobile APP operational	WP4	6/2016	Mobile APP for naturalistic VRU studies is operational
MS35	Advanced system operational	WP4	12/2017	Advanced object tracking system is operational
MS36	WP4 reports completed	WP4	10/2017	D4.3, D4.4 and D4.5 reports completed
MS37	Cost calculation review ready	WP5	10/2017	Report D5.1 Review of European accident cost calculation methods ready
MS38	Input for Task 5.3 ready	WP5	10/2017	Input from Tasks 5.1 & 5.2 (Reports D5.1 & D5.2) are ready for use in task 5.3
MS39	Framework for cost	WP5	10/2017	Report D5.3 Framework for

	calculation ready			the adjustment of accident cost calculation methods for the assessment of socio-economic costs for vulnerable road users ready
MS40	Methods handbook outline ready	WP14	6/2016	Outline of the methods handbook ready (internal deliverable I6.1
MS41	Handbooks ready	WP6	4/2018	Books D6.1 Hands-on manual for the application of the developed automated traffic conflict observation tool and D6.2 Hands-on manual for the application of the developed naturalistic cycling research tool ready
MS42	Safety diagnosis handbook ready	WP6	4/2018	Book D6.3 VRU safety diagnosis handbook ready
MS43	Kick-off project website	WP7	8/2015	Project website is up and running
MS44	Social media account set-up	WP7	8/2015	Social media is up and running
MS45	Templates ready to use	WP7	9/2015	Presentation templates, etc. are delivered to all partners
MS46	Final event	WP7	4/2018	Final event

Table 2. List of Deliverables

Deliverable	Title	WP	Type	Dissemination level	Due Date
D1.1	Project plan	WP1	Report	Public	7/2015
D1.2	M18 status report	WP1	Report	Public	10/2016
D1.3	M36 status report	WP1	Report	Public	4/2018
D2.1	Methods review	WP2	Report	Public	8/2016
D3.1	Surrogate safety indicators	WP3	Report	Public	4/2018
D3.2	VRU naturalistic studies	WP3	Report	Public	4/2018
D4.1	Watch-dog software	WP4	Other	Public	4/2016
D4.2	Advanced tracking software	WP4	Other	Confidential	12/2016
D4.3	Watch-dog report	WP4	Report	Public	10/2017
D4.4	Advanced system report	WP4	Report	Confidential	10/2017
D4.5	Mobile APP report	WP4	Report	Public	10/2017
D5.1	Cost calculation review	WP5	Report	Public	10/2016
D5.2	Accident self-reporting	WP5	Report	Public	10/2016
D5.3	Accident cost calculation methods	WP5	Report	Public	4/2018
D6.1	Automated conflict observations manual	WP6	Report	Public	4/2018
D6.2	Naturalistic study manual	WP6	Report	Public	4/2018
6.3	Safety diagnosis	WP6	Report (book)	Public	4/2018

	handbook				
D7.1	Project leaflet	WP7	Web-sites, patents filling, etc.	Public	7/2015
D7.2	Communication & dissemination plan	WP7	Report	Public	8/2015
D7.3	Newsletter 1	WP7	Web-sites, patents filling, etc.	Public	10/2015
D7.4	Newsletter 2	WP7	Web-sites, patents filling, etc.	Public	4/2016
D7.5	Newsletter 3	WP7	Web-sites, patents filling, etc.	Public	10/2016
D7.6	Newsletter 4	WP7	Web-sites, patents filling, etc.	Public	4/2017
D7.7	Newsletter 5	WP7	Web-sites, patents filling, etc.	Public	10/2017
D7.8	Newsletter 6	WP7	Web-sites, patents filling, etc.	Public	4/2018
D7.9	Final report	WP7	Report	Public	4/2018
D7.10	Preliminary exploitation plan	WP7	Report	Public	10/2016
D7.11	Final exploitation plan	WP7	Report	Public	4/2018

3. Risk management

It is the task of WP1 – project management – to efficiently deal with risks and other issues as they arise. This is specified in Task 1.4: Risk Management

The European Commission will receive regular reports on the project progress. These will be provided at work package and task levels. Adherence to EC guidelines will be monitored in order to guarantee transparency not only in dealings within the project, but also with the European Commission and other stakeholders. After collecting and aggregating the technical and financial data from the partners, the processed information will serve as a basis for the risk analysis and quality check by the Project Coordinator (PC).

