

TRUST Traffic Safety Culture | A Systematic Transition towards Shared
Responsibility for Safe and Sustainable Mobility in the EU

D2.2c | Inventory of current Traffic Safety Culture measures and good practice

TRUST

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Statement on the use of AI

During the preparation of this work, the authors used ChatGPT to support language editing, including checking for grammatical errors, improving clarity, shortening text, and identifying overly long or repetitive sentences or sections that could be shortened or moved to an annex. Chat GPT was also used to change table format and layout, and each cell was checked manually afterwards. This support was used solely for editorial and structural purposes and did not affect the substantive content, analysis, or conclusions of the work.

All AI-generated suggestions and outputs were reviewed and validated by the authors, who take full responsibility for the content of the publication.

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Glossary & abbreviations

Term / abbreviation	Explanation
AB	Advisory Board
CHSC	Center for Health and Safety Culture
DUI	Driving Under the Influence
ELM	Elaboration Likelihood Model
EPPM	Extended Parallel Process Model
ERSC	European Road Safety Charter
EU	European Union
HBM	Health Belief Model
IMB	Information-Motivation-Behaviour Model
ISO	International Organisation for Standardisation
LMIC	Low- and Middle-Income Countries
OSC	Organisational Safety Culture
PCF	Positive Culture Framework
PMT	Protection Motivation Theory
PRISMA	Preferred Reporting Items for Systematic reviews and Meta-Analyses
RSC	Road Safety Culture
SC	Safety Culture
SCT	Social Cognitive Theory
SDG	Sustainability Development Goal
SLT	Social Learning Theory
SMS	Safety Management System
SSCMM	Safe System Cultural Maturity Model
SUMP	Sustainable Urban Mobility Plan
TPB	Theory of Planned Behaviour
TSC	Traffic Safety Culture
TTM	Transtheoretical Model of behaviour change
WP	Work Package

Executive summary

The TRUST project recognises that achieving Vision Zero objectives require more than traditional road safety measures. While traditional road safety measures like infrastructure, enforcement, technology, and legislation remain essential, long-term progress also depends on changing the shared values, beliefs, attitudes and norms that influence road user behaviour. Traffic Safety Culture (TSC) is therefore increasingly recognised as a key component of road safety policy, complementing traditional measures.

Building on the TRUST definition of TSC developed in Deliverable D2.1 – “Traffic Safety Culture encompasses shared values, beliefs, attitudes, norms, and behavioural patterns that shape how traffic safety is understood and enacted within a meaningfully defined group of actors in the transport system. This meaningfully defined group of actors can refer to road users, organisations, authorities, or other actors within the transport system” – this report examines how cultural approaches are currently being applied to improve road safety. It distinguishes between:

- Community-level TSC interventions, targeting private road user groups and broader societal groups.
- Organisational Safety Culture (OSC) interventions, targeting road user groups at work and organisations.¹

The report has three main objectives:

- To create an inventory of evaluated interventions to improve traffic safety that explicitly or implicitly apply a cultural approach.
- To identify good practices from road transport and other safety-critical transport domains and sectors.
- To derive lessons, success factors, barriers, and recommendations that can support the design, implementation, and evaluation of future TSC/OSC interventions.

Given the absence of a universally accepted definition of what constitutes a TSC intervention, the concept was operationalised broadly, building further on the TRUST TSC definition. Interventions were included when they primarily aimed to influence cultural elements such as shared values, beliefs, norms, attitudes, or related shared ways of thinking, in a defined group, rather than focusing exclusively on direct behavioural control through e.g. infrastructure, legislation, or enforcement. Changing intentional behaviour in a sustainable way is more likely when underlying beliefs, social norms etc. (i.e., the TSC-elements) are tackled. The explorative inventory therefore also includes traditional campaign and education measures, which use a broader holistic approach and/or are integrated with other traditional measures.

The complementary methods used were scientific literature reviews (OSC, TSC), professional/grey research literature review (TSC), an expert input request (TSC) and expert interviews.

Findings on Traffic Safety Culture interventions

The explorative inventory was based on the preliminary TSC intervention operationalisation and yielded relatively few interventions that explicitly describe themselves as TSC initiatives or cultural approaches. Most collected interventions focus on changing one or more TSC-elements (attitudes, norms, beliefs, behaviour) without necessarily using the term “culture.” Moreover, due to the broad initial conceptualisation most collected interventions are also traditional education/campaign measures. It can

¹ TRUST refers to both as TSC (community TSC and OSC) but in this deliverable the differentiation between TSC and OSC is used because of the disparity in literature maturity.

be concluded that scientific literature on evaluated interventions to change TSC in private road user groups, at community level is scarce.

Main results of the explorative inventory are:

- Overall, the collected interventions are very heterogenous and highly context-specific, with a considerable variety in settings, objectives, target groups, strategies/methods, evaluations etc. This complicates a valid comparison of interventions and their effects and impedes an easy generalisation of results and findings.
- The collected interventions vary greatly in extent of the situation and problem analysis as starting point for building the intervention. Targets groups are always defined but in very different levels of specificity. Objectives are always defined but also in different levels of specificity and not always or often not clearly related to a pre-measurement in the target group or theoretical model.
- Many of the collected interventions do refer to one or more behavioural/psychological theory or model underlying the intervention strategy and/or for the effect evaluation (outcome variables). Mostly the Theory of Planned Behaviour (TPB) is cited. Little reference is made to specific culture models.
- There is consensus in the studies collected on the use of TSC-elements as outcome variables to assess intervention effectiveness: social norms, attitudes, beliefs, and related and other variables (e.g. self-reported/observed behaviour, awareness, knowledge, intentions, willingness, self-efficacy, risk perception).
- The findings on TSC-elements and theoretical base are related to the literature search strategy, which was oriented towards evaluated interventions aimed at changing TSC-elements (bias).
- As the inventory was aimed at evaluated interventions, all collected interventions were evaluated (bias), but with a large variety in design and robustness. Most include a process and an outcome evaluation, mostly using surveys.
- Most collected interventions have mixed to positive effects. This can be related to a publication bias. Often evaluation design limitations make it difficult to validate and generalise effects and to assess sustainability.
- Finally, only a few of the collected interventions link with other Sustainable Development Goals (SDGs) than the one for road safety (reduce road deaths/injured).

The results of this exploration suggest that TSC(-elements) can be influenced through targeted interventions. Evidence on TSC interventions explicitly mentioning cultural approaches, is nevertheless still rather scarce in scientific literature. This is related to the fact that TSC is a relatively new research field and that there is a current lack of a common (conceptual) understanding in the road safety field. This highlights the importance of the TRUST project.

Dedicated TSC intervention research is more often published in professional research publications. These provide elements for a proposed finetuning of the initial “TSC intervention” concept (Table 1):

Elements for proposed finetuning of the TSC intervention concept
Minimum
• Aim: The main aim is to change in a relatively short time period at least one of the TSC-elements in terms of shared ways of thinking/feeling about traffic safety, i.e. shared values and/or shared norms and/or shared beliefs and/or shared attitudes, that are known to sustainably influence wilful, intentional, deliberate behaviour among members of a meaningfully defined bonded group of actors (target group(s)) in the road transport system. At community level this refers to private road user target groups and broader societal target groups. This differentiates TSC interventions from interventions aimed at direct (forced/imposed) behavioural change like enforcement, law (changes), infrastructure and

Elements for proposed finetuning of the TSC intervention concept	
technology, which may also lead to changes in shared ways of thinking/feeling but rather as an effect after a longer period of time and indirectly. A comprehensive approach combining cultural strategies with other strategies does lead to a greater impact on TSC. • Background: TSC interventions are theory-based (social science/behavioural model) and consider the underlying social and cultural motives and external influences on the target behaviour in the target group(s), based on pre-measurements. • Strategies: TSC interventions focus on the most critical/salient shared ways of thinking/feeling underlying the target behaviour in the target group(s) and use messages that are tailored to the target group(s).	
Recommended	
• Social environment actions: Comprehensive TSC approaches create a social environment (broader than target group culture) to support the target behaviour change, by including strategies/actions for/by stakeholder groups in the different social ecology layers. This also refers to the use of a multi-factorial approach (combination with other strategies) as this takes the complexity of the road transport system and involved interactions into account and improves overall effectivity (reinforcing effect) to change shared ways of thinking/feeling. • Frame behaviours in terms of their social meaning: TSC campaign interventions target at least shared (behavioural/normative/control) beliefs “about the social environment” to make safe behaviour the norm. This would include for example campaigns focusing on drink driving leading to negative “social” consequences (behavioural beliefs), or sober drivers being highly valued “within the community” (normative beliefs), or the control everyone has to keep “loved ones” from driving when they are drunk (control beliefs). These messages aim at changing underlying shared critical or salient beliefs (values, norms, attitudes) which relate to the social environment. This differentiates culture-based campaigns from education- and enforcement-based campaigns, which on the other hand focus on knowledge, skills and (risk) awareness, and on explicit rules and consequences. • Positive framework: TSC interventions use positive framing of shared values/norms/beliefs/attitudes/behaviour, highlighting positive aspects of the group culture that already exist, to motivate a sense of shared responsibility and collective safe behaviour.	

TABLE 1 | Proposed finetuning of the TSC intervention concept

Furthermore, theoretical and methodological guidance on the main steps to build (diagnosis, design, implementation) and evaluate a TSC intervention also mainly derive from professional research-based grey literature. Based on the integrated literature results, common methodological key factors for success for TSC interventions are provided in Table 2.

Group	Key success factors
A. Diagnosis Understand the problem and the (sub)culture	Start with a sound understanding of the problem (risk behaviour and risk group(s)), based on available knowledge, data and research.
	Define the target groups based on that: primary (risk) group(s); group(s) in the social environment which can influence the primary group
	Understand the target group sub-culture(s): theory-based pre-measurement of the (risk) behaviour and underlying social and cultural motives and external influences, using social science/behavioural model(s), to identify <i>shared</i> TSC-elements (values, norms, attitudes, beliefs) that predict engagement in risky or protective behaviours in the target group(s) and/or that provide hypotheses about the interrelations of TSC elements and behaviour

Group	Key success factors
B. Design Objectives, strategies and messages	Definition of specific intervention objectives based on the pre-measurement; focus on the critical/salient shared beliefs (and/or other TSC elements) of the target group influencing behaviour, not on individual TSC-elements
	Strategy(ies) built upon the objectives, also for different stakeholder groups in the social environment; a mix of tailored actions/strategies across the different social-ecology layers
	Relatable/credible/representative messages for the target group(s), focusing on the critical/salient shared beliefs (and/or other TSC elements), ideally those concerning the social environment, to make safe behaviour the norm, with an appropriate approach
	Positive framing of shared values, norms, beliefs, attitudes and behaviour, building upon positive aspects of the group culture that already exist, to motivate a sense of shared responsibility and collective safe behaviour.
C. Implementation & sustainability	Implementation: continuous leadership, management commitment and stakeholder engagement and monitoring/adjusting; systematic approach; sufficient resources/capacity
	Sustainability of the intervention: secure its continuation beyond a one-off action
	Use of a multi-factorial approach (combination with other strategies like enforcement, infrastructure...) takes the complexity of the road transport system into account and reinforces effects
D. Evaluation	Rigorous evaluation including a process evaluation and a pre-post outcome evaluation, preferably with a long-term follow-up and a control/comparison group to isolate effects of the intervention

TABLE 2 | Common success factors for TSC interventions

For each success factor practical assessment criteria are derived.

Findings on Organisational Safety Culture interventions

Compared with community-level TSC interventions, the evidence base for OSC interventions is more mature. Research from road transport, aviation, rail, maritime transport, nuclear energy, and petroleum sectors provides substantial insight into how safety cultures can be strengthened within organisations.

Successful OSC interventions typically share several characteristics related to the process:

- Strong, visible and sustained top management commitment
- Employee engagement and support
- Trustful relationship between managers and employees
- Clear and strong motivation for the intervention
- Regulatory focus and support
- Clear and coherent implementation
- Absence of competing organisational processes
- Quality of design and relevance of the intervention content

Success factors include also strong safety leadership, structured safety management systems, continuous learning and improvement processes, open communication and reporting cultures, integration of safety

into everyday organisational practices, and the use of long-term, systematic approaches rather than isolated short-term campaigns.

Methods to strengthen safety culture through safety management system are:

- Introducing mandatory safety management system requirements in road which formalise procedures and measures that enable organisations to work systematically with safety.
- Implementing the Safety Ladder for road safety management in transport companies, which includes four main categories of measures, structured in ascending levels of priority, targeting work-related risk factors.

Conclusion

In conclusion, the evidence suggests that TSC and OSC can be influenced through targeted interventions. While the scientific literature on OSC interventions is mature, dedicated literature on TSC interventions is scarce. This is a gap in current road safety field practice and thus also in scientific literature, which is related to the still rather new concept and lack of a common understanding. The importance of the TRUST work is thereby highlighted.

The results on TSC provide elements for a proposed finetuning of the concept of a TSC intervention:

A TSC intervention aims at changing in a relatively short time period at least one of the TSC-elements in terms of shared ways of thinking/feeling about traffic safety, i.e. shared values and/or shared norms and/or shared beliefs and/or shared attitudes, that are known to sustainably influence wilful, intentional, deliberate behaviour among members of a meaningfully defined bonded group of actors (target group(s)) in the road transport system. At community level this refers to private road user target groups and broader societal target groups.

Further minimum and recommended conceptual elements are proposed.

With regard to OSC interventions, research from road transport, aviation, rail, maritime transport, nuclear energy, and petroleum sectors provides substantial insight into how safety cultures can be strengthened within organisations.

Key methodological factors for success have been identified for both TSC and OSC interventions. These indicate that elaborate and sustainable efforts are required to increase intervention effectivity, while it is not guaranteed that intended results are achieved.

The report includes an overview of (good) practice examples for changing TSC (elements) and OSC aspects. Besides the collected interventions, also practices described in relevant EU projects (CAST, LEARN, PAIR, ERSC) are included. Some of these practices are judged as 'good' practice by experts without a proper evaluation study; these should be considered as practice examples though.

1. Introduction

1.1. Background

Safe System has become the state-of-the-art approach for road safety management, and it is recommended to countries worldwide. Europe adopted a Vision Zero approach with the aim of zero fatalities on the road by 2050. While traditional road safety measures targeting driver behaviour, technological improvements, and infrastructure have led to significant reductions in traffic crashes (Elvik et al., 2009), there are signs that the trend of decreasing road fatalities is stagnating or reversing in some countries (ETSC, 2025). Approaches are thus needed that go beyond the traditional measures to reach Vision Zero (Nævestad et al., 2019a). A risk factor that is generally not addressed in traditional measures is Traffic Safety Culture. This perspective extends the focus from structural measures to the cultural beliefs, attitudes, values and norms that shape traffic behaviour. Whilst progress can still be expected from improvements in traditional measures, road safety experts believe that a cultural change or a change in the shared ways of thinking and acting that are relevant to traffic safety is needed (Nævestad et al., 2025b).

In the first TRUST Deliverable 2.1, Nævestad et al. (2026) define Traffic Safety Culture (TSC) as follows:

Traffic Safety Culture encompasses shared values, beliefs, attitudes, norms, and patterns of behaviours that shape how traffic safety is understood and enacted within a meaningfully defined group of actors in the transport system. This meaningfully defined group of actors can refer to road users, organisations, authorities, or other actors within the transport system.

The authors indicate that the conceptual elements are relatively similar for the TSC of different actors within the road transport system. For road users at work, on the other hand, different cultural aspects related to organisations are also important, e.g. management commitment to safety, learning culture, just culture, etc.

While the culture concept is increasingly mentioned in road safety strategies, it remains unknown to what extent interventions using a TSC approach are actually being implemented, and which approaches are successful. This knowledge gap also led stakeholders in the USA to formulate a research need statement “*Inventory of Traffic Safety Culture Strategies and Develop Guidance for Strategy Implementation*” as 1 of 20 research needs in their Traffic Safety Culture Research Roadmap (National Academies of Sciences, Engineering, and Medicine, 2024).

1.2. Aims

The aim of TRUST Deliverable 2.2c is to create an inventory of current interventions and good practices applying a cultural approach to improve road safety, and the deduction of success factors, barriers and good practice guidelines for developing and implementing effective interventions and for evaluating them. This includes interventions for private road user groups in society (community level, e.g., national, regional, local) and for road user groups at work (organisational level).

To fulfil this aim, the study has the following main subgoals:

1. **Inventory of interventions explicitly or implicitly following a TSC approach in road safety.** This includes the intersection with measures to increase sustainability. A main distinction is made between private road user groups (community) and road user groups at work who generally are members of organisations. The search aims to collect successful and less successful approaches in order to identify factors for success vs. failure.
2. **Stocktaking of good practices from other transport domains and different sectors.** Interventions and good practices in the aviation, rail, and maritime domains for implementing

TSC approaches at organisational level will be collected. Good practices on safety culture interventions from a regulatory perspective in three promising pioneering sectors (nuclear, petroleum, rail) will be included.

3. The overarching aim of the inventories of interventions and good practices is the **identification of key elements and** indications of **factors for success**. This will provide guidance on designing, implementing and evaluating interventions that are effective and sustainable.

The outcomes of this report will serve the TRUST pilot studies and evaluations and will be included in the TRUST guidance documents.

2. Methodology

General statements on the open science principles and transparency considerations in this study can be found in Annex 1.

2.1. Preliminary TSC intervention operationalisation

The lack of a common conceptual understanding of the TSC concept and in extent of the concept of a TSC intervention among current traffic safety practitioners in the broad sense, together with the fact that relevant interventions may not be labelled as such, complicates the elaboration of an inventory of TSC interventions.

Linking to the TSC definition determined in TRUST Deliverable 2.1 (Nævestad et al., 2026), the proposed operationalisation of a “TSC intervention” or a “traffic safety intervention with a cultural approach” in this explorative inventory is to focus on interventions (strategies) primarily aimed at changing culture in terms of shared ways of thinking: shared values, norms, beliefs, attitudes in a meaningfully defined group of actors in the transport system. These TSC-elements are known to influence deliberate behaviour affecting traffic safety (e.g. Theory of Planned Behaviour (TPB) (Ajzen, 1991), Social Cognitive Theory (SCT) (Bandura, 1986)).

This is a first broad operationalisation for this TRUST task which will be evaluated based on the findings throughout the task (literature reviews, expert input, interviews).

Traditional road safety education and awareness raising strategies can be efficient ways to reach people and influence group culture. These can be single strategies towards a specific primary target group, but as those are rare, we primarily aim at collecting integrated (holistic) approaches (e.g. mixed strategies, targeting different groups in the social environment with specific strategies and tools). Multi-factorial and target group approaches can improve the overall effectivity to change shared ways of thinking, as these take the complexity of the road transport system and involved interactions into account (Delhomme et al., 2009; Austin et al., 2021).

The focus is not on interventions aimed at direct or forced (e.g. legal, physical) behavioural change, unless in combination with the above. Infrastructure for instance prohibits certain risk behaviours but does not directly lead to a sustainable change in intentional behaviour at locations without infrastructure. Of course, the ultimate aim of TSC interventions is to change not only shared ways of thinking but also shared patterns of behaviour in order to decrease the number of road crashes. There is a relationship between how you think and feel or experience (values, norms, attitudes, beliefs) and behaviour. A way to change intentional behaviour in a sustainable way is by orienting underlying beliefs towards more safety. When beliefs change, people’s chosen behaviours are also likely to change (e.g. Austin et al., 2021). It is acknowledged that traditional measures that impose direct behavioural change like enforcement, law (changes), infrastructure and technology, are effective and crucial for road safety (Elvik et al., 2009; meta-analyses on different measures in the Decision Support System of EU project [SafetyCube](#), e.g. Botteghi et al. (2017); Noella (2017); Svensson (2017). Such measures can also lead to changes in shared ways of thinking about road safety in society, but this is rather indirect and in the long term.

Finally, the inventory focuses on delineated interventions aimed at direct changes in TSC for which sufficient methodological information is available and which are evaluated, to have an objective indication of effects and success factors. These can be part of a broad-scale long-term Safe System Approach, like Vision Zero, which refer to formal aspects of road safety management (e.g., policy, legislation), but the inventory is not on the implementation of these overarching concepts.

Table 3 shows a summary of the criteria used to select TSC interventions in the inventory.

The interventions: • should target traffic safety culture/climate explicitly and/or shared values, beliefs, attitudes, norms, and patterns of behaviours that shape how traffic safety is understood and enacted, within a clearly defined target group • should be in the context of road traffic safety • preferably have been evaluated using a robust design • preferably take a holistic approach (addressing multiple levels and/or dimensions) • can include educational, awareness-raising, or campaign measures, ideally combined with other measures (e.g., a national speeding campaign combined with increased enforcement) • should exclude separate enforcement, legislation, infrastructure, engineering measures for the general population unless they are combined with targeted educational, awareness-raising, or campaign measures.

TABLE 3 | Summary of criteria to select TSC interventions in the inventory

2.2. Search strategies for TSC interventions - community level

An explorative inventory of interventions following the first broad TSC operationalisation (as defined in section 2.1) in road safety was carried out in different steps, including two scientific literature reviews, an input request to TRUST experts and the consultation of grey literature. These steps are described in more detail below. The focus was on interventions that are sufficiently methodologically described (development, implementation and evaluation) to allow extraction of relevant factors.

Annex 4, sections (1) and (2) provide overviews of the considered interventions in the inventory (N=24).

2.2.1. Inventory: scientific literature

The detailed search strategies can be found in Annex 2.

At first, the peer reviewed scientific literature that was collected in scope of the literature search for defining TSC in the first TRUST Deliverable 2.1 (Nævestad et al., 2026) (654 articles for title and keyword check; 136 abstract checks) was searched for explicitly discussed interventions related to road transport and referring to the aim to change culture. Based on this, 5 interventions aimed at changing traffic safety culture were found and added in the inventory.

Next, scientific review papers were searched to find interventions aiming at changing TSC in an implicit way, thus not necessarily referring to culture, which was operationalised as: interventions in the road transport domain primarily aimed at changing shared ways of thinking, i.e. values, beliefs, attitudes, norms and related elements. Although the selected review articles (8) were not included as such in the inventory, they provide ground for discussion of good and bad practices. Through snowballing, 6 examples of interventions discussed in these review articles were integrated in the inventory.

2.2.2. Inventory: expert consultation input and grey literature

All TRUST partners (N=49, from 17 organisations) and Advisory Board (AB) members (N=14) were consulted to gather interventions not documented in peer-reviewed scientific literature and to get grey literature references (professional publications/books, self-published reports). A request was mailed in March 2026, asking to provide key information from 3 to 5 existing TSC interventions and/or to provide relevant grey documentation. The interventions had to fall within the scope of the TRUST TSC definition, relate to road safety, and preferably have been evaluated using a robust design (see Annex 3: expert request outline). This led to 13 additional examples of interventions for which sufficient methodological information was available. More interventions were provided by the experts, but if no methodological information on development nor on evaluation was added, these were not included in the final inventory.

2.2.3. Methodological recommendation from professional grey literature

Finally, professional grey literature was consulted, both for finding additional interventions and good practices and to gather input on recommendations for developing, implementing and evaluating TSC interventions. These generally referred to projects/initiatives within TRUST and newly provided references during the expert consultation (e.g. reports from the Centre for Health and Safety Culture (USA); EU projects: CAST, LEARN, PRAISE, SafetyCube).

2.3. Search strategies for OSC interventions - organisational level

In order to collect OSC interventions within the road transport domain, a combined search strategy was used, in addition to the one done above: first the scientific literature collected in the literature search for defining OSC in the first TRUST Deliverable 2.1 (Nævestad et al., 2026) was searched, focusing on road transport (693 articles for title and keyword check; 320 abstract checks). This search revealed two systematic reviews on organisational safety culture interventions with a focus on road (road users at work in traffic) (Nævestad et al., 2018b; Austin et al., 2022).

All interventions analysed in Nævestad et al. (2018) were included in this inventory. A similar literature search was performed to update this review, but this led to no extra interventions. The recent review from Austin et al. (2022) also reported a lack of peer-reviewed journal articles focused on *"the implementation and evaluation of traffic safety culture change initiatives"* (Austin et al., 2022, p. 4). They broadened their search to grasp learnings from other disciplines and organisations.

This inventory includes 10 studies on OSC road transport interventions (all analysed in Nævestad et al., 2018). See Annex 4 section (3) for an overview of the articles.

Input on good practices for implementing TSC approaches in organisational contexts from other transport domains (sea, air and rail) was derived from the systematic scientific literature review from Nævestad et al. (2018). In this deliverable, we rely only on this study, as Nævestad et al. (2018) analyse OSC interventions from road, rail, air and sea to identify four main elements that are crucial in all the interventions and eight influencing factors. Thus, this review provides general lessons about OSC interventions and good practices that are applicable across sectors. Additionally, more recent reviews have shown that few intervention studies have been added since then. This inventory includes key methodological information on OSC interventions in these domains based on 10 studies. See Annex 4 section (4) for an overview. Additional examples of good practices in the air, rail and sea transport domains were provided by TRUST experts (Deep Blue) based on a mixed-source approach integrating findings from peer-reviewed academic research on interventions to support safety climate, grey literature (e.g. ERA safety climate survey, official data from regulatory bodies), and established industry good practices (e.g. use of safety management system). These are included in Annex 5. Finally, input on safety culture interventions from a regulatory perspective in 3 promising pioneering sectors – nuclear industry, petroleum and rail – was derived from Nævestad et al. (2018, 2019b, 2021b). See Annex 4 section (5) for an overview of the articles.

2.4. Expert interviews

Several complementary interviews were conducted on the basis of identified information gaps in the inventory. Input was provided in oral and written form.

1. Group interviews with international road safety experts, including national partners in the European Road Safety Charter were conducted as well as complementary plenary discussions and informal interviews during the following meetings:
 - 41st meeting of the International Road Traffic Safety Data and Analysis Group (**IRTAD**) on 15 April 2026 in Athens, Greece

- **FERSI** (Forum of European Road Safety Research Institutes) General Meeting on 21-22 April 2026 in Sofia, Bulgaria

The group interviews and subsequent discussions were based on the proposed TSC intervention operationalisation (see section 2.1) and the difficulty in finding scientific literature on evaluated road safety interventions for private road users (community level) which use a cultural approach beyond traditional awareness raising campaigns and educational measures. Preliminary findings were presented and audience was confronted with questions on their level of clarity and agreement. The subsequent discussions mainly concerned the TSC intervention concept. The sessions lasted between 30 and 60 minutes.

2. **Nicholas Ward**, Director of Safe System Culture, LTD (former Director of the CHSC), and member of the TRUST Advisory Board, was interviewed on his conceptualisation of a TSC intervention, based on theory and long-term expertise in the field.
4. **Hanna Wennberg**, researcher at Lund University and consultant at Trivector Mobility (former strategist in traffic safety at the Swedish Transport Administration) and part of the TRUST team, was asked to provide examples of experiences in Sweden concerning "Traffic Safety Culture" among societal actors. This was to fill the gap in the inventory as it lacks input on this specific target group. Such experiences are generally not documented in scientific publications, but in internal or national reports.

With the OSC intervention concept and related scientific literature being more mature and agreed upon, no further interviews were planned on this part besides the one with Hanna Wennberg.

3. Results on TSC interventions

In the following, we present a summary of the collected TSC interventions from scientific/professional grey literature and expert inputs, as well as derived recommendations from literature for developing, implementing and evaluating such interventions.

A detailed overview of the method and results of the TSC interventions collected in the inventory (N=24) and a summary of the results and the recommendations from the scientific review papers can be found in Annex 4.

Annex 5 sections (1) and (2) include additional (good) practice examples of interventions within EU projects on traffic safety LEARN (education) and ERSC (European Road Safety Charter). "Good practice" examples refer to practices that are considered effective based on a proper evaluation study, while "practice" examples refer to practices that have not been evaluated properly (e.g. only based on expert judgement).

3.1. Overview of main results & key elements

1.3.1. Scientific literature and expert input: explorative inventory

As indicated before, examples of TSC interventions as operationalised in section 2.1 were only included in the inventory if sufficient methodological information on development and evaluation was available.

Table 4 gives an overview of the collected interventions (N=24) in the inventory. More details on these interventions can be found in Annex 4.

Collected TSC interventions in the inventory
Interventions with a broader, integrated and/or comprehensive approach (holistic, mix of interventions/methods, different target groups/stakeholders) - Center for Health & Safety Culture (2019), USA: Together for Life - Increasing seat belt use in rural Utah. - Milch & Nævestad (2024), Norway: Heart Zone as a measure to influence Traffic safety Culture - Milch et al. (2024), Norway: Knowledge based on the effects of Heart Zone. - Mirman et al. (2018), USA: School safe driving climate: promoting teen driver safety in school settings.
School - Student focused interventions - Adeola et al. (2016), USA, Puerto Rico, Canada & 21 other countries: Get the message: a teen distracted driving program. - Cuenen et al. (2016), Belgium: Road safety education program based on victim testimonials in high schools. - Kennedy et al. (2018), Australia: Peer passenger intentions to speak up to a risky driver: a high school road safety education program. - Lewis et al. (2021), Australia: Slow down! Get off that phone! A high school road safety education program. - Riaz et al. (2019), Belgium: Road safety education program based on driving under influence and traffic risks for higher secondary school students. - Internal report Università Cattolica del Sacro Cuore (2018), Italy: Viaggio nel Senso della Strada - Unni et al. (2017), USA: Hospital-school program to promote teen motor vehicle safety. - Finley et al. (2024a), USA: Resources and Tools to Reduce Multiple Risky Driving Behaviors. - Internal report KFV, Austria (intervention 2018-2019) - School class workshop "speeding: risk?"
General public campaigns - Bundesministerium für Innovation, Mobilität und Infrastruktur (Hrsg.) (2025), Austria: Kampagne „Voll am Leben“ Bd. 99." - De Dobbeleer et al. (2009), Belgium: Pan-European road safety campaign. - Vilwoc-Witte et al. (2023), USA: Improving Traffic Safety Culture Using a Novel Dissemination Method.
Employee focused interventions (excl. road transport sector)

Collected TSC interventions in the inventory
- Forward et al. (2020), Sweden: Persuade habitual cyclists to use helmets – bicycle helmet campaign. - Otto et al. (2022), USA: Increasing Readiness to Grow Traffic Safety Culture and Adopt the Safe System Approach: A Story of the Washington Traffic Safety Commission. - Kazemi et al. (2009), Sweden: Swedish bicycle helmet wearing campaign 2008.
Other target group interventions
- Taubman et al. (2014), Israel: The contribution of parents' driving behavior, family climate for road safety, and parent-targeted intervention to young male driving behavior. - Internal report KfV, Austria (intervention 2021–2022): Workshop "Mindful. Safe. Mobile. Driving a car." for elderly drivers.
Interventions in non-Western countries
- Perego et al. (2018), Tanzania: Psychology intervention on the perception of road hazards in a Tanzanian secondary school. - Forward (2025), Zambia: Increasing traffic safety at schools in Zambia. - Biassoni et al. (2019), Madagascar: Road safety education intervention (ALFA Project) by assessing road crossing behaviour in students.

