TRANSPORT CHALLENGE IN HORIZON 2020

ECTRI SUGGESTIONS FOR THE THIRD WORK PROGRAMME (2018-2020)
in the field of
"TRAFFIC MANAGEMENT"

November 2016

The European Conference of Transport Research Institutes (ECTRI) is an international non-profit association that was officially founded in April 2003. It is the first attempt to unite the forces of the foremost multimodal transport research centres across Europe and to thereby promote the excellence of European transport research.

Today, it includes 28 major transport research institutes or universities from 21 European countries. Together, they account for more than 4,000 European scientific and research staff in the field of transport. ECTRI as the leading European research association for sustainable and multimodal mobility is committed to provide the scientifically based competence, knowledge and advice to move towards a green, safe, efficient, and inclusive transport for people and goods.

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1. Introduction

ECTRI launched its Thematic Groups in September 2007 as a means to facilitate exchanges among its researchers interested in similar research fields and in order to promote joint initiatives and positions. One of these groups is the Thematic Group on Traffic Management (TG-TM). The main objectives of this group are to define research challenges of interest for supporting EC policies and programmes, to increase successful participation in EU projects and to provide a platform for networking and scientific exchanges. The group consists of 31 experts from 21 Institutes and Universities representing 12 countries[1]. They represent the top European institutes in the field of modelling of road transport, analysis of traffic data, traffic management and traffic information, and also integration of IT technology in cooperative ITS.

A number of the partners* were involved during five years in the network of excellence NEARCTIS on cooperative traffic management (FP7). They have gathered together a valuable expertise in this field of research in transportation. The consolidation of the network is on its good way with the active participation to the TG-TM, which is the first step of the creation of virtual centre of excellence (VCE) in TM (http://www.nearctis-vce.eu/).

2. Suggested Research Challenges

The traffic management (TM) of the future will be very different from the TM in the past. While the main goals remain unchanged
- Increase the efficiency of road transport and tackling traffic congestion.
- Improve the safety levels, by reducing the number of crashes
- Improve sustainability, by cutting down GHG and other pollutant emissions,

the underlying methodology is going to change profoundly, which will provide new and exciting opportunities for R&D in the near future. Three main drivers may be identified, which are a) much more and much better data, b) a new focus on mobility management instead of just traffic management (including the services related to this), and c) the ongoing or future automation of transport systems.

The ECTRI TG-TM constitutes on research organizations providing expertise in five Research Themes. Out of these Research Themes, TG-TM has identified a series of research challenges that are highly relevant for the objectives of the Horizon 2020 programmes. ECTRI thinks that given their importance, these aspects of traffic management should be identified as research challenges in future programme of "Horizon 2020" and beyond.

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[1]

AIT	Austrian Institute of Technology	AT
BASt	Federal Highway Research Institute	DE
CDV	Transport Research Institute	CZ
CENIT	Universitat Politècnica de Catalunya	ES
DEUSTO	University of Deusto	ES
DLR	German Aerospace Center*	DE
EPFL	École polytechnique fédérale de Lausanne*	CH
FhG	Fraunhofer-Gesellschaft	DE
HIT	Hellenic Institute of Transport	GR
IFSTTAR	Institute Francais des Sciences et Technologies des Transports, de l'Amenagement et des Reseaux*	FR
TRL	Transport Research Laboratory	UK
TUC	Technical University of Crete*	GR
TUD	Delft University of Technology*	NL
UCL	University College London*	UK
UNEW	Newcastle University	UK
UNIZA	University of Zilina	SK
UoS	University of Southampton*	UK
UPM	Universidad Politécnica de Madrid	ES
UVEG	University of Valencia	ES
VGTU	Vilnius Gediminas Technical University	LT
VTI	Swedish National Road and Transport Research Institute	SE