The main tasks for Risk Management are:

- Progress management and risk assessment for the project,
- Any minor deviations from the plan will be reported to the Project Coordinator, who will consider the problems and, where appropriate, make recommendations for implementing the contingency plan(s) associated with the work package(s) in question.
- In the event of serious problems, the Project Coordinator will convene the General Assembly (GA) to determine the best route forward and will advise the EC's Project Officer of the problem and seek approval for the proposed solution.

Table 3. Critical Implementation risks and mitigation actions

Risk number	Description of risk	WP Number	Proposed risk-mitigation measures
R1	Limitations to data collection based on privacy legislation (applies mainly to video observations)	WP3	Define a balance between acceptable resolution of video images, where individuals cannot be identified, but the quality is enough for data analysis. Anonymize statistical data.
R2	Vandalism/theft of data collection equipment	WP3	Regular downloading and storage of collected data; use of vandal-proof protection for the equipment
R3	A key partner leaves the consortium	WP1, WP2, WP3, WP4, WP5, WP6, WP7	Overlaps of competencies among the partners may mitigate the consequences of a partner leaving the consortium.
R4	Disagreement between partners	WP1, WP2, WP3, WP4, WP5, WP6, WP7	The decision making process will be clearly described in the Consortium Agreement
R5	Delay in meeting deadlines	WP1, WP2, WP3, WP4, WP5, WP6, WP7	The progress of the project will be systematically and frequently assessed by the Steering Committee in order to predict any possible delays and act accordingly

There are a large number of internal and external factors that may determine the success of the defined goals of the InDeV project. Potential risks include scientific, technical and organisational aspects, see Table 3.

Division of tasks and responsibilities: The formal responsibility of risk management is with the PC, who also should provide the status of the risk analysis in the annual progress report (as defined in WP1). The WP leaders and the GA will be involved in assisting the PC with the task. The potential risks will be analysed by this group during the GA meetings.

Decision making capabilities: The GA will have the ultimate decision making capability with regard to contingency strategies. If a decision has to be made through voting, each GA member will have one vote. In case of an equal number of votes, the PC's vote will be the deciding vote.

4. Ethics and treatment of sensitive issues

InDeV deals with a number of sensitive ethical issues, such as:

- Involvement of human participants;
- Collection and processing of personal data;
- Second use of personal data already collected;
- Involvement non-EU countries.

The project has an external independent Ethics Adviser, senior professor Ulf Görman at Jönköping University (Sweden). The ethics adviser attends Advisory Board meetings and consult on any current issues that arise.

Ethical standards and guidelines of Horizon 2020 must be rigorously applied regardless the country in which the research is carried out.

Each partner has to contact local/national Ethics Board and receive clearance for each study the partner is involved in prior to the start of any sensitive aspect of the study. The documentation on this issue has to be submitted to the European Commission.

Detailed information on the data used in the project and procedures for handling the data is given in Data Management and Protection Plan. It will ensure that all the partners follow the same routines in handling of sensitive data. **This document has to be revised and if necessary updated annually.**

Confirmations for authorised access to the accident databases have to be submitted to the European Commission by each partner using accident data.

Copies of authorisation for the collection of personal data by the competent Data Protection Officer/ National Data Protection authority must be submitted to the European Commission.

Identification of the potential high-risk sites must be done in tight co-operation with the local authorities. To establish a robust communication channel between the researchers and the local municipality, the following procedure is to be followed:

- Co-operation is initiated with a live meeting of local research team representatives and the municipality. The purposes and methods of the study must be clearly explained. It must be clearly indicated who will be the contact persons from the research team and the municipality;

- The municipality suggests a list of potentially relevant sites to be studied. Any complementary information about the sites that researchers collect from other sources (e.g. accident databases, pilot field measurements, etc.) is shared with the municipality at this stage;

- After the decision about which sites to be studied is made, the final site list is provided to the authorities;

- In case video observations require approval by other authorities (e.g. data protection agency, ethical committee, etc.), these documents are provided to the local authorities before the start of the observations;

- The municipality contact person regularly receives the information about the current status of the project. This is done through task-milestone meetings (i.e. at stages where new information during data analysis emerges), but also additional and more frequent updates are sent regarding the status of the local sites investigation;

- Any early results or other information that potentially can be used to improve the safety and prevent accidents must be provided to the municipalities immediately;

- The results received from the local sites analysis are presented to the municipality at a live meeting. The municipality should also have access to the intermediate data (e.g. data on individual traffic conflicts, not only the aggregated counts) unless this contradicts the data protection policy of the project (e.g. high-resolution video cannot be shared).