TABLE 4 | Collected TSC interventions from scientific and professional literature in the inventory (N=24)

Only a few of the interventions collected explicitly refer to the use of a '**cultural approach**' or have the aim of cultural change (e.g. The Center for Health and Safety (CHSC), 2019; Milch & Nævestad, 2024). The CHSC (2019) intervention in the US aims at changing shared beliefs that already exist in a community's culture to be more supportive for seat belt wearing. This is done through various actions addressing different stakeholder layers in the social environment which all together influence individual behaviour, i.e. actions towards (1) individuals to reinforce 'asking others to buckle up', (2) families: focus on family rules, (3) schools: education/promotion, (4) workplaces: workplace policies, (5) law enforcement: seat belt use enforcement and (6) key leaders: advocating). In Milch & Nævestad (2024) the aim is to make the geographical environment around schools safer, for which a set of different possible strategies (e.g. education, campaign, infrastructure) targeting different groups can be used, depending on the local situation (Norway). Both use an integrated approach combining different strategies and/or tools towards different target groups. They combine broad collaboration efforts for the implementation with a wide range of stakeholders/partners. In-depth analysis of the problem situations and primary target groups fed the design of the final interventions. CHSC (2019) provides a detailed overview of the stepwise methodological approach used to develop and implement their strategy. We also refer here to Mirman et al. (2018) which is a school-based mixed-method peer-led traffic safety program in the USA, aimed at promoting a school safe driving climate. This program covers different awareness raising and educational activities for high school students. For the implementation, the peer-leading students organising the actions were encouraged to collaborate with different stakeholders (school administration, but also external stakeholders e.g. police).

Because the initial search did not yield many results on the implementation and evaluation of TSC interventions, an additional search was done to review papers using broader terminology to find interventions implicitly aimed at changing one or more of the **TSC-elements** (shared values, beliefs, norms, attitudes and related concepts) and thus not explicitly referring to "culture". Together with the grey (professional) literature inputs from experts, this yielded a larger set of interventions. Many of these fall within the scope of the traditional "E" (education) domain of road safety interventions: mostly public awareness raising campaigns (some integrated with other strategies and/or addressing different target groups, thus aligning with the above indicated cultural approaches). Next to that, mainly educational programmes/interventions targeting students in school settings were collected. Some studies target employees (not professional drivers in the transport sector, cf. section 4) with education or campaigns; one is a change process to grow TSC and adopt the Safe System Approach with road safety professionals. One study includes technology and training, focusing on family climate. The expert input furthermore

included three interventions in non-Western countries (education for students, a campaign, and an intervention around schools focusing on infrastructure).

Overall, the interventions collected are very heterogeneous and highly context-specific, with a considerable variety in settings, objectives, target groups, strategies/methods, evaluations etc. This heterogeneity complicates a valid comparison of interventions and their effects, which impedes an easy generalisation of results and findings.

The interventions' **objectives** are multifaceted: from general road safety objectives to specific (risk) behaviour objectives, including objectives of influencing traffic safety culture. Specific TSC-element formulations in the objectives are changes of shared beliefs, social/subjective norms, attitudes, perceived behavioural control, behavioural patterns, intentions, anticipated regret; increase of risk awareness, knowledge, personal/social responsibility, attention in traffic situations, etc. These concern a mix of road safety topics and specific (risk) behaviours like seatbelt use, speeding, distraction, helmet wearing. They also refer to the content/**topics** of the interventions.

Intervention **methods** include integrated approaches combining intervention types (e.g. campaign supported by education and/or enforcement and/or infrastructure) and the use of mixed methods and tools for awareness raising/education (e.g. variety of mass media tools, demonstrations, contracts/discounts (for helmets), trainings/workshops with presentations/videos, interactive workshops/sessions, group discussions, quizzes, role-playing, drive tracking/feedback, enacted crash scenes, hospital tour, survivor/victim testimony). Especially these latter ones aim at triggering emotional engagement. Some school-based campaign interventions are peer-led and empower students to influence their peers.

The **settings** and **target groups** also differ considerably. In all studies at least a primary (risk) target group is specified, with varying levels of detail in its specification and background information (problem situation/analysis). Several studies mention an in-depth analysis or a pre-assessment of the target group(s) as input for designing the intervention (e.g. Finley et al., 2024a; De Dobbeleer et al., 2009; Forward et al., 2020). Secondary target groups are also indicated, especially in larger campaign interventions. The approach in the community campaign in the USA to increase seatbelt use (CHSC, 2019) extends their initial target group with different (communication) tools and messages for different stakeholders in the social system around individuals. This is done to reinforce supportive actions at the different levels which altogether lead to individual change. Many of the intervention examples are school based (education/awareness raising) with a primary focus on teenagers (e.g. "RACQ Docudrama", Traffic Weeks, "Be in the Zone"), followed by national/community campaigns (targeting primarily young male drivers). Some interventions take place in an organisational/professional setting (changing culture at road safety authority level; increase the use of bicycle helmets in employees at their workplace). Very specific sub-populations can also be targeted, e.g. elderly drivers.

The **scope** varies from single interventions towards one risk target group to integrated approaches combining strategies towards different target groups. The latter approaches more often depend on collaboration of more **stakeholders**/partners. Milch & Nævestad (2024) for instance describe the use of a multisectoral safe school environment scheme developed through collaboration of municipalities, school management, road owners, the Norwegian road safety council, with the main actors for implementation and monitoring being the municipality and school.

The available **background** or information base for developing the interventions varies from a general problem referral to an extended situation/problem analysis based on different sources (literature, crash data, observation, survey), and/or the inclusion of a theoretical model for a better understanding of risk behaviours, based on which the main target group(s) and topics are determined. Sometimes this is followed by a baseline assessment (e.g. existing beliefs) in the target groups, which allows specifying detailed objectives.

Many of the collected interventions refer to one or more behavioural and psychological **theory or model** underlying the intervention strategy and/or the effect evaluation (outcome variables). Mostly the Theory of Planned Behaviour (TPB), used to address attitudes, subjective norms, and perceived behavioural control, is cited. The Transtheoretical Model (TTM) is also mentioned several times; it is used to assess readiness for change (e.g. helmet use; workshop for elderly drivers). Other models cited are Health Belief Model (HBM), Social Cognitive Theory (SCT), Extended Parallel Process Model (EPPM), Information-Motivation-Behaviour (IMB) Model and Protection Motivation Theory (PMT). Little reference is made to specific culture models. One exception is Milch & Nævestad's study (2024) of a school community-based intervention, which refers to Schein's (2004) principles of organisational culture.

There is a clear link with the **Sustainable Development Goals** (SDGs) because the primary goal of each of the collected interventions is 'traffic safety', i.e. SDG3 (Good Health and Well-being) and SDG 3.6 (reduce road deaths and injuries). In addition, some other SDGs are implicitly referred to in the objectives: several also have a strong focus on sustainability (SDG 11: sustainable cities & communities: 11.2: safe and accessible transport systems) and some interventions advocating increased walking/cycling are also beneficial to environmental and public health (SDG 13: Climate action, and SDG 15: Life on land).

The **evaluation designs** range from simple to complex. As the search was aimed at interventions that have been evaluated, all interventions collected were evaluated to a certain extent (literature search bias). Most include a process evaluation and an outcome evaluation, mostly done using surveys. Design robustness varies, e.g. only a post-intervention measurement, a pre-post measurement collected together after the intervention or a real pre-post design, either with or without a control/comparison group. Evaluations of long-term effects were rarely included. None used the golden standard "pre-post-post with control group" design. Pre-post measurement is the most used design to measure effects, in terms of changes in e.g. attitudes, beliefs, knowledge, intentions, but often no control of comparison group is used, and sample sizes are generally small (lacking power to find significant results). Qualitative methods like interviews and focus groups are often used for process evaluation (e.g. feedback, appreciation, reach) and to identify barriers and facilitators for implementation. In a few studies objective data were used, such as counting seat belt use or observing texting-while-driving rates (behaviour observations). Although many studies lack a control group, some use quasi-experimental or randomised controlled trials to increase rigor. Some studies moreover use inferential analyses (e.g. regression) to get deeper insights.

There is a broad consensus in the studies collected on the use of TSC-elements as **outcome variables** to assess intervention effectiveness: social norms, attitudes, beliefs, together with related and other variables (e.g. self-reported/observed behaviour, awareness, knowledge, intentions, willingness, self-efficacy, anticipated regret, risk perception, change readiness). This is of course related to the literature search strategy (bias). These interventions mostly have a theoretical base, with specifically defined critical variables and relationships between them. The high consistency in outcome indicators across the designs and studies is related to this.

The **effects** across the studies are generally mixed but promising related to the objectives. Only a few indicate limited effects (e.g. general public campaign on fatigue: repetition needed to strengthen the effect). This may be related to a publication bias. Knowledge of safety rules and risk awareness generally increase successfully. With regard to attitudes and intentions, positive changes are frequently reported immediately after the intervention (e.g. higher willingness to "speak up" to risky drivers). Reported effects on actual behaviour are often smaller or not significant. However, some interventions (like "Heart Zone" and "Be in the Zone") showed measurable reductions in risky behaviours. Often evaluation design limitations make it difficult to validate and generalise effects and to assess sustainability. A critical finding is that positive effects often fade over time (e.g., after 3 months), highlighting the need for 'boosters' (repeated sessions/messages).

As some collected interventions are traffic safety campaigns, reference can also be made to results of meta-analyses indicating that these strategies can be effective. Phillips et al. (2011) collected 437 individual campaign effects and associated variables from 228 campaign evaluation studies (14 countries). After accounting for publication bias, positive weighted average effects were found for different outcome variables (e.g. 9% decrease in crash levels, 25% increase in seatbelt use, 16% reduction in speeding). Kaiser & Aigner-Breuss (2017) did a meta-analysis on road safety campaigns and concluded that there is *"some indication that campaigns are beneficial for road safety on various levels. Meta-analyses show an association with crash reduction, increased safe behaviours and risk awareness. However, for other outcome variables such as drink-driving or safety relevant attitudes, no such effect was found. Furthermore, meta-analysed studies vary strongly, mainly regarding the design of the evaluated campaigns."* (p. 1). Within the EU [SafetyCube](#) project meta-analyses of campaigns addressing specific risk behaviours (seatbelt, aggressive behaviour, drink driving, speeding) were also done. Overall, these conclude with a careful (indicative) positive effect on road safety (Aigner-Breuss & Eichhorn, 2017; Aigner-Breuss & Pilgerstorfer, 2017; Eichhorn & Kaiser, 2017; Pilgerstorfer & Eichhorn, 2017; Eichhorn & Kaiser, 2017).

Key Learnings and Success Factors. The collected interventions and evaluations are heterogeneous, which complicates comparison. Several success factors are mentioned. Some are very context specific, while other factors refer to common good practice methodological approaches, e.g.

- At the level of the main organiser (e.g. school, company), leadership, management commitment, stakeholder engagement, the use of a systematic approach, and sufficient resources/capacity are essential for effective implementation.
- Campaigns in a clearly defined area (e.g. company, school, i.e. more homogeneous groups) are easier to run than in a broad environment (e.g. national general public, shopping centre).
- Use of literature, surveys, crash data and other data can correct misperceptions on the problem behaviour and/or risk groups in key stakeholder groups.
- The intervention should be based on a sound understanding of the problem and target group.
- Use of a clear and concise communication, with credible messages for the target group.
- Use of a positive framing (relatable, connecting, empowering).
- Moderate emotional arousal is often more engaging and sustainable compared to "fear/shock appeals" which may lead to defensive reactions and disengagement.
- Social ecology can be used as a strategic way to organise the work, with the need for different strategies/tools for stakeholder groups in the different layers of the social environment.
- Use of booster messages after the intervention and repeated interventions to capitalise the direct effects, for sustainability.
- Use of safety cues in campaigns e.g. free helmets because availability increases probability to use.
- Use of participatory/interactive and practical approaches in education stimulating self-reflection are rated higher and show better engagement than passive approaches.
- Use of engaging peer-involved or peer-led approaches
- Engaging normative beliefs (supportive social norms)

One recent **systematic review** aimed at finding examples of evaluated TSC strategies was found (Austin et al., 2022). Their search of peer reviewed papers on the implementation and evaluation of TSC change initiatives (incl. in organisations) only yielded three studies. Therefore, they expanded their search to other than traffic/transportation domains (e.g. healthcare). Their review indicated that very limited peer-reviewed papers on TSC intervention evaluations have been published so far. Further common findings which are similar to ours are: attitudes, beliefs, values and behaviours are the most common indicators as part of cultural theories – the focus is rather on these culture elements than on outcome variables that culture is intended to impact (e.g. risky behaviour and crashes). There is widespread evidence that culture change interventions can be effective, regardless of the specific cultural theory used to inform

the intervention. Studies that did not specify an explicit model of culture had the fewest positive or mixed results – which suggests the possibility that a lack of a clear cultural theory may result in a lack of a clear causal model, either to establish a culture change intervention or to establish a model for how culture impacts the performance outcomes. Due to the diversity of evaluation designs including the indicators of independent and dependent variables, it is very difficult to generalise results. They conclude that while there is a solid consensus that culture programmes can work, the field still needs more conceptual and empirical research for a better understanding of culture, its functions and how it can effectively be changed.

1.3.2. Professional (grey) literature: good practice methodological recommendations

Dedicated guidelines for planning TSC interventions can be derived from professional research publications (reports, books, manuals) from CHSC (2024), Ward et al. (2019 a, b), Austin et al. (2021). In addition, evidence-based methodological guidelines from the EU CAST project (Campaigns and Awareness-Raising Strategies in Traffic Safety) (Delhomme et al., 2009; Boulanger, 2009; Boulanger & Meng, 2009; Forward & Kazemi, 2009) are referred to as a good base for developing, implementing and evaluating TSC interventions. Many of the collected interventions are campaigns and there is a scientific consensus that theoretically informed campaigns can lead to changes in community expectations, values, beliefs etc. which contribute to social and behavioural change (Lewis et al., 2019 a, b; Phillips et al., 2009; EU [SafetyCube](#) meta-analyses (2017)).

Relevant publications dedicated to planning (traffic safety) culture strategies, including methodological guidance reports for traffic safety professionals are: e.g. “Ten principles for Traffic Safety Culture” (Ward et al., 2019a), “A primer for traffic safety practitioners” (Ward et al., 2019b), guidance on using the “Positive Culture Framework” for improving health and safety (CHSH, 2024), and guidance for “Evaluating TSC strategies” (Austin et al., 2021).

Ward et al. (2019a, p. 21-22) determine 10 interrelated principles that provide the basic logic and purpose for developing TSC strategies:

1. *“Traffic crashes are a significant public health concern.*
2. *Most traffic crashes are caused by human behaviour, not the roadway, vehicle, or environment (e.g., weather).*
3. *Human behaviour is influenced by beliefs.*
4. *Beliefs develop based on experience (actual and vicarious) and socialization.*
5. *Socialization is the process whereby an individual develops beliefs which align with the culture of a group with which the individual identifies (social identity).*
6. *Individuals can form an identity with many different groups in their social environment, each with a different degree of bonding.*
7. *A stronger bond results in greater conformity and motivation to abide with the group culture.*
8. *The shared beliefs of a group that affect behaviours related to traffic safety are called traffic safety culture.*
9. *The traffic safety culture of a group emerges from actions taken by stakeholders across the social ecology.*
10. *Traffic safety culture strategies increase actions by stakeholders across the social ecology to improve traffic safety culture among various groups.”*

The last two principles refer to social ecology. FIGURE 1 shows the various hierarchically organised, interconnected layers within the social environment, which all have an impact on the individual. The authors state that TSC interventions should not only develop strategies targeted to a risk target group, but also to stakeholder groups whose actions can influence the primary risk target group, e.g. increasing seatbelt use through actions in individuals (e.g. asking others to buckle up), families (highlighting family rules on seatbelt wearing), schools (use of education/promotion), workplaces (dedicated workplace

policies), law enforcement (increased seat belt enforcement) and key leaders e.g. local/national government (advocating). They conclude that *"to improve traffic safety, experiences within the social environment need to be created that change the traffic safety culture of groups to which road users are most closely bonded. Such strategies can be instigated by actions from stakeholders across the social ecology. The most effective and sustainable strategies will indeed be those that integrate stakeholder actions across all levels of the social ecology to create a safe traffic system (OECD, 2016)"* (Ward et al. (2019a, p. 36).



FIGURE 1 | Social Environment as an Ecology that Influences Behaviour. (Source: Ward et al., 2019a).

In addition, Ward et al. (2019b, p.1) also stipulate that *"a cultural perspective on improving traffic safety requires expanding efforts to address the behaviours of additional stakeholders such as families, schools, workplaces, community agencies, etc. As each of these groups has their own unique sub-cultures, no single strategy or approach will work for all these groups. Thus, efforts to grow a positive traffic safety culture will require multiple strategies tailored to specific populations."* They add that developing a positive Traffic Safety Culture encourages safe road user behaviour and aligns all stakeholder efforts to support those behaviours. Since cultural influences are strongest at the local level (e.g., own parents have a greater influence on children than other parents; workplace policies have a greater influence on employees than state or national policies, etc.), traffic safety leaders must actively engage local communities to leverage their local cultures to improve traffic safety. They developed communication tools introducing a common language and understanding about TSC for traffic safety practitioners to help them engage other stakeholders, with the aim to reduce the variation in interpretation and implementation of TSC strategies. Some of their key messages include: (p. 3)

- TSC encourages safe road user behaviour and effective partnerships among stakeholders.
- In order to change deliberate behaviour, beliefs must be changed.
- People rely on social relationships and identify (shared belief systems that defines the group 'culture') with many groups in the social environment.
- TSC is the shared belief system of a bonded group that has an influence on road user behaviours and stakeholder actions that impact traffic safety.
- Our social environment includes many traffic safety stakeholders – these can all take actions together to change road user beliefs.
- TSC can improve by growing beliefs that increase protective behaviours, not only beliefs to reduce risky behaviour.
- Positive TSC not only encourages safe behaviour but also to be proactive by supporting all TS efforts and encouraging others to also behave safely.
- Positive TSC increases motivation and capability of TS stakeholders to build effective partnerships resulting in the integration of strategies to form a safe system.
- Growing TSC is not a single intervention; it's a process.

The CHSC (2024) provides a step-by-step guide for traffic safety professionals to build strategies to improve health and safety in communities and organisations through the use of a Positive Culture Framework (PCF) for changing behaviour (see Figure 2). The idea behind it to create strategies that leverage or show positive aspects of the group culture that already exist. For example, teen sport teams may have low seat belt compliance, but they all share the positive value of team spirit: wanting to keep each other safe and win together. Showing how wearing seatbelts helps, support this desirable value and is an example of this positive approach. Another example is showing a group that most of them in fact DO wear their seatbelt when people say they don't wear theirs because they (mistakenly) assume no one else does either. This framework is theoretically grounded and based on evidence on key factors to achieve effectiveness in health-prevention work. The PCF thus focuses on cultivating positive values, beliefs and behaviours (protective behaviours) rather than on reducing risky behaviours, and on the use of an appreciative approach rather than a fear-appeal approach. It is based on research that shows how cultural aspects impact behaviours and suggests that systemic change is more effective than individual behaviour change.

They describe seven steps of the PCF process:

1. Plan and advocate: Transforming culture is a new endeavour for many stakeholders, especially at the community level. Build a sustainable infrastructure to engage the key stakeholders across the social ecology in the work. Establish leadership in process planning and coalitions needed to support a long-term culture change effort. Develop resources and an evaluation plan.
2. Assess culture: Each of the many community layers has common and unique values, beliefs, and behaviours. Assess the cultural factors (shared values and beliefs among an identified group that predict engagement in risky or protective behaviours) based on behavioural models to get baseline measures. This allows identification of system interactions and gaps. Map existing strategies to influence cultural factors.
3. Establish common purpose and prioritize opportunities: Align strategies around a unified purpose to increase engagement. Target the most critical health and safety issues. Prioritize the assessed in cultural factors' gaps and opportunities for cultural change.
4. Develop portfolio of strategies: Create a multi-layered portfolio of evidence-based strategies to change cultural factors (based on available research on effectiveness and outcomes) that address specific behaviours across the social ecology layers. Develop logic models for change.
5. Pilot and refine: To optimize resource efficiency, test strategies and communication messages on a small scale with stakeholders and target audiences to gather feedback. Evaluate initial results and revise the strategies based on this before broad implementation.
6. Implement strategies: Implement the refined strategies broadly across the community with ongoing monitoring and evaluation. Keep managing the public conversation.
7. Evaluate effectiveness and needs: Continuously monitor evaluations to adjust strategies if needed, reflect on lessons learned, and identify emerging opportunities for future needs.

For each step, specific tasks and areas for capacity building are described in detail.

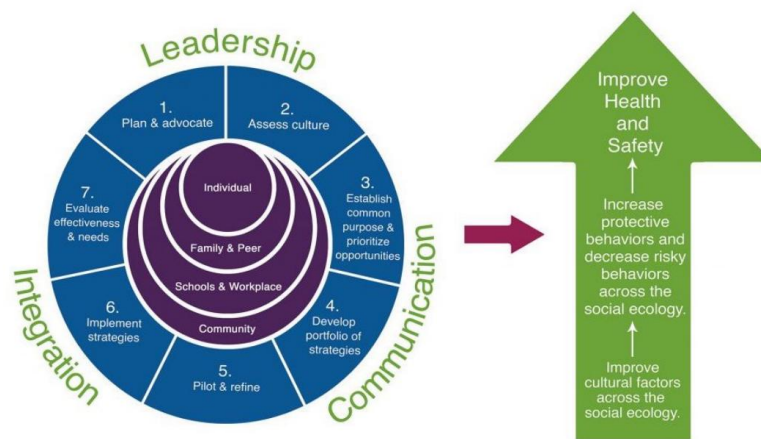


FIGURE 2 | The Positive Culture Framework (Source: CHSC, 2024)

The PCF process is also the basis for the 7-step process to guide the development of a communication effort (e.g. campaign) (p. 72-74):

1. *"Planning and environmental advocacy: investment in planning and capacity building of key stakeholders"*
2. *Baseline data: develop an understanding of the existing positive norms, actual vs. perceived norms, and the key gaps that provide opportunities for messaging and communications"*
3. *Message development: seven guidelines for creating messages - positive, normative, reflective, inclusive, neutral, clear, data-based and source-specific"*
4. *Communication plan: sufficient reach, frequency and duration to impact beliefs/behaviours of focus audience"*
5. *Pilot testing and refining: all messages should be tested in the focus audience to ensure their cultural competence - they should align with the local culture"*
6. *Campaign implementation: preparing key stakeholders to support the message"*
7. *Evaluation: learnings and effects; design determined in step 1 "*

The importance of systematic approaches to develop effective strategies and for evaluation is stressed (e.g. CHSC, 2020, 2024).

To support traffic safety professionals, Finley et al. (2024 a, b, c) produced a series of good practice resources, tools/toolboxes and case studies that can be used to optimise their efforts in reducing different types of risk behaviours (multiple risk driving behaviours (speeding, driving under the influence, seat belt use, distracted driving); aggressive driving; pedestrian safety).

CHSC (2020) finally provides guidance for evaluating TSC strategies:

- Evaluation should include process (strategy implementation, reach), outcome (degree to which the aimed change occurred) and impact (consequences of the changes in improved public health) evaluation
- Key components of effective evaluation are data quality (reliable: accurate, consistent; valid: truly representing the measured concepts); data comparisons (benchmark-based: comparison with a stated reference, time-based: comparison across different time points e.g. before and after, place-based: comparison across different places e.g. using a control site/group, combined time-place evaluations allow more confident conclusions about changes caused by the strategy)
- They conclude with steps to plan, implement and make meaning of an evaluation (stakeholders, strategy, data measures/comparisons, analysis/interpretation, sharing)

Several evaluation studies of TSC interventions were published within the CHSC framework. A good practice example is a TSC program aimed at increasing seat belt use in rural Utah, with actions targeting different stakeholder groups in different layers of the social environment (CHSC, 2019 Otto et al., 2019) (described in 3.1 and Annex 4 section (1)). An older also relevant example from this group (not in the inventory) is a controlled evaluation study of a high-intensity social norms campaign to reduce the prevalence of drink-driving among 21- to 34-year-olds (Linkenback & Perkins, 2005). The campaign message was based on the result in a baseline survey that only 20.4% percent of Montana young adults reported having driven within one hour of consuming two or more drinks in the last month, while 92% perceived that the majority of their peers had done so. To tackle this discrepancy, the positive normative message that “MOST Montana Young Adults (4 out of 5) Don’t Drink and Drive” was communicated. Surveys on several outcome variables were conducted before, during and after the campaign, also in a control group. This strategy proved to be effective, with less misperceptions of DUI frequency among peers (perceived peer norms) as well as positive changes in attitudes and reported behaviours related to DUI. Key success factors described are: intensive exposure to the normative messages, and positive (no fear-based) messages.

With regard to the potential impact of campaigns on TSC, Lewis et al. (2019b, p. 289) stress that “... to create social and behavioural change, designers of road safety advertising campaigns must be cognizant of the myriad of influences on individuals’ behaviour and of broader ecological frameworks that recognize that individual behaviour exists within a complex system of varying layers of influence. ... when theoretically informed in their design and sensitive to the array of potential personal, social, and cultural influences which may be at play, advertising can contribute to both reinforcing contemporary culture [reinforcing other countermeasures like enforcement and legislation with messages highlighting the potential harm or threat of police detection] and transforming contemporary culture [influencing community-wide attitudes, values, norms]. They highlight the role of theory and propose the use of the Step approach to Message Design and Testing (SatMDT; Lewis et al., 2016) which has been developed as a framework for designing and evaluating road safety advertising campaigns (Figure 3). It is built upon several social psychological behavioural theories (TPB (Ajzen, 1991), Extended Parallel Process Model (EPPM) (Witte, 1992), Elaboration Likelihood Model (ELM) (Petty & Cacioppo (1986), Social Learning Theory (SLT) (Bandura, 1969, 1977)). The framework identifies four steps:

1. pre-existing individual characteristics: assessment of the links between psychosocial factors and risky driving behaviour (e.g. underlying beliefs, perceptions, motives...), including consideration on socio-demographic background variables. This provides an understanding of the broad and varied range of personal and social-cultural influences which may underpin individuals’ behaviour, and which are the critical beliefs that significantly explain the variance in intentions and/or behaviour.
2. message-related characteristics: messages can either challenge or emphasise underlying beliefs, use threats or emotional approaches – they aim at eliciting salient motivators underlying the behaviour in the target group. The effectivity of different approaches (emotion vs. information, threats, positive emotions) differs, also in relation to particular target audiences.

Steps 1 and 2 are the sources for the message content development. Steps 3 and 4 relate to the campaign evaluation. In this scope, the authors also refer to the role of primary objectives (behaviour that needs to be changed) and secondary objectives (factors that support the primary objective, e.g. beliefs, knowledge) – which can be well-informed by theory – as well as formative (piloting), process (implementation) and outcome (impact) evaluation (cf. Delhomme et al., 2009).

3. individual responses: this refers to piloting the messages and checking the target groups’ responses to them, in order to assure that responses are as intended/anticipated.
4. message outcomes: this refers to the evaluation of the persuasive outcomes (acceptance/rejection and impact) and focus mainly on the secondary objectives because

unsafe behavioural change is a long-term process which cannot be achieved with one campaign. The importance of using a pre- and post-exposure assessment, of a longer-term effect's assessment and of a control group is stressed.

STEP 1 Pre-existing individual characteristics			STEP 2 Message-related characteristics		STEP 3 Individual responses		STEP 4 Message outcomes	
Identify	Elicit		Focus & Content		Emotional & Cognitive		Acceptance & Rejection	
Gender/ age (relevant socio-demographic variables) + Extent & nature of involvement in/with behaviour	Salient beliefs + Strategies for avoiding behaviour (response efficacy)	Methodology Step 1 Pilot work	Focus of Message Challenge perceived benefits And/Or Highlight perceived disadvantages <u>Key content</u> • Emotional appeal type (e.g., fear-based, humour-based) • Modelling of behaviour • Strategies	Methodology Step 2 Message Exposure	Emotional responses (anticipated emotion elicited?) + Cognitive responses (e.g., perceptions of response efficacy, involvement)	Methodology Step 3 Concept testing & Message checks	Intentions to adopt message and/or denial, defensive avoidance reactions	Methodology Step 4 Quantitative-based assessment of persuasive effects Persuasive effects measured over time

FIGURE 3| The SatMDT (Source: Lewis et al., 2016)

In the CAST project, detailed manuals for evaluating road safety campaigns (Boulanger, 2009) and for reporting their effectiveness (Boulanger & Meng, 2009) were developed. Both manuals are supported by a comprehensive 6-steps guidance manual for designing, implementing, and evaluating road safety campaigns (Delhomme et al., 2009) (see Table 5). Road safety professionals are advised to use these manuals for the design, implementation, evaluation and reporting steps of the strategic approach. If planned according to the provided methodological steps, campaigns can be effective in changing shared beliefs in community.

