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ADVERTS **A**ssessing **D**istraction of **V**ehicle drivers in **E**urope
from **R**oadside **T**echnology-based **S**ignage**.**

Roadside advertising: knowledge gaps and research strategies

Deliverable No: D1.1c

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Partners

SWOV Institute for Road Safety Research, Netherlands

Transport Research Laboratory, United Kingdom

Vias institute, Belgium

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Assessing **D**istraction of **V**ehicle drivers in **E**urope
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D1.1c

Roadside advertising: knowledge gaps
and research strategies

Start date of project: September 2017   End date of project: February 2019

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Glossary of Terms

Attention
Orientation to sensory events; detection of objects or event for cognitive processing, and the maintenance of a vigilant state.

Billboard
Surface that displays an advertisement.

Distraction
A diversion of attention away from activities critical for safe driving toward a competing activity.

Eye tracking

An eye tracker is a device for measuring eye positions and eye movement. Eye trackers are used in research on the visual system, also often in driving simulators.

Gaze Behaviour

The pattern of eye movements of an individual

LED-screen
Surface composed out of Light Emitting Diodes (LED). These screens emit light and on these screens advertisements can be displayed. These advertisements can be displayed for a given period of time and then digitally be replaced by another (static digital billboards). These billboards can also display advertisements with moving images (video billboards).

Roadside advertising (RsA)
All kinds of visible expressions road users can see that promote a product, event or activity.

Static digital billboard
One light emitting screen or a light emitting screen composed out of various screens that displays a static advertisement (i.e. an advertisement in which nothing moves). This static advertisement is digitally replaced by another static advertisement after it has been displayed for a given time.

Traditional static billboard
Billboard that displays one advertisement continuously. An old advertisement has to be removed and new advertisement put up manually. Traditional static billboards can be illuminated.

Video billboard

A light emitting screen or a light emitting screen composed out of various screens that displays videos or moving animations.

Visual clutter

Disturbance of visual attention that is required for the driving task (e.g. looking at road signs) due the visual attraction of billboards.

1. Introduction

1.1. The ADVERTS project

ADVERTS is a project commissioned by the Conference of European Directors of Roads (CEDR). The main objective of ADVERTS is to compile and disseminate information for European road authorities to help inform them on issues related to distraction from roadside billboards – with a special focus on digital billboards - so that they do not interrupt the safe execution of the driving task and, as a consequence, do not disrupt traffic flow.

Distraction is one of the main challenges currently facing road transport. Distraction not only arises from sources inside the vehicle, but also from sources outside the vehicle. With respect to the latter, the increasing interest in roadside advertising via (digital) billboards is of particular interest. Some features of roadside advertising are likely to be more distracting than others.

The project is being undertaken by a consortium comprising the Dutch Institute for Road Safety Research SWOV (coordinator), TRL (UK) and Vias institute (BE).

ADVERTS consists of three principal work packages: WP1 takes stock of knowledge and current practices that will be used as input to develop guidelines for good practice (WP2). WP3 takes care of benefit realisation and dissemination of the project results.

1.2. The present deliverable

Before preparing the current deliverable two steps have been taken already in the ADVERTS project: first, an extensive review of the scientific literature about distraction by roadside advertising (RsA) and its effects on road safety (D1.1a); subsequently, a survey among European National Road Authorities in order to make inventory of current RsA practices and future trends (D1.1b). The present deliverable (D1.1c) focuses on the revealed knowledge gaps by both the literature review and the survey. It aims to gives a concise overview of current knowledge gaps related to (digital) RsA, as derived from the two previous ADVERTS WP1 deliverables.

The report is meant to serve as a helpful input for defining future research related to possible safety issues of RsA. The present document gives an overview of knowledge gaps and also provides – without being exhaustive - suggestions for applicable research designs that have a reasonable potential to provide answers to fill the identified knowledge gaps.

The report starts with a brief description of the methodology (Chapter 2). Subsequently a structured overview of the results is given (Chapter 3). Finally, the report presents some overall conclusions on the knowledge gaps and research needs (Chapter 4).

2. Method

2.1. Sources of information

The ADVERTS D1.1a literature review was the main basis of the identification of knowledge gaps. Other knowledge gaps were identified from the targeted CEDR survey and interviews with CEDR experts and stakeholders from the advertising industry in D1.1.b.

Based on input from both reports, as well as from additional dedicated scientific literature, a list of knowledge gaps and hot topics that require a (better) scientific basis in the near future was established. Knowledge gaps refer to issues that are insufficiently understood and thus need to be studied or for which there are contradictory study results without a logical explanation.