- The researches must not interfere with the road safety work of the municipalities, for example by asking to wait for implementation of the safety measures until the data collection is finished.

The collected data, especially video recordings, may potentially contain dramatic elements that cause a psychological trauma of the staff involved in the project work. Each partner must confirm that the personal working with the data has possibility to refrain from these tasks at any time if it causes psychological discomfort. Also, each partner must investigate the possibilities for medical/psychological help and have a plan for such help ready before the data analysis is initiated.

In the studies involving volunteers (i.e. self-reporting of accidents and mobile phone tracking), the involved researchers must provide to the European Commission:

- The procedures for the recruitment of the participants;

- Detailed information on the informed consent procedures that will be implemented;

- Copies of examples of the Informed Consent Forms and Information Sheets.

No children can be involved in these studies.

The Project Coordinator will coordinate efforts to monitor ethical issues, develop and implement necessary contingency strategies. The individual partners will have to obtain ethical approvals by the competent local/national Ethics Boards/Bodies/administrations.

The Project Coordinator will establish a specific list of which of the tasks of the individual studies listed in the beginning of this chapter will be carried out by the respective partners. Two steps will be considered:

1. Data Collection,
2. Analysis of data collected in another country.

Thereafter, each partner is asked to examine the measures required in their home country to implement the relevant parts of the project since the rules are different in each country. Depending on local regulations, various parts of the project may require approval by or notification to the ethics board, data inspection, or other public authority or equivalent.

5. Data Management and Protection Plan

The Data Management and Protection Plan regulates the procedures for data collection, storage, sharing, analysis and publication.

All project partners are obliged to follow the procedures described here. Before start of each study in which sensitive data is collected, each partner involved in the study must contact the national ethical board for approval.

This document has to be revised and if necessary updated once a year. Any changed routines are to be applied even for the data already collected.

5.1 Data collected in the project

The following types of data will be collected in InDeV:

- Accident records (police & hospital registries);
- In-depth accident investigations reports;
- Answers to questionnaires for self-reporting of accidents;
- Video recordings of traffic environments;
- Naturalistic cycling/walking data (complemented with questionnaire answers).

5.2 Accident records

Data description

All partner countries have national databases for traffic accidents registered by police (and sometimes by hospitals). The records are already pre-processed and the most sensitive information like names of persons involved or vehicle registration numbers is removed. The remaining information normally contains:

- Date and time of the accident;
- Location of the accident;
- Types of road users involved – vehicle driver, vehicle occupant, cyclist, pedestrian, etc.;
- Types of vehicles involved – car, heavy truck, tram, etc.;
- Description of the accident event;
- Injuries obtained in the accident.

Ethical concerns

The main concern here is that even though the most obvious personal data is removed from the records it is still theoretically possible to figure out which person was involved in a particular accident (for example, through comparing with publications in media or other data sources). The involved researchers will sign a declaration of non-disclosure of the data.

Data collection procedure

There are certain procedures that a researcher has to follow in order to get access to the accident databases. In Germany, BASt is named by law to have access to the official road accident statistics for accident research purposes. In Sweden, it is necessary to take a special education course and sign a declaration of non-disclosure of the data unless it has been aggregated. Similar rules exist in other countries.

All the project partners already have personnel qualified to access the accident databases. The documentation supporting this fact will be provided to EC prior to the extraction of the data from the databases.

The institutions and organisations with access to the CARE database are decided and named by the European High Level Group on Road Safety. The maximum number of access-points per member state is limited to three. In Germany, BASt has full access to the CARE-database.

Data processing and storage

The extracts from the accident databases will be used for the general description of the problem scale, detection of possible high-risk locations and conditions as well as for analysis of the problem of under-reporting.

The data can be stored on a regular computer hard drive of the person working with it unless higher level of protection is required by the national rules[1]. It is allowed to have a back-up copy on an external media (USB-stick, external hard drive) or the server of the organisation. Reasonable level of security has to be provided to prevent the theft of the equipment storing the data or hacking into the back-up server. No copies on public cloud services like Dropbox or OneDrive are allowed.

Access to the CARE-database is possible for evaluation issues only. Storage and processing of disaggregated CARE-data is not possible.