Research Themes	Corresponding Research Challenges
Development of data processing & communication techniques for emerging road traffic measures	1) Data processing & Big data for traffic management
	7) Custom Oriented Mobility Services
Modelling future road transport	2) Traffic Management considering all road users
	3) Shared mobility
	4) Cooperative and Autonomous Vehicles
	5) Control of the Multi-modal Transport System
Understanding the consequences of road traffic measures and optimization of their use	4) Cooperative and Autonomous Vehicles
	6) User Centred Mobility Modelling
	7) Custom Oriented Mobility Services
	8) Road Safety & VRUs
Control the complexity of traffic and mobility management in a dynamic world	2) Traffic Management considering all road users
	3) Shared mobility
	5) Control of the Multi-modal Transport System

All of these challenges lead to the overall goal of a smooth, efficient, sustainable, and safe transport of people and goods. The suggested research topics are reflected in the form of research challenges aiming to highlight their significance for inclusion in the upcoming calls of Horizon 2020, and in particular to achieve the resource-efficient transport that respects the environment. Those topics have also a close relation to the key drivers for supporting the achievement of low carbon mobility as suggested by ECTRI in its recent position paper[2]: 1. Systemic approach; 2. Resilience; 3. Human factors; 4. Policy-making. In particular, topics 1 and 4 relate to the systemic approach, topic 5 to resilience, topics 2, 6 and 8 to human factors, and topics 3 and 7 to policy-making. Those topics are also supporting the new challenge in mobility management within the European economical context and with the rapid evolution of the automation of transport systems.

Of course, the traditional traffic management subjects (traffic estimation and prediction, data fusion, route guidance and navigation systems, integrated motorway traffic control, urban road network control, macroscopic and microscopic traffic flow modelling) are still very relevant. They become even more significant as fundamental pre-requisites for traffic management in view of the novel challenges and opportunities due to cooperative and autonomous vehicles, hence they deserve being addressed.

On this basis, TG-TM is proposing eight research challenges that are essential for the future deployment of advanced transport systems. These proposals are fully in line with the complexity of the urban environment and the necessity to develop smooth mobility services while reducing the environmental impact. Without a smart and coordinated mobility management, it will be difficult to achieve acceptance by the citizens of more automation in transport.

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[2] ECTRI position paper on the third Transport Work programme "Towards low carbon mobility", July 2016

1) Data processing & Big data for traffic management

Motivation:
Recently, the availability of data is highly increasing in the context of interconnected smart cities and transport, bringing the opportunity to improve multiple processes and services in road traffic management.

Currently, real time information can be gathered from very different sources, such as sensing devices, vehicles, infrastructure, smartphones, mobile phones operators, open data, social media etc. and various types of data and information, as it is the case of image, sound, text, etc. However, these data come with challenges of their own, such as their quality and reliability, the efficiency on the data gathering process, the needs of Software and Hardware infrastructure to handling large amounts of data in real time.

These new data will bring the opportunity to improve different information services on road traffic management, such as communication architectures, traffic congestion, prediction on potential risks/incidents, traffic events management, among others. For this the performance of the systems involved need to be improved in order to deliver highly reliable, accurate and rich real time information for supporting the road traffic managers on their daily decision making process.

Scope:
In order to meet these challenges, proposals need to address the following research aspects:
Identification of **new data sources and more efficient intelligent sensing** is required in order to reach higher degree of situational awareness directly on the spot and new structures and approaches are needed that can be used to transmit, deliver and communicate such information either to humans or machines.

- **Development of hardware and software architectures**, which allow using of information coming from a wide range of diverse sources with the purpose of improving the support to decision making and prediction of incidents to be done by road operators. Storage and processing of large amounts of diverse data will be required, and the Big Data paradigm is necessary for such challenging applications.

- **Research on methodologies and applications** for traffic management relying on the assessment of the suitability and reliability of the different sources of information, for delivering highly reliable services on: congestion prediction, risk management, potential incident detection, evaluation of implemented actions, etc. Thus, data from different sources need to be analysed (historical, real time) in order to identify different behavioural patterns on traffic and to provide better and richer information to managers.