Summary of step-by-step guide to design, implement and evaluate campaigns, developed within the EC CAST project	
1. Getting started	
- Identifying and defining the problem - Problem behaviour & risks (based on crash data, offences, observed behaviour, ...); Current issues (e.g. new legislation) - Locating partners and stakeholders and getting them involved - Public authorities, private organisations, police, sponsors,... - Drafting the budget - Including budget for evaluation - Kick-off meeting + setting up the campaign team - Defining general objective, possible strategies, identifying needs + resources	
2. Analysing the problem	
- Which target audience(s)? - Group(s) involved in problem behaviour = primary audience; - Group(s) influencing primary audience (e.g. peers);	

Summary of step-by-step guide to design, implement and evaluate campaigns, developed within the EC CAST project

- Audience segmentation (subgroups according to socio-demographic variables, lifestyle, etc.)
- Main motivations for target audience behaviour?
 - Research on factors contributing to problem behaviour/safe behaviour (behavioural models, studies, previous evaluated campaigns...)
- How to influence behaviour?
 - How to reach and influence the target audience;
 - Interests and needs of target audience;
 - Inspiration from previous campaigns
- Define specific objectives
 - SMART: Specific, Measurable, Achievable, Realistic, Time-bound
 - Reach and appreciation within target audience (e.g. reach: '80% of all car drivers aged 18 to 25 in Brussels', e.g. appreciation: '90% of target audience think campaign message is clear')
 - Effects in terms of...
 - Knowledge (e.g. '80% of target audience know that speed limit near schools is 30 kph');
 - Attitudes: Subjective norms, values, beliefs... linked to behavioural model (e.g. '80% of target audience believe that driving faster than 30 kph seriously endangers children');
 - Behaviour: Behavioural intentions/self-declared behaviour/observed behaviour (e.g. '70% of target audience intends to.../ declares to.../acts...')

3. Campaign design

- Specific objectives, social marketing strategy, and available budget determine campaign type and style, approach, message, timing and duration, and media choice
- Campaign type & scale
 - (Mass) media only or combined/integrated campaign (field activities, enforcement, special events...)
 - Scale: local, regional, national,...
- Approach & tone of voice: several options
 - Moralising (!); Fear appeal (!) – with caution as these might trigger defensive reactions – Emotional; Confronting; Humour, Irony;
 - Positive, stressing desired behaviour: Humour, emotion, identification; Social disapproval of risk behaviour
- Message
 - Positive (in term of gains) or negative (in term of loss) framing
 - Only arguments pro, or pro + contra
 - Must get noticed, be understood and accepted (specific, unambiguous, short, convincing, credible, clear, easy to understand, attention-grabbing, concrete, realistic)

3. Evaluation design

- Why evaluate?
 - Know if campaign has effects or not, and why
 - Input for future campaigns (improvement)
 - Justification for commissioners/sponsors
- Thorough evaluation consists at least of
 - Process evaluation (reach, appreciation) - Methods: counting systems/questionnaires
 - Outcome evaluation (effects on knowledge, attitudes, behaviour) - Methods: questionnaires/ police reports/counting systems...
 - Before and after measurement
 - Ideally including a control or comparison group (similar audience not subjected to campaign messages) - for drawing valid conclusions about effectiveness in a before and after measurement design

Summary of step-by-step guide to design, implement and evaluate campaigns, developed within the EC CAST project
- Based on specific objectives - Reach and appreciation within target audience - Effects in terms of - Knowledge (xx % of target audience knows that...) - Attitudes (xx % of target audience thinks that...): norms, values, beliefs ... linked to behavioural model - Behaviour (xx % of target audience declares/acts...): self-declared behaviour; observed behaviour
4. Implementation
- Implementing pre-measurement - Producing and distributing campaign materials, coordination with partners - Launch: - Careful choice of timing (other news/events); Press release, press conference or event - Follow-up campaign implementation: - Does it run as planned? Adjustments if necessary.
5. Completing evaluation and conclusions
- Implementing after measurement(s) - Data processing and analysis - Conclusions - Target audience reached? To what extent? Why (not)? - Effects on knowledge/attitudes/behaviour? To what extent? Why (not)? - Campaign objectives achieved? To what extent? Why (not)?
6. Final reporting
- Why report? - Input for future campaigns – learning process - Justification for commissioners/sponsors - Report content - Overview of campaign elements: Topic, audience, budget, partners, strategy, message, media planning, campaign progress... - Overview of campaign results (evaluation): Before measurement; After measurement; Conclusions - Publish the report

TABLE 5 | Summary of step-by-step guide to design, implement and evaluate campaigns, developed within the EC CAST project on Campaigns and Awareness Raising Strategies in Traffic Safety (Source: Delhomme et al., 2009)

Further dedicated recommendations for designing and implementing effective campaigns and for evaluating them are derived from Delhomme et al. (2009) and Forward & Kazemi (2009):

- Base the intervention on an in-depth analysis: statistics and research (problem behaviour, target audiences, motivational factors influencing target audience behaviour).
- Define a specific target audience (group involved in the problem behaviour = primary target; group(s) influencing the primary audience = secondary target).
- Base the strategy on a behavioural influence theory (theoretical psychological model that explains the risk behaviour or safety problem). Using a well-established theory helps in selecting and assessing a range of different constructs known to predict behaviour.
- Define specific objectives (SMART; reach, appreciation, knowledge, attitudes, behaviour...). By including both primary (e.g. behaviour) and secondary objectives (e.g. attitudes) change can be assessed with greater accuracy.
- Develop the strategy and media plan (based on specific objectives).

- More chances of success are expected with: a personal approach/influence; combination of emotional and rational content; focus on social norms; short and personal messages (intimacy, trust); communication along the road (direct, adapted to the situation); availability of external resources which makes the behaviour easier to perform (e.g., offering bicycle helmets for free when signing a contract).
- Carefully formulate the message (credible, convincing, concrete...). Communication has to be based on the cultural codes used in the target community (national, regional, sub-groups etc.).
- Conduct a proper implementation (launch, follow-up, coordination). Duration and intensity influence effects. To be exposed is no guarantee to be effective.
- Integrated programs increase effectiveness (combined actions including campaigns and e.g. enforcement).
- Ensure rigorous evaluation (process: reach, appreciation, outcome: effects on TSC-elements, knowledge, behaviour; pre-post design, ideally with control or comparison group; based on the specific objectives). Be aware that simultaneous external factors (e.g. tragic crashes reported in media, a law change) can also have an impact on the effects. Differences in outcome variables between experimental and control group can be due to systematic differences between the two groups rather than a consequence of the intervention itself. Therefore, results from an evaluation using a before and after study is more valid and easier to interpret.
- Publish results and conclusions (report as input for future interventions).

1.3.3. Expert interviews

3.1.3.1. International road safety experts' views on the concept of TSC interventions

FERSI and IRTAD are international traffic safety working groups whose members include road safety experts from various professional backgrounds – from traffic engineering and psychology to law and economy. Table 6 lists a summary of the main discussion points, providing crucial insight into other road safety experts' conceptualisation and misconceptions of Traffic Safety Culture interventions, rather than complementing the TRUST inventory or sharpening its inclusion/exclusion criteria.

Group	Discussion points
Concept and other strategies	The TRUST definition of TSC interventions was received as rather narrow. A lack of understanding became apparent: why are campaigns that address specific patterns of risky behaviour not TSC interventions in the strict sense?
	The introduction of well-researched engineering and legal measures like T30 zones incl. street furniture, raised plateaus, together with adequate speed enforcement are commonplace. Don't they all grow TSC as well?
	If TSC interventions are leveraged across the board, will "classical" interventions such as in the fields of infrastructure, enforcement, and legislation not be needed anymore?
Design	There are differences in disciplinary perspectives on the expectations on the impact of shocking messages. Social science indicates that shocking messages may lead to psychological avoidance mechanisms.
	The design of TSC interventions requires an in-depth knowledge of the target groups' psychological dimensions, such as values, norms, attitudes, and beliefs. How to get a grip of those characteristics of difficult groups such as drivers under the influence of cannabis?

Group	Discussion points
Impact	The impact of TSC intervention work was questioned, like the sole communication of societal norms rather than highlighting the aberrant behaviour – and correction of normative misperceptions (e.g., 95% of citizens do pay their taxes).
	How can the impact of a TSC intervention be measured in the short term?
Other	Some road users seem to turn reckless after crossing borders to neighbouring countries, so do they take on another culture then, and why?
	In a country, there is not just one culture, but a multitude. How can you draw a model of those, how can you modify this multitude?

TABLE 6 | International road safety experts: main discussion points

This collection of misconceptions or misunderstandings confirms the need for a rigorous definition and communication about what TSC interventions are, how road safety can be impacted through improved TSC but also about limitations. TSC interventions are not a panacea but an effective complementary approach to well-established road safety measures – if applied correctly and rigorously. Insight from the group discussions and interviews will inform communication strategies regarding the TRUST results and outputs.

3.1.3.2. Nicholas Ward, Director of Safe System Culture, LTD (Former Director of the Center for Health and Safety Culture, CHSC)

Based on the lack of a common definition in literature of TSC and of what a TSC intervention is, Nicholas Ward was asked to provide written input on his conceptual idea about it, based on his extended expertise in the field.

He highlights that integration of the social environment (family, friends, classmates/colleagues, neighbours, citizens...) and actions of stakeholders in the social environment form the specificity of cultural approaches.

As shown in Figure 4, he stipulates:

- Our sense of identity is derived from the groups in our social environment that we bond with.
- Groups are governed by a shared culture.
- Groups may comprise specified roles with associated expectations.
- Groups may also interact in common contexts.

Thus, the context a person is in may shift his/her attention to the group culture and role that is most relevant for that context.

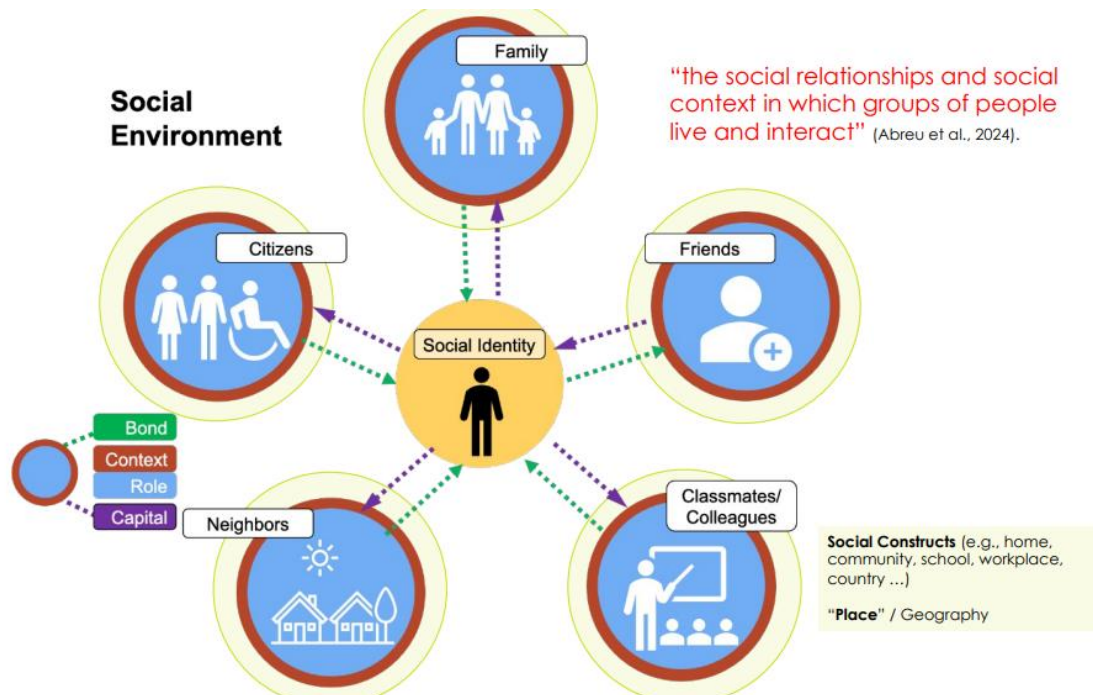


FIGURE 4| Social Environment (Ward, 2026; Abreu et al., 2024)

He refers to TSC as the shared beliefs of a *bonded* group of people that influence their *deliberate collective* behaviours affecting traffic safety. His focus is on beliefs about the social environment: such as behavioural beliefs (about social consequences of behaviour), normative beliefs (about what behaviour is typical and expected), and control beliefs (about our influence over the social environment and its influence on our behaviours). While general strategies aim to change individuals, the focus of cultural strategies is to normalise collective change. This is achieved by changing the social meaning of the behaviour and its relationship to our social identity. As culture changes, the desire to protect our social identity may then become the source of motivation to change behaviour.

For example, culture change campaigns can shift social norms by leveraging community values to increase community commitment. In such cases, the social meaning of the behaviour changes: for example, using a message like "We all buckle up in our community". This contrasts with education-based campaigns that focus on risk assessment with a message like "Wear your seatbelt, it saves lives". Figure 5 presents three main types of traffic safety campaigns (Ward, 2026).



FIGURE 5| Types of traffic safety campaigns (Source: Ward, 2026).

He proposes several design criteria for TSC strategies:

- **Data:** Cultural beliefs of target group are measured (based on an explicit behavioural model) rather than assumed.
- **Belief:** Focused on changing beliefs about the social environment that motivate wilful and intentional behaviours.
- **Aligned:** Message delivered by members of the target audience (or an entity perceived as trustworthy).
- **Context:** Strategy incorporates familiar social context where the target behaviour occurs.
- **Identity:** Message is directed toward a meaningful social role associated with group identity, rather than toward individuals portrayed as isolated actors.
- **Bond:** Strategy targets a group with a demonstrated (quantified) bond between individuals and group identity. That is, there is evidence they are a "meaningful group" - meaningful to each other.
- **Collective:** The design goal is to motivate group-level change - cause the group to normalize the target behaviour.

3.1.3.3. Hanna Wennberg, researcher at Lund University and consultant at Trivector Mobility (Former strategist in traffic safety at the Swedish Transport Administration)

In TRUST Deliverable 2.1 (Nævestad et al., 2026), reference is made to another specific group for TSC practices besides private road users and road users at work, namely people working in road safety authorities and stakeholder organisations. For these, specific additional relevant cultural aspects can be the extent of system responsibility attitudes concerning the role of authorities, views on authorities' possibilities and capabilities to influence private road users and road users at work.

As the inventory in this task lacks input on this specific group, Hanna was asked to provide written input on examples of experiences in Sweden concerning "Traffic Safety Culture" among societal actors.

- **Actor Surveys and Strategy for National Actor Collaboration:** The Swedish Transport Administration (STA) initiated a work to gain a better understanding of actors' responsibilities and commitment for traffic safety. When they initiated this work, they mainly referred to "Traffic Safety Culture", but they have realised that this concerns readiness and the preconditions for actors to implement measures to improve traffic safety in which "culture" and views on traffic safety play an important role. The STA refers to this as "Actor Surveys" and two surveys have so far been carried out: among Swedish municipalities (2024) and companies (2025). They have recently initiated surveys among the regions and all Swedish government agencies which both will be carried out during 2026. The Actor Surveys is a part of the Strategy for National Actor Collaboration and a part of the STAs management-by-objectives approach for traffic safety in road traffic. Documentation referred to are the road traffic safety stakeholder survey 2025 result reports of municipalities as employers and procurers of transport services (Västå et al., 2025b) and of companies as employers and purchasers of transport services (Västå et al., 2025a).
- **Local traffic safety audits in Swedish municipalities** (former Trafiksäkerhetsrevisionen, later Trafiksäkerhetslyftet): The Swedish Association of Local Authorities has together with the Swedish Transport Administration (contracted for the work: Trivector) developed a tool for systematic traffic safety implementation in Swedish municipalities. This prior version (Trafiksäkerhetsrevisionen) was launched in 2005 and was used by more than 40 municipalities mainly during 2005-2010 (and some also later, e.g. Gothenburg (Wennberg & Evanth, 2020). The revised version (Trafiksäkerhetslyftet) was launched in 2023. It is currently used in a research project (by Lund University, Trivector, and TØI) in which we evaluate effects on traffic safety culture and collect experiences from twelve municipalities. Documentation referred to are a comprehensive report - basis for a revised road safety audit (Wennberg et al., 2022a) and audit materials online (<https://skr.se/trafikochinfrastruktur/trafik/trafiksakerhet.8216.html>).

She also provided an example related to organisations/OSC (cf. Chapter 4):

- **Occupational traffic safety in organisations** (Trafiksäkra verksamheten): The Swedish Transport Administration has together with the Swedish Work Environment Authority (contracted for the work: Trivector) developed guidance materials for employers, transport providers, and transport buyers for their implementation of measures and setting requirements on traffic safety. This includes an inspirational handbook on how to work systematically with traffic safety and to build traffic safety culture in the organisation (based on Nævestad's Safety Ladder and good practice examples from Swedish companies and municipalities). These materials are currently used in a research project (by Trivector and TØI) in which effects on Traffic Safety Culture are evaluated and experiences from ten companies and municipalities are collected. Documentation referred to are a comprehensive report on knowledge support for employers, transport providers, and transport buyers (Wennberg et al., 2022b) and guidance material (guidelines, checklists, and inspirational handbook) online (<https://bransch.trafikverket.se/trafiksakra-verksamheten>).

3.2. Key results and recommendations: concept, success factors and assessment criteria

2.3.1. Finetuned TSC intervention concept

The initial operationalisation in this explorative inventory of a "TSC intervention" or a "traffic safety intervention with a cultural approach" was built upon the TSC definition in TRUST Deliverable 2.1 (Nævestad et al., 2026). This laid the focus on "interventions primarily aimed at changing culture in terms of shared ways of thinking and feeling (experiencing), i.e. shared values, norms, beliefs, attitudes, in a

meaningfully defined group of actors in the transport system". Such interventions are aimed at influencing deliberate, wilful behaviour. While this includes campaigns and educational measures aimed at changing shared values, norms, beliefs and attitudes in target groups, this withdrew the focus of the inventory from interventions primarily aimed at directly forced (e.g. legal, physical) behavioural change, without actions to also change the critical underlying beliefs (norms, attitudes...). The idea behind is that in order to change risky behaviour to wilful, intentional and deliberate safe behaviour in a sustainable way (stable, also outside the scope of technical or legal boundaries for the behaviour), the critical underlying beliefs (norms, attitudes...) for the risky behaviour have to be oriented towards more safety. When the critical beliefs (norms, attitudes...) change, people's behaviours are also likely to change (e.g. Austin et al., 2021).

The presumed logic behind is that a change in shared beliefs about a risk behaviour in a bonded group indicates a change in the shared culture, and this leads to a sustainable change in collective behaviour and ultimately to a change in road safety outcomes like the number of crashes and casualties (see Figure 6).



FIGURE 6 | Logic model to show the presumed logic between shared beliefs, culture, behaviour and safety outcomes.

As indicated in the rationale behind this conceptualisation for the inventory (section 2.1) it is acknowledged that traditional measures that impose direct behavioural change like enforcement, law (changes), infrastructure and technology, are effective ways to reduce road casualties and are thus crucial for road safety (Elvik et al., 2009). Such measures can also lead to changes in shared ways of thinking and feeling about road safety in society, but this is rather an indirect and after-effect where forced/imposed behavioural change leads to habits and changes in beliefs, norms, attitudes.

The results' section 3.1 provide input on conceptualising interventions directly aimed at sustainable change in shared beliefs (norms, attitudes, values) and TSC, based on CHSC (2024), Ward et al. (2019 a, b), Lewis et al. (2019 a, b) and the interview with Nicholas Ward (section 3.1.3), e.g.:

- TSC strategies are built upon understanding of the cultural factors, i.e. shared values and beliefs among an identified group that predict engagement in risky or protective behaviours, identified using pre-assessments based on theoretical behavioural models.
- TSC interventions integrate the social environment: they require not only strategies targeted to a risk target group but also tailored strategies towards the stakeholders in the social environment (family, friends, classmates/colleagues, neighbours, citizens...) because their actions can influence the primary risk target group.
- TSC interventions should be sensitive to the many different potential social and cultural influences on individuals' behaviour. Designers should be aware of the broader ecological frameworks that recognise that individual behaviour exists within a complex system of varying layers of influence.
- Road safety campaigns can lead to culture change if they are culture-based, i.e. when they frame behaviours in terms of their social meaning (e.g., association with social values and normative expectations). Experiences are designed to convey and reinforce social expectations that normalise the behaviour. Their primary goal is to change culture to motivate group-level (collective) behaviour change that is supported by the broader social environment. This approach is different from education-based and enforcement-based campaigns:

- Education focuses on knowledge, skills and (risk) awareness. Road user behaviours are framed as skills with associated risks. Information is provided to raise risk awareness and develop the technical skills required to perform safer alternatives. The primary goal is to produce informed and capable individuals.
- Enforcement focuses on explicit rules and consequences. Behaviours are framed as system requirements to maintain a safe system. Enforcement is used to align behaviour with the operational rules that govern system performance. The primary goal is to produce individuals that are compliant with operational system requirements.

The last bullet extends the first three general methodological design elements by indicating that TSC strategies should focus on “beliefs about the social environment” that are predicted to influence behaviour. This refers for example to behavioural beliefs about *social* consequences of behaviour, normative beliefs about what behaviour is *typical and expected*, and control beliefs about our influence over the *social* environment and the influence of the social environment on our behaviours. Ward et al. (2019b) and CHSC (2024) furthermore support a “positive framework” for changing behaviour, using strategies that leverage or show positive aspects of the group culture that already exist rather than focusing on reducing risky behaviour.

The above complements provide input to finetune the original concept of a TSC intervention:

Elements for proposed finetuning of the TSC intervention concept
Minimum
• Aim: The main aim is to change in a relatively short time period at least one of the TSC-elements in terms of shared ways of thinking/feeling about traffic safety, i.e. shared values and/or shared norms and/or shared beliefs and/or shared attitudes, that are known to sustainably influence wilful, intentional, deliberate behaviour among members of a meaningfully defined bonded group of actors (target group(s)) in the road transport system. At community level this refers to private road user target groups and broader societal target groups. This differentiates TSC interventions from interventions aimed at direct (forced/imposed) behavioural change like enforcement, law (changes), infrastructure and technology, which may also lead to changes in shared ways of thinking/feeling but rather as an effect after a longer period of time and indirectly. A comprehensive approach combining cultural strategies with other strategies does lead to a greater impact on TSC. • Background: TSC interventions are theory-based (social science / behavioural model) and consider the underlying social and cultural motives and external influences on the target behaviour in the target group(s), based on pre-measurements. • Strategies: TSC interventions focus on the most critical/salient shared ways of thinking/feeling underlying the target behaviour in the target group(s) and use messages that are tailored to the target group(s).
Recommended
• Social environment actions: Comprehensive TSC approaches create a social environment (broader than target group culture) to support the target behaviour change, by including strategies/actions for/by stakeholder groups in the different social ecology layers. This also refers to the use of a multi-factorial approach (combination with other strategies) as this takes the complexity of the road transport system and involved interactions into account and improves overall effectivity (reinforcing effect) to change shared ways of thinking/feeling. • Frame behaviours in terms of their social meaning: TSC campaign interventions target at least shared (behavioural/normative/control) beliefs “about the social environment” to make safe behaviour the norm. This would include for example campaigns focusing on DUI leading to negative “social” consequences (behavioural beliefs), or sober drivers being highly valued “within the community” (normative beliefs), or the control everyone has to keep “loved ones” from driving when they are drunk (control beliefs). These messages aim at changing underlying shared critical or salient beliefs (values, norms, attitudes) which

Elements for proposed finetuning of the TSC intervention concept
relate to the social environment. This differentiates culture-based campaigns from education- and enforcement-based campaigns, which on the other hand focus on knowledge, skills and (risk) awareness, and on explicit rules and consequences. • Positive framework: TSC interventions use positive framing of shared values/norms/beliefs/attitudes/behaviour, highlighting positive aspects of the group culture that already exist, to motivate a sense of shared responsibility and collective safe behaviour.

TABLE 7 | Proposed finetuning of the TSC intervention concept

2.3.2. Common success factors and proposed assessment criteria

Scientific literature on evaluated interventions to change TSC is scarce. Most collected interventions are (also) traditional education/campaigns which would not all fall within the narrowed TSC intervention concept. A few interventions include a clear cultural approach (e.g. strategies for different target groups in the social/physical environment, strategies to change shared social values and norms). The results show that few of the collected intervention evaluations use a definition or theory of “culture”. Cultural elements are measured in different ways, related to variations in theories/behavioural models, TSC-(definition)-elements but also inferred or other variables, and the evaluation designs differ a lot.

Theoretical and methodological guidance on building, implementing and evaluating TSC interventions mainly derive from grey literature.

Based on the integrated section 3.1 findings, common key success factors for TSC interventions are presented in Table 8.

Group	Key success factors
A. Diagnosis Understand the problem and the (sub)culture	Start with a sound understanding of the problem (risk behaviour and risk group(s)), based on available knowledge, data and research.
	Define the target groups based on that: primary (risk) group(s); group(s) in the social environment which can influence the primary group
	Understand the target group sub-culture(s): theory-based pre-measurement of the (risk) behaviour and underlying social and cultural motives and external influences, using social science/behavioural model(s), to identify <i>shared</i> TSC-elements (values, norms, attitudes, beliefs) that predict engagement in risky or protective behaviours in the target group(s) and/or that provide hypotheses about the interrelations of TSC elements and behaviour
B. Design Objectives, strategies and messages	Definition of specific intervention objectives based on the pre-measurement; focus on the critical/salient shared beliefs (and/or other TSC elements) of the target group influencing behaviour, not on individual TSC-elements
	Strategy(ies) built upon the objectives, also for different stakeholder groups in the social environment; a mix of tailored actions/strategies across the different social-ecology layers
	Relatable/credible/representative messages for the target group(s), focusing on the critical/salient shared beliefs (and/or other TSC elements), ideally those concerning the social environment, to make safe behaviour the norm, with an appropriate approach

Group	Key success factors
	Positive framing of shared values, norms, beliefs, attitudes and behaviour, building upon positive aspects of the group culture that already exist, to motivate a sense of shared responsibility and collective safe behaviour.
C. Implementation & sustainability	Implementation: continuous leadership, management commitment and stakeholder engagement and monitoring/adjusting; systematic approach; sufficient resources/capacity
	Sustainability of the intervention: secure its continuation beyond a one-off action
	Use of a multi-factorial approach (combination with other strategies like enforcement, infrastructure...) takes the complexity of the road transport system into account and reinforces effects
D. Evaluation	Rigorous evaluation including a process evaluation and a pre-post outcome evaluation, preferably with a long-term follow-up and a control/comparison group to isolate effects of the intervention

TABLE 8 | Common success factors for TSC interventions

The main derived assessment criteria for TSC interventions are:

- Risk behaviour and risk group are described based on data/research
- Target group(s) are defined
- primary group(s) involved in the (risk) behaviour
- group(s) s influencing the primary group
- A theoretical model is used to explain (risk) behaviour
- Pre-measurement of the TSC-elements in the target group(s) is model-based
- Specific (SMART) objectives are defined
- Primary objective: influence (factors influencing) (risk) behaviour of target group(s)
- Secondary objectives: related to one or more of the pre-measured TSC-elements (shared values, shared beliefs, shared attitudes, shared norms, shared patterns of behaviour)
- The strategy/message is linked to the specific objectives
- Pre-test of message(s) in the target group(s)
- The process of the implementation is monitored and evaluated
- Evaluation includes:
 - Process evaluation
 - Outcome evaluation
 - Pre – post design
 - Pre – post 1 – post 2 design (longer-term follow-up evaluation)
- Outcome variables are linked to the specific objectives (TSC-elements, aspects)
- Control / comparison group to isolate the intervention effect

Section 3.1.2 covers detailed set-by-step methodological guidelines which can support the planning, roll-out and evaluation of TSC interventions (including the TRUST pilot studies).

4. Results on OSC interventions in transport domains

The focus of this chapter is first on interventions and strategies in organisations with (light/heavy) vehicle fleets, within the road transport domain, and within other transport domains (rail, air, sea) (4.1 and 4.2). In 4.3 three good practice examples from a regulatory perspective from pioneering sectors are presented and in 4.4. Their relevance for the road domain is explained.

In Annex 4, sections (3) to (5) provide a detailed overview of the collected interventions and practices.

In Annex 5, sections (3) to (6) provide (good) practice examples of road safety supporting activities and interventions in organisations (employers/employees/drivers to/at work), as well as considered good practices in the aviation, railway and maritime transport domain, from different sources (e.g. EU project PRAISE, Newnam & Muir, 2019).

4.1. Overview of main results and key elements

The systematic review from Nævestad et al. (2018) of safety culture in four transport domains (road, sea, air and rail) aimed at (a) mapping interventions that can be used to develop good safety culture in transport companies within the four transport domains, (b) assessing expected effects of interventions on safety culture and safety outcomes and (c) identifying factors influencing safety culture change. By systematically reviewing the scientific literature, they identified 20 studies that describe and evaluate interventions to improve safety culture: 10 in road transport organisations and 10 in the three other transport domains. This review focuses on intervention studies, typically presenting clearly defined relationships between the content of the intervention, the evaluation method, and the resulting effects. A detailed overview of the collected interventions in this review can be found in Annex 4, sections (3) and (4).