Data sharing and access

The raw data extracted from the databases (individual accident reports), electronic or printouts, can be shared with other persons in the same organisation only if they are also qualified to access the same accident database.

Other personnel in the same organisation or other project partners can access the data with greatly limited level of details (no individual accident protocol is exposed, but location, date and simplified description of the accident can be read)[2].

Only aggregated data can be shared publically (for example, through reports or publications in journals). The locations and types of the accidents can be shown schematically, but it should not be possible to match an individual accident location with any data presented elsewhere.

Strategy for long-term preservation

It is not required by the consortium to delete the original data after the project lifetime. However, as long as the data exists, the rules for data storage, access and sharing described in this plan apply.

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[1] For Germany the rules for storage and processing are generally more strict compared to other countries: disaggregated accident data (individual accident cases) are stored and processed exclusively in a separated unit of BASt on a foreclosed server with no internet access. Copies on hard drives on systems with internet access, on external media or on public cloud services are not allowed.

[2] For data from the official German accident statistic only aggregated data is allowed to be shared outside the accident statistics unit of BASt. To share disaggregated data a highly limited level of details (no location information, no date and no personnel information) would be necessary.

5.3 In-depth accident investigations reports

Data description

The German In-Depth Accident Study (GIDAS) database comprises information on in-depth road traffic accident data from two regions of Germany since the year 1999. By the end of the year 2014 the database comprised 26,380 accidents which is the sum of about 2,000 cases per year. Information is available on up to 3,000 variables per accident, including police recorded crash information and detailed technical and medical data on:

- specific crash location (e.g. junction, pedestrian crossing, bicycle path, roundabout, etc.);
- the type of crash (e.g. heads-on collision, run-off, side-collision, crash between motorised vehicle and an unprotected road user, etc.);
- crash reconstruction parameters (e.g., driving speed, collision speed, impact angle, etc.);
- contributory factors (e.g. speeding, lack of safety equipment, faulty safety equipment, etc.);
- personal medical information.

Ethical concerns

Any personal data, collected within the process of GIDAS, is collected only with the explicit declaration of consent of the aggrieved parties. Any re-identification of persons is prevented by appropriate post-treatment of the data. The usage of the data is confined to scientific purposes only, which are aimed at the improvement of road traffic safety in general.

Data collection procedure

GIDAS aims to cover all road traffic accidents with at least one injured person in two areas of Germany (cities of Dresden and Hanover and their surrounding regions) in four time shifts per day (based on special statistical investigation method). Specialised investigation teams are called directly after the crashes occur (on-the-spot approach) which allows an in-depth recording of various technical and medical crash details.

Data processing and storage

The GIDAS teams from Dresden and Hanover work in accordance with special agreements with their regional district governments which allow e.g., the investigation of personal data and the entry to accident scenes after approval from the police. All recorded data is stored at local servers and is anonymised after completion of the individual case investigations. Thus, GIDAS partners and clients are not able to trace back personal data. The GIDAS steering committee, consisting of representatives from BASt and the Research Association of Automotive Technology (FAT), monitors the investigation methodology and the data management process. Further, regular technical meetings address appearing ad-hoc key issues to ensure the project's overall quality claims.

Data sharing and access

GIDAS data are accessible only to restricted partners. Within the InDeV project, BASt will perform analyses using the GIDAS database and will provide results to the InDeV consortium. However, only aggregated data can be shared, e.g. the locations and types of the accidents can be shown schematically, but it won't be possible to match an individual accident location with any data presented elsewhere.

Strategy for long-term preservation

GIDAS partners have the permission to store a copy of the anonymised GIDAS database. GIDAS partners are announced by the GIDAS steering committee. The data usage is fixed in contracts.

5.4 Answers to questionnaires for self-reporting of accidents

A self-report questionnaire will be sent out in three ways:

1) A self-report questionnaire will be sent out to citizens in the participating countries, asking them to recall and describe accidents they have had in the last month. During one year the same participants will be asked once every month.
2) Pedestrians and bicyclists, who – on request - download the APP for accident detection developed in WP4 (description given in the section about naturalistic cycling/walking data), will, if an accident is recorded, be prompted to answer a questionnaire on the accident.
3) Pedestrians and bicyclists, who have downloaded the APP, will be asked once a month, if they have experienced an accident that was not registered by the APP.

The first two questionnaires (1 and 2) contain the same types of information, while the questions in case nr. 3 only consist of time of accident and indication of walking or bicycling when the accident happened.