2.2. Procedure

The approach for this task is structured as follows:

1. Template development for inventory of gaps/needs and proposed associated research methods (see Table 1)
2. Primary list input from D1.1a authors (SWOV, TRL)
3. Additional list input from D1.1b authors (Vias institute)
4. Input elaboration and logical structuring
5. Inventory of possible additional input on applicable and scientifically sound research methods, also based on latest technologies

The output of this task (report) is a concise overview of research needs in the area of distraction by roadside advertising and other, non-traffic related, roadside information, as well as promising research methods for bridging the knowledge gaps.

Table 1: Template for inventory of knowledge gaps and research methods

	Instructions
Research gap or need	- Copy-paste direct input on gaps/needs from literature. - Describe derived input on gaps/needs in as much detail as possible. - Ideally one gap/need per table row.
Reason	- Describe in as much detail as possible the reason behind defining this as a research gap or need: why do we need more knowledge about this particular issue?
Source/reference	- ADVERTS D1.1a or D1.1b - If a gap is directly defined as such in other scientific articles and reports, add this reference - Describe other gap sources in as much detail as possible (e.g. CEDR interview, with source affiliation).

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Possible research method(s)	- Copy-paste direct input on methods to overcome the gap/need from literature.
	- Add info on applicable methods (e.g. research questions, study designs and protocols, data sources, technologies, tools …), based on methodological and statistical expertise, and experience with scientific research.
	- Methods that can be considered include observational studies, quasi-experimental field studies, driving simulator studies, naturalistic driving studies, (in-depth) accident studies, accident data analysis, and so-on

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3. Results

This section provides the results of the inventory of knowledge gaps and needs on (digital) RsA, as derived from the ADVERTS literature review D1.1a (and other dedicated literature) and from the ADVERTS inventory of practices D1.1b, together with proposed research methods to overcome the gaps, as derived from published experience and methodological expertise of the ADVERTS research consortium.

The resulting knowledge gaps can be grouped in **five main categories**:

- Outcome metrics to examine effects of roadside advertisements
- Effects of roadside advertisements on safety indicators
- Criteria for optimal design, placement and operation of roadside advertisements.
- Role of driver characteristics
- Expected market evolutions affecting RsA

These categories are further explained and discussed in the paragraphs below. For each category one or more specific research gaps are listed and a brief motivation is given why the gap is selected.

Finally, full details of all research gaps including references to the source that identified the research gap as well as a brief description of some possible research methods are listed in Table 7 on page 1.

3.1. *Outcome metrics to examine effects of roadside advertisements*

Which outcome metrics are to be used in studies examining possible distraction of roadside advertisements? Necessarily, there has been a focus on gaze duration and behavioural outcomes such as lane keeping, in an attempt to quantify in some way the effects of different types of distracting stimuli. This means that the starting point of the research field is very much focused on the typical outcomes that safety researchers are trying to measure. However, stakeholders who have an interest in roadside advertising from a commercial perspective appear to require a different outcome; crudely, at the behavioural level they want people to look at the advertisements as much as possible and as long as possible. If one assumes that gaze behaviour is a proxy for safety then it looks like the two sides cannot find compromise; it can then simply be argued that the degree to which an advert is successful in its intended purpose commercially is equivalent and opposite to its impact on road safety through distraction. There may be, however, another way of thinking about what is desired by the 'two sides' here. What advertisers actually want as an end result may be brand awareness; it is possible that gaze duration is not the best proxy for this, and that by focusing on this metric the field is missing the opportunity to find ways of advertising that promote greater brand awareness without requiring longer gaze duration. Thus, researchers should begin to use different metrics in their studies, to help us understand the interaction between gaze duration metrics, and metrics which might represent more accurately the desired outcomes of advertisers.

Table 2: Research gap 'outcome metrics'

Research gap/need	Reason
Which metrics to be used in studies examining distraction	What advertisers actually want as an end result may be brand awareness; it is possible that the typically used 'gaze duration' is not the best proxy for this, and that by focusing on this metric the field is missing the opportunity to find ways of advertising that promote greater brand awareness without requiring longer gaze duration.

3.2. Effects of roadside advertisements on safety indicators

Road authorities want to know whether roadside advertisements have some unwanted effects on road safety or not. Safety can be assessed by looking at effects on the number of accidents but also by assessing effects on outcomes such as driver performance, gaze duration, lane keeping or following distances. Identified research gaps related to safety effects of roadside advertisements are listed in Table 3 below.