They concluded that the reviewed interventions differ considerably in terms of scope and comprehensiveness. Furthermore, the absence of standardised outcome measures and controlled evaluations makes it difficult to compare interventions, both within and across sectors. Nevertheless, most studies report improvements in safety culture where this has been measured.

A review from Austin et al. (2022) led to a similar conclusion, pointing at the diversity of evaluations designs. They recommend practitioners to select pragmatic designs aligned with the organisations' needs, resources and capacities. They also highlight that interventions can be effective at influencing organisational or safety culture, regardless of used cultural theory.

At the same time, Nævestad et al. (2018) notice that there was a notable lack of research examining the mechanisms through which cultural change leads to behavioural change and improved safety performance. Although safety culture is an organisational-level concept, only one peer-reviewed study was identified that examined efforts to improve safety culture in a single air transport organisation, and no such studies were found in the maritime sector.

Overall, the authors concluded that OSC interventions appear to be effective, but also comprehensive and resource intensive. They recommended that future research should focus on developing simpler interventions by identifying the core requirements for safety culture change. In this regard, they identified four key activities (content) that are common across the reviewed interventions, as well as eight key factors (process) that influence their success.

Nævestad et al. (2018) concluded that although the interventions vary significantly across sectors and organisational contexts, they tend to include four key elements, related to content:

1. **Appointing a key person** (generally a manager) to be responsible for implementing the intervention.
2. **Institutionalising joint discussions and risk assessments** of workplace hazards, involving managers and employees.
3. **Implementing and monitoring** measures based on these discussions and joint risk assessments, e.g. reporting systems, training.
4. **Maintain effective communication** about safety issues in the organisation, in line with Reason's (1997) depiction of an informed safety culture.

Based on this, they concluded that the fundamental requirement for safety culture improvement appears to be the institutionalisation of joint discussions of workplace hazards, supported by strong management commitment and active employee involvement.

4.2. Key factors influencing the success of OSC interventions

Nævestad et al. (2018) identified eight key factors influencing the success of safety culture interventions, related to the process:

1. **Top management commitment.** Strong and visible commitment from top management throughout the intervention period is crucial. This factor is consistently highlighted across all transport sectors (e.g., Lappalainen et al., 2014; Belland et al., 2010; Edkins, 1998; Zuschlag et al., 2016). Studies emphasise that weak commitment or unclear managerial roles can undermine interventions by reducing their visibility and effectiveness (Amtrak, 2015; Roberts et al., 2015). These findings align with broader safety culture research (Flin et al., 2000; Nævestad, 2010).
2. **Employee engagement and support.** Active employee involvement in the intervention process is essential. Engagement in risk analysis and the development and implementation of measures enhances effectiveness, particularly through group-based discussions (Salminen, 2008). Union cooperation may further support engagement. Conversely, lack of employee involvement has been shown to hinder interventions (Amtrak, 2015; Roberts et al., 2015).
3. **Relationship between managers and employees.** Trust between managers and employees is a key condition for successful safety culture change. Distrust, resistance among employees, and perceptions of an unjust culture can significantly impede interventions (Amtrak, 2015; Zuschlag et al., 2016). Previous research also highlights how blame and power dynamics can obstruct organisational learning (Pidgeon & O'Leary, 2000; Reason, 1998).
4. **Motivation for the intervention.** A clear and strong motivation is often present in successful interventions. This may stem from safety problems, high incident rates, technological changes, or recognition of poor safety culture. In the road sector, business-related incentives (e.g., productivity gains) may also play a role. Lack of motivation or removal of incentives can weaken intervention outcomes (Amtrak, 2015).
5. **Regulatory focus and support.** A strong regulatory emphasis on safety culture, combined with active support to companies, can facilitate successful interventions (e.g., Edkins, 1998; Zuschlag et al., 2016). However, regulatory focus alone is not sufficient, and some successful interventions occur independently of such influence.
6. **Clear and coherent implementation.** Successful interventions require clear, structured, and well-integrated implementation. Unclear roles, lack of integration with existing systems, or overly complex procedures can reduce effectiveness (Amtrak, 2015; Lappalainen et al., 2014). Coherence with organisational practices is therefore essential.
7. **Competing organisational processes.** Reorganisations and other internal changes may disrupt interventions by diverting attention or removing key personnel involved in implementation, thereby negatively affecting outcomes.

8. **Content of the intervention.** The design and relevance of the intervention itself influence participation and effectiveness. If the content is perceived as unclear, irrelevant, or poorly designed, employee motivation and engagement are likely to decline (Amtrak, 2015).

4.3. Good practices in other sectors

Nævestad et al. (2021b; 2019b) focused on safety culture interventions from a regulatory perspective in three pioneering sectors, i.e. safety culture as an authority tool for contributing to safety in organisations. This is a relatively representative intervention context. Another one that is not represented could be organisational interventions without regulatory involvement. The 2019 review examined regulatory strategies and experiences, which are more often qualitative in nature. Rather than emphasising strictly measured effects, these studies tend to focus on the role of regulatory authorities, and the outcomes or experiences associated with their efforts to influence safety culture.

Summing up reviewed intervention studies from the nuclear sector, the Norwegian petroleum sector, and North American rail sector show that regulators can influence safety culture in several different ways, ranging from broad regulatory requirements and advisory activities to more concrete interventions such as training, audits, reporting systems, self-assessment tools, and safety management systems. However, the studies also show that these approaches differ substantially in their level of specificity, the kinds of outcomes they target, and the strength of the available evidence.

A detailed description per sector and a table summing up the main aspects (main types of interventions studied in each sector, the main positive results reported, the key limitations and challenges, and the overall strength of evidence) can be found in Annex 4 section (5). Taken together, the comparison highlights both the promise of safety culture interventions and the importance of how they are implemented and evaluated.

Across the three sectors, safety culture interventions generally led to improvements in organisational learning, awareness, and safety-related practices. However, the strength of documented outcomes varies considerably. The North American rail sector provides the most robust evidence, demonstrating measurable improvements in safety culture, behaviour, and crash and accident reduction through well-evaluated interventions. This is, however, also a result of the focus on accidents and crashes and behaviours in this study. In contrast, the nuclear sector shows positive but largely indirect effects, mainly related to competence development and continuous improvement processes. The Norwegian petroleum sector primarily demonstrates learning and increased attention to safety culture, but with high interpretive costs and limited evidence of concrete safety outcomes. Overall, the findings suggest that the effectiveness of safety culture interventions depends strongly on how they are implemented and evaluated.

4.4. Relevance for the road domain and recommendations

The findings from the nuclear, petroleum, and rail sectors provide several important implications for the design and implementation of safety culture interventions in the road transport sector (Nævestad et al., 2021a; 2025a). The common denominator between these studies and studies of OSC in the road sector is that they all focus on culture in organisational settings. Moreover, safety management systems and OSC is far more well developed in the previous sectors than in the road sector, due to safety management system requirements aiming to develop good OSC in the previous sector. More well-developed measures related to safety management and OSC are indeed needed in the road sector.

Driving as part of work is often the most hazardous activity employees engage in, representing the greatest risk of injury (Helman et al., 2014). Traffic crashes account for between 20% and 40% of work-related accidents in industrialised countries (Fort et al., 2010; ETSC, 2010), and employees who drive for work seem to be more vulnerable to occupational accidents than other workers. Overall, 39% of work-

related fatalities in the EU are traffic related (ETSC, 2009). This increases to between 40% and 60% when including commuting crashes (European Commission, 2015). A Norwegian study shows that 38% of traffic fatalities in Norway from 2005 to 2013 involved at least one driver who was “on the job” at the time of the crash, while 11% involved people commuting to or from work (Nævestad et al., 2015a). This means that 49% of road fatalities in Norway can be classified as work-related - i.e., the deceased or others involved were either working or commuting. Among those working, 31% were professional drivers (truck, bus, taxi), and 7% were non-professional drivers. Kullgren et al. (2023) found that 37% of traffic fatalities in Sweden in 2019 involved a working driver, and 10% involved a commuting driver. These figures are nearly identical to the Norwegian ones from 2005–2013 (Nævestad et al., 2015a). In other words, there is a significant and seemingly untapped potential for improving traffic safety by enhancing the safety of work-related driving.

Underneath, methods to strengthen safety culture through safety management system requirements are described.

4.4.1. Introduce mandatory safety management system requirements in road

Although relatively few systematic studies exist in the road field, available research suggests that implementing safety management systems (SMS) can improve road safety. A systematic review shows that SMS implementation is associated with positive safety outcomes (Thomas, 2012). In several high-risk industries such as nuclear, aviation, and oil and gas, SMS are legally mandated as tools for promoting and operationalising safety culture (Bernard, 2018; ICAO, 2021; Kringen, 2009).

SMS represent the formal dimension of safety in organisations, that is, “how things should be done.” In contrast, the informal dimension is typically referred to as safety culture, that is “how things are actually done.” Safety culture can be understood as shared, safety-relevant ways of thinking and acting that are continuously shaped through social interaction (Nævestad, 2010; Bjørnskau & Longva, 2009). Developing a positive safety culture is an explicit objective of SMS in sectors such as maritime, aviation, and rail (IMO, 2018; ICAO, 2021; European Rail Agency, 2021), and is also reflected in voluntary standards for road safety. The underlying assumption is that formal procedures influence everyday practices (Reason, 1997). Empirical studies support this, showing that SMS can positively affect safety culture in different transport sectors (Adjekum & Tous, 2020; Lappalainen et al., 2012; Zuschlag et al., 2016).

Typically, SMS include formal procedures and measures that enable organisations to work systematically with safety. These often involve establishing safety policies and goals, defining roles and responsibilities, systematically collecting data on incidents and hazards, implementing countermeasures, monitoring their effects, and making adjustments where necessary (Thomas, 2012). Importantly, SMS also clarify companies’ responsibility for preventing work-related accidents through such structured approaches (Elvebakk et al., 2017).

Studies of SMS implementation in the road sector report reductions in crashes and incidents, as well as improvements in safety culture and road safety behaviour (Mooren et al., 2014; Murray et al., 2009; Murray et al., 2012; Wallington et al., 2014). For example, organisations that work systematically with safety management tend to achieve better safety outcomes (Gregersen et al., 1996). In addition, companies transporting dangerous goods often have lower crash risks and more developed safety management practices than other hauliers (Nævestad et al., 2017).

Despite these promising findings, Norwegian research indicates that neither transport companies nor authorities sufficiently prioritise SMS or organisational responsibility for safety in the road sector (Nævestad & Phillips, 2013; Phillips et al., 2018). Similar tendencies have been found in other countries, where work-related road safety has traditionally been managed through driver-focused measures rather than through SMS and safety culture (Newnam & Watson, 2011; ITF, 2017).

This strong emphasis on the driver rather than the organisation is linked to the legal framework governing crash prevention in the road sector. Authorities often rely on the Road Traffic Act, which places primary responsibility for safety on the driver (Samferdselsdepartementet, 2021), in their enforcement practices (Nævestad & Phillips, 2013). As a result, drivers at work are effectively treated as private drivers, even though employers have legal responsibility for their safety under the Working Environment Act (WEA, 2021). Studies indicate that relatively few employers recognise this responsibility in practice, for instance by implementing SMS (Elvebakk, 2015). Based on this, researchers argue that the road sector should learn from other high-risk industries, where organisational responsibility for safety is emphasised and operationalised through SMS (Nævestad & Phillips, 2018; Hudson, 2003). This recommendation is also reflected in international discussions on transport safety (ITF, 2017).

4.4.2. Implement the Safety Ladder for road safety management

Strengthening safety culture through safety management system requirements is not realistic in the road sector, since national implementation in one country has been said to violate with European competition rules, and it requires competence and resources that neither regulators, nor companies have. The most realistic solution is therefore to implement resources that companies can use to learn from this systematic SMS approach and adapt by implementing what they have the time and resources to do. Such an approach is offered by the Safety Ladder for road safety management (Nævestad et al., 2018a).

Previous studies indicate that organisations with employees who drive for work often place little emphasis on work-related risk factors for transport safety and little focus on organisational safety management (Nævestad et al., 2015b). This likely applies even more to occupational drivers who are not professional drivers, e.g., tradespeople, sales representatives, healthcare workers. International research also finds little emphasis on organisational safety management for employees who drive for work (e.g., Mooren et al., 2014; Wills et al., 2006).

Traditionally, work-related road safety has been handled by emphasising the individual responsibility of drivers, not through organisational safety management by employers (Nævestad & Phillips, 2023).

This lack of organisational safety focus is particularly apparent when compared to other transport sectors. Legal requirements exist for safety management systems in aviation, maritime, and rail sectors to foster a positive safety culture (Amtrak, 2015; Hudson, 2003; Lappalainen et al., 2014). In contrast, companies with employees driving for work can choose whether or not to implement such systems, e.g., ISO 39001.

Greater organisational focus on safety management for work-related driving can significantly increase road safety (Banks, 2008; Gregersen et al., 1996; Murray et al., 2009; Naveh & Marcus, 2007; Thomas, 2012; Mooren et al., 2014). Previous studies show up to a 60% reduction in crash risk in organisations with drivers (Gregersen et al., 1996). Furthermore, managers of employees who drive have both authority and responsibility to implement impactful safety measures (e.g., speed limiters, driving behaviour monitoring systems, alcohol locks).

Lack of focus on organisational safety management likely relates to company size and insufficient knowledge about the effects of safety measures, both in terms of safety and economic outcomes (Nævestad et al., 2018a). Literature reviews indicate that most organisational safety management initiatives are extensive, requiring time, resources, and expertise (Nævestad et al., 2018a). There are few robust studies clearly showing safety effects, and none that quantify economic outcomes of such measures.

The idea behind the **Safety Ladder** is that companies should begin at the lowest rung if they currently lack measures targeting work-related risk factors. This progression is based on research literature that suggests this particular order of implementation, emphasising the importance and priority of the measures (Flin et al., 2000; Thomas, 2012). Drawing from previous studies, it is assumed that the lower

levels are easier to address and yield the greatest impact. The Safety Ladder is built on an assumption that most transport companies have **limited resources** to develop comprehensive safety management systems (Fourie et al., 2010). On this basis, it is proposed that companies with **limited time, safety expertise, and financial resources** can begin by focusing on **basic and foundational efforts**.

4.4.3. The “Safety Ladder” Approach

This was the motivation for Nævestad et al. (2018) to develop the Safety Ladder for Safety Management in Transport Companies. It includes four main categories of measures, structured in ascending levels—companies start at the bottom if they have no measures targeting work-related risk factors.

The idea is that lower levels are easier to implement and more effective. The steps are:

1. **Management and employee engagement** in traffic safety—seen as essential for all further safety measures.
2. Systematic monitoring of speed and driving style through fleet management systems.
3. **Focus on work-related factors affecting safety**, e.g., stress and time pressure influencing driving behaviour.
4. **Implementation of a formal Safety Management System**, e.g., ISO 39001—systematic risk assessments, incident reporting, learning systems, etc.

4.4.4. Safety Ladder for safety management in transport organisations

Nævestad et al. (2018) developed the **Safety Ladder for Safety Management** through a systematic analysis of crashes involving drivers at work and a comprehensive review of all available research literature on organisational measures to improve safety for this group.

In identifying effective measures, Nævestad et al. (2018a) based their work on five key criteria. The measures must:

1. **Target the most significant risk factors** identified in previous research.
2. **Have demonstrated effectiveness** (or be closely associated with) various safety outcomes—such as crashes, incidents, or behaviour—based on sound research methods.
3. **Be associated with relatively low costs**, both financially and in terms of human resources, even for small businesses.
4. **Not be overly complex, context-dependent, or resource-intensive.**
5. **Complement existing safety management standards** in a way that allows them to serve as an introduction to formal standards, while also being effective even when they do not ultimately lead to full certification (e.g., ISO 39001).

Based on these criteria, Nævestad et al. (2018) identify **four measures** that can be arranged on a ladder, where organisations begin at the lowest level and progress upward, as illustrated in Figure 7.

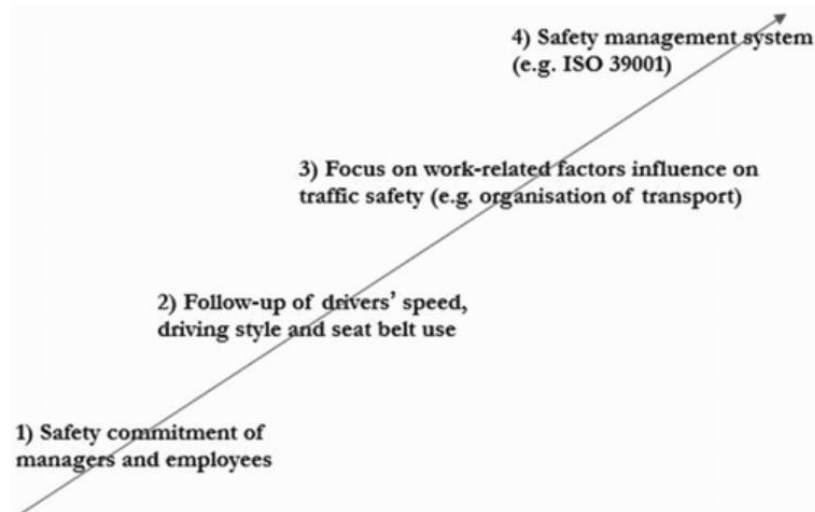


FIGURE 7 | The Safety Ladder for Safety management (Source: Nævestad et al., 2018a).

5. Summary and discussion

5.1. Synthesis

Building on the TRUST definition of TSC developed in Deliverable D2.1 – “shared values, beliefs, attitudes, norms, and behavioural patterns that shape how traffic safety is understood and enacted within a meaningfully defined group of actors in the transport system” – this deliverable examines how cultural approaches are currently being applied to improve road safety. It distinguishes between:

- Community-level TSC interventions, targeting private road users and broader societal groups.
- Organisational Safety Culture (OSC) interventions, targeting road users at work and organisations.

To fulfil this aim, the study had the following subgoals:

- To create an inventory of evaluated interventions to improve road safety that explicitly or implicitly apply a cultural approach.
- To identify good practices in the road transport and other safety-critical transport domains and sectors.
- To derive lessons, success factors, barriers, and recommendations that can support the design, implementation, and evaluation of future TSC interventions, at community and organisational (OSC) level.

Given the absence of a universally accepted definition of what constitutes a “TSC intervention”, the concept was initially operationalised as interventions that mainly aim at influencing TSC-elements (shared values, beliefs, norms, attitudes in a meaningfully defined group) or related shared ways of thinking, which are known to influence intentional behaviour. Measures aiming at direct behavioural control through e.g. infrastructure, legislation, or enforcement, are excluded in this concept. It is nevertheless acknowledged that traditional measures that impose direct behavioural change are effective and crucial for road safety, but the way to change deliberate behaviour in a sustainable way is by orienting underlying beliefs, social norms etc. towards more safety.

A mix of methods was used for the inventory: review of scientific literature identified during previous TRUST work on TSC and OSC definitions; additional searches for scientific review papers on relevant interventions; search on grey literature (reports and professional publications) and expert input on interventions in grey literature from TRUST partners and AB members.

1.5.1. Findings on TSC interventions

The literature results on TSC provide support for finetuning the “TSC intervention” concept. TSC interventions can be considered traffic safety culture-change interventions when they:

- aim at changing in a relatively short time period at least one of the TSC-elements in terms of shared ways of thinking/feeling about traffic safety, i.e. shared values and/or shared norms and/or shared beliefs and/or shared attitudes, that are known to sustainably influence wilful, intentional, deliberate behaviour among members of a meaningfully defined bonded group of actors (target group(s)) in the road transport system;
- are theory-based (social science/behavioural model) and consider the underlying social and cultural motives and external influences on the target behaviour in the target group(s), based on pre-measurements;
- focus on the most critical/salient shared ways of thinking/feeling underlying the target behaviour in the target group(s) and use messages that are tailored to the target group(s)

Further relevant elements are that they:

- create a social environment (broader than target group culture) to support the target behaviour change, by including strategies/actions for/by stakeholder groups in the different social ecology layers (e.g. family, school/workplace, local/national authorities, police...) to consider the complex system of varying layers of influence. This also refers to the use of a multi-factorial approach (e.g. combination with other strategies like enforcement, infrastructure, information campaigns...);
- target at least shared (behavioural/normative/control) beliefs "about the social environment" to make safe behaviour the norm;
- use positive framing of shared values/norms/beliefs/attitudes/behaviour in the strategies, highlighting positive aspects of the group culture that already exist, to motivate a sense of shared responsibility and collective safe behaviour.

The explorative inventory was based on the initial broader conceptual operationalisation and yielded relatively few interventions that explicitly describe themselves as TSC initiatives or cultural approaches. Most of the collected interventions focus on changing one or more TSC-elements (attitudes, norms...) without necessarily using the term "culture." The collection of intervention examples is very heterogeneous, covering a range of settings, strategies, objectives, target groups, evaluation designs, outcome variables etc. which complicates comparison and generalisation of results or findings. Most interventions are also traditional education/campaign measures, of which not all would still comply with the proposed finetuned concept of a TSC intervention.

The literature moreover provided clear methodological input on key success factors for TSC interventions. In summary, these include:

- Start with a sound understanding of the situation/problem
- Define the target group(s)
- Understand the target group (sub-)culture(s): theory-based pre-measurement of social and cultural motives and external influences that predict engagement in risky or protective behaviours in the target group(s)
- Definition of specific objectives: focus on the critical/salient shared beliefs
- Build strategy(ies) upon the objectives
- Create relatable/credible/representative messages, building upon positive aspects of the group culture that already exist
- Use of a comprehensive approach (combination with other strategies)
- Conduct a rigorous evaluation

Practical assessment criteria are proposed for each methodological success factor.

1.5.2. Findings on OSC interventions

Compared with community-level TSC interventions, the evidence base for OSC interventions is more mature. Research from road transport, aviation, rail, maritime transport, nuclear energy, and petroleum sectors provides substantial insight into how safety cultures can be strengthened within organisations.

Successful OSC interventions typically share several characteristics related to the process:

- Strong, visible and sustained top management commitment
- Employee engagement and support
- Trustful relationship between managers and employees
- Clear and strong motivation for the intervention
- Regulatory focus and support
- Clear and coherent implementation

- Absence of competing organisational processes
- Quality of design and relevance of the intervention content

Success factors also include strong safety leadership, structured safety management systems, continuous learning and improvement processes, open communication and reporting cultures, integration of safety into everyday organisational practices, and the use of long-term, systematic approaches rather than isolated short-term campaigns.

Methods to strengthen safety culture through safety management system are:

- Introducing mandatory safety management system requirements in road which formalise procedures and measures that enable organisations to work systematically with safety.
- Implementing the Safety Ladder for road safety management in transport companies, which includes four main categories of measures, structured in ascending levels of priority, targeting work-related risk factors.

The first suggestion relates to something that national authorities can do, or transport buyers through tenders or contract. The latter measure (implementing the Safety Ladder) is something that organisations can do themselves, and which provides a stepwise and simplified approach to implement a safety management system, which is based on systematic review of crashes and effective measures.

5.2. Strengths and limitations

The literature review and inventory on evaluated examples of TSC vs. OSC interventions differed in terms of complexity, essentially due to the lack of a clear TSC intervention concept and a substantial difference in literature maturity. The conceptualisation and scientific literature on safety culture practices in organisations is quite mature. On TSC interventions or road safety interventions with a cultural approach the literature is scarce, especially scientific literature, which is related to the fact that TSC is a relatively new research field and a current lack of a common (conceptual) understanding in the road safety field.

The first challenge was conceptualising a TSC intervention. The starting point was the consensus reached in TRUST Deliverable 2.1 (Nævestad et al., 2026) on the definition of TSC, but this does not automatically lead to a concise concept of a TSC intervention. It was commonly decided to operationalise it as an intervention primarily aimed at changing at least one of the elements of the TSC (definition) (shared values, norms, beliefs and attitudes) related to road safety in a defined group. The focus lay on shared ways of thinking as this aims to lead to a sustainable change in intentional behaviour. This operationalisation is on the one hand specific, by excluding interventions that aim at direct behavioural change like traditional engineering or enforcement measures. On the other hand, it is still broad as it also includes traditional education and campaign measures focusing on these TSC-elements (e.g. TPB approaches). It was as a result of the literature reviews that a finetuned conceptualisation could be proposed. A consequence is that not all collected interventions in the inventory would have been selected if the finetuned concept were used from the start. This task would have gained specificity if it could have started from a conceptual consensus. But as this was not part of the TRUST Deliverable 2.1 objectives, this knowledge had to be built-up progressively within this task.

Moreover, the proposed finetuning elements for the TSC intervention concept are based solely on literature and thus lack a structured expert consensus which would be required for final validation within TRUST. A formal consensus-building process, such as the Delphi Technique used in Deliverable 2.1 for defining TSC, was not included in the scope of this task.

The first literature review to find examples of TSC interventions was based on the scientific literature that was collected in the initial searches on TSC and OSC in scope of TRUST Deliverable 2.1. These were systematically searched on described interventions, practices and/or strategies. For TSC this led to a

limited number of possibly applicable interventions, while for OSC this led to several clear OSC interventions, including a systematic review. In order to collect more TSC interventions, the search was therefore broadened to scientific literature reviews on road safety interventions aimed at changing one or more TSC-(definition)-element, as well as to published and unpublished grey literature, and a request to TRUST experts (partners and AB members) to provide input. This yielded more interventions, although quite a lot falling into the scope of traditional “E” (education/campaign) interventions.

This inventory was exploratory rather than exhaustive. Many other interventions aiming to change some elements of culture likely exist. Some might not be documented or evaluated, others would be expressed using other keywords, would refer less systematically to a theory or be written in another language. The consultation of experts aimed to bridge this gap to some extent by bringing interventions which would not have been found in the database searches.

The main methodological characteristics of the collected interventions were coded in a standard scheme, with content instructions, to support comparison and evaluation. This was done by the main researchers in this task but also by other TRUST WP2 partners and AB members who provided expert input. Challenges relating to this procedure are the possible interpretation and coding differences between people. For instance, for some interventions very detailed descriptions are provided while other interventions are more generally described. The source documentation was not always available (in English). This complicates a thorough comparison. The descriptive analysis in section 3.1.1 therefore focuses on the big lines.

The scientific reviews were done in Scopus and Web of Science (published, peer-reviewed articles). Additional and broader search engine such as Google Scholar could have brought up other interventions. The scientific search databases were chosen to align with past research.

Considering the proposed finetuned concept of a TSC intervention, documented methodological guidelines and intervention examples essentially derive from foundational literature (dedicated professional books and reports) of a pioneering group of researchers (grey literature e.g. Ward et al., 2019 and publications from the CHSC, Montana State University etc.). This is due to the fact that this is an emerging research field worldwide. While this poses a potential risk of confirmation bias or over-reliance, our close collaboration with Nicholas Ward, one of the TRUST AB members, was an advantage for this task, since he has a unique long-term academic and practical expertise in culture-change strategies in traffic safety and provided invaluable access to his deep domain expertise.

5.3. Future research

The results in this report show the importance of the TRUST project for setting the framework for TSC interventions by providing theoretical insight and methodological guidance for practitioners in the road safety domain, because of the clear current lack of consensus and common understanding.

As the proposed elements for finetuning the TSC intervention concept are based on literature only, a suggestion for further research is to use the Delphi Technique for formal consensus-building.

Another main recommendation is the continued and extended inventory of TSC strategies to develop more finetuned guidance for implementation. This is also a defined research need in the recently published Traffic Safety Culture Research Roadmap (USA; National Academies of Sciences, Engineering, and Medicine, 2024).

Even though the scarcity of evaluated TSC interventions in this inventory is supported by results of a recent systematic analysis of the “state of the science” (Austin et al., 2022), a further extended literature search may provide more applicable examples. For instance, by using less restrictive scientific search engines (e.g. Google Scholar), by not focusing only on peer-reviewed papers, as well as through

snowballing within dedicated professional reports on TSC (e.g. of grey literature, like the book of Ward et al. (2019) "TSC: definition, foundation and application", and the "Traffic Safety Culture Research Roadmap (2024)" from the National Academies of Sciences, Engineering, and Medicine (2024)). This would on the other hand probably not have changed anything on the heterogeneity of current findings. The high number of hits in Google Scholars will also necessitate, for future works to be manageable, some further restriction in the search terms or a focus on some specific intervention types.

As TSC knowledge and common understanding will further build up in the road safety field, also based on the TRUST project, it is expected that more TSC interventions will be implemented and properly evaluated. A continued inventory of these practices is highly recommended as well as the use of systematic or meta-analyses when the number of evaluations rises. This would also allow developing a database of best practices.

Another recommendation is to use extended qualitative analysis of interventions used to change an existing culture to get a more detailed understanding of the strategies used, contextual factors playing a role and the impacts of these factors.

5.4. Mechanism-based approach to Traffic Safety Culture interventions

A link of this work to TRUST WP3 (Development of models, tools and interventions for TSC) is that interventions should change the set of beliefs comprising TSC, by drawing on the mechanisms between TSC-OSC and safety behaviour/crashes that are identified in WP3.

Deliverable 3.1 in the TRUST project provides a conceptual model of TSC, based on analyses of explicit/implicit mechanisms between TSC at different levels and crashes (Nævestad et al., 2026). This knowledge about mechanisms is crucial for developing TSC interventions. A mechanism-based approach to TSC interventions starts from the premise that effective interventions should target the causal processes that generate the phenomenon of interest, rather than merely addressing observed associations between variables. According to Elster (2007), explaining a social phenomenon requires identifying the mechanisms that produce it; that is, the sequence of causal processes linking causes to outcomes. Rather than asking only whether Traffic Safety Culture is associated with safer behaviour, a mechanism-based approach asks how Traffic Safety culture influences behaviour and through which processes this influence occurs (Nævestad et al., 2026). Understanding these mechanisms provides a stronger basis for intervention design because interventions can be directed at the factors that actually produce behavioural change.