Data description

The questionnaire contains questions regarding the accident and its consequences:

- Date and time of the accident;
- Location of the accident;
- Types of road users involved – cyclist, pedestrian, etc.;
- Types of vehicles involved – car, heavy truck, tram, etc.;
- Schematic figure of vehicle and road users movements prior to the accident;
- Description of the accident event;
- Days of absenteeism due to injuries obtained in the accident;
- Road user's contact to medical service, police or insurance (yes/no);
- The use of helmet if road user was a bicyclist and if the bike was electric or not.

Also questions on the road users' personal data will be asked:

- Age;
- Gender;
- Zip-code /town of residence;
- Social Security Number;
- Contact e-mail address.

Ethical concerns

When dealing with personal information, maintaining anonymity is always a concern. As only aggregated data will be made public, the anonymity of respondents is ensured when presenting results of the questionnaires.

The researchers analysing the data from the questionnaires will be aware of the respondents' identities during the research process. The respondents will be made aware of this before they answer the questionnaire, and as the participation is voluntary, they may refrain from answering

if they do not wish researchers to know their personal information. The involved researchers will sign a declaration of non-disclosure of the data.

Data collection procedure

As previously mentioned, data will be gathered in three ways: 1) A one year study across all countries, 2) When APP is triggered by accident, 3) Once every month to APP users.

1) In each country, a large number of inhabitants (appr. 2000, age 18 and above) will be asked to participate in the study. They will be informed of the project scope, and an assurance of anonymity in public research and information of researchers knowing the identity of participants also will be given. It will be made clear to the participants that they can leave the project any time and are not obligated to answer the questionnaires. If agreeing to participate, they will be asked to give their e-mail address, as e-mails will be sent each month with a link to the online questionnaire.

2) When the APP registers a movement that could be categorized as a possible accident, a questionnaire is sent to the APP-user. *More information on the APP is given in the description of naturalistic cycling/walking data.*

3) Once a month, APP-users will be sent a very short questionnaire, asking the participant to tell if they have had any accidents where the APP was not triggered. If answering yes, they will be asked when the accident took place and if they were walking or bicycling when it happened. *More information on the APP is given in the description of naturalistic cycling/walking data.*

Data processing and storage

Answers of the questionnaire will be used to compare accidents with data from police recorded accidents and, where possible, hospital recorded accidents. Thus data will be processed to gain knowledge on the number of accidents and their characteristics, injuries and involvement of insurance company, police and medical authorities, and concurrence between official data and self-reported information.

The data will be stored on an external device (hard disk or USB-drive) or on a server belonging to the partner organisation. If data is stored on an external device, the device must be locked away when not in use to prevent theft. If data is stored on a server, reasonable security must be provided to prevent hacking. Access to data on the server or the external device must require a password.

A working copy of the data can be stored on hard drives on the computers of the researchers analysing the data (unless national rules require stricter protection, in that case the national rules are to be followed). If a working copy is stored on a computer, the computer must be protected with a password, and reasonable measures against theft and hacking must be taken.

No copies on public cloud services are allowed.

Data sharing and access

As no personal information will be transferred across borders, the questionnaires will be anonymized by the partner organisation in each country before it will be available to the other partners.

Each partner organisation must consider discretion when handling the non-anonymized data in order to make the anonymization and to make any data enquiries that need access to personal information.

Only aggregated data will be used in publications (presentations, reports, papers, etc.).

Strategy for long-term preservation

It is not required to delete the data before the termination of the project, however as long as data are stored by the institutions the guidelines regarding data storage, sharing and access shall be followed.

5.6 Video recordings of traffic environments

Data description

Three types of video recordings are performed in the project:

- Pilot test of the equipment and setup;
- Short-period recordings (1-4 weeks continuous recording at one site);
- Long-period recordings (1-1.5 years of continuous recordings).

The types of equipment to be used include:

- Regular video (RGB) cameras;
- Thermal cameras;
- Tests with other types of equipment like radar or lidar.

The cameras directed towards traffic facilities will be placed on lampposts or nearby buildings at a height of 8-12 meters. To cover a larger area and avoid occlusions, several cameras with different perspectives will be used at the same site.