- Assessment of the advantages and opportunities of **sharing data** by the different road agents (vehicles, people, road operators etc.) as well as the possible issues that arise in this. Boosting data sharing measures towards open data. Sensitive issues such as **data security and privacy** have to be properly addressed, especially in the case of the data gathered from smartphones.

Expected impacts:
- Increase the awareness on the road traffic status by means of real time information with greater accuracy and reliability, improving the services delivered to the agents involved.
- Improving the road operators' decision making process related to road traffic, giving the option to implement preventive actions in road traffic management.
- Increase the efficiency of road transport, tackling traffic congestion.
- Improve the safety levels, by reducing the number of crashes.
- Improve sustainability, by cutting down GHG and other pollutant emissions.

Funding level and instrument:
RIA

2) Traffic Management considering all road users

Motivation:
Urban network congestion remains a significant societal problem with negative implications for travel times, safety, fuel consumption and the urban and global environment. The ongoing and forthcoming re-distribution of public space to benefit active transport modes (walking, cycling) calls for a transport system which is designed to optimized traffic flows of different modes, which all have their own properties. This way, efficiency for the traffic system can be guaranteed and policy measures to increase the use of active modes can be backed up by traffic measures favouring those modes.

Traffic management requires knowledge on the current traffic state of the network as a whole as well as the individual links. In order to identify potential bottlenecks, traffic demand needs to be known as well as supply (network structure and local capacity). Here, the interplay between traffic demand and supply requires knowledge of road user behaviour, such as mode choice and route choice. Once the future traffic state is known, measures to influence it need to be identified. To this end, effects of (combined) measures need to be known, new measures may be added and an assessment method is required to come to the 'best' measures.

Research needs / aspects to consider:
- Data collection techniques for real-time information are available for vehicles, but new methods need to be developed to measure pedestrians and cyclists. The focus is both on the real-time monitoring required for traffic management purposes, and the historical data collection for planning purposes. Demand prediction is a complex task, requiring advance transport planning for all road users, but also a distribution over various origins and destinations in the network (the origin-destination (OD) matrix). Though OD based approaches are well-established for public transport and motorized individual transport planning, these are unsuitable due to their large spatial scale and the minor integration in the multi-modal nature of active modes of transport. OD estimation for active modes and the corresponding transport planning are thus subjects for future research.
- To assign the demand to the network, insights into road user behaviour are essential. In urban areas, this mode choice extends to active modes, contrary to more traditional choices between car and public transport. Insights into all road users' mode choice behaviour, and also the assignment of different modes to the urban network (where modes compete for the same limited space), as well as route choice are limited, but essential for traffic management, but also in the planning stage. Traffic flow theory is strong for vehicular traffic, but needs extensions to cover cyclists, pedestrians and spaces shared by different modes. These theoretical concepts are essential for the modelling needed in developing traffic management measures. Moreover, though knowledge exists on traditional traffic management measures, a fresh approach is needed to tackle the intricacies of the urban environment, for example holistic traffic signal management.
- The final step is the assessment of the traffic management measures. Here, disturbances and interruptions in a traffic stream, caused by another mode crossing a traffic stream need to be addressed as well. While more insight is required into the consequences of the combination of measures, also the spatial effect of the measures requires more research, e.g. network-wide optimization and coordination of traffic lights, allowing for various speeds of road users.

Expected impacts:
The above described research changes the attention of traffic management towards urban networks, with its range of modes: vehicles, cyclists and pedestrians. This research will give the tools to implement policies on active modes and identifies ways to collect data and identify traffic management measures, considering all road users. The intended consequence is to reduce congestion, pollution, and noise levels in cities. At the same time, accessibility will increase, and a more frequent use of actives mode will also increase health.

Steering behaviour and traffic with policy changes is a difficult task; this behavioural and traffic engineering study is an important step towards more sustainable cities.