The conceptual review presented in Deliverable 3.1 adopts precisely this mechanism-based perspective. Instead of simply reviewing whether Traffic Safety Culture is associated with traffic safety outcomes, the review identifies the mechanisms that are assumed to connect Traffic Safety Culture to behaviour at different cultural group levels (e.g. national, regional, family, peer levels). Across these different cultural group levels, results indicate that membership in cultural groups influences traffic safety behaviour through mechanisms such as shared values, descriptive and injunctive norms, attitudes, modelling, communication, monitoring, social learning, and peer influence. These mechanisms differ across the analytical levels. At the national level, abstract cultural values are translated into shared norms; at the regional and local levels, contextual norms influence behaviour; while at the family and peer levels, culture operates through direct social interaction, modelling, communication, and social pressure. The conceptual model developed in Deliverable 3.1 synthesises these findings into a causal framework linking cultural groups, mechanisms, behaviour, and traffic safety outcomes.

This understanding provides a systematic basis for developing Traffic Safety Culture interventions. Rather than designing interventions around broad concepts such as "improving safety culture," interventions can be targeted at the specific mechanisms that influence behaviour within particular cultural groups.

For example, if descriptive norms are found to maintain speeding within a community, interventions may focus on changing perceptions of what constitutes normal driving behaviour. If parental modelling is identified as the primary mechanism influencing novice drivers, interventions should target parents' own driving behaviour and communication practices rather than focusing exclusively on young drivers themselves. Similarly, interventions aimed at peer groups may seek to reduce peer pressure, strengthen positive group norms, or increase young drivers' resistance to social influence. Because different mechanisms operate at different analytical levels, the most effective interventions are likely to combine multiple approaches that address the mechanisms most relevant to the target group and behaviour.

The distinctive contribution of this approach is that it moves beyond describing Traffic Safety Culture toward explaining how traffic safety culture produces safety outcomes. Previous Traffic Safety Culture research has often identified associations between culture and behaviour but has rarely specified the causal mechanisms linking them. By explicitly identifying these mechanisms and organising them within a multi-level conceptual framework, the mechanism approach provides a stronger theoretical foundation for intervention development. It also allows interventions to be selected, designed, and evaluated according to whether they successfully modify the mechanisms that are expected to produce behavioural change. In this way, the mechanism-based approach offers a more transparent, theoretically grounded, and transferable framework for developing Traffic Safety Culture interventions than approaches based solely on empirical associations or broad cultural concepts.

While traditional Traffic Safety Culture research asks whether culture influences behaviour, the point of the mechanism-based approach is to ask how it does so, in order to provide a direct foundation for intervention design.

6. Conclusion

The results of this exploration suggest that TSC and OSC can be influenced through targeted interventions. Methodological factors for success have been identified, as well as proposed assessment criteria.

Evidence on TSC interventions is nevertheless still rather scarce in scientific literature which is related to the fact that TSC is a relatively new research field and that there is a current lack of a common (conceptual) understanding in the road safety field. This highlights the importance of the TRUST project.

The results on TSC provide support for finetuning the core concept of a TSC intervention:

A TSC intervention aims at changing in a relatively short time period at least one of the TSC-elements in terms of shared ways of thinking/feeling about traffic safety, i.e. shared values and/or shared norms and/or shared beliefs and/or shared attitudes, that are known to sustainably influence wilful, intentional, deliberate behaviour among members of a meaningfully defined bonded group of actors (target group(s)) in the road transport system. At community level this refers to private road user target groups and broader societal target groups.

This differentiates TSC interventions from interventions aimed at direct (forced/imposed) behavioural change like enforcement, law (changes), infrastructure and technology, which may also lead to changes in shared ways of thinking/feeling but rather as an effect after a longer period of time and indirectly. A comprehensive approach combining cultural strategies with other strategies does have a greater impact on TSC.

Additional relevant elements to the concept are proposed, including a required theoretical base and evidence-based design building upon knowledge of the target behaviour and group, the creation of a social environment to support the target behaviour change, and in campaigns: the framing of behaviours in terms of their social meaning and the highlighting of positive aspects of the group culture that already exist.

Scientific literature on the OSC intervention concept and on evaluated practices is more mature. Research from road transport, aviation, rail, maritime transport, nuclear energy, and petroleum sectors provides substantial insight into how safety cultures can be strengthened within organisations. Nævestad et al. (2018) have identified four key activities (content) which seem to be common in all the reviewed interventions, and eight key factors (process) influencing the success of efforts to influence safety culture. The basic requirements of safety culture change seem to be to institutionalise joint discussions of workplace hazards facilitated by manager commitment and employee involvement.

Key methodological factors for success have been identified for both TSC and OSC interventions. These indicate that elaborate and sustainable efforts are required to increase intervention effectivity, while it is not guaranteed that intended results are achieved./

References

- Abreu, T. C., Beulens, J. W., Heuvelman, F., Schoonmade, L. J., & Mackenbach, J. D. (2024). Associations between dimensions of the social environment and cardiometabolic health outcomes: a systematic review and meta-analysis. *BMJ Open*, 14(8). <https://doi.org/10.1136/bmjopen-2023-079987>
- Adeola, R., Omorogbe, A. & Johnson, A. (2016). Get the message: a teen distracted driving program. *Journal of Trauma Nursing*, 23(6), 312–320. <https://doi.org/10.1097/JTN.0000000000000240>
- Adjekum, D. K., & Tous, M. F. (2020). Assessing the relationship between organizational management factors and a resilient safety culture in a collegiate aviation program with Safety Management Systems (SMS). *Safety Science*, 131, 104909. <https://doi.org/10.1016/j.ssci.2020.104909>
- Aigner-Breuss, E., & Eichhorn, A (2017). Awareness raising and campaigns – Seatbelts, European Road Safety Decision Support System, developed by the H2020 project SafetyCube. Retrieved from www.roadsafety-dss.eu on 01 06 2026
- Aigner-Breuss, E., & Pilgerstorfer, M. (2017), Awareness raising and campaigns – Child restraint. European Road Safety Decision Support System, developed by the H2020 project SafetyCube. Retrieved from www.roadsafety-dss.eu on 01 06 2026.
- Ajzen, I. (1991). The theory of planned behavior. *Organizational Behavior and Human Decision Processes*, 50(2), 179–211.
- Amtrak (2015). Safety and security: opportunities exist to improve the Safe-2-Safer program, (Audit Report OIG-A-2015-007, February 19, 2015).
- Antonsen, S., Nilsen, M., & Almklov, P. G. (2017). Regulating the intangible Searching for safety culture in the Norwegian petroleum industry. *Safety Science*, 92, 232–240. <https://doi.org/10.1016/j.ssci.2016.10.013>
- Arslan, V., Kurt, R. E., Turan, O., & De Wolff, L. (2016). Safety Culture Assessment and Implementation Framework to Enhance Maritime Safety. *Transportation Research Procedia*, 14, 3895–3904. <https://doi.org/10.1016/j.trpro.2016.05.477>
- Austin E., Ward, N., Otto, J., Green, K., & Watson, H. (2022). Assessing the Impact of Culture: A Systematic Analysis of Culture-Based Interventions and Evaluations. *Front. Future Transportation*, 3, 917915. <https://doi.org/10.3389/ffutr.2022.917915>
- Austin, E., Otto, J., Green, K., Watson, H., Ward, N. J., & Dively, K. (2021) Guidance for Evaluating Traffic Safety Culture Strategies. Center for Health and Safety Culture, Montana State University. https://rosap.nhtl.bts.gov/view/dot/55813/dot_55813_DS1.pdf
- Avril, E., Picco, A., Lescarret, C., Lemerrier, C., Arguel, A., & Caroux, L., (2024) Gamification in the transport and mobility sector: a systematic review *Transportation Research F: Traffic Psychol. Behav.*, 104, 286–302, [10.1016/j.trf.2024.06.004](https://doi.org/10.1016/j.trf.2024.06.004)
- Bandura, A. (1969). Principles of behavior modification. New York, NY: Holt, Rinehart and Winston.
- Bandura, A. (1977). Social learning theory (Vol. 2). Englewood Cliffs, NJ: Prentice Hall.
- Banks, T. D. (2008). An investigation into how work related road safety can be enhanced [PhD dissertation, Queensland University of Technology].

Belland, K. M., Olsen, C., & Lary, R. (2010). Carrier air wing mishap reduction using a Human Factors Classification System and risk management. *Aviation, Space and Environmental Medicine*, 2010(81), 1028–1032. <https://doi.org/10.3357/ASEM.2539.2010>

Bernard, B. (2018). Safety Culture Oversight: An Intangible Concept for Tangible Issues within Nuclear Installations. *Safety*, 4(4), 45. <https://doi.org/10.3390/safety4040045>

Bernard, B. (2014). Safety culture as a way of responsive regulation: proposal for a nuclear safety culture oversight model. *International Nuclear Safety Journal*, 3(2), 1–11. <https://nuclearsafety.info/international-nuclear-safety-journal/index.php/INSJ/article/viewFile/28/pdf>

Biassoni, F., Perego, P., Rasolohajamanana, F., Silva, A., Rasamison, N., Raharimanana, S., Ratsima, H., Ralimamy, H., & Randrianarisoa, J. (2019) Evaluation of a road safety education intervention (ALFA Project) by assessing road crossing behaviour in students, Transaid. <https://doi.org/10.13140/RG.2.2.34403.50728>

Bjørnskau, T., & Longva, F. (2009). Sikkerhetskultur i Transport; (TØI Rapport 1012/2009). Transportøkonomisk Institutt: Oslo, Norway.

Boedigheimer, D. (2010). Exploring reactions to pilot reliability certification and changing attitudes on the reduction of errors [PhD. Dissertation, Northcentral University]. Prescott Valley, Arizona.

Botteghi, G., Theofilatos, A., & Macaluso, G. (2017). Speeding: general police enforcement, speeding, European Road Safety Decision Support System, developed by the H2020 project SafetyCube. Retrieved from www.roadsafety-dss.eu on 01 06 2026.

Boulanger, A., & Meng, A. (Eds.) (2009). Reporting tool for effects of a single campaign. EC CAST project, Campaigns and Awareness-Raising Strategies in Traffic Safety. Sixth Framework Programme, DG Energy and Transport. Belgian Road Safety Institute.

Boulanger, A. (Ed.) (2009). Evaluation tool for road safety campaigns. EC CAST project, Campaigns and Awareness-Raising Strategies in Traffic Safety. Sixth Framework Programme, DG Energy and Transport. Belgian Road Safety Institute.

Bundesministerium für Innovation, Mobilität und Infrastruktur (Hrsg.) (2025). Evaluierung der Kampagne „Voll am Leben“ Bd. 99. https://www.bmimi.gv.at/verkehrssicherheit/beratung-foerderung/vsf/publikationen/forschungsarbeiten/99_voll-am-leben.html

Bye, R. J., Rosness, R., & Røyrvik, J. O. D. (2016). 'Culture' as a tool and stumbling block for learning: The function of 'culture' in communications from regulatory authorities in the Norwegian petroleum sector. *Safety Science*, 81, 68–80. <https://doi.org/10.1016/j.ssci.2015.02.015>

CHSC - Center for Health & Safety Culture (2019). Together for Life Final Report. Increasing seat belt use in rural Utah. Montana State University. Western Transportation Institute. www.chsculture.org : <https://chsculture.org/wp-content/uploads/2024/03/UT-DPS-TFL-Final-Report-2019-11-27.pdf>

CHSC - Center for Health & Safety Culture (2020). Guidance for evaluating traffic safety culture strategies. Montana State University, Center for Health and Safety Culture.

CHSC - Center for Health & Safety Culture (2024) Positive Culture Framework. A Foundation For Cultural Transformation. Montana State University, Center for Health and Safety Culture <https://chsculture.org/wp-content/uploads/2024/03/Positive-Culture-Framework-Booklet.pdf>

- Classen, S., Winter, S. M., Brown C, Morgan-Daniel, J., Medhizadah, S., & Agarwal, N. (2019). An Integrative Review on Teen Distracted Driving for Model Program Development. *Front. Public Health* 7:111. <https://10.3389/fpubh.2019.00111>
- Cuenen, A., Brijs, K., Brijs, T., Van Vlierden, K., Daniels, S., & Wets, G. (2016). Effect evaluation of a road safety education program based on victim testimonials in high schools in Belgium. *Accident Analysis & Prevention*, 94, 18-27. <https://doi.org/10.1016/j.aap.2016.05.006>
- De Dobbeleer, W., Nathanail, T., & Adamos, G. (2009). Pan-European road safety campaign: campaign evaluation. EC CAST project TREN-05-FP6TR-S07.59641-019520-CAST, Deliverable 5.3.
- Delhomme, P., De Dobbeleer, W., Forward, S., & Simões, A. (Eds.) (2009). Manual for designing, implementing, and evaluating road safety communication campaigns. EC CAST project, Campaigns and Awareness-Raising Strategies in Traffic Safety. Sixth Framework Programme, DG Energy and Transport. Belgian Road Safety Institute. <https://www.vias.be/storage/main/cast-manual-final.pdf>
- Edkins, G. D. (1998). The INDICATE safety program: Evaluation of a method to proactively improve airline safety performance. *Safety Science*, 30(3), 275–295. [https://doi.org/10.1016/S0925-7535\(98\)00049-6](https://doi.org/10.1016/S0925-7535(98)00049-6)
- Eichhorn, A., & Kaiser, S. (2017). Awareness raising and campaigns – Aggressive and inconsiderate behaviour, European Road Safety Decision Support System, developed by the H2020 project SafetyCube. Retrieved from www.roadsafety-dss.eu on 01 06 2026.
- Eichhorn, A., & Kaiser, S. (2017). Awareness raising and campaigns – Driving under the influence, European Road Safety Decision Support System, developed by the H2020 project SafetyCube. Retrieved from www.roadsafety-dss.eu on 01 06 2026.
- Elvebakk, B. (2015). Between Control. and Collaboration: Transport. Safety Inspectorates in Norway, TØI Report 1404/2015; Institute of Transport Economics: Oslo, Norway.
- Elvebakk, B., Nævestad, T.-O., & Ranestad, K. (2017). Work-Related Accidents in Norwegian Road, Sea and Air Transport. Roles and Responsibilities; TØI Report 1567/2017; TØI: Oslo, Norway.
- Elvik, R., Høy, A., Vaa, T., & Sørensen, M. (2009). The handbook of road safety measures. Second edition. Emerald Group Publishing Limited. <https://doi.org/10.1108/9781848552517>
- ERA - European Rail Agency (2021a) European Rail Safety Climate Survey (ERA-SCS) European Rail Safety Climate Survey (ERA-SCS) | European Union Agency for Railways.
- ERA - European Rail Agency (2021b). Safety Management Systems. https://www.era.europa.eu/activities/safety-management-system_en (accessed on 14 March 2021).
- ETSC (2010). PRAISE: Thematic Reports 1-6. <http://www.etsc.eu/documents/PRAISE%20Leaflet.pdf> Accessed 25. January 2012.
- ETSC (2025). Ranking EU progress on road safety 19th Road Safety Performance Index (PIN) Report.
- ETSC (2009). PRAISE: Preventing road accidents and injuries for the safety of employees (Report 1).
- European Commission (2015). Work-Related Road Safety, European Commission, Directorate General for Transport, September 2015.

- Faus, M., Alonso, F., Esteban, C., & Useche, S. (2022). Are adult driver education programs effective? A Systematic Review of evaluations of accident prevention training courses. *International Journal of Educational Psychology*, 12(1). <https://doi.org/10.17583/ijep.8805>
- Faus, M., Alonso, F., Fernández, C., & Useche, S. A. (2021). Are Traffic Announcements Really Effective? A Systematic Review of Evaluations of Crash-Prevention Communication Campaigns. *Safety*, 7(4), 66. <https://doi.org/10.3390/safety7040066>
- Finley, K., Hanson, B., & Green, K. (2024a). Resources and Tools to Reduce Multiple Risky Driving Behaviors. Center for Health and Safety Culture, Montana State University.
- Finley, K., Hanson, B., Otto, J., & Green, K. (2024b). Understanding Aggressive Driving and Ways to Reduce It – Phase 1. Center for Health and Safety Culture Montana State University.
- Finley, K., Otto, J., Green, K., & Hanson, B. (2024c). Tools and resources to improve pedestrian safety. Center for Health and Safety Culture, Montana State University. <https://www.mdt.mt.gov/research/projects/trafficsafety.aspx>
- Flin, R., Mearns, P., O'Connor, R., & Bryden, R. (2000). Measuring safety climate: identifying the common features. *Safety Science*, 34, 177–192 [https://doi.org/10.1016/S0925-7535\(00\)00012-6](https://doi.org/10.1016/S0925-7535(00)00012-6)
- Fort, E., Pourcel, L., Davezies, P., Renaux, C., Chiron, M., & Charbotel, B. (2010). Road accidents, an occupational risk. *Safety Science*, 48(10), 1412–1420. <https://doi.org/10.1016/j.ssci.2010.06.001>
- Forward, S., & Kazemi, A. (Eds.) (2009). A theoretical approach to assess road safety campaigns Evidence from seven European countries. EC CAST project, Campaigns and Awareness-Raising Strategies in Traffic Safety. Sixth Framework Programme, DG Energy and Transport. Belgian Road Safety Institute.
- Forward, S., Linderholm, I., & Henriksson, P. (2020). Persuade habitual cyclists to use helmets – a scientific study developing and evaluating a bicycle helmet campaign (summary in English). VTI report 1057, Swedish National Road and Transport Research Institute, Linköping; Sweden.
- Forward, S., Henriksson, P., Silvano, A. P., Miyoba, T., Sinkala, S., Mawele, S., & Mwamba, D. (2025). Increasing traffic safety at schools in Zambia: a before and after study. VTI report 1226A, Swedish National Road and Transport Research Institute, Linköping; Sweden.
- Fourie, C., Holmes, A. Hildritch, C., Bourgeois-Bougrine, A., & Jackson, P. (2010). Interviews with operators, regulators and researchers with experience of implementing Fatigue Risk Management Systems. Road Safety Research Report. London, Department for Transport.
- FRA Federal Railroad Administration (2006). Canadian Pacific Railway Investigation of Safety-Related Occurrences Protocol Considered Helpful by both Labor and Management, RR 06-13 September 2006, U.S. Department of Transportation Federal Railroad Administration, Research Results, <https://www.fra.dot.gov/eLib/details/L03518>.
- FRA Federal Railroad Administration (2016a). C3RS is Implementing Corrective Actions and Expanding Within the Railroad Industry. U.S. Department of Transportation Federal Railroad Administration (2016) https://www.fra.dot.gov/eLib/details/L17405#p1_z5_gD_ksafety%20culture
- FRA Federal Railroad Administration (2016b). System Safety Program. Final rule (Docket No. FRA-2011-0060, Notice No. 3). Retrieved from <https://www.fra.dot.gov/eLib/Details/L18294>
- FRA Federal Railroad Administration (2017). System Safety Program (Docket No. FRA-2011-0060, Notice No. 4). Retrieved from https://www.fra.dot.gov/eLib/details/L18584#p1_z5_gD_ksystem

- Gałązkowski, R., Wolkowski, W., Mikos, M., & Stanislav, S. (2015). The strategy of training staff for a new type of helicopter as an element of raising the security level of flight operations. *International Journal of Occupational Safety and Ergonomics*, 21(4), 558–567. <https://doi.org/10.1080/10803548.2015.1095010>
- Goettee, D., Spiegel, W., Tarr, R., Campanian, C., & Grill, L. (2015). Overview of federal motor carrier safety administration safety training research for new entrant motor carriers. Motor Carrier Services: The SAGE Corporation. https://rosap.nhtl.bts.gov/view/dot/208/dot_208_DS1.pdf
- Gregersen, N. P., Brehmer, B., & Morén, B. (1996). Road safety improvement in large companies. An experimental comparison of different measures. *Accident Analysis & Prevention*, 28(3), 297–306. [https://doi.org/10.1016/0001-4575\(95\)00060-7](https://doi.org/10.1016/0001-4575(95)00060-7)
- Griffioen, J., Van Der Drift, M., & Van Den Broek, H. (2021). Enhancing Maritime Crew Resource Management Training by Applying Resilience Engineering: A Case Study of the Bachelor Maritime Officer Training Programme in Rotterdam. *Education Sciences*, 11(8), 378. <https://doi.org/10.3390/educsci11080378>
- Grote, G., & Weichbrodt, J. (2013). Why regulators should stay away from safety culture and stick to rules instead. In: Bieder, C., & Bourrier, M. (Eds.), *Trapping Safety into Rules: How Desirable and Avoidable is Proceduralization of Safety?* (1st ed., pp. 225–240). CRC press. <https://doi.org/10.1201/9781315549774>
- Haukelid, K. (2008). Theories of (safety) culture revisited—an anthropological approach. *Safety science*, 46(3), 413–426. <https://doi.org/10.1016/j.ssci.2007.05.014>
- Helman, S., Christie, N., Ward, H., Grayson, G., Delmonte, E., & Hutchins, R. (2014). Strategic review of the management of occupational road risk, The Royal Society for the Prevention of Accidents (RoSPA), <https://www.rospace.com/rospaweb/docs/Advice-Services/Road-Safety/morr-strategic-review.pdf>
- Hudson, P. (2003). Applying the lessons of high risk industries to health care. *Quality and Safety in Health Care*, 12, i7–i12. <https://pmc.ncbi.nlm.nih.gov/articles/PMC1765769/>
- IAEA (1991). *Safety Culture* (Safety Series 75-INSAG-4). International Atomic Energy Agency, Vienna.
- IAEA (1992). *The Chernobyl Accident: Updating of INSAG-1 INSAG-7*. International Atomic Energy Agency, Vienna.
- IAEA (1997). *Examples of Safety Culture Practices* (Safety Reports Series No. 1). International Atomic Energy Agency, Vienna.
- IAEA (2002). *Key Practical issues in strengthening safety Culture, INSAG 15. A REPORT by the International Nuclear Safety Advisory Group*, International Atomic Energy Agency, Vienna.
- IAEA (2006). *The Management System for Facilities and Activities: Safety Requirements* (Safety Standards Series No. GS-R-3). International Atomic Energy Agency, Vienna.
- IAEA (2009). *The Management System for Nuclear Installations* (Safety Guide No. GS-G 3.5). International Atomic Energy Agency, Vienna.
- IAEA (2013). *Regulatory Oversight of Safety Culture in Nuclear Installations* (IAEA TECDOC-1707). International Atomic Energy Agency, Vienna.
- IAEA (2016). *OSART– Independent Safety Culture Assessment (ISCA) Guidelines*. International Atomic Energy Agency, Vienna.

ICAO (2021). ICAO Annex 19, Safety Management. Available online: <https://skybrary.aero/articles/icao-annex-19-safety-management> (accessed on 14 March 2021).

IMO (2018). ISM Code. International Safety Management Code with Guidelines for Its Implementation; IMO: London, UK.

ITF (2017). Safety Management Systems. Summary Report of roundtable meeting held at OECD headquarters on 23–24 March 2017. In ITF/TRC (2017)21; ITF: London, UK.

Kaiser, S., & Aigner-Breuss, E. (2017). Effectiveness of Road Safety Campaigns, European Road Safety Decision Support System, developed by the H2020 project SafetyCube. Retrieved from www.roadssafety-dss.eu on 01 06 2026.

Karlsen, J. E., & Valen, H. (2010). The social construction of HSE culture: A case study from the Norwegian petroleum industry. In: Ale, Papazoglou, Zio (Eds.), Reliability, Risk and Safety. Taylor and Francis Group, London.

Katrakazas, C., & Talbot, R. (2017). Education – Elderly training, European Road Safety Decision Support System, developed by the H2020 project SafetyCube. Retrieved from www.roadssafety-dss.eu on 01 06 2026.

Kaye, S.-A., Rodwell, D., Watson-Brown, N., Rose, C., & Buckley, L. (2022). Road users' engagement in prosocial and altruistic behaviors: A systematic review. *Journal of Safety Research*, 82, 342–351. <https://doi.org/10.1016/j.jsr.2022.06.010>

Kazemi, A., & Forward, S. (2009). Evaluation of the Swedish bicycle helmet wearing campaign 2008. In Forward, S. & Kazemi, A. (Eds). A theoretical approach to assess road safety campaigns: Evidence from seven European countries. Cast Project. Belgian Road Safety Institute (IBSR-BIVV), Brussels.

Kennedy, A., Cullen, B., Firman, D., Fleiter, J. J., & Lewis, I. (2018). Peer passenger intentions to speak up to a risky driver: A theoretically guided investigation of the effects of a high school road safety education program. *Transportation Research Part F: Traffic Psychology & Behavior*, 54, 15–27.

KFV (n.d.). Internal report on school class workshop "speeding: risk?", Austria (intervention 2018-2019).

KFV (n.d.). Internal report on workshop "Mindful. Safe. Mobile. Driving a car", Austria (intervention 2021-2022).

Kongsvik, T., Gjøesund, G., & Vikland, K. M. (2016). HSE culture in the petroleum industry: lost in translation? *Safety Science*. 81, 81–89. <https://doi.org/10.1016/j.ssci.2015.04.019>

Kringen, J. (2009). Culture and Control: Regulation of Risk in the Norwegian Petroleum Industry. [Ph. D. dissertation, University of Oslo] Center for Technology, Innovation and Culture, Faculty of Social Sciences, University of Oslo, Oslo, Norway.

Kullgren, A., Stigson, H., Rizzi, M., & Tingvall, C. (2023). Fatalities in value chains—An attempt to classify road traffic crashes in accordance with the United Nations General Assembly Resolution 74/299. *Traffic Safety Research*, 5, 000027.

Lappalainen, F. J., Kuronen, J., & Tapaninen, U. (2012). Evaluation of the ISM Code in the Finnish shipping companies. *Journal of Maritime Research*, 9(1), 23–32.

Le Coze, J.-C., & Wiig, S. (2013). Beyond procedures: can 'safety culture' be regulated? In: Bieder, C., Bourrier, M. (Eds.), *Trapping Safety Into Rules. How Desirable or Avoidable Is Proceduralization?* Ashgate, Farnham.

Lewis, D., Côté, P. A., Lacombe, M., & Moser, G. (2007). *Stronger Ties: A Shared Commitment to Railway Safety- Report of the Advisory Panel. Railway Safety Act Review Secretariat, Ottawa, Canada.* www.tc.gc.ca/tcss/RSA_Review-Examen_LSF

Lewis, I., Elliott, B., Kaye, S.-A., Fleiter, J. J., & Watson, B. (2019a). "The Australian Experience with Road Safety Advertising Campaigns in Improving Traffic Safety Culture" In: *Traffic Safety Culture*. Published online: 01 Apr 2019; 275-295. Permanent link to this document: <https://doi.org/10.1108/978-1-78714-617-420191017>

Lewis, I., Forward, S., Elliott, B., Kaye, S.-A., Fleiter, J. J., & Watson, B. (2019b). Designing and Evaluating Road Safety Advertising Campaigns. In Ward, N., Watson, B. & Fleming-Volg, K. (eds.), *Traffic Safety Culture*. (pp. 297-319). <https://doi.org/10.1108/978-1-78714-617-420191018>

Lewis, I., Watson, B., & Ho, B. (2021). Slow down! Get off that phone! The impact of a high school road safety education program in influencing whether a young person speaks up to a risky driver. *Transportation Research Part F: Traffic Psychology & Behavior*, 78, 353–368.

Lewis, I., Watson, B., & White, K.M. (2016). The step approach to message design and testing (SatMDT): A conceptual framework to guide the development and evaluation of persuasive health messages. *Accident Analysis and Prevention*, 97, 309-314.

Linkenbach, J., & Perkins, H. W. (2005). Montana's MOST of Us Don't Drink and Drive Campaign. A Social Norms Strategy to Reduce Impaired Driving Among 21-34-Year-Olds. Montana Social Norms Project. Montana State University, USA.

Liu, Y., Ye, L., & Guo, M. (2021). Does formal mentoring impact safety performance? A study on Chinese high-speed rail operators. *Journal of Safety Research*, 77, 46–55. <https://doi.org/10.1016/j.jsr.2021.02.001>

Magkafas, F., Fountas, G., Anastasopoulos, P. Ch., & Basbas, S. (2025). Beyond Speed Reduction: A Systematic Literature Review of Traffic-Calming Effects on Public Health, Travel Behaviour, and Urban Liveability. *Infrastructures*, 10(6), 147. <https://doi.org/10.3390/infrastructures10060147>

Makahleh, H. Y., Taamneh, M. M., & Dissanayake, D. (2025). Promoting Sustainable Transport: A Systematic Review of Walking and Cycling Adoption Using the COM-B Model. *Future Transportation*, 5(3), 79. <https://doi.org/10.3390/futuretransp5030079>

Milch, V., & Nævestad, T.-O. (2024). Heart Zone as a measure to influence traffic safety culture: which factors influence culture change? *Traffic Safety Research*, 6. <https://doi.org/10.55329/nzwz4807>

Milch, V., Nenseth, V., Opheim, I., Even, L., & Nævestad, T.-O. (2024). Kunnskapsgrunnlag om virkninger av Hjertesone. (Knowledge based on the effects of Heart Zone), Transportøkonomisk institutt (TØI) <https://www.toi.no/publikasjoner/kunnskapsgrunnlag-om-virkninger-av-hjertesone>

Mirman, J., Roche, B., & Higgins-D'Alessandro, A. (2018) School safe driving climate: Theoretical and practical considerations for promoting teen driver safety in school settings. *Traffic Injury Prevention*, 19(6), 644-650. <https://doi.org/10.1080/15389588.2018.1476689>

Mod Ali, N. (2008). Challenges in promoting radiation safety culture. *Journal of Nuclear Science and Technology*, 45, 623–626. <https://doi.org/10.1080/00223131.2008.10875932>

Mooren, L., Grzebieta, R., Williamson, A., Olivier, J., & Friswell, R. (2014). Safety management for heavy vehicle transport: A review of the literature. *Safety Science*, 62, 79–89. <https://doi.org/10.1016/j.ssci.2013.08.001>

Mumlu Karanfil, S. (2025). Evaluating the Reporting and Safety Culture of an Airline According to Patankar and Sabin's Safety Culture Pyramid. *International Journal of Aviation, Aeronautics and Aerospace*, 12(1). <https://doi.org/10.58940/2374-6793.1953>

Murray, W., Ison, S., Gallemore, P., & Nijjar, H.S. (2009). Effective Occupational Road Safety Programs A Case Study of Wolseley. *Transportation Research Record*, 2096, 55–64. <https://doi.org/10.3141/2096-08>

Murray, W., White, J., & Ison, S. (2012). Work-related road safety: A case study of Roche Australia. *Safety Science*, 50(1), 129–137. <https://doi.org/10.1016/j.ssci.2011.07.012>

Nævestad, T.-O. & Phillips, R. O. (2013). Trafikkulykker ved kjøring i arbeid - en kartlegging og analyse av medvirkende faktorer. TØI rapport 1269/2013. Oslo, Transportøkonomisk institutt.