Table 3: Research gap 'effects on safety indicators'

Research gap/need	Reason
Effect of non-digital, static digital and video billboards on crash rate	Results are inconclusive and most study designs are weak, with many confounding factors present that can provide alternative explanations for accident occurrence.
Impact of luminance and glare on driver's performance.	Only one study was found about glare caused by LED-billboards. More studies are required, especially studies with older drivers.
Distracting vs. stimulating effects of roadside advertisements.	In certain conditions, e.g. on long, monotonous roads which do not exert a lot of cognitive demands on the driver, roadside advertisement may shortly stimulate a fatigued driver?
The effects of advertisements on road users who do not drive (e.g. bicyclists and pedestrians)	All identified studies are about drivers. Contemporary issues in (mainly urban) road safety often involve bicyclists and pedestrians too.

3.3. Criteria for optimal design, placement and operation of roadside advertisements

This category contains all the selected research gaps related to specific design and placement aspects of roadside advertisements that might affect drivers' responses in various ways. Details are provided in
Table **4**. This is the largest category in terms of the number of selected research gaps. The research gaps are relatively heterogeneous, but have in common that they all address

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operational considerations for road authorities when setting up a regulatory framework for roadside advertisements.

Table 4: Research gap 'criteria for design and operation'

Research gap/need	Reason
Optimal length of the transition time and best method of transition.	No studies were found about the effects on distraction of the way one advertisement replaces another on digital billboards (e.g. fade, zoom, fly-in…). Some legislation requires rapid transitions and others require slow transitions. Insufficient evidence is available to underpin legislation.
Use of different levels of motion in advertisements.	Some literature exists showing that video billboards attract more attention, but it is not clear whether the degree of motion has an impact.
Effects of lengths of exposure time of advertisements on digital billboards.	Static digital billboards attract most attention when an advertisement switches. The less drivers notice a switch of advertisements when they pass a digital billboard the better. This implies long exposure durations of advertisement billboards but wat is the minimum duration in order to be safe?
Effects of different shapes, sizes and compositions (e.g. information presentation – numbers, spacing, letter type, etc. – and quantity of information) of advertisements.	Only a few studies had size as an independent variable and only one study was found about the composition of advertisements.
Optimal lateral position of the billboard.	Billboards that are located straight ahead are more often looked at than billboards that require drivers to take their eyes of the road or even require drivers to turn their head in order to 'read' the advertisement. However, although drivers do not look very often at billboard that require effort to 'read', eyes are longer of the road when they do. What is the optimum angle taking into account the percentage of drivers that gaze at a billboard and the time the eyes are of the road?
Effects of advertisements that look like official road signs.	For obvious reasons, most authorities have banned advertisements that look like official road signs. However, no studies were found about the effects of such misleading advertisements.
Effects of visual clutter on road sign conspicuity.	When there are a lot of signs and advertisements to read, drivers can get confused and miss important road signs. No studies were found about the effects of visual clutter in particular.
Effects on driving behaviour of texts that potentially elicit dangerous actions (e.g. 'dial	No studies were found about the effects of text that elicit dangerous actions by the driver.

Research gap/need	Reason
now and win ….').	
Relative importance of the various criteria for regulating roadside advertisements.	Plenty of criteria are used by many road authorities to regulate roadside advertisement. Still many different approaches exist across jurisdictions and knowledge is lacking about the relative importance of the different possible criteria (e.g. longitudinal placement, lateral distance, vertical placement, orientation viewing angle, road environment,..). For example: if criterion A is not met, can B, C, or D then be an alternative or not? Road authorities want to know which roadside criteria to be most strict/severe on.
Potential hacking of billboards.	With the growing digitalisation of roadside advertising, hacking is a growing concern. When hacked, adverts may become very distractive in an uncontrolled way. What are the risks and how can these be limited?
Do different sorts of roads need a different treatment, i.e. different regulations or different design/placement criteria?	Impact on different aspects of roadside advertisement in function of high/low traffic flow, road type… is often unclear.
Effects of contents of a message (e.g. emotion-laden message)	Some messages might exert stronger effects than others. Only limited research in this area so far.

3.4. Role of driver characteristics

Drivers differ according to a great number of characteristics that are likely to influence also the way how they can be distracted by advertisements. One can distinguish driver characteristics that differ *between* drivers (such as age, gender and personality characteristics) as well as characteristics that differ *within* drivers such as emotions. This category contains research gaps related to both sorts. Details are provided in Table 5.