Funding level and instrument:
RIA, IA

3) Shared mobility

Motivation:

In the last decade we have been observing the rise of what is named shared economy whereby sharing benefits all consumers and makes a more efficient usage of the available resources. Mobility is one of the economy sectors benefiting from such trend: carsharing and bikesharing systems are appearing in most of the big cities in the world and private companies like Uber are making the use of traditional taxis much easier and widespread with its information technologies to match drivers and riders. There is even a vision for the future in which automated shared cars would cover most of the urban mobility demand, without the need for private vehicles which usually stay idle for 95% of the time.

Carsharing mobility is increasing, however little is known about the effects of these services in urban mobility patterns since demand is currently at a level that it does not change considerably travel times in the road network or passenger loads in traditional public transport. Yet as more companies decide to compete for the sharing market, questions are being raised by city authorities as to what are the advantages for a city in providing support for shared mobility: from simple operation authorization to direct subsidies and parking spaces supply.

Most of the traditional Transport Demand models are not yet considering these highly dynamic options and the more sophisticated academic shared mobility models are usually too big to run together with all the other transport modes in a city. There is a need to make these new transport modes, motorized and non-motorized, part of the existing operating transport models hence allowing the estimation of the demand that they capture from each specific mode. The effect on mobility sustainability will be different if demand is being captured from private or from public transportation. Moreover the fact that the vehicles, either cars or bicycles, are moving in the city from area to area, there are added management complexities in relocating these vehicles according to the dynamic demand. This much needed real time management of the fleets is expensive and adds empty kilometres which hinder some of the positive effects of shared mobility. A complete cost benefit analysis must look further beyond value of time savings toward a complete accounting of all costs and benefits of urban transport modes so that more efficient solutions can be reached.

Research needs / aspects to consider:

- Integration of the new highly dynamic shared modes into the traditional transport demand models such as the 4-steps model that is being used all over the world to take strategic investment decisions on new transport projects.
- Added difficulties come from incorporating in simple traffic assignment models a transport mode whose demand changes supply, because vehicles are transferred from area to area affecting the availability of transport capacity in carsharing, Uber like systems or bikesharing systems.
- Understanding behaviour of travellers when facing a shared mobility alternative without owning their private vehicle. Willingness to walk to get a vehicle or to wait for a vehicle are critical to the systems.
- Managing shared mobility system in an efficient way so that they are able to provide a higher transport capacity without losing efficiency with logistical operations of vehicle relocations.
- Expanding traditional cost-benefit analysis to consider benefits such as mobility inclusiveness and environmental effects in order to fairly estimate the contributions of carsharing to urban mobility.

Expected impacts:

Enabling a better knowledge of the effects of shared mobility will improve decision making at the level of the municipal authorities, which are still struggling with understanding the effect of shard mobility in the territories that they manage. Findings will determine where to invest resources in order to obtain a better cost/benefit ratio of transport demand management policies that can contribute to a more sustainable urban mobility.

Funding level and instrument:

RIA. IA

4) Communicating, Cooperative and Autonomous Vehicles

Motivation:
Vehicular automation is becoming a reality. Autonomous vehicles are being tested in Europe and worldwide and they are expected to contribute substantially to the improvement of traffic flow and to the increase of traffic safety and efficiency. A wider impact on a society is expected since autonomous vehicles will completely change a traditional concept of driving experience and they may change vehicle ownership to a novel concept of using a vehicle as a service. From a control point of view an autonomous vehicle should interact with other vehicles and surroundings including the infrastructure and vulnerable traffic users such as cyclists and pedestrians. If a vehicle is a part of some vehicle network, it should receive or sent the data from other vehicles. This data exchange serves for a vehicle control process. When an autonomous vehicle meets a traffic user which is not a part of the vehicle network then the autonomous vehicle should identify its speed, direction of motion, possible change of motion and to make a decision on its next own action and to perform it. In other words, autonomous vehicles need to be able to monitor the behaviour of other road users and react safely. This will involve machine learning as vehicles have to use data on how other road users behave in order to improve their interactions with other road users. For example, an autonomous vehicle could learn to anticipate when a vehicle intends to turn off a road, for example by analysing road position or braking patterns. Communicating and cooperating vehicles will disseminate this information explicitly. Also a number of unexpected traffic situations may happen, and control technologies of the future vehicles should be prepared to operate as safely as possible. Braking, steering and suspension control should be adaptive according to road and traffic conditions like roughness, friction as well as geometry, and the presence and density of other users and in particular their intentions, actions and decisions.