Nævestad, T.-O. (2017). Safety culture, working conditions and personal injuries in Norwegian maritime transport. *Marine Policy*, 84, 251–262. <https://doi.org/10.1016/j.marpol.2017.07.019>

Nævestad, T.-O., & Phillips, R. O. (2023). The limits of soft safety regulation: Does successful work with safety culture require SMS implementation? *Transportation Research Interdisciplinary Perspectives*, 17.

Nævestad, T.-O., Elvebakk, B., & Phillips, R. O. (2018a). The safety ladder: developing an evidence-based safety management strategy for small road transport companies. *Transport Reviews*, 38(3), 372–393. <https://doi.org/10.1080/01441647.2017.1349207>

Nævestad, T.-O., Hesjevoll, I. S., & Phillips, R. O. (2018b). How can we improve safety culture in transport organizations? A review of interventions, effects and influencing factors. *Transportation Research Part F: Traffic Psychology and Behaviour*, 54, 28–46. <https://doi.org/10.1016/j.trf.2018.01.002>

Nævestad, T.-O., Phillips, R. O., Laiou, A., Bjørnskau, T., & Yannis, G. (2019a). Safety Culture among Private and Professional Drivers in Norway and Greece: Examining the Influence of National Road Safety Culture. *Safety*, 5(2), 20.

Nævestad, T.-O., Storesund Hesjevoll, I., Elvik, R., Lothe Brunstad, Ø., & Blom, J. (2025b). Safe System, Vision Zero, and Sustainable Safety: a scoping review. *Traffic Safety Research*, 9, e000115. <https://doi.org/10.55329/ekkh368>

Nævestad, T.-O. (2010). Culture, Crises and Campaigns: Examining the Role of Safety Culture in the Management of Hazards

Nævestad, T.-O., & Phillips, R. O. (2018). The relevance of safety culture as a regulatory concept and management strategy in professional transport: Comparing the experiences of regulators and companies from four sectors. TØI rapport 1668/2018, Oslo: Transportøkonomisk institutt.

Nævestad, T.-O., Blom, J., & Storesund Hesjevoll, I. (2025a). How can we integrate road safety into occupational health and safety management 'to save lives beyond 2025'? A study of safety management among drivers at work. *Traffic Safety Research*, 9, e000104. <https://doi.org/10.55329/eldk4357>

Nævestad, T.-O., Phillips, R. O., & B. Elvebakk, B. (2015a). Traffic accidents triggered by drivers at work - a survey and analysis of contributing factors, *Transportation Research Part F: Psychology and Behaviour*, 34, 94-107.

Nævestad, T.-O., Phillips, R. O., Elvebakk, B., Bye, R. J., & Antonsen, S. (2015b). Work-related accidents in Norwegian road sea and air transport: prevalence and risk factors, TØI report 1428/2015, Oslo: Transportøkonomisk institutt.

Nævestad, T.-O., Storesund Hesjevoll, I., & Elvik, R. (2021b). How can regulatory authorities improve safety in organizations by influencing safety culture? A conceptual model of the relationships and a discussion of implications. *Accident Analysis & Prevention*, 159, Article 106228.

Nævestad, T.-O., Storesund Hesjevoll, I., Ranestad, K., & Antonsen, S. (2019b). Strategies regulatory authorities can use to influence safety culture in organizations: Lessons based on experiences from three sectors. *Safety Science*, 118, 409–423.

Nævestad, T.-O., Elvebakk, B., & Ranestad, K. (2021a). Work-Related Accident Prevention in Norwegian Road and Maritime Transport: Examining the Influence of Different Sector Rules. *Infrastructures*, 6, 72.

Nævestad, T.-O., Meesmann, U., Wallén Warner, H., Kaiser, S., Milch, V., De Roeck, M., Schachner, M., Nikolaou, D., Björklund, G., Laiou, A., Storesund Hesjevoll, I., Forward, S., & Wennberg, H. (2026). Traffic Safety culture: Framework; influencing factors; traffic safety impact. Deliverable 2.1 of the EC Horizon Europe project TRUST.

National Academies of Sciences, Engineering, and Medicine. (2024). Traffic Safety Culture Research Roadmap. Washington, DC: The National Academies Press. <https://doi.org/10.17226/27488>

Naveh, E., & Katz-Navon, T. (2015). A longitudinal study of an intervention to improve road safety climate: Climate as an organizational boundary spanner. *Journal of Applied Psychology*, 100(1), 216–226.

Naveh, E., & Marcus, A. (2007). Financial performance, ISO 9000 standard and safe driving practices effects on accident rate in the U.S. motor carrier industry. *Accident Analysis and Prevention*, 39(4), 731–742. <https://doi.org/10.1016/j.aap.2006.11.004>

Newnam, S., & Muir, C. (2019). Workplace Road Safety and Culture: Safety Practices for Employees and the Community. In Ward, N., Watson, B. & Fleming-Volg, K. (eds.), *Traffic Safety Culture*. (pp. 221-249). <https://doi.org/10.1108/978-1-78714-617-420191006>

Newnam, S. & Oxley, J. (2016). A program in safety management for the occupational driver: Conceptual development and implementation case study. *Safety Science*, 84, 238–244. <https://doi.org/10.1016/j.ssci.2015.12.020>.

Newnam, S., & Watson, B. (2011). Work-related driving safety in light vehicle fleets: A review of past research and the development of an intervention framework. *Safety Science*, 49, 369–381.

Noella, K., (2017). Implementation of rumble strips at centreline, European Road Safety Decision Support System, developed by the H2020 project SafetyCube. Retrieved from www.roadsafety-dss.eu

Norwegian Ministry of Labour and Government Administration (2002). St.meld. nr. 7 (2001–2002): Om helse, miljø og sikkerhet i petroleumsvirksomheten [White Paper No. 7 (2001–2002): On health, environment and safety in the petroleum activities]. Oslo: Arbeids- og administrasjonsdepartementet.

- O'Connor, P. (2011). An evaluation of the effectiveness of bridge resource management training. *International Journal of Aviation Psychology*, 21(4), 357–374. <https://doi.org/10.1080/10508414.2011.606755>
- O'Mara, E., Cole, P., Wynn, A., & Collison, R. (2015). A fit for purpose training programme for the decontamination of personnel. *Journal of Radiological Protection*, 35(2), 249–256. <https://doi.org/10.1088/0952-4746/35/2/249>
- OECD (2016). Zero road deaths and serious injuries: Leading a paradigm shift to a safe system. Paris: Organisation for Economic Co-operation and Development.
- Otto, J., Ward, N., Finley, K., Baldwin, S. T., & Alonzo, W. (2022). Increasing Readiness to Grow Traffic Safety Culture and Adopt the Safe System Approach: A Story of the Washington Traffic Safety Commission. *Front. Future Transp.*, 3, <https://doi.org/10.3389/ffutr.2022.964630>
- Otto, J., Ward, N. J., & Finley, K. (2019). Guidance for the Measurement and Analysis of Traffic Safety Culture. In Ward, N., Watson, B. & Fleming-Volg, K. (eds.), *Traffic Safety Culture*. (pp. 65-91) <https://doi.org/10.1108/978-1-78714-617-420191006>
- Perego, P., & Tripodi, A. (2025). Communication and enforcement under constrained conditions: evidence from a national road safety campaign in Saint Lucia, unpublished (internal communication).
- Perego, P., Biassoni, F., King, M. J., & Ciceri, M.R. (2018). Perception of road hazards in a Tanzanian secondary school before and after a traffic psychology intervention. *Journal of Transport and Health*, 10, 37–43.
- Petty, R. E., & Cacioppo, J. T. (1986). The elaboration likelihood model of persuasion. In *Communication and Persuasion: Central and Peripheral Routes to Attitude Change* (pp. 124). New York, NY: Springer.
- Phillips, R. O., Ulleberg, P., & Vaa, T. (2009). Do road safety campaigns work? A meta-analysis of road safety campaign effects. In: Forward, S. & Kazemi, A., *A theoretical approach to assess road safety campaigns. Evidence from seven European countries. Campaigns and awareness-raising strategies in traffic safety (CAST) project*.
- Phillips, R. O., Nævestad, T.-O., & Jordbakke, G. (2018). Increasing the Implementation of Traffic Safety Management Systems by Organisations, TØI Report 1664/2018; TØI: Oslo, Norway.
- Phillips, R. O., Ulleberg, P., & Vaa, T. (2011). Meta-analysis of the effect of road safety campaigns on accidents. *Accident Analysis and Prevention*, 43, 1204–1218.
- Pilgerstorfer, M., & Eichhorn, A. (2017). Awareness raising and campaigns – Speeding, European Road Safety Decision Support System, developed by the H2020 project SafetyCube. Retrieved from www.roadsafety-dss.eu on 01 06 2026
- Ranney, J., & Nelson, C. (2004). Impacts of participatory safety rules revision in U.S. railroad industry: an exploratory assessment. *Transportation Research Record*, 1899(1), 156–163.
- Ranney, J., Zuschlag, M., Morell, J., Coplen, M., Multer, J., & Raslear, T. (2013) Evaluations of demonstration pilots produce change: fourteen years of safety culture improvement efforts by the FRA. *Transportation Research News*, 286, 28–36.
- Reason, J. (1997). *Managing the Risks of Organizational Accidents* (1st ed.). Routledge. <https://doi.org/10.4324/9781315543543>

Reason, J. (1998). Achieving a safe culture: Theory and practice. *Work and Stress*, 12(3), 293–306. <https://doi.org/10.1080/02678379808256868>

Riaz, M. S., Cuenen, A., Dhondt, S., Craps, H., Janssens, D., Wets, G., Brijs, T., & Brijs, K. (2019). Evaluation of a road safety education program based on driving under influence and traffic risks for higher secondary school students in Belgium. *Safety*, 5(2), 34. <https://doi.org/10.3390/safety5020034>

Roberts, H., Retting, R., Webb, T., Colleary, A., Turner, B., Wang, X., & White, C. (2015). Improving safety culture in public transportation. Transit Cooperative Research Program (TCRP) report 174.

Röttger, S., Vetter, S., & Kowalski, J. T. (2016). Effects of a classroom-based bridge resource management training on knowledge, attitudes, behaviour and performance of junior naval officers. *WMU Journal of Maritime Affairs*, 15(1), 143–162. <https://doi.org/10.1007/s13437-014-0073-x>

Salminen, S. (2008). Two interventions for the prevention of work-related road accidents. *Safety Science*, 46, 545–550 <https://doi.org/10.1016/j.ssci.2007.05.007>

Samferdselsdepartementet (2021). Norwegian Road Traffic Act. Available online: <https://lovdata.no/dokument/NL/lov/1965-06-18-4> (accessed on 14 February 2021).

Schein, E. H. (2004). *Organizational Culture and Leadership* (3. ed) (San Francisco: Jossey- Bass).

Svensson, M. (2017). Anti-Whiplash - EuroNCAP, European Road Safety Decision Support System, developed by the H2020 project SafetyCube. Retrieved from www.roadsafety-dss.eu

Szawranskyj, P., & Choudhury, A. (2025). Pilot Training Modalities in Aviation: A Systematic Review of Their Impact on Safety. AHFE HAWAII International Conference (AHFE HAWAII 2025). <https://doi.org/10.54941/ahfe1006954>

Talbot, R. (2017). Education – non-statutory training for novice drivers, European Road Safety Decision Support System, developed by the H2020 project SafetyCube. Retrieved from www.roadsafety-dss.eu on 01 06 2026.

Taubman-Ben-Ari, O., Musicant, O., Lotan, T., & Farah, H. (2014). The contribution of parents' driving behavior, family climate for road safety, and parent-targeted intervention to young male driving behavior. *Accident Analysis and Prevention*, 72, 296–301. <https://doi.org/10.1016/j.aap.2014.07.010>

Thomas, M. (2012). A Systematic Review of the Effectiveness of Safety Management Systems (No. AR-2011-148); Australian Transport Safety Bureau: Canberra, Australia.

Universita Cattolica del Sacro Cuore (2018). Viaggio nel Senso della Strada, internal report.

Unni, P., Estrada, C. M., Chung, D. H., Riley, E. B., Worsley-Hynd, L., & Stinson, N. (2017) A multiyear assessment of a hospital-school program to promote teen motor vehicle safety. *Journal of Trauma and Acute Care Surgery*, 83(2), 289–95. <https://doi.org/10.1097/TA.0000000000001521>

Västå, A., Gustafsson, F., Wennberg, H., & Johansson, A. (2025a). Aktörsundersökning inom trafiksäkerhet väg 2024: Företag som arbetsgivare och transportköpare. Trafikverket TRV 2025/70623. Publikationsnummer: 2025:140. ISBN: 978-91-8045-504-6. <https://trafikverket.diva-portal.org/smash/get/diva2:2002448/FULLTEXT01.pdf> [Companies as employers and purchasers of transport services].

Västå, A., Gustafsson, F., Wennberg, H., & Johansson, A. (2025b). Aktörsundersökning inom trafiksäkerhet väg 2025: Kommuner som arbetsgivare och transportupphandlare. Trafikverket TRV 2025/70623.

Publikationsnummer: 2025:141. ISBN: 978-91-8045-505-3. <https://trafikverket.diva-portal.org/smash/get/diva2:2002839/FULLTEXT01.pdf> [Road Traffic Safety Stakeholder Survey: Municipalities as employers and procurers of transport services].

Vilwock-Witte, N. M., Clouser, K., Fay, L., May, D., Hetherington, N., Johnson, L., & Sullivan, J. (2023). Improving Traffic Safety Culture Using a Novel Dissemination Method. *ITE Journal*, 12, 34-38. <https://westerntransportationinstitute.org/wp-content/uploads/2024/01/2023-ITE-Journal-MDT-Safety-Video-WTI-MSU-ITE-Article.pdf>

Wallington, D., Murray, W., Darby, P., Raeside, R., & Ison, S. (2014). Work-related road safety: Case study of British Telecommunications (BT). *Transport Policy*, 32, 194–202. <https://doi.org/10.1016/j.tranpol.2014.01.002>

Ward, N. J. (2026). Framework to Define and Assess Culture-Based Traffic Safety Campaigns. Draft white paper for KDOT Drive to Zero traffic safety plan.

Ward, N. J., Otto, J., & Finley, K. (2019a). Ten Principles of Traffic Safety Culture. In Ward, N., Watson, B. & Fleming-Volg, K. (eds.), *Traffic Safety Culture*. (pp. 21-39) <https://doi.org/10.1108/978-1-78714-617-420191004>

Ward, N. J., Otto, J., & Finley, K. (2019b). *Traffic Safety Culture Primer*. Bozeman, MT: Center for Health and Safety Culture, Montana State University. https://www.mdt.mt.gov/other/webdata/external/research/docs/research_proj/tsc/TSC_PRIMER/PRIMER.pdf.

WEA (2021), Norwegian Working Environment Act. <https://lovdata.no/dokument/NL/lov/2005-06-17-62> (accessed on 14 March 2021).

Wennberg, H., & Evanth, K. (2020). *Trafiksäkerhetsrevision av Trafikkontoret, Göteborgs Stad Revisionsrapport*. Projektnr: 19231. Trivector Traffic Rapport 2020:33 Version 1.0. <https://tekniskhandbok.goteborg.se/wp-content/uploads/Trafiksakerhetsrevision-av-Trafikkontoret-Goteborgs-Stad-2021-04.pdf> [Road Safety Audit of the Traffic and Public Transport Authority, City of Gothenburg Audit Report].

Wennberg, H., Dahlholm, O., & Slotte, J. (2022 a). *Trafiksäkerhetslyftet – underlag för en omarbetad trafiksäkerhetsrevision*. Projektnummer: 22137. Trivector Rapport 2022:199 Version 1.0. https://trivectormobility.se/wp-content/uploads/2025/05/2022_199-skr-omarbetad-trafiksakerhetsrevision-v1-0.pdf [The Road Safety Initiative – Basis for a Revised Road Safety Audit].

Wennberg, H., Hannes Englesson, H., & Pernilla Hyllenius Mattisson, P. (2022 b). *Kunskapsstöd till arbetsgivare, transportutförare och transportköpare: Underlagsrapport*. Projektnummer: 22111. Trafikverket Trivector Rapport 2022:136 Version 1.0. Rapportnummer: 2022:136 https://trivectormobility.se/wp-content/uploads/2025/05/2022_136-trafikverket-kunskapsstod-arbetsgivare-underlagsrapport-v1-0.pdf [Knowledge Support for Employers, Transport Providers, and Transport Buyers: Background Report].

Wills, A. R., Watson, B., & Biggs, H.C. (2006). Comparing safety climate factors as predictors of work-related driving behaviour. *Journal of Safety Research*, 37(4), 375–383. <https://doi.org/10.1016/j.jsr.2006.05.008>

Witte, K. (1992). Putting the fear back into fear appeals: The extended parallel process model. *Communication Monographs*, 59(4), 329-349.

Zuschlag, M., Ranney, J. M., & Coplen, M. (2016). Evaluation of a safety culture intervention for Union Pacific shows improved safety and safety culture. *Safety Science*, 83, 59–73. <https://doi.org/10.1016/j.ssci.2015.10.001>

Annex 1 | Ethical, open science and transparency considerations

Open science compliance statement

This deliverable follows the Open Science principles outlined in the Grant Agreement. The study design, methods, and analytical approach are described transparently to support reproducibility and critical appraisal. Where possible, results are reported in a way that allows traceability from data collection to interpretation.

Publications arising from this work will be made available through open-access channels in accordance with project requirements. Data generated in the course of the study are handled in line with ethical and GDPR obligations. As the study involves expert input and qualitative material, some underlying data cannot be made fully open due to confidentiality and anonymisation constraints. However, aggregated results, methodological descriptions, and analytical frameworks are reported in sufficient detail to support reuse and secondary analysis.

Any limitations to data sharing are justified on ethical and legal grounds, and do not affect the transparency of the study's methods or conclusions.

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Annex 2 | Detailed scientific literature search strategies

Topic	Initial search	Abstract and article selection
	Initial search in D2.1 Main search terms searched in titles and key words, sector terms in title, keyword and abstract. Publication type: Article or review article English language Publication date: 2010-2025 Search terms ("safety culture" OR "safety climate" OR "organisational culture" OR "company culture" OR "corporate culture" OR "workplace culture")) AND (safety) AND ("air pilot" OR helicopter OR aviation OR airline seafarer OR maritime OR ship OR boat OR ferry OR offshore OR nautical rail OR railway OR subway OR metro OR tram OR subway OR road OR traffic OR street OR taxi OR cab OR "professional driver" OR "truck driver" OR lorry OR "bus driver" OR "work driver" OR nuclear OR IAEA) Articles for screening: 693 Initial search in D2.1 Searching title or key words. English language. Publication type: Article or review article Search terms (traffic OR road OR pedestrian OR cyclist OR bike OR car OR lorry OR moped OR motorcycle OR truck OR road user* OR bus OR taxi OR cab OR cyclist OR highway) AND safety AND (climate OR culture) Articles for screening: 654 Search terms (adapted from Nævestad, 2018) (safety AND intervention AND "truck driver") OR (work-related AND road AND safety) OR (fleet AND safety AND intervention) OR (organizational AND intervention AND safety AND road) OR (safety AND effect AND "professional driver")	Initial abstract selection in D2.1 The search was then further restricted to the abstracts selected in D2.1 search process. These were then rejected if focus is only on a different sector, or on no sector, if main focus is not culture or the focus is not on employees/employers, but on all/other people. This led to the selection of 320 abstracts. Further title and abstract selection Title and abstracts were screened stepwise for articles discussing specific interventions. If any doubts, the full text was screened to look for interventions. Interventions: 10 - all included in 1 review paper Nævestad et al., 2018b Initial abstract selection in D2.1 The search was then further restricted to the abstract selected in D2.1 search process. Hits were rejected in D2.1 if not about TSC or traffic safety climate or if the focus is on another sector than road transport. This led to the selection of 136 abstracts. Further abstract selection The abstracts were then screened for articles discussing specific interventions. If any doubts, the full text was screened to look for interventions. Interventions: 5 Title and abstracts were screened stepwise for articles discussing specific interventions. Interventions: 0

Topic	Initial search	Abstract and article selection
	Search criteria Searching title, abstract or key words. English language. Publication type: Article or review article Publication date: 2016-2025 Articles for screening: 224	
	Search terms (traffic OR road OR pedestrian OR cyclist OR bike OR car OR lorry OR moped OR motorcycle OR truck OR road user* OR bus OR taxi OR cab OR cyclist OR highway) AND safety AND ("shared value" OR belief* OR attitude* OR norm* OR behaviour*)	Title and abstracts were screened stepwise for review articles discussing specific interventions. This led to 8 reviews. Then, through snowballing, 6 examples of relevant interventions in 3 of these reviews were selected.
	Search criteria Searching title, abstract or key words. English language. Publication type: review article Publication date: 2010-2025 Articles for screening: 463	Interventions: 6

Note: The first two searches were conducted early July 2025 on Scopus and Web-of-Science, the latter two in February 2026 on Web-of-Science.

TABLE 9 | Search strings, restrictions and selection strategies for each of the four literature searches for interventions on traffic or organisational safety culture in the transport sector.

Annex 3 | Expert consultation for TSC interventions

Outline of the expert consultation mail. The first request was sent 11/03/2026, a reminder was 23/03/2026.

Object: Input needed on Traffic Safety Culture Interventions

Dear TRUST partners [TRUST AB members],

Within WP2, we need to make an inventory of existing traffic safety culture (TSC) interventions aiming at improving road safety. This will provide guidance for the elaboration and evaluation of interventions in WP4 and WP5.

Besides our scientific literature search (Web of Science, papers in English, 2010-2026), we would like to ask all TRUST partners [AB members] to provide input on interventions documented in grey literature, e.g. (inter)national project deliverables, study reports.

Your task is to:

- Provide 3–5 existing traffic safety culture interventions in the Excel file
- Prioritise interventions/projects **you/your organisation** were involved in or that took place in **your country** to lower risk of duplication
- Complete **Sheet 2** with the requested information per intervention
- Note the **name/reference** of the interventions you included in this **shared file**
- Send back the Excel file together with **documentation** (also if not in English) before **March 25th**
- You can also send us relevant documents/papers that you did not include in the Excel file

The interventions should:

- Explicitly target **traffic safety culture/climate**, i.e. shared values, beliefs, attitudes, norms, and patterns of behaviours that shape how traffic safety is understood and enacted, within a clearly defined target group
- Be in the context of **road traffic safety**
- Preferably have been evaluated using a **robust design** (outcome evaluation: pre-post with control group)
- Preferably include documented **good and/or bad practices**
- May also be ongoing interventions that have not yet been evaluated

We are particularly interested in interventions that:

- Target **non-professional road users** (e.g., communities, peer groups, families, countries)
- Take a **holistic approach** (addressing multiple levels and/or dimensions)
- Include **educational, awareness-raising, or campaign measures**, ideally combined with other measures (e.g., a national speeding campaign combined with increased enforcement)
- **Exclude enforcement, legislation, infrastructure, engineering measures** for the general population **unless** they are combined with targeted educational, awareness-raising, or campaign measures.

Annex 4 | Structured inventory results: evaluated interventions

(1) TSC: Inventory of interventions

Broader / integrated interventions

Intervention with a broader approach (holistic, mix of interventions/methods, different target groups, stakeholders)

Center for Health & Safety Culture, (2019), USA (campaign with tools for different stakeholders in social ecology)

Center for Health & Safety Culture (2019) Together for Life Final Report. Increasing seat belt use in rural Utah. Montana State University. Western Transportation Institute. www.chsculture.org <https://www.towardzerodeaths.org/wp-content/uploads/2020/09/UT-DPS-TFL-Final-Report-2019-11-27.pdf>

GENERAL DESCRIPTION: The Highway Safety Office of the Utah Department of Public Safety engaged the Center for Health and Safety Culture to apply the Center's **Positive Culture Framework** in a pilot study with three rural counties to increase seat belt use. In 2016, four additional counties were added to the project. *Objective* is to change shared beliefs that already exist in a community's culture (supportive beliefs for seat belt wearing). *Stakeholders:* Highway Safety Office of the Utah Department of Public Safety engaged the Center for Health and Safety Culture (CHSC) (for strategy/approach/toolbox/support); training/support of public health workers, state leaders and county coordinators in 7 rural counties; in each county: collaborations with local coalitions (e.g. law enforcement, schools, workplaces, department of transportation, and hospitals). *SDG:* SDG 3

THEORETICAL MODEL: The Center uses an approach called the **Positive Culture Framework** to improve health and safety. The framework uses a seven-step process applied across the **social ecology** to grow beliefs supportive of protective behaviours. The Center worked with the public health coordinators to bolster skills in leadership, communication, and integration of strategies.

INTERVENTION CONTENT: Resources of the Positive Culture Framework approach included **tools** (toolbox: toolkits **for different stakeholders**) to work with local law enforcement, workplaces, key leaders, students, and community members (e.g. media sources, statistical reports, activity decision-making worksheets, speaking points, press releases, booklets...). The Center provided the local coordinators training (2 days: positive culture framework approach and toolbox) and ongoing support (monthly calls with prevention specialists) about the resources and how to use them in their communities. Media (campaign including video/social media, audio/radio ads, and print/poster/booklets/banners with local county-level data, and website) were created and locally placed. Some media used local individuals as voices in radio spots.

(OUTCOME) EVALUATION METHOD: **Pre-post** survey and **observational** studies: results are summarised for adults, students, law enforcement, and key leaders. Pre-post surveys in (1) community adults and (2) students, to assess changes in behaviours and beliefs. Random sample of 12 000 households in each county (7). Overall response rate (1) 38% (pre; N 3169) and 43% (post N 3 114). **Comparison group** (not heard/seen the media). Also process evaluation.

EFFECT: Pre-post survey: **mixed effects**

- Adult behaviours and beliefs changed positively, especially the campaign exposed persons (over one-third of those surveyed).

- More males reported wearing a seat belt, had beliefs supportive of using seat belts, and asked others to wear a seat belt (changes among females were smaller and often not statistically significant).
- More male high school students reported wearing seat belts and had supportive beliefs about seat belts as well as intentions to ask their friends to wear a seat belt.
- Also changes in behaviour/beliefs in key leaders.
- No significant changes in beliefs or behaviours among law enforcement officers (either about wearing seat belts themselves or about consistently enforcing seat belt laws).
- Observational studies: increases in seat belt use as the self-reported surveys: Observed seat belt use increased by an average of 20% in the seven counties compared to 7% in urban counties between 2012 and 2019.
- Furthermore, in 2018, the numbers of unrestrained fatalities and serious injuries in these seven counties were also lower; however, these events are rare, and the number of events in any given year is difficult to interpret as a meaningful trend.

It is important to note that Utah **changed** its **seat belt law** from a secondary law (enforced only when another traffic violation has occurred) to a primary law (enforced as standalone violation) in 2015. This change in the law most likely supported increases in seat belt use as well.

No control group: This evaluation does not include comparisons to communities that did not participate in Together for Life (i.e., "control" communities). While the changes revealed in the observational and self-report surveys are consistent with the goals of the project (in terms of the beliefs that changed and how the changes in beliefs are associated with awareness of the messages), we cannot draw the conclusion that it was the Together for Life project that caused these changes.

Process: 37% had heard about the campaign a few times a year or more often positive feedback on toolkit, collaborations...

LEARNINGS - FACTORS LEADING/IMPEDING SUCCESS – REMARKS: Challenges based on interviews:

- Statewide leader interviews: biggest challenge was employee turnover and differing levels of **engagement** throughout the project.
- Coordinators: not having enough **time** to devote to the project.
- Other challenges included the lack of engagement from law enforcement and the coalition's desire to use scare tactics.

Social Ecology: Using the social ecology to address seat belt use influenced the respondents' thinking in a number of ways. Many felt like using the social ecology helped them better understand behaviours and the factors that influence behaviours like values and norms. The **social ecology helped the coordinators better understand the need for different strategies and approaches with different audiences**. The coordinators also started to recognize how using the social ecology to address seat belt use could be replicated with other issues they work on. It provided a foundation for all the health and safety work they do. The social ecology provided a **strategic way for them to organize and prioritize** their work.

Barriers: Some **stakeholders were hard to reach** (e.g. law enforcement) -> listen to what they wanted or needed and provide tools to assist stakeholders in doing their jobs. **Different stakeholders required different approaches**; The coordinators expressed that a lot of time was needed to build relationships with hard-to-reach stakeholders; -> Program Manager support: The tools should be presented as resources that are available to help make the stakeholder's job easier and their workplace safer.