Table 5: Research gap 'driver characteristics'

Research gap/need	Reason
Impact of driver type (younger vs. older) and purpose for driving (e.g. work-related or recreational)	Stavrinos et al. (2016) showed that younger drivers seemed to be more prone to being distracted than older, more experienced drivers. However there may be other differences between groups of drivers which could impact on their interaction with billboards, such as their purpose for driving (social versus driving for work). This is especially relevant for those driving for work, since distraction has been identified in a number of studies as a risk

Research gap/need	Reason
	factor for work-related driving (Grayson & Helman, 2011).
Impact of driver state	There is no literature yet focussing on how the potentially impairing effects of distraction interact or combine with existing impairment in drivers, for example from fatigue, drink or drugs. It may be that these groups present a particular challenge for road authorities; if billboards are tested for their distracting effects on alert and compliant drivers, then their effects on those drivers who have less strategic and executive control over their attention could be underestimated.

3.5. Expected market evolutions affecting RsA

The last category of research gaps relates to the market evolutions related to RsA, as elaborated in Table 6.

Table 6: Research gap 'expected market evolutions'

Research gap/need	Reason
Expected market evolutions affecting RsA	For advertisers, roadside advertisements are just one part of a full set of available means of communication. The market demand for RsA might therefore be dependent on structural and temporal factors that affect the size (number of RsA) and the nature of the demand (type of messages, target audience). Moreover technological evolutions in either RsA (e.g. cheaper LED-screen technology) or in 'competing' means of advertisement (e.g. in social media) may structurally affect the advertisement market and thus also influence the market needs for roadside advertisement.

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3.6. Detailed list of knowledge gaps

Table 7 lists all the identified research gaps, including a motivation and provides the main source that identified the research gap. In the last column, research methods are listed that are considered adequate to address the identified gaps. The list of research methods is not exhaustive. For each gap at least one research method is proposed but in nearly all cases alternative approaches are possible too. The selection of an appropriate research method should in general be dependent on the specific research question and is in practice also limited by ethical, organisational or technical constraints but clearly also by available resources. In a typical research process, the research design is to be chosen by the involved researcher based on an adequate definition and operationalisation of the research problem. For many research problems a 'triangulation' approach including various methods is likely to be the most promising way forward.

Table 7: Detailed list of knowledge gaps on roadside advertisement and proposed research methods

Research gap/need	Reason	Source/reference	Possible methods
Which metrics to be used in studies examining distraction	What advertisers actually want as an end result may be brand awareness; it is possible that the typically used 'gaze duration' is not the best proxy for this (gaze duration is not necessarily exactly measuring attention/distraction), and that by focusing on this metric the field is missing the opportunity to find ways of advertising that promote greater brand awareness without requiring longer gaze duration.	• ADVERTS inventory D1.1b	• Driving simulator studies that use multiple outcome measures (gaze behaviour, observed behaviour, brand awareness… • Naturalistic driving studies
Effect of non-digital, static digital and video billboards on crash rate	Results are inconclusive and most study designs are weak, with many confounding factors present that can provide alternative explanations for accident occurrence.	• ADVERTS literature review D1.1a • ADVERTS inventory D1.1b	• Before-and-after accident data analysis with comparison groups (As accidents are rare events, sufficiently long data periods should be considered, e.g. 5 years before and after).
Impact of luminance and glare on driver's performance.	Only one study was found about glare caused by LED-billboards. More studies are required, especially studies with older drivers.	• ADVERTS literature review D1.1a • Zalesinska, M. (2018). • ADVERTS inventory D1.1b	• Field studies (i.e. real-life, on-road) and laboratory studies.(especially with elderly subjects).