Research needs / aspects to consider:
According to the Taxonomy and Definitions for Terms Related to On-Road Motor Vehicle Automated Driving Systems (SAE J 3016), the degree of automation can be scaled at five levels, where level 0 represents 'No automation' and level 4 'Full Self-Driving Automation'. The latter means that vehicles can perform all driving functions and monitor roadway conditions for an entire trip, and so may operate with vulnerable traffic users such as pedestrians and cyclists. Therefore, it is needed to develop a solution that will be able to evaluate the traffic situation and to manage this mixed mode traffic, especially within urban environments, i.e.:

- To recognise vulnerable road users (cyclists, pedestrians, tractors, animals and others) without environment monitoring systems and to anticipate their motion and direction;
- To suggest or force vehicle motion to avoid the collision with vulnerable road users;
- To be able to use the captured data for future analysis;
- To use novel techniques, such as massive learning techniques based on Artificial Intelligence Neural Networks (unsupervised feature learning, deep learning, machine learning) to create systems to detect, predict and react to the behaviour of vulnerable traffic users by providing intervention such as vehicle road guidance and navigation.

To ensure a smooth operation of such a mixed transport system, it is not enough to produce an autonomous vehicle. The infrastructure has to be adopted, too, existing connected vehicle (CV) technologies such as vehicle-to-vehicle (V2V), vehicle-to-infrastructure (V2I), and vehicle to others such as pedestrians and cyclists (V2X) shall be revised and all these technologies and systems need to be incorporated through an overall transport system and integrated to new ways of mixed mode traffic management.

Expected impacts:
Actions will address the ICT-infrastructure related challenges to enable the transition towards advanced levels of road vehicle automation. Considerable progress will be made regarding real time control systems for automated driving. Actions will contribute to more reliable processing of information for automated transport based on data fusion algorithms to combine V2V and V2X information with on-board sensor information. Actions will contribute to opening up a services market, as well as advancing public interest applications based on data captured from automation processes concerning e.g. the driver, the vehicle and the journeys made.

Funding level and instrument:
RIA, IA, CSA

5) Control of the Multi-modal Transport System

Motivation:

Urban and interurban transport plays a pivotal role on cities' operations across many sectors. However, some relatively common stresses as traffic accidents, roadworks or big events may cause large and costly disruptions in its usual working.

This topic is about developing more robust, integrated and flexible transport planning and management systems able to deal with peak demands, shocks or unforeseen events to ensure a quick recovery and a smooth functioning (resilience of the system). At the management side, still the prediction of incidents a) interruptions of public transport, and b) congestion at all road levels is still an issue pending to tackle in traffic management.

The analysis of a multi-modal network as a whole is very complex and a pure holistic approach is often too demanding, if possible at all. In order to reduce the complexity inherent in multi-modal transport systems one has to divide the task into different layers of services and users (e.g. vehicles, public transport, bicycles, pedestrians) and scales (corridors between cities, city-wide, zones).