Toolkits for different audiences: general positive feedback, especially life cards 'wear it for me', as conversation starter or as a way to assist awareness raising.

Surveys and data were used to correct misperceptions, increase knowledge, educate leaders, pinpoint target groups etc.

Positive Approach: All the statewide leaders and coordinators interviewed believed that the use of a positive approach to address seat belts was beneficial to the project. The positive approach was more relatable, energy giving, connected with people on an emotional level, warmer, and more inviting for others to participate. They recognised that scare tactics do not work when making sustainable behaviour change. The **positive messages are more effective and focus on what they are seeking**, health. A few of the coordinators mentioned that this has also impacted their work on other health and safety issues. Using positive messages was empowering and brought hope to the work.

Milch & Nævestad (2024), Norway (different interventions around/in school)

Milch & Nævestad (2024) Heart Zone as a measure to influence traffic safety culture: which factors influence culture change? Traffic Safety Research vol. 6. <https://doi.org/10.55329/nzwz4807>

GENERAL DESCRIPTION: Nationally available scheme to **influence traffic culture in the specific geographical area around schools, through collaboration of local key road traffic actors** (municipality, school management...), aiming at changing awareness, norms and behavioural patterns. Target group: primarily parents of school children; more broadly local community (external road users). *Stakeholders:* Local/community: The Heart Zone initiative is a comprehensive, multisectoral scheme developed through the collaboration of key road traffic actors: municipalities, school managements and road owners, Norwegian road safety council. Main actors for implementation and monitoring are the municipality and schools. *SDG:* It advocates for increased walking and cycling to school, extending beyond safety to also benefit environmental and public health (SDG 3, SDG13, SDG15)

THEORETICAL MODEL: The intervention operationalises culture as **descriptive norms**, which are defined as road users' perceptions of what others actually do in traffic. The underlying theoretical assumption is that subtle social pressure acts as the mediating mechanism, motivating individuals to behave in conformity with perceived "normal" or "socially accepted" behaviours.

INTERVENTION CONTENT: **Different types of interventions** can be implemented, e.g. education/campaigns (walking/cycling campaigns, bicycle training, traffic education, information for parents), infrastructural (e.g. drop-off zones, traffic-calming), and symbolic sanctions (for unnecessary driving in the area) aiming at reduced motorised traffic and increased active modes' traffic around schools, depending on the local traffic conditions and school challenges

OUTCOME/EFFECT EVALUATION METHOD: **Post-test:**

- Qualitative (focus groups, interviews - municipality and school level of implementation)
- Quantitative survey of parents (N220) on implementation indices, traffic safety behaviour, TSC-descriptive norms (perception of how others typically behave), safety perceptions, knowledge and awareness...
- Process evaluation (implementation and perception of management/commitment)

EFFECT: Based on the post-intervention parents' survey: **successful** establishment of a Heart Zone Traffic Safety Culture at several schools with **increased parental vigilance** towards students walking or cycling and **more dropping off at the recommended zone** if they drive. 18% of parents report an **increase in walking or cycling** and 14% report a **decrease in car use** for school drop-offs (most pronounced for parents living within 1km of the school) (behavioural changes); 35% agree that conflicts during drop-off and pick-up has decreased (safety perception); 46% report more awareness of vulnerable road users and 54% more concern of overall traffic safety around the school. But **no comparison to a pre-test**.

LEARNINGS - FACTORS LEADING/IMPEDING SUCCESS – REMARKS: The study identifies specific factors facilitating and impeding traffic culture change, related to enclosed geographical areas like the Heart Zone, developing an analytical model that researchers and future traffic culture measures like this can learn from.

- Factors related to implementation of culture in geographical areas: **interaction of road users (social norms), perceived suitability/adequacy of infrastructure** and traffic situation. Impeding factors: composition of road users (not much influence on users circulating in HZ that are not affiliated to the school).
- Factors related to implementation of culture in organisational setting: **management sanctions** (reactions to unnecessary driving in HZ, police, cameras...), management **commitment** (incorporated in formal processes, prioritised, on agenda, in parent meetings...), **systematic approach** = 'Traffic Safety plan' as tool (systematise existing work and give directions), resources and capacity (time), support 3rd party (municipal area of investment)

Milch et al. (2024), Norway (different interventions around/in school)

Milch, V., Nenseth, V., Opheim, I., Even, L., Nævestad, T.O. (2024) *Kunnskapsgrunnlag om virkninger av Hjertesone - Transportøkonomisk institutt (Knowledge based on the effects of Heart Zone)*
<https://www.toi.no/publikasjoner/kunnskapsgrunnlag-om-virkninger-av-hjertesone>

GENERAL DESCRIPTION: Local initiative aimed at improving traffic safety around schools. *Objectives:* change awareness, norms and behavioural patterns of students and parents. Aspects considered at (school) organisational level: management's commitment to safety, communication. *Stakeholders:* The initiative can come from different actors. Sometimes the schools, sometimes the municipality, other times the parents at school. *SDG:* SDG 3, SDG 11. Implicit, but the measure also has a strong focus on sustainability, though traffic safety is the primary target.

THEORETICAL MODEL: Traffic Safety Culture: **Social norms**

INTERVENTION CONTENT: It's context specific for each school what type of measures they include. Common measures are walking groups, physical decorations outside the school, traffic education for kids, and awareness raising measures such as reflector days. etc.

OUTCOME/EFFECT EVALUATION METHOD: **Comparison of HZ schools and schools that have not implemented the measure (control group).** Survey on Traffic Safety Culture (norms) and behaviour. The evaluation included schools that had implemented the measure, and schools that were planning to implement, but had not yet done so. The evaluation focused on whether the intervention influenced Traffic Safety Culture and travel behaviours (survey to parents): awareness, norms and behavioural patterns. Also process evaluation (survey to school/municipalities on implementation success factors/barriers). A survey about Heart Zone was sent to all schools in Norway with primary education levels (n=2267) during March-May 2023. 662 schools responded to the survey. About 20% of the schools currently have a Heart Zone, while 12% plan to introduce the measure. 37% of the schools had not heard of the measure.

EFFECT: **Intervention influenced Traffic Safety Culture**, but limitations to design. There are significant differences between Heart Zone schools and schools that have not implemented the measure in what is considered normal ways of delivering/collecting. There are indications that the measure has led to **changes in travel habits** among parents and students. 16% of parents at Heart Zone schools state that they **deliver/collect by car less** than before the introduction, 14% report that their **children cycle more**, and 10% report that their **children walk to/from school more** often. Over half of the schools report that Heart Zone has contributed to **more systematic traffic safety work**, and **greater awareness** of traffic safety among parents, staff and students.

LEARNINGS - FACTORS LEADING/IMPEDING SUCCESS – REMARKS: **School management commitment** to implementation important facilitating factor (engagement from the school's management, especially the principal, is essential to legitimise the initiative), so is **Parent-Teacher Association commitment** (strong commitment acts as a vital link between the school and parents). **Information work**, especially directed at parents and through repeated reminders, is also highlighted. **Student involvement** promote engagement. **Physical measures**, such as the establishment of drop zones and the increasing the visibility of the Heart Zone with guards, as well as signage, support the initiative's effectiveness. **Attitude-influencing measures**, such as bicycle and walking competitions, reflector days, and visible traffic guards outside the school, are mentioned as effective in promoting safe and healthy travel habits.

Lacking **economic resources** to follow up the measure can impede the process. Physical conditions, such as a **lack of suitable areas** for drop zones and challenging traffic conditions, are also barriers mentioned. Other perceived challenges include a **lack of coordination** at the interface with external actors and a **lack of cooperation** with the municipality. Organisational challenges, such as a **lack of capacity and insufficient involvement** of school management, can also prevent successful implementation and follow-up of the initiative.

Mirman et al. (2018), USA (school safe driving climate program)

Mirman, J., Roche, B. & Higgins-D'Alessandro, A. (2018) School safe driving climate: Theoretical and practical considerations for promoting teen driver safety in school settings, Traffic Injury Prevention, 19:6, 644-650, DOI: 10.1080/15389588.2018.1476689

GENERAL DESCRIPTION: **School-based peer-led traffic safety program** at high schools to raise awareness and promote transportation safety among students. Peer student leaders develop and implement the program for their fellow students and are encouraged to find other partners, e.g. police, for additional resources to help develop and execute the program. **Collaboration** with teacher advisors, school administration. *Target group:* students (adolescents) at high school. *Stakeholders:* schools are responsible to develop and implement the program. They receive financial, technical and administrative support from the Champion Schools Program agency. A faculty member work with them to develop the program. Students also identify **community-based partners** to develop their own peer program. *SDG:* SDG 3 - Good Health & Well-being: Target 3.6: Reduce road deaths and injuries.

THEORETICAL MODEL: A **novel construct** was developed and assessed (School Safe Driving Climate; SSDC), which **integrates theory on school climate used in educational research, social norms and identity**. It consists of (1) clear and consistent rules and norms about safe transportation, (2) teaching and learning on the topic of transportation safety, (3) institutional resources supportive of safe transportation, and (4) peer and teacher–student relationships supportive of safe transportation.

INTERVENTION CONTENT: The peer-led program consists of activities on graduated driver licensing compliance, encouraging enforcement at home, increasing practice driving hours; Student-created materials to promote safety themes; Key sharing on safe driving and GDL laws

OUTCOME/EFFECT EVALUATION METHOD: **Retrospective pre-post** test design (**pre and post were questioned in 1 survey), no control group.**

- Quantitative survey of students in one school (N946), reporting perceptions “after the program” and “before the program” at the same timepoint (school safe driving climate, driving behaviour, compliance with GDL, driving variables related to social/interpersonal factors)
- Qualitative: structured interviews with teacher advisors from all schools for contextual info (N44)

EFFECT:

- Students reported an **improvement in administrative safety climate** (i.e. the administrative contributions to the school safety climate).
- Student team members reported **improved value of safety climate** (i.e., the value seen by others about safety); **however, other students reported a small decrease**, though this difference was very small.

Positive perceptions of "administrative safety climate" and the "value of safety climate" – these were positively associated with self-reported safe driving behaviours and active concern for safety. General limitation: pre and post were questioned in 1 survey.

LEARNINGS - FACTORS LEADING/IMPEDING SUCCESS – REMARKS: From the interviews, 8 themes emerged:

- The 4 benefits were (1) student engagement, (2) resources, (3) expanding the campaign/program, and (4) skill building opportunities.
- The 4 challenges were (1) lack of participation, (2) lack of outside support, (3) difficult logistics, and (4) difficulties in implementing the campaign/program.

School - Student focused interventions

Adeola et al. (2016), USA, Puerto Rico, Canada & 21 other countries

Adeola R, Omorogbe A, Johnson A. (2016) *Get the message: a teen distracted driving program*. *Journal of Trauma Nursing* 23:312–20. doi: [10.1097/JTN.0000000000000240](https://doi.org/10.1097/JTN.0000000000000240)

GENERAL DESCRIPTION: The "Get the message: A teenage distracted driving program" is an educational program to influence teenagers' attitudes, driving behaviours and knowledge/awareness of the dangers of distracted driving. *Target group:* teenage drivers (high school students 14–18-year-old) *Stakeholders:* the R Adams Cowley Shock Trauma Center (STC) and the STC's Center for Injury Prevention and Policy (CIPP). *SDG:* SDG3 - decrease the risk of distracted driving among teens to reduce preventable injuries and establish a culture of injury prevention in Maryland

THEORETICAL MODEL: The program components were created based on the theoretical constructs of the Health Belief Model and Social Cognitive Theory

INTERVENTION CONTENT: The educational/awareness raising program includes a presentation (to give an understanding of the frequency, severity and mechanisms of patient injuries and different types of distraction; Health belief model); hospital tours (journey of a patient from arrival to discharge), survivor testimonies (by a former patient as a teen to inform, engage and influence the teens; social cognitive theory), and an educational video (fatal car crash caused by texting; to capture physical, emotional, and mental trauma that is the consequence of a motor vehicle crash due to distracted driving; horrific crash scene, potential traumatic impact on parents, friends...).

OUTCOME/EFFECT EVALUATION METHOD: Pre-post survey (no control group, no random assignment) to evaluate the teens' behaviours, attitudes and knowledge/awareness about distracted driving. Pre-survey at the beginning of the program, post-survey after completion to measure changes (matching IDs). A convenience sample of 1,238 teens was obtained through a partnership. Of this sample, 910 teens had parental consent to complete pre- and post-surveys. Also process evaluation.

EFFECT: Positive effects but no control group. Pre vs post changes:

- increase in the number of participants who state they are unlikely or not likely to send or reply to a text while driving and to make or answer a phone call while driving.
- increase in participants who believe that the risk of a crash increases 23 times when texting and driving

- increase in teens who associate texting with visual, cognitive, and manual distractions

Sample bias: The group consisted of "academically gifted" students, which may not be representative of the general teen population. Process: almost all found the video (very) informative, almost 90% (very) educational "

LEARNINGS - FACTORS LEADING/IMPEDING SUCCESS – REMARKS: Wide age range: participants aged 14–18 have varying cognitive maturity, suggesting a need for more age-targeted content

Cuenen et al. (2016), Belgium

Cuenen, A., Brijs, K., Brijs, T., Van Vlierden, K., Daniels, S., & Wets, G. (2016). *Effect evaluation of a road safety education program based on victim testimonials in high schools in Belgium*. *Accident Analysis & Prevention*, 94, 18-27. <https://doi.org/10.1016/j.aap.2016.05.006>

GENERAL DESCRIPTION: Educational road safety program 'Traffic informers' at school to promote road safety supportive views by emotionally affecting them through victim testimonials. Target group: 16–17-year-old high school students (pre-drivers) in general, technical and occupational education. Stakeholders: the Flemish Ministry of Transportation and Public Works. SDG: SDG 3 - 3.6 Reduce road deaths and injuries (helmet, drink driving, speeding, crossing red lights)

THEORETICAL MODEL: Socio-cognitive and behavioural variables from the Theory of Planned Behaviour were assessed to evaluate effectiveness.

INTERVENTION CONTENT: Victim testimonials is a 2-hour session aiming at stimulating students to reflect on their own behaviour and responsibility. It uses a serene and interactive approach (not relying on fear appeals) to encourage self-reflection. First hour: A personal testimonial from a crash victim or a relative, focusing on their life before the crash, the circumstances of the event, and the long-term emotional and social impact. Second hour: Group discussion where students share their opinions and reflect on social responsibility in traffic.

OUTCOME/EFFECT EVALUATION METHOD: Quasi-experimental pre-post survey design with 1 baseline-follow-up group (paper survey before the session and online survey 2 months later) and 1 post-test follow-up group (paper survey immediately after the session and online survey 2 months later), controlled for differences between the groups on demographic variables. The evaluation includes TPB variables, cognitive/emotional impact and controls for social desirability bias. Sample: N 1 362 students. No evaluation of the separate parts.

EFFECT: Both immediate and two months after attendance, small to medium positive effects on most socio-cognitive and behavioural variables, but the effect depends on student characteristics. However, effects depended on participants' demographic profile, their baseline values on the socio-cognitive and behavioural variables, and the degree to which they were cognitively/emotionally affected by the program: 1) small significant immediate positive intervention effects for students of general and occupational education (more road safety supportive than prior to the session: attitude, subjective norm, perceived behavioural control, intention); no immediate effects for students of technical education. 2) Medium-sized positive program effects for male (especially) and female students after 2 months; 3) Students were both cognitively and emotionally affected by the program (more cognitively than emotionally); female students more impacted than male students; 4) Participants that were more cognitively and emotionally affected were overall more road safety supportive. The results of this study in some way could be an underestimation of the program's true effectiveness because participants were already quite road safety supportive before the intervention. The external validity of this study is limited in different ways. Results apply only to programs adopting a comparable format. Results cannot be generalized to programs addressing different target populations than the one addressed here. The study

was conducted in high schools in Flanders only, so there is also a geographical restriction on the validity of our results."

LEARNINGS - FACTORS LEADING/IMPEDING SUCCESS – REMARKS: Recommendations:

5. Use of personal testimonials by crash victims can stimulate high school students to reflect upon their participation in traffic in such a way they become more road safety supportive
1. The effect of the program depends on characteristics of the student (i.e., education type, gender). It illustrates that high school students are not a homogenous group. Therefore, different strategies are needed for the different subtypes of high school student to make them more road safety supportive.
2. While the objective of victim testimonials is to stimulate (self-) reflection by means of an emotional trigger care must be taken of fact that the right emotions are being activated at the appropriate strength levels. It is advised to aim at moderate emotional arousal levels since these can be expected to result in optimal message processing (excessive shock can lead to defensive reactions, too little impact to disengagement)

Kennedy et al., (2018), Australia

Kennedy, A., Cullen, B., Firman, D., Fleiter, J. J., & Lewis, I. (2018). Peer passenger intentions to speak up to a risky driver: A theoretically-guided investigation of the effects of a high school road safety education program. Transportation Research Part F: Traffic Psychology & Behavior, 54, 15–27.

GENERAL DESCRIPTION: The RACQ "Docudrama Program" is a high school road safety education program that focuses on improving the decision-making processes and behaviour of individuals in a risky on-road situation. The program is delivered by RACQ staff, who are qualified teachers, to high school students (i.e., 16- and 17-year-olds). The objectives are to empower young adults to take control of their own and others' well being, make safety-conscious decisions about on-road situations, to trust their "gut instinct" if an on-road situation does not feel right, and to speak up. Target group: High school students aged 16 and 17. Stakeholders: Collaboration with the RACQ and local emergency services - in schools. SDG: SDG 3: Good health & well-being (empower young adults to take control of their own and others' well being)

THEORETICAL MODEL: Extended Parallel Process Model (EPPM; threat and coping appraisal) and Theory of Planned Behaviour (TPB).

INTERVENTION CONTENT: The RACQ Docudrama Program is delivered to classes in schools as a one-off, three-hour long program, comprising 3 parts (3 hours) :

1. (dramatised car crash scene outdoors in the campus) students are exposed to a dramatisation incorporating a mock car crash scene where a passenger is fatally injured. The dramatisation involves 3 classmates (driver, 2 passengers) as well as police, ambulance officers and funeral service personnel.
2. (prequel video) in-class debriefing session where students are shown a 'prequel' video which depicts the 12h preceding the crash. Students are asked to identify the risk factors that would have likely contributed to the crash.
3. (voting and discussion) facilitated classroom discussion session with the students to explore potential strategies to avoid risky on-road situations and use electronic polling to discuss own behaviours.

OUTCOME/EFFECT EVALUATION METHOD: Between groups design to compare differences between students who had been exposed to the Program and those who were yet to be exposed to the program (control group) using a single survey on-site. Primary outcome: Intentions and willingness to "speak up" to a friend who is using a mobile phone. Participants in the intervention group either provided their

responses on the same day, immediately after exposure to the program, or up to a maximum of 8 days later after exposure. Sample: 260 high school students (Mean age 16.34; SD 0.67 years; range 15–18 years) from 5 schools (small sample size so no generalisation).

EFFECT: Evaluations of this program showed it successfully empowered peer passengers:

- Exposure to the program is associated with positive effects in terms of stronger intentions to speak up amongst students in the Intervention relative to the Control group.
- Students who participated in the program (i.e., Intervention group) reported significantly higher scores than the Control group on all of the EPPM's key constructs.
- Females, relative to males, were more influenced by the program as a whole, given their tending towards higher intentions to tell a friend to stop using their mobile phone while driving. The results also suggest that females were more influenced by the physical threat within the program, while males more so by the social threat content.
- The program significantly heightened students' perceptions of control regarding their ability to intervene in risky situations.

Need to extend the number of students and schools involved in future similar research because too small sample size = no generalisation to the wider population of young people. Overrepresentation of female students, so need to increase the number of male students. What about the impact on a long term?

LEARNINGS - FACTORS LEADING/IMPEDING SUCCESS – REMARKS: The program's approach in supplementing the mock car crash scene with two subsequent sessions of classroom discussion did function to enhance students' perceptions of efficacy and control over being able to speak up in risky situations. Gender differences suggested that the program may benefit from paying further attention to, and/or emphasising more, the social threat of potential social disapproval directed at the young driver.

Lewis et al. (2021), Australia

Lewis, I., Watson, B., & Ho, B. (2021). Slow down! Get off that phone! The impact of a high school road safety education program in influencing whether a young person speaks up to a risky driver. Transportation Research Part F: Traffic Psychology & Behavior, 78, 353–368.

GENERAL DESCRIPTION: The Royal Automobile Club of Queensland's (RACQ) "Docudrama program" is a high school road safety education program that focuses on improving the decision making processes and behaviour of individuals if and when they may find themselves in a risky on-road situation. The program is delivered by RACQ staff, who are qualified teachers, to year 11 and 12 high school students from schools throughout the Australian state of Queensland. The RACQ Docudrama program aims to empower young people to make informed and safe decisions both as drivers and passengers. Objectives: Help young people understand the important role they play as peer passengers and, thus, the importance of being willing to speak up to a driver who may be engaging in risky behaviours. Stakeholders: SDG: SDG 3: Good health & well-being (empower young adults to take control of their own and others' well being)

THEORETICAL MODEL: an extended TPB framework

INTERVENTION CONTENT: (idem above) The RACQ Docudrama Program is delivered to classes in schools as a one-off, three hour long program, comprising 3 distinct parts:

1. dramatisation incorporating a mock car crash scene where a passenger is fatally injured.
2. facilitated in-class debriefing session ('prequel' video which depicts the 12 h preceding the crash)
3. classroom discussion session with the students on potential strategies

OUTCOME/EFFECT EVALUATION METHOD: Repeated-measures design: participants' responses (intentions, willingness) were assessed at Time 1 (pre-program exposure up to one month before seeing the program), Time 2 (immediate post-program exposure), and Time 3 (follow-up post program exposure assessed 3 months later). No control group. At each of the 3 time points, participants completed a survey in classroom groups, in the presence of teachers and during school time. Sample consisted of 572 students participating in the RACQ Docudrama program => 253 students completed at least 1 survey across the 3 time points => 95 students (38 males and 57 females) completed a survey at all 3 points. Primary outcome variable: Explore the long-term effects of the program (intentions to tell a friend to slow down/to stop using the mobile phone; willingness to speak up) and whether the effects of the program differed depending on its metropolitan versus regional implementation.

EFFECT: After the program:

- Higher anticipated regret for having not spoken.
- Positive influence of the program (engaging in safer behaviours as passenger) but only significant effects immediately after the program and not significant anymore after 3 months:
- For intentions to tell a friend who is speeding to slow down: high overall irrespective of time, including at Time 1; results immediately after the program are positive and strong with heightened intentions, but this effect returned to pre-existing levels 3 months later.
- For intentions to tell a friend to stop using a mobile phone while driving: no effect of time
- For willingness to speak up to a speeding driver or a driver using their mobile phone, scores were higher immediately after participating in the program with scores decreasing at Time 3."

LEARNINGS - FACTORS LEADING/IMPEDING SUCCESS – REMARKS: Results after 3 months support for the potential to include some sort of 'booster' to capitalise on the positive immediate effects that the program evokes (sending of brief materials to be sent as hard-copy or electronic resources to students directly or through a teacher facilitated class session). These materials could feature an activity which encourages students to form implementation intentions. As an example, some risky passenger or driver-related scenarios may be presented to the students, and they could be asked to outline what they would do in such circumstances. They would be encouraged to be as detailed in the strategies and steps as possible so that, in the event such a circumstance was to arise, they could action the plan that they had identified at an earlier time. The intent of the activity would, thus, be in keeping with key messaging about strategies that the program conveys.

Riaz et al. (2019), Belgium

Riaz, M. S., Cuenen, A., Dhondt, S., Craps, H., Janssens, D., Wets, G., Brijs, T. & Brijs, K. (2019). Evaluation of a road safety education program based on driving under influence and traffic risks for higher secondary school students in Belgium. Safety, 5(2), 34. <https://doi.org/10.3390/safety5020034>

GENERAL DESCRIPTION: Traffic Weeks is a large-scale school-based road safety education program, focusing on two pillars: increasing knowledge of traffic rules and situations, and reinforcing positive road safety attitudes and risk-awareness. Target group: Higher secondary school students: 16–19-year-olds (pre-drivers; general, technical, and occupational education). Stakeholders: Traffic Weeks is organized by the Flemish foundation for traffic knowledge (VSV). SDG: "SDG 3: 3.6 Reduce road deaths and injuries (drink driving, speeding, fatigue and distractions)"

THEORETICAL MODEL: Theory of Planned Behaviour to structure the workshops

INTERVENTION CONTENT: The program focuses on driving under Influence (DUI) and traffic risks (speeding, fatigue, and distraction). DUI Workshop: Provides facts about drugs and alcohol and includes assignments to help students understand impairment risks, sometimes using special glasses that

simulate being under the influence. Traffic Risks Workshop: Discusses major and minor risks in traffic and outlines precautionary measures to avoid them.

OUTCOME/EFFECT EVALUATION METHOD: Single-group pre-post-survey design, no control group, to assess change in socio-cognitive and behavioural variables (TPB variables, behaviour) (N175: matched pre-post test sample). Pre-post-survey 1 week before the workshops and post-survey 1 week after the workshops. No evaluation of separate aspects. Additional focus group discussion for volunteers months later to share experiences and suggest improvements. Also a process evaluation is included.

EFFECT: Pre-post changes in socio-cognitive and behavioural variables: mixed effects:

- Students were quite road safety supportive already before the intervention
- DUI workshop: no significant main immediate effect for male students of all education types; the female students of general education had a significant positive impact on attitude, subjective norm-friends and intention
- Traffic risks workshop: no significant main immediate effect of measurement for male students; no significant immediate main effect for female students except on the PBC ("To what extent do you have an influence on whether you get involved in a crash?")

Process: A possible explanation of more effects for the DUI workshop than the traffic risks workshop is that participants had a better appreciation of the DUI workshop. In addition, the fewer effects in the traffic risks workshop could be due to the broader scope in this workshop (speeding, fatigue, and distraction) compared to the scope of the DUI workshop (only alcohol and drugs). Appreciation: >70% found the information clear and 66.3% found it useful.

The results of this study in some way could be an underestimation of the program's true effectiveness because participants were already quite road safety supportive before the intervention. It could be that the actual program's primary focus is to positively reinforce instead of increasing the knowledge, awareness, and socio-cognitive variables of students who are already road safety supportive.

LEARNINGS - FACTORS LEADING/IMPEDING SUCCESS – REMARKS: Include discussion with a focus group in future programs to create new material provide participants with strategies and options on how to avoid risks that they have encountered (e.g., peer pressure), to increase the appreciation level in order to tailor the program according to the needs of participants (e.g., to increase the appreciation level of students of occupational education) so that they benefit more from the program.

Università Cattolica del Sacro Cuore, (2018), Italy

Università Cattolica del Sacro Cuore (2018), Viaggio nel Senso della Strada, internal report

GENERAL DESCRIPTION: Journey into the Meaning of the Road is a road safety education intervention implemented in Italian secondary schools (Rome, Florence, Milan) and targeting adolescents approaching driving age. The overall goal is to strengthen traffic safety culture by promoting awareness of road risks, personal responsibility, safe behavioural norms and patterns of behaviour among young road users (influencing beliefs, attitudes, norms). Stakeholders: The intervention was organised by the Traffic Psychology Unit of Università Cattolica del Sacro Cuore in collaboration with the NGO La Strada and implemented in secondary schools in Florence, Rome and Milan, with the support of school administrations and teachers. SDG: SDG 3 – Good Health and Well-being (Target 3.6: reduce road deaths and injuries); SDG 11 – Sustainable Cities and Communities (Target 11.2: safe and sustainable mobility).

THEORETICAL MODEL: Risk perception theory; hazard perception in traffic psychology; social norms and responsibility in road safety behaviour.

INTERVENTION CONTENT: Interactive educational sessions including analysis of real crash cases reported in the media, discussions on responsibility and risk in traffic, and practical exercises on attention and hazard perception in traffic. The activities were designed to influence risk perception, attitudes and social norms related to safe road behaviour. It also supports communication and peer reflection on shared values related to safe road use.

OUTCOME/EFFECT EVALUATION METHOD: Pre- and post-intervention questionnaires were used to explore changes in students' perceptions and attitudes toward road safety (indicators aligned with the objective of strengthening traffic safety culture among adolescents by increasing awareness, responsibility and safer behavioural norms). No control group. Also process evaluation.

EFFECT: The intervention increased students' awareness of road risks, attention and personal responsibility in traffic situations, as indicated by changes in questionnaire responses and qualitative feedback. Results suggest that interactive and reflective activities are effective in promoting traffic safety culture among adolescents. Process: overall positive appreciation.

LEARNINGS - FACTORS LEADING/IMPEDING SUCCESS – REMARKS: Feedback suggested that interactive elements and practical exercises were particularly effective, while recommendations included maintaining high engagement and ensuring clear and concise communication during presentations. Interactive activities, real crash case discussions and practical exercises on attention and perception were effective in engaging students and increasing awareness of road risks. The intervention showed that participatory approaches and links to real-life situations are important to influence young road users' attitudes and responsibility in traffic. The intervention was effective; however, its short duration limits the possibility of assessing long-term behavioural change. Future implementations could strengthen the intervention by integrating repeated sessions, stronger links with driving education, and follow-up evaluations to better assess sustained impacts on traffic safety culture.