Research gap/need	Reason	Source/reference	Possible methods
Distracting vs. stimulating effects of roadside advertisements.	In certain conditions, e.g. on long, monotonous roads which do not exert a lot of cognitive demands on the driver, roadside advertisement may shortly stimulate a fatigued driver?	• ADVERTS inventory D1.1b	• Simulator study with eye tracking. (Effects on driving and visual behaviour of a long monotonous road condition with and without roadside advertisement; fatigued participants).
The effects of advertisements on road users who do not drive (e.g. bicyclists and pedestrians)	All identified studies are about drivers. Road safety problems in urban areas impact cyclists and pedestrians very often.	• ADVERTS literature review D1.1a	• Conflict/behaviour observation studies based on video-analysis.
Optimal length of the transition time and best method of transition.	No studies were found about the effects on distraction of the way one advertisement replaces another on digital billboards (e.g. fade, zoom, fly-in…). Some legislation requires rapid transitions and others require slow transitions. Insufficient evidence is available to underpin legislation.	• ADVERTS literature review D1.1a • OMA (2014). • ADVERTS inventory D1.1b	• Driving simulator study with eye tracking. (Comparison of effects on driving and visual behaviour of different transition times and transition designs).
Use of different levels of motion in advertisements.	Some literature exists showing that video billboards attract more attention, but it is not clear whether the degree of motion has an impact.	• ADVERTS literature review D1.1a • ADVERTS inventory D1.1b	• Driving simulator study with eye tracking. (Comparison of effects on driving and visual behaviour of different levels of motion – note TRL is currently undertaking such a study, which with the permission of the funder will be published in 2018).
Effects of lengths of exposure time of advertisements on digital billboards.	Static digital billboards attract most attention when an advertisement switches. The less drivers notice a switch of advertisements when they pass a digital billboard the better. This	• OMA (2014). • ADVERTS inventory D1.1b.	• Driving simulator study with eye tracking. (Comparison of effects on driving and visual behaviour of

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Research gap/need	Reason	Source/reference	Possible methods
	implies long exposure durations of advertisement billboards but wat is the minimum duration in order to be safe?		different static RsA exposure durations; in function of different road types / speed regimes).
Effects of different shapes, sizes and compositions (e.g. information presentation – numbers, spacing, letter type … – and quantity of information) of advertisements.	Only a few studies had size as an independent variable and only one study was found about the composition of advertisements.	• Marciano, H., & Setter, P. E. (2017). • ADVERTS inventory D1.1b	• Simulator study with eye tracking. (Comparison of effects on driving and visual behaviour of different shapes, sizes and compositions in function of different road types).
Optimal lateral position of the billboard.	Billboards that are located straight ahead are more often looked at than billboards that require drivers to take their eyes of the road or even require drivers to turn their head in order to 'read' the advertisement. However, although drivers do not look very often at billboard that require effort to 'read', eyes are longer of the road when they do. What is the optimum angle taking into account the percentage of drivers that gaze at a billboard and the time the eyes are of the road?	• ADVERTS literature review D1.1a • ADVERTS inventory D1.1b	• Simulator study with eye tracking. (Comparison of effects on driving and visual behaviour of different positions).
Effects of advertisements that look like official road signs.	For obvious reasons, most authorities have banned advertisements that look like official road signs. However, no studies were found about the effects of such misleading advertisements.	• ADVERTS literature review D1.1a • ADVERTS inventory D1.1b	• Simulator study and eye tracking. (Comparison of effects on driving behaviour or errors and visual behaviour of different types of look-alike road signs as compared with control situations; e.g. effects of ad resembling the official STOP sign, or digital green ad close to traffic lights…)

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Research gap/need	Reason	Source/reference	Possible methods
Effects of visual clutter on road sign conspicuity.	When there are a lot of signs and advertisements to read, drivers can get confused and miss important road signs. No studies were found about the effects of visual clutter in particular.	• ADVERTS literature review D1.1a • ADVERTS inventory D1.1b	• Simulator study and eye tracking. (Comparison of effects on driving and visual behaviour of different levels of visual clutter; different age groups).
Effects on driving behaviour of texts that potentially elicit dangerous actions (e.g. 'dial now and win ….').	No studies were found about the effects of text that elicit dangerous actions by the driver.	• ADVERTS literature review D1.1a • ADVERTS inventory D1.1b	• Simulator study with eye tracking. (Comparison of effects on driving and visual behaviour of different types of triggered actions).
Relative importance of the various criteria for regulating roadside advertisements.	Plenty of criteria are used by many road authorities to regulate roadside advertisement. Still many different approaches exist across jurisdictions and knowledge is lacking about the relative importance of the different possible criteria (e.g. longitudinal placement, lateral distance, vertical placement, orientation viewing angle, road environment,..). For example: if criterion A is not met, can B, C, or D then be an alternative or not? Road authorities want to know which roadside criteria to be most strict/severe on.	• ADVERTS inventory D1.1b	• Meta-analysis. (On multiple scientific studies with similar research questions relating to effects of different aspects of roadside advertisement; see ADVERTS D1.1a). • Naturalistic driving study. (Observing drivers' behaviour in real traffic, e.g. by means of instrumented vehicles).
Potential hacking of billboards.	With the growing digitalisation of roadside advertising, hacking is a growing concern. When hacked, adverts may become very distractive in an uncontrolled way. What are the risks and how can these be limited?	• ADVERTS inventory D1.1b	• Expert consultation (advertising and related IT industry).