Research needs / aspects to consider:
- Improvement the forecasting of disruptions at the planning stage by establishing plans that reduce the risks of shocks in the service by the coordination and redundancy of transport media.
- Integration of new trends in connectivity of the different road agents to improve traffic congestion prediction in urban and interurban areas
- Development of strategies to respond in case of a disruptive event by readapting the distribution of passenger flows across the different portfolio of transport options and by providing a richer and more customized information to users
- Alternative efficient routing will be necessary for traffic congestion situations. For this, new business models need to be explored in order to enhance the data sharing from users.
- Decomposition of the different transport network layers in a smart way is required and application of hierarchical control principles to enable efficient traffic management.
- One option is to describe traffic per zones. Although recent advancements in urban traffic description suggest moving towards this methodology, the detailed description the dynamics of traffic and precise impact assessment techniques at the zone level require more investigations.
- Finally, the integration techniques to connected traffic descriptions at different scales need to be further improved.

Expected impacts:

Improving modelling at all levels enables to test and optimize traffic management measures. In this way, resilient, multi-modal transport planning and management can take place. The decision maker at strategic and operational level gets useful support about the transportation network performance (decision support system for traffic management can be a product of this project).

Funding level and instrument:

RIA

6) User Centred Mobility Modelling

Motivation:

To optimize mobility management and planning based on User Centred Mobility Modelling requires deeper understanding about human mobility behaviour. State of the art models are not able to deal with complex issues where several influences and rebound effects take place.

Therefore, a first step is the identification of the key factors for mode choice and route choice for routine and non-routine trips considering local influences like spatial structure and local culture. These factors should represent opportunities (infrastructure accessibility, information access, etc.), competences (skills, training, experiences, etc.) and meaning (attitudes, preferences, aversions, etc.). Key is to implement these factors and their interdependencies in a consolidated demand model.

The second step is to apply such a model, which enables real user-centred mobility management by estimating the impact of soft and hard control measures on behaviour transitions of different social groups. The coordination and target-oriented management of transport systems is then performed by comparing and optimizing different sets of measures.

Research needs / aspects to consider:
- Identification of key influence factors (so far only pure rational factors have to be taken into account at mobility demand models)
- Handling the complexity involved at models dealing with a high number of factors, different types of factors (ordinal, different units) and high interdependencies between the factors
- Identification and specification of data requirements (rational vs. emotional decision making) and the according acquisition technologies
- Definition of indicators, representing the quality of such novel mobility demand models
- Exploration of the potential to transfer similar models from other domains like macro-economic modelling of rebound and backfire effects, behavioural economics, …
- Enriching map data to enable the application of complex, inter-modal mode and route choice in the simulation
- Efficient calibration of the simulation to guarantee accurate results for decision support

Expected impacts:

Overcoming the limitations of the state of the art, purely rational models (that neglect rebound effects), and of the current 'predict and provide' paradigm enables a new generation of traffic and transport management tools. Efficient bundles of measures can be designed and tested to achieve transport policy goals like the reduction of energy usage and GHG emissions, sustainable growth and quality of life for the citizens. On top of that, even the effect of new transport solutions and services such as automated vehicles on the transport system and according management requirements can be assessed on a scientific basis.

Funding level and instrument:

RIA, CSA

7) Custom Oriented Mobility Services

Motivation:

The traditional way of planning and organizing mobility considers travellers as a mass, as a collective. Transport infrastructure and services are provided to meet a quantitative demand, such as a certain number of vehicles per hour at a certain corridor or a certain number of travellers on a certain line.

On the other hand, C-ITS as a customer oriented technology has proven its strong potential to improve road safety and the efficiency and environment friendly road transportation. Furthermore, tools are required for local planning authorities to collate mass raw data that represent traveller's itineraries on all transport modes. These tools should be affordable not only for metropolitan areas and should go beyond short-time samples in order to allow a significant representation of mobility behaviour on the network.

Combining these three worlds ends up with mobility as a service (MaaS). A service that is for people serving their mobility need, so the individual person, its demand, the reason for the travel, the mode, time and characteristics of travels are taken into consideration when offering optimal mobility services. This view opens the administration's view about travellers (and not just traffic) and consequentially traffic space can be re-distributed.