The national regulations when it comes to video surveillance differ from country to country and might put limitations to what resolution can be used. Prior to installation of cameras, each partner has to contact the national authority to receive the necessary permits or clearance for making recordings. From earlier experiences it is known that with the planned height and perspective of cameras, images with resolution of 640x480 do not allow to recognise individual faces or read licence plates on vehicles which makes identification of individuals impossible. However, for the project purposes we will aim at higher resolution where the national legal framework permits it.

Thermal images allow to distinguish the general silhouette of the objects, but not to see faces or read number plates. The resolution will not exceed 640x480.

Radar or lidar data provide 3D-data of the scene, but the resolution is far below what is necessary to identify individuals.

Ethical concerns and risks

The main ethical concern is that in high-resolution videos it is possible to identify individuals and misuse this information. Videos may end up in improper hands either through unauthorised access on computers where the analysis is performed, stealing the physical copies (hard drives) or stealing the equipment while making the recordings. The involved researchers will sign a declaration of non-disclosure of the data.

Data collection procedure

The equipment for data collection will have a reasonable level of security to prevent theft or vandalism. The hard disks on which the data is stored in the field are to be placed in locations that are hard to reach (e.g. a balcony or at the top of the lamp post together with the camera) or to be protected by a metal box chained to some fixed object. In case of long-period recordings, the hard drives are to be emptied at least once per month.

Data processing and storage

The collected data is to be stored on external hard drives in two copies. For extra security against theft, the hard drives are to be stored in a locked cabinet (locker). Access to the hard drives has to be protected by a password.

In case of high-resolution video (possible identification of individuals):

- All data transfers are done by transporting a physical copy of the data with a courier, never through network connections.
- If the national rules do not permit data transfer outside the country, the analysis has to be done in the country of origin at local project partner facilities. The necessary support is to be provided by other partners who have the necessary competence.
- Any processing is to be done on off-line computers not connected to network.
- All persons having access to the data must sign a statement of non-disclosure.

In case of low-resolution video (identification of individuals NOT possible):

- Data can be transferred between the project partners;
- Data transfer can be done through secured FTP connections;
- Processing can be done on regular computers with Internet connection.

The expected distribution of the tasks on video data collection and analysis and transfer of the data is given in Table 4.

Table 4. Distribution of the video data collection and analysis tasks between the partners.

Country	Data collection			Data analysis		
	Pilot set-ups	Short-period observations	Long-period observations	Automated processing	Manual processing	Data transferred outside country
Sweden	+	+		LU	LU	no
Denmark	+	+		AAU	AAU	no
Germany		+ (?) if permitted		AAU at BASt	LU, WUT at BASt	no
Belgium		+	+	LU, UHasselt	LU, UHasselt	yes
Netherlands		+		TNO	TNO	no, but maybe if needed for WP4 development
Poland		+	+	LU	WUT	yes
Spain		+	+	AAU	LU, WUT	yes
Canada	data collected in other projects but the set-up will be maximally adjusted to what is used in InDeV			PM	PM	no

Data sharing and access

All European project partners can have access to the original data unless the national rules of a particular country do not allow data transfer outside the country borders. It is the responsibility of each partner to check the national regulations on that and follow them. High-resolution videos cannot be transferred outside Europe. Low-resolution video (individuals cannot be recognised) can be shared with the non-European partner and members of the Advisory Board on request.

Short clips or still images from the video recordings will be used to illustrate the method and demonstrate the results of the project. Before this is done, one must ensure that the videos do not contain any personal information. If it is the case, the sensitive information has to be removed by

decreasing the resolution of the video or putting a mask (black or blur) on faces, car number plates or any other parts of the image that make the recognition of the individuals possible.

By default, no third party access to the video is allowed. This includes (but is not limited to) police, local authorities, accident victims or their relatives, etc. However, if the local legislation requires that such access is granted (for example, in case of a criminal investigation), the local laws are to be followed.

No video data can be made publicly available, for example, in form of a public dataset for the research community.

Strategy for long-term preservation

It is not required by the consortium to delete the original data after the project lifetime. However, as long as the data exists, the rules for data storage, access and sharing described in this plan apply.

5.7 Naturalistic cycling/walking data

Data description

- A smartphone APP will be developed to record cyclist and pedestrian accidents automatically. When installing the APP, the road users are asked to register their:
- Age;
- Gender;
- Zip-code /town of residence;
- E-mail address.