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Research gap/need	Reason	Source/reference	Possible methods
Do different sorts of roads need a different treatment, i.e. different regulations or different design/placement criteria?	Impact on different aspects of roadside advertisement in function of high/low traffic flow, road type… is often unclear.	• ADVERTS inventory D1.1b	• Simulator studies with eye tracking (e.g. previously mentioned simulator studies, including interaction effects of traffic flow, road (speed) type…)
Effects of contents of a message (e.g. emotion-laden message)	Some messages might exert stronger effects than others. Only limited research in this area so far.	• ADVERTS literature review D1.1a	• Simulator study with eye tracking.
Impact of driver type (younger vs. older) and purpose for driving (e.g. work-related or recreational)	Stavrinos et al. (2016) showed that younger drivers seem to be more prone to distraction than older, more experienced drivers. However there may be other differences between drivers which could impact on their interaction with billboards, such as their purpose for driving (social versus driving for work). This is especially relevant for those driving for work, since distraction has been identified in a number of studies as a risk factor for work-related driving (Grayson & Helman, 2011).	• Stavrinos et al. (2016) • ADVERTS literature review D1.1a • Grayson & Helman, 2011	• Simulator study with eye tracking. • Naturalistic driving study (Observing drivers' behaviour in real traffic, e.g. by means of instrumented vehicles).
Impact of driver state	There is no literature yet focussing on how the potentially impairing effects of distraction interact or combine with existing impairment in drivers, for example from fatigue, drink or drugs. It may be that these groups present a particular challenge for road authorities; if billboards are tested for their distracting effects on alert and compliant drivers, then their effects on those drivers who have less strategic and executive control over their attention could be underestimated.	• ADVERTS inventory D1.1b	• Driving simulator study

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Research gap/need	Reason	Source/reference	Possible methods
Expected market evolutions affecting RsA	For advertisers, roadside advertisements are just one part of a full set of available means of communication. The market demand for RsA might therefore be dependent on structural and temporal factors that affect the size (number of RsA) and the nature of the demand (type of messages, target audience). Moreover technological evolutions in either RsA (e.g. cheaper LED-screen technology) or in 'competing' means of advertisement (e.g. in social media) may structurally affect the advertisement market and thus also influence the market needs for roadside advertisement.		• Stakeholder survey

3.7. Prioritisation of research gaps

The order of the research gaps as presented above does not reflect a prioritization as the selected gaps are of a different nature. Further prioritisation of research topics will be dependent on specific needs of road authorities. These needs are likely to vary across jurisdictions.

Some criteria can be used to prioritise research needs. In general we recommend a focus on those knowledge gaps that:

- are the most likely to be filled by executing proper research
- are not yet addressed or – to the opinion of the commissioning party - not yet sufficiently addressed by the currently available research
- are related to potentially important problems or sources of distraction
- are the most directly relevant to road authorities.

4. Conclusions

Based on the ADVERTS literature review on effects of roadside advertising (RsA) (D1.1a) and the inventory of current practices and future trends (D1.1b), 20 knowledge gaps or research needs have been identified. They are grouped into five categories:

- Outcome metrics to examine effects of roadside advertisements
- Effects of roadside advertisements on safety indicators
- Criteria for optimal design, placement and operation of roadside advertisements.
- Role of driver characteristics
- Expected market evolutions affecting RsA

While some of the gaps are rather general in nature (e.g. effect of different types of advertisement devices on crash rate), most are related to the lack of information on effects of very specific RsA characteristics. Furthermore, most of the identified gaps relate to digital advertisement.

The report remained deliberately short on the possible research methods to address the identified gaps. For each gap at least one research method was proposed, but in nearly all cases alternative approaches are possible. Experimental driving simulator studies including eye-tracking are the primary proposed study method for most 'specific' research gaps. Other research designs such as quasi-experimental before- and after-studies and naturalistic driving studies show also a good potential for some of the research questions.

The selection of an appropriate research method should in general be dependent on the specific research question. In practice the selection is also limited by not only ethical, organisational and technical constraints, but clearly also by available resources.

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