Research needs:

- For citizens new skills will be required to use and benefit from these developments which may be quite difficult for some groups of the society. Thus inclusive C-ITS is the sense of "mobility for all" is a societal challenge considering all related learning aspects.
- Design of tools and techniques to determine mode-sharp real user behaviour, such as user groups and their characteristics, individual itineraries, travel modes, missing options, abandoned options
- Methods to assess the service quality in order to continuously improve its quality, considering societal aspects, inclusion, etc.
- The design of novel methods and tools has to inherently integrate data protection and privacy as key features, when collecting, processing, combining, evaluating, and using individual data
- Assessment of demand elasticity as an instrument to actively promote sustainable mobility solutions
- Identification of influence factors that allow an ex-ante assessment of the effectiveness of control measures
- Last mile considerations such as peripheral connectivity, "round the corner" versus door-to-door, spatial and temporal distribution of traffic space in city centers, functionality of hubs, etc.

Expected impact:

A broad societal support for C-ITS, public awareness and acceptance of C-ITS by different user groups, in particular by non-connected users – those that are usually not a part of C-ITS.

Such a 'customer-access' enables to provide user as well as demand oriented integrated mobility services (MaaS).

Funding level and instrument:

RIA, IA, Infrastructure funds TEN-T + "Connecting Europe Facility"

8) Road Safety & VRUs

Motivation:

Road safety is important for traffic management for two principal reasons: first of all, crashes are a major source of incidents which are responsible for delays, traffic jams, and increased emission of pollutants and GHGs. Secondly, traffic management measures can be directed to reduce the number of crashes. An interesting result in this context was the introduction of the London Congestion Charge, clearly a traffic management intervention, which led (among other things) to an over-proportional decrease in the fatal casualty and crash frequencies in London.

Therefore, the interest is to identify and to better understand the key influence factors of traffic safety, and especially those which might be susceptible to traffic management measures. This will open up a completely different avenue to road safety research. What is also missing is an approach that does not only look at ever more detailed measures in isolation, but a more systemic approach that brings together all the different ideas ranging from educational approaches that advertise for safer road use (and reaching the correct groups), in fact detailed analyses of key influence factors, and actions to improve traffic safety on a local level. This bears a strong relationship to the topics "Traffic Management considering all road users", to "User Centred Mobility Modelling", and "Control of the Multi-modal Transport System" described above.

Research needs / aspects to consider:
- Development of methods to compute routes that are not only cost-minimal, but also traffic-safety-risk minimal, both for VRU's as well as for vehicle drivers
- Collect and analyse detailed data on human traveling behaviour and pre-crash situations; the approaches like uDRIVE have to be extended to include not only the driving behaviour of motorized vehicles, but also the behaviour of cyclists and pedestrians as well. Those data may also be helpful in the development of better microscopic simulation models
- Discern between crashes that have a true reason in the underlying infrastructure versus accidents that are in fact due to inappropriate human behaviour (e.g. because of distraction, fatigue).
- A better understanding is needed about the effect of Advanced Driver Assistance Systems: while they seem beneficial for traffic safety at first, they also have a tendency to further minimize driver's vigilance and attention (behavioural adaptation).
- Better tools have to be developed for a large scale analysis of accident data-bases: by applying deep learning approaches it might be possible to reveal so far unknown and helpful correlations and causations, and provides input to deliver a safest route.
- A deeper investigation of the development of the ADAS and autonomous vehicles is needed: not anything which improves safety also improves traffic flow, and improving traffic flow by autonomous driving might not necessarily lead to a safer traffic system, especially when a mix of human-driven and various different kinds of autonomous vehicles is considered.

Expected impacts:

A better understanding of the reasons for crashes, especially with regards to reasons that are susceptible to traffic management, and approaches how to avoid them, could be the result of this work. From this, certain recommendations for detailed actions for the authorities can be derived, which will help in keeping on track for the EU road safety target or even a grand Vision Zero challenge. Especially the work on safety-maximal routes might also help to approach this goal from the different angle of the individual users, which again is an interesting means of the traffic management of the future.

Funding level and instrument:

RIA, IA

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