Based on speed and acceleration patterns, the APP will detect potential accidents of the road user. If the APP is triggered, the following data will be stored:

- Date and time of the event;
- GPS coordinates of the event;
- Mean of transport used at the time of the event;
- Total distance travelled as a cyclist or pedestrian;
- Speed and acceleration patterns covering 30 seconds prior to and 10 seconds following the event.

Ethical concerns

The main concern is that with the APP, the road users can be tracked and identified, and that this information can be misused. As only aggregated data of the distance travelled and GPS coordinates for the location of the accident will be stored, the anonymity of respondents and their travel patterns is ensured.

The researchers analysing the data from the APP will be aware of the respondents' identities during the research process. The respondents will be made aware of this before they install the APP, and as the participation is voluntary, they may refrain from installing the APP if they do not wish researchers to know their personal information. The involved researchers will sign a declaration of non-disclosure of the data.

Data collection procedure

Pedestrians and cyclists in selected cities in three partner countries will be encouraged to install the APP on their smartphone and thus participate in the study. Upon installation of the APP, the

road users will be informed of the project scope and the type of data collected in the APP. Assurance on anonymity in public research will also be given. It will be made clear to the participants that they can leave the project any time by deleting the APP. If agreeing to participate, the road users will be asked to give their email, as emails will be sent each time an incident is detected as well as each month with a link to an online questionnaire to register any accidents that may not have been detected in the APP. This information will not be used for any other purposes.

After installing the APP, the speed and acceleration of the road users will be registered via the accelerometer in the smartphone and will be analysed continuously in order to detect potential accidents and the means of transport of the user. In case a potential accident is detected, and if the road user was either pedestrian or cyclist, information of the event will be stored.

When the APP registers a movement that could be categorized as a possible accident, a questionnaire is sent to the APP-user. *More information on the questionnaire is given in the description of questionnaires for self-reporting of accidents.*

Data processing and storage

Accident data from the APP will be combined with the answers of the questionnaire to gain knowledge on the number of accidents and their characteristics.

The data will be stored on a server belonging to the organisation. A working copy of the data can be stored on hard drives on the computers of the researchers analysing the data (unless national rules require stricter protection, in that case the national rules are to be followed). It is allowed to have a back-up copy on an external media (USB-stick, external hard drive). Reasonable level of security has to be provided to prevent the theft of the equipment storing the data or hacking into server.

No copies on public cloud services are allowed.

Data sharing and access

As no personal information is allowed to be transferred across borders, the collected APP data will be anonymised by an institution in each country before it will be available to the other partners.

Concerning the questionnaires sent to the road users who have installed the APP, the conditions mentioned in the description of questionnaires for self-reporting of accidents apply.

Only aggregated data can be shared publically (for example, through reports or publications in journals). The locations and types of the accidents can be shown schematically, but it should not be possible to match an individual accident location with any data presented elsewhere.

Strategy for long-term preservation

It is not required to delete the data after the termination of the project. However, as long as data are stored by the participating organisations, the guidelines regarding data storage, access and sharing will be followed.

6. Quality Assurance Plan

6.1 Quality control of applied scientific methods

The project consortium joins experienced experts in the area of VRU safety. The following actions will ensure the high quality of the scientific output of the project:

- Project experts will have regular work meetings (physical or through video-conference) to plan and implement the research activities and discuss the results;
- The project Advisory Board meets once a year and provide formalised feedback on the project activities and progress. Individual experts from the Advisory Board can be involved in the discussions of the individual studies at any time when their competence is necessary;
- InDeV team will have regular communication with the sister RDI projects within the same call (X-CYCLE, PROSPECT, SafeCube, SENIORS);
- The project aims at 12 publications in peer-reviewed journals which will guarantee independent quality control of publications by external reviewers.

6.2 Procedure for control deliverables to the EC

For quality assurance of the deliverables the following procedure will be applied:

1. An early draft deliverable is submitted to the Executive Board latest 3 weeks before the stipulated deadline of the report.

2. The Executive Board appoints two reviewers, not participating in the production of the deliverable. If necessary, external experts can be involved, for example the members of the Advisory Board.

3. The peer review will focus on the scientific content of the deliverable, checking that the deliverable fulfils the requirements from scientific and technical perspectives, and that conclusions and recommendations are validly drawn from the results of the analysis.

4. The peer reviewers provide their comments latest one week before the stipulated deadline of the report.

5. The responsible task manager will take the comments from the peer reviewers into consideration and will develop a final version of the deliverable.

6. The final deliverable will be submitted to the EC by the project management team.