Unni et al. (2017), USA

Unni, P., Estrada, C.M., Chung, D.H., Riley, E.B., Worsley-Hynd, L., Stinson, N. (2017) A multiyear assessment of a hospital-school program to promote teen motor vehicle safety. *J. Trauma Acute Care Surg.* (2017) 83:289–95. doi: 10.1097/TA.0000000000001521

GENERAL DESCRIPTION: The "Be in the Zone" (BITZ) Teen Motor Vehicle Safety program is a hospital - school collaborative program that educates teenage drivers of the dangers of texting while driving. It is a sequential combination of hospital and school-based components over a school year. The goal of this program was to reduce texting while driving among high school teens through a unique peer-generated anti-texting campaign (developed by students who first undergo an intensive hospital-based experiential program). Objectives are to increase awareness of the dangers and consequences of texting while driving, promote safe driving behaviours - reduce incidence of texting while driving. Target group: all students, young novice drivers, in participating schools + local communities and parents. Stakeholders: The "Be in the Zone" (BITZ) Teen Motor Vehicle Safety program is an initiative of the Monroe Carell Jr. Children's Hospital at Vanderbilt. SDG: SDG 3: Good health (safe driving)

THEORETICAL MODEL: This approach is modelled on the social ecological framework which favours the use of supportive social and physical environments to facilitate behaviour change.

INTERVENTION CONTENT: The program includes 2 phases:

- Phase 1 (Hospital-based): small groups of 5-8 selected student leaders from high school participate in a unique, half-day, hospital-based experiential motor vehicle safety education program featuring trauma surgeon lectures, videos, interactive demonstrations, emergency department simulations...

- Phase 2 (School-based): the trained student leaders from Phase 1 return to school and lead a year-long, peer-to-peer school-wide campaign against texting while driving. This includes school assemblies, mock crashes, public safety announcements, use of pledge cards.

OUTCOME/EFFECT EVALUATION METHOD: Prospective quasi-experimental pre-post design, no control group and no randomization:

1. surveys: student leaders completed a pre-survey at the start of phase 1 and an online follow-up survey 5 months later to measure changes in attitudes/beliefs, knowledge/awareness, self-reported behaviour regarding texting while driving, intentions/empowerment
2. observations by student-observers (possible bias): unannounced driver observations near participating school at the beginning and end of the campaign (phase 2) to get data on objective texting rates

Sample size: Phase 1 (N 111/137 students - small), Phase 2 (N 12 309 observations before the campaign and N 13 153 observation after). Also process evaluation.

EFFECT: Pre-post changes: The program had some success in influencing teenagers to be willing to take positive steps like telling the driver that their texting was making them uncomfortable or avoiding riding with such drivers in future. Generally positive changes:

- Beliefs: no statistically significant changes in the belief that they could get into a crash while texting and driving (high pre and post), nor in the belief that texting while driving is the most dangerous cell phone-related task (>80% pre and post).
- Knowledge/Awareness about laws governing teen drivers' cell phone use while driving went up significantly: The proportion of teen drivers who indicated that it was not legal for a driver under 18 years of age to talk on phone while driving went up from 72% to 87% and the proportion who indicated it was not legal for a driver under 18 years of age to text and drive went up from 88% to 99%; awareness of GDL laws went up from 37% to 87%.
- Self-reported texting behaviour: the proportion of teenagers who did not text while driving in the last 7 days went up from 42% to 56% (significant)
- Attitudes: significant increase in teens who would "very likely" tell the driver that their texting while driving was making them uncomfortable (from 40% to 62%), and in teens who would "very likely" avoid riding with such drivers in future (from 11% to 22%). The proportion of teens who would take some action (as opposed to doing nothing) in this situation rose from 46% to 64% (significant)
- Observed behaviour: significant reduction in texting while driving (from 13% to 9%)

Because of the small sample size in phase 1, it could be some analyses were not statistically significant due to a lack of power. Observations were done by students which could lead to a bias because they were involved in the campaign.

Process: very favourable evaluation and 3.9 on 4 rating; most liked element (60%) impacted speaker presentation"

Finley et al. (2024a), USA

Finley, K., Hanson, B., Green, K. (2024) Resources and Tools to Reduce Multiple Risky Driving Behaviors. Center for Health and Safety Culture, Montana State University.

GENERAL DESCRIPTION: Brief intervention for drivers engaged in multiple risky driving behaviors. Goal is to reduce multiple risky driving behaviors. Proposed intervention seeks to meet the person where they are in the process of behavior change, explore cognitions related to multiple risky driving behaviors,

provide behavioral strategies to increase safe driving behaviors, use strategies to seek to grow a person's motivation.

THEORETICAL MODEL: The intervention designed for drivers engaged in multiple risky driving behaviors has a strong theoretical foundation. An Integrated Behavior Model was developed to inform the assessments and the development of the intervention curriculum regarding behavioural/normative/control beliefs and their influence on the multiple risk behaviours to be changed. By understanding which constructs influence decision-making, interventions can be developed to grow these beliefs and thereby influence behavior. This is based on a thorough risk behaviour analysis (literature, models). Further used in the design of the intervention: Motivational Interviewing, Transtheoretical Model of Behavioral Change, Harm Reduction, Cognitive-Behavioral Approach, and a Strengths-Based Perspective.

INTERVENTION CONTENT: Based on literature review and pilot tested. Five web-based virtual modules (Emotion, Seat Belt, Distracted Driving, Driving Under the Influence of Substance, and Speeding) lasting each 5-7 minutes. These are each followed by a series of text messages to support participant learning between each session.

OUTCOME/EFFECT EVALUATION METHOD: Pre-post-post randomized controlled trial (N 43). Participants (university students) were randomly assigned to one condition control or intervention. All participants completed measures at three timepoints baseline, post-intervention (i.e., immediately following intervention for intervention participants and the same time delay from baseline for control participants), and follow up (i.e., three months following post-intervention). Primary Outcome Measures: Speeding, Driving under the influence, Seat belt use, Distracted driving. Secondary Outcome Measures: Impulsivity, Risk perception, Protective beliefs (control beliefs, normative beliefs), Driver's emotional intelligence, Increased use of risk-mitigating strategies. Also process evaluation: feedback.

EFFECT: Overall, no significant difference was found between intervention and control participants in risky driving behavior or other study variables (e.g., impulsivity, emotional intelligence, beliefs), likely due to a small sample size and inadequate power. Results demonstrated that intervention participants did utilize selected strategies to address their risky driving behaviors following the intervention and continued utilizing strategies three months later. Participants' feedback: satisfaction with intervention and describing positive impacts of participating.

LEARNINGS - FACTORS LEADING/IMPEDING SUCCESS – REMARKS: Recommendations and guidance for traffic safety professionals were given. It is recommended that:

- traffic safety professionals consider providing secondary strategies (e.g. I will not use my phone when I'm driving at high speed) that mitigate risk and reduce harm in addition to primary (e.g. I will not use my phone) prevention strategies when engaging young adults. Those engaging in multiple risky driving behaviors may benefit from recommendations and strategies that allow more choices, including harm reduction strategies.
- that a single-touch method may not be adequate and that traffic safety professionals identify ways to increase dosage, repetition, and reminders to encourage and sustain behavior change, especially among young adults.
- that traffic safety professionals support emotion regulation among youth and young adults in their communities and states and consider leveraging existing infrastructures to integrate emotion regulation skill-building (e.g. in driver's education curriculum).
- that traffic safety professionals use strategies to increase motivation to address risky driving behaviors, increase willingness to contemplate driving behaviors, and consider changing driving behaviors.

Internal report, Austria (intervention 2018-2019)

GENERAL DESCRIPTION: The school class workshop "speeding: risk?" was developed for pupils, age 16-17, and lasts 2,5 hours. The workshop aims to raise young people's awareness of speed- and risk-related issues. In line with the model developed by Fisher and Fisher (1992), it focuses on attitudes and knowledge. Objective to change awareness and behavioural patterns. Stakeholders: KfV as a non-profit organisation provides this workshop for secondary schools. Some of the workshops are financed by federal provinces in Austria. SDG: SDG 3 (implicit)

THEORETICAL MODEL: Information-Motivation-Behaviour model by Fisher & Fisher.

INTERVENTION CONTENT: The concept of the workshop, based on the model from Fisher & Fisher, includes these elements:

- Information: Providing information on risky behaviour and 'safe' behaviour
- Information and motivation: Explaining the link between speed and risk
- Motivation: Examining social norms, reflecting on experiences within the group
- Behavioural skills: developing behavioural skills (avoidance and setting boundaries), encouraging self-reflection, increasing personal competence

Methods: interactive workshop with quiz, role-play and group discussions.

OUTCOME/EFFECT EVALUATION METHOD: Pre-post-post survey measurement, no control group (just before and after attending the workshop, 3 months later): evaluation of the effects of the workshop regarding knowledge, risk perception, social norms, behavioural skills, self-reported behaviour. Sample (3 school-classes): N=60. Primary outcome variables: speeding behaviour and influencing speeding behaviour as passenger; secondary: social norms, attitudes, risk perception, behaviour skills; others: knowledge. Also process evaluation.

EFFECT: The workshop had a positive impact on the attitudes and knowledge of the participating pupils. This, in turn, influenced their self-reported behaviour as passengers with regard to speeding.

1. significant improvement in knowledge levels and a change in attitude regarding the link between speed and the consequences of crashes
2. significant positive impact on the passengers' intention to urge the driver to slow down: The young people's ability to effectively convey and reinforce their message – "Slow down!" – has improved.

The pilot-workshops mainly included pupils as passengers, few pupils had driving licences and were drivers. Therefore, the impact of the workshop could only be assessed by the group of passengers.

Process: workshop was delivered in line with the teaching concept and was rated 'good' by the pupils. The facilitator also considered the methodological and teaching approach to be well suited to the target group.

General public campaigns

Bundesministerium für Innovation, Mobilität und Infrastruktur (Hrsg.) (2025), Austria
Bundesministerium für Innovation, Mobilität und Infrastruktur (Hrsg.) (2025). Evaluierung der Kampagne „Voll am Leben“ Bd. 99. https://www.bmimi.gv.at/verkehrssicherheit/beratung-foerderung/vsf/publikationen/forschungsarbeiten/99_voll-am-leben.html

GENERAL DESCRIPTION: National road safety campaign 'Voll am Leben' (Fully Alive) aimed to raise awareness of the dangers of speeding among drivers, particularly male drivers aged between 17 and 24

(core target group). Objectives: changing awareness and attitudes regarding speeding - attitudes, prototypical image, behavioural intentions. Stakeholders: Authority: Federal Ministry Innovation, Mobility and Infrastructure Republic of Austria. SDG: SDG 3, SDG 11. Implicit, but the measure also has a strong focus on sustainability, though traffic safety is the primary target.

THEORETICAL MODEL: Theory of planned behaviour adapted by Otto et al., 2019

INTERVENTION CONTENT: Campaign on the dangers of speeding in order to reduce speeding offences and thus increase road safety.

OUTCOME/EFFECT EVALUATION METHOD: Representative online survey during and after the campaign. Each sample consisted of the core target group (male car drivers aged 17 to 24 [n= 350]) and Austrian car drivers (aged 17 to 65 [n= 650]). The evaluation examined how attitudes, norms, prototypical images and behavioural intentions regarding speeding changed. As part of the evaluation, the effects of the campaign on relevant attitudes and opinions were repeatedly recorded and maximised through appropriate adjustments during the campaign period. Also process evaluation.

EFFECT: The initial survey confirmed that young car drivers have riskier attitudes and tend to exceed speed limits more than Austrian car drivers. The campaign succeeded in changing the attitudes of the core target group to a small extent. Process: Overall, the campaign achieved a high level of awareness among young drivers (67% remembered the campaign). The campaign launch was postponed, therefore the baseline measurement was not taken immediately before the start of the campaign, but a year earlier. In the meantime, other influencing factors or social changes could have had an impact on the relevant attitudes and behaviours.

LEARNINGS - FACTORS LEADING/IMPEDING SUCCESS – REMARKS: Due to the high level of social acceptance of speeding, a wide range of measures over a longer period of time are also needed to bring about lasting change in widespread attitudes and behaviour.

De Dobbeleer et al. (2009), Belgium

De Dobbeleer, W., Nathanail, T. & Adamos, G. (2009) Pan-European road safety campaign: campaign evaluation. EC CAST project TREN-05-FP6TR-S07.59641-019520-CAST, Deliverable 5.3.

GENERAL DESCRIPTION: National road safety campaign aimed at reducing the number of crashes due to driver fatigue by awareness-raising and information of road users on the risks of fatigue and the promotion of effective countermeasures. Stakeholders: National road safety institute (Vias) assigned for conducting national road safety campaigns led the implementation.

THEORETICAL MODEL: Protection Motivation Theory (PMT): motivation for safe behaviour is a function of threat appraisal (increasing beliefs on personal vulnerability) and solution for the threat (coping appraisal) (increase response efficiency by giving information about the effective countermeasure; decrease response costs by removing social barrier to perform safe behaviour)

INTERVENTION CONTENT: Central message: if you feel tired, take a power nap! Campaign includes radio spots (youngsters' stations, weekend nights), online campaign: website with information + online game, gadget giveaway: PITSTOP package, small posters (youth clubs...), information leaflet, field actions: sleep-ins + volunteer network.

OUTCOME/EFFECT EVALUATION METHOD: Pre-post survey (representative population sample): quasi-experimental design: target group aged 18-25, N=598 and comparison groups 26+, N=605. No control group. Representative sample Belgian population 18+. Elements: Knowledge: increase on effective

solution ("powernap") (> response efficiency), Beliefs: decrease effectivity belief of other solutions; decrease the importance of "getting home asap"; decrease importance of the opinion of friends/relatives; increase personal risk-estimate (> response efficiency, response costs, severity, vulnerability), Increase intention to "powernap", decrease intentions other solutions (> protection motivation), Self-reported behaviour: increase "powernap". Also process evaluation.

EFFECT: Results pre-post in target group 18-25: mixed effects (not significant for most outcome variables):

- Increase: Knowledge about effective remedy
- Partial decrease: (false) Beliefs about effectiveness of other remedies, Sense of personal invulnerability, Behavioural intentions regarding other remedies
- Not changed: Beliefs about personal motivation and social threshold (I feel sleepy, I keep driving to get as home as soon as possible; If I feel sleepy while driving, I take a powernap before continuing, even if my friends/family do not agree with this; I drive better than other drivers, even if I feel sleepy), Behavioural intentions regarding pit stop, Self-reported behaviour related to pit stop
- Main barrier: feeling unsafe in car parks

After the campaign, youngsters rank the powernap first as the best solution, before the campaign the first position was held by "opening the windows". The campaign was not able to challenge the belief that getting home as soon as possible is most important, this belief remains especially present in the 18-25 target audience. The opinion of friends and family is another important factor, but which was only slightly altered by the campaign. There was a slight increase of personal risk apprehension in the 18-25 target audience after the campaign; however, there was an increase in the percentage of youngsters who indicated to drive better than the others, even when sleepy.

Process: high recall (33% of primary target group at least 1 campaign element), high appreciation (original, striking, comprehensible, credible, informative).

LEARNINGS - FACTORS LEADING/IMPEDING SUCCESS – REMARKS: The observed differences were not significant for most of the outcome results. All factors changed in the good direction, but a repetition of the campaign is necessary to strengthen these effects. The absence of large-scale effects in terms of outcome results is probably due to the fact that the PITSTOP campaign was the first campaign on fatigue to be conducted in Belgium. In this light, it is understandable that the campaign effects remain limited to only some of outcome parameters. Moreover, the campaign message was primarily geared towards a change in knowledge and risk perception, and not directly towards behaviour change.

CAST Project recommendations: stepwise method for effective campaigns + evaluation:

- Campaign based on statistics and research
- Defining a specific target group
- Campaign strategy based on behavioural influence theory
- Setting specific objectives
- Formulating an unambiguous, credible and clear message
- Rigorous evaluation
- Publish results and conclusions

Vilwock-Witte et al. (2023), USA

Vilwock-Witte, N. M., Clouser, K., Fay, L., May, D., Hetherington, N., Johnson, L., Sullivan, J. (2023) *Improving Traffic Safety Culture Using a Novel Dissemination Method*. *ITE Journal*, 12, 34-38
<https://westerntransportationinstitute.org/wp-content/uploads/2024/01/2023-ITE-Journal-MDT-Safety-Video-WTI-MSU-ITE-Article.pdf>

GENERAL DESCRIPTION: Intervention with traffic safety videos displayed at waiting areas of government offices, to educate the general public and improve TSC. Target group: general population 18+ in governmental waiting rooms. stakeholders: transport and justice state departments, access to public space with TV display through government offices. SDG3.6: State departments of transportation focus on eliminating fatalities and serious injuries. Addressing traffic safety culture is one approach that can help with this goal

THEORETICAL MODEL: No explicit model

INTERVENTION CONTENT: Continuous video loops risky driving situations (impaired driving, seatbelt use, roadway departures, intersection safety, navigating roundabouts, work zone safety)

OUTCOME/EFFECT EVALUATION METHOD: Post-post-survey (no control group):

- Survey at the location: TV conspicuity, waiting time, immediate recall of content + to get contact details (N 1 632), among which N 518 reported viewing the TV.
- Follow-up survey after 2 weeks of persons that agreed to be contacted again (N 67): longer-term recall and changes in safety beliefs and behaviours.

EFFECT: The majority of survey respondents reported that the videos did not result in a change in their beliefs (67%). Ten survey respondents (20%) reported sharing what they learned in the videos with someone else and two (5 %) reported discussing the slogan with some else.

Follow-up survey respondents seemed to suggest that they would be safer drivers but did not report a change in their own driving behaviour. These results suggest a minimal impact to Traffic Safety Culture. To sum up: it encouraged to be safer drivers, but safety beliefs were not changed.

High level of immediate visual recall (but response bias towards those having seen it more). 67% reported that the videos did not change their safety beliefs and very few reported actual changes in driving behaviour. 20% reported sharing what they learned.

Employee focused interventions (not road transport sector)

Forward et al., (2020), Sweden

Forward, S. E., Linderholm, I., & Henriksson, P. (2020). *Persuade habitual cyclists to use helmets – a scientific study developing and evaluating a bicycle helmet campaign (summary in English)*. VTI report 1057, Swedish National Road and Transport Research Institute, Linköping; Sweden <https://vti.diva-portal.org/smash/record.jsf?pid=diva2%3A1471316&dswid=6709>

GENERAL DESCRIPTION: Project to develop and evaluate a bicycle helmet campaign aimed at habitual cyclists, who are not normally using a helmet, with the objective to change shared beliefs about bicycle helmets and increase its use. Target groups were employees working for the same company and visitors to a shopping centre. Primary target group for the campaign are cyclists aged 30–50 who never wear a helmet. Stakeholders: NGO. SDG: SDG3 and SDG11

THEORETICAL MODEL: TPB and TTM: the development of the campaign was inspired by theories about communication, behavioural science and more specifically, Theory of Planned Behaviour (TPB) and Transtheoretical Model of Change (TTM).

INTERVENTION CONTENT: The campaign consisted of two films designed with the help of a well-established PR agency. One of the films lasted about a minute. The main message of the campaign was "Think of the brain when you ride a bike". The second film was a series of still images (slideshow), with two of the images conveyed facts about how large a proportion of severe head injuries could be reduced if a helmet was used and the proportion of single crashes. During the campaign, when the films were

still on display, the research group visited the workplace and the shopping centre. The purpose of this visit was to demonstrate helmets and with the help of facts to inform them what to consider when buying a helmet. The employees in Karlskrona also got a chance to buy a discounted helmet at a nearby sports shop. Subsequent to the educational session, the participants were given an opportunity to sign a bicycle helmet contract according to which the employees received a helmet for free if they committed themselves to wearing the helmet when biking.

OUTCOME/EFFECT EVALUATION METHOD: Pre- and post-survey evaluation, primary target groups vs. rest, no control group. Only quantitative data: questionnaire including TPB variables and one item measuring TTM, knowledge of the effect of helmets before and after and self-reported behaviour. Signed helmet contracts. Total sample included in the analysis was 141. The same people participated in both studies. Also process evaluation.

EFFECT: A very important aim of this study was to assess whether the campaign succeeded in influencing the target group in the right direction, i.e. those who did not wear a bicycle helmet. The results showed that this was the case, because the target group felt safer and wiser. They also agreed to a greater extent than before with the statement that the helmet protects the head. That these attitudes were influenced can very well be linked to the main message of the campaign, which was "Give your brain some thoughts when biking" and that a helmet helps to protect it. The results showed that 72% of the variance in intention to wear a helmet was explained by TPB. The strongest predictor was perceived behavioural control.

Process: The results also showed that the content was regarded as: important, credible and clear, which may explain why it had such a good effect.

LEARNINGS - FACTORS LEADING/IMPEDING SUCCESS – REMARKS: A clear description of the target group's mental starting point, i.e. their attitudes, norms and behaviour, creates a solid foundation for the campaign's success. They need credible reasons to change their behaviour.

The use of both TPB and TTM clearly demonstrated the need to not only focus on the behaviour but also to evaluate the so-called secondary effects (attitudes, norms, etc.). This provides further support for the argument that a campaign is not enough and that the work has to be long-term.

Easier to run a campaign for employees in a workplace (clearly defined area, employers can send legitimacy to the message, more homogeneous target group who are in contact with each other and can discuss the campaign) than in a shopping centre (broad primary target group of around 600 employees + thousands of customers per day = big audience can be reached but more effort/resources needed to show the films in the shopping centre; too many competing activities ongoing).

Pitfalls related to the venue: pre-post survey requires time from staff, during working hours; companies' own activities come first; companies' information policies and GDPR can hinder data collection: no e-mails shared - hinders pre-post surveys; shopping staff don't use computer often so info and survey via computer is not ideal - better to have a team going to the shopping to recruit.

Otto et al. (2022), USA

Otto J., Ward N., Finley K., Baldwin ST. and Alonzo W. (2022) Increasing Readiness to Grow Traffic Safety Culture and Adopt the Safe System Approach: A Story of the Washington Traffic Safety Commission. Front. Future Transp. 3:964630. <https://doi.org/10.3389/ffutr.2022.964630>

GENERAL DESCRIPTION: Adoption of the Safe System approach to transform TSC to reach the zero traffic fatalities goal, at the Washington traffic safety commission (staff, commissioners and partners) (road safety professionals). Target group: Internal: Organisational members/employees (road safety professionals); External: General road user population (all citizens). Stakeholders: program manager /

employees WTSC and agency with an influence on traffic safety which are part of the commission. SDG 3.6: goal of achieving a vision zero traffic fatalities and injuries.

THEORETICAL MODEL: The evaluation uses the Model of Change Readiness. This model posits that transformational change - changing behaviour, process, and culture - is driven by 3 perceptions of change readiness: cultural (change aligns with values), commitment (organisation is committed to change), and capacity (available resources for the change) readiness. They use the Positive Culture Framework, which moves away from fear-based messaging towards a focus on partnership and a "shared belief system" of the majority of safe road users.

INTERVENTION CONTENT: The new approach includes systemic organisational changes (shared terminology, long-term strategies...) and a positive culture framing approach for their adds instead of fear-based messaging, highlighting that most citizens drive safely, to encourage them to intervene when someone acts unsafely.

OUTCOME/EFFECT EVALUATION METHOD: Qualitative - 2 interviews with 2 WTSC leaders; use of the Model of Change Readiness; evaluation of public engagement quality (community feedback depth/thoughtfulness on social media)

EFFECT: The approach leads to transformation of organisational culture and public communication strategies:

- The use of a positive culture approach led to a more thoughtful public (community) engagement on social media (citizens sharing personal stories, rather than posting negative comments)
- Greater alignment among staff and leaders regarding organisational values (innovation, collaboration, learning)
- Successful implementation of multi-year funding and long-term culture-based strategies.

Kazemi et al., (2009), Sweden

Kazemi, A., & Forward, S. (2009). *Evaluation of the Swedish bicycle helmet wearing campaign 2008*. In S Forward, & A, Kazemi. (Eds). *A theoretical approach to assess road safety campaigns: Evidence from seven European countries*. Cast Project. Belgian Road Safety Institute (IBSR-BIVV), Brussels. https://www.academia.edu/77667591/A_theoretical_approach_to_assess_road_safety_campaigns_evidence_from_seven_European_countries

GENERAL DESCRIPTION: This study was set out to design, implement and evaluate a bicycle helmet wearing educational campaign using a theory-based approach in order to predict, explain, and promote helmet wearing among adult bicyclists in Sweden: Educational campaign for employees in an insurance company held by the Swedish Falck Ambulance. The objective was to change shared beliefs about bicycle helmets and increase its use. Stakeholders: The campaign was conducted by the Swedish Falck Ambulance. SDG: SDG3 and SDG11

THEORETICAL MODEL: TPB and TTM

INTERVENTION CONTENT: Standardised educational material was used. The session took 1 hour and took place eight times to include as many as possible employee participants. The emphasis was put on describing human brain and its functions. Furthermore, the educational staff described an ordinary working day and shared some experiences of crashes in general and bicycle crashes in particular. The participants were also given an opportunity to sign a bicycle helmet contract according to which the employees received a helmet free of charge if they committed themselves to wearing the helmet when biking. The staff also pointed to the importance of exercising and that biking is a good way to keep in shape and encouraged them to wear helmets. The seminar included both humour and fear.

OUTCOME/EFFECT EVALUATION METHOD: Pre- and post-evaluation (before and 6 weeks after). One experiment group and one control group. The latter group was selected to match the experiment group in relevant respects (e.g., the nature of work, age, gender). Only quantitative data was collected: survey on TPB variables (beliefs: behavioural, normative, control and intention to wear a bicycle helmet when travelling to work, but in addition to this it also included past behaviour, anticipated regret and descriptive norm), one item measuring TTM, self-reported behaviour. Signed helmet contracts. The respondents also rated the content of the campaign. Total sample included in the pre study was 250 (experiment group 195 and control group 55). In the post study 143 and 40, the later refers to the control groups.

EFFECT: More agreement with pro-helmet behavioural beliefs in experiment group vs control group after the intervention. Significantly more agreement with pro-helmet beliefs after the intervention in the experimental group. The results showed that 59.1 % of the variance in intention to wear a helmet was explained by TPB. The strongest predictor was perceived behavioural control. As shown by the results from the TTM participants moved to a higher 'change' stage. The campaign was also successful in affecting participants' propensity to use helmets to a greater extent. Participants in the pre-contemplation stage and in the contemplation stage becomes lesser after the campaign. The number of people in the preparation, action, maintenance and termination increased after the campaign.

LEARNINGS - FACTORS LEADING/IMPEDING SUCCESS – REMARKS: Information campaigns are an important tool for increasing road safety. In order to increase their chances of success it need to be based on a sound understanding of the target groups beliefs. It could be concluded that an educational campaign at a workplace which also include elements of reinforcement (i.e. to be given a bicycle helmet when signing a contract to use the same) significantly increases the likelihood of using a bicycle helmet. In this study an extended version of the TPB was tested as the aim of this research was to achieve an increased understanding of what affects bicycle helmet wearing. An extended version of the TPB was tested as the aim of this research was to achieve an increased understanding of what affects bicycle helmet wearing. Recommendations based on belief results: future campaign studies should: more specifically emphasize the importance of being a role model for others when it comes to traffic safety; more actively engage normative beliefs as people in general as social creatures are much influenced of what others think about them. Availability of safety cues: in safety promoting campaigns it is important to make the safety tools (in this case free helmets) available to people. The results showed that this was successful since many signed the contract which obligated them to use the helmet when cycling. This would then also be in agreement with Berkowitz and Lepage (1967) who argued that when something is made available the probability of its use increases considerably.

Other target group interventions

Taubman et al. (2014), Israel

*Taubman-Ben-Ari O., Musicant O., Lotan T., Farah H. (2014) The contribution of parents' driving behavior, family climate for road safety, and parent-targeted intervention to young male driving behavior. *Accid Anal Prev.* 2014 Nov; 72:296-301. <https://doi.org/10.1016/j.aap.2014.07.010>*

GENERAL DESCRIPTION: Family climate intervention to improve young male drivers traffic safety culture (reduce risky driving), incl. in-vehicle data recording providing feedback on all driving trips and increased parental commitment and monitoring. Target group: primarily young male drivers; involving also their parents. stakeholders: this is a university-led intervention which required the use of an in-vehicle data recording system manufactured by GreenRoad Technology.

THEORETICAL MODEL: The theoretical basis for this intervention is the Family Climate for Road Safety (FCRS). This concept was borrowed from workplace safety climate studies and adapted to characterize the parent-teen relationship regarding driving. FCRS refers to the values, perceptions, priorities, and practices of parents and the family with regard to safe driving, as they are perceived by young drivers. It

consists of seven dimensions: Modelling, Feedback, Communication, Monitoring, Commitment to Safety, Messages, and Limits.

INTERVENTION CONTENT: Technology-based intervention and parents' training: tracking of specific risky manoeuvres (e.g. hard braking, fast acceleration...) while driving, real-time and web-feedback with risk colours and summary of trips and risky events; parents training in monitoring and discussion driving data with their child.

OUTCOME/EFFECT EVALUATION METHOD: Longitudinal experimental design (3 experimental and 1 control group) over 12 months with 166 families randomly assigned to 1 of 4 groups (feedback to teen only (N44), feedback to teen and parents (39), feedback to teen and parents + training for parents (43), control group without feedback (40)). Combined behavioural and self-report data (family climate for road safety scale, measures of objective risk scores).

EFFECT: All intervention groups receiving driving feedback had a lower rate of risky events compared to control. Personal example provided by parents (parents' behaviour) is a crucial predictor in the decision of their sons to drive safely. However, the family climate for road safety (perceptions of communication and commitment) significantly influences the teen, even beyond the parent's direct modelling.

Internal report, Austria (intervention 2021-2022)

GENERAL DESCRIPTION: The workshop "Mindful. Safe. Mobile. Driving a car." was developed for elderly drivers aged 65 and over and lasts 2,5 hours. The aim is to raise awareness about safe driving and age-related changes. Objectives: change awareness, improving participants' self-awareness, self-assessment, self-efficacy; earning compensatory strategies. Stakeholders: KFV as a non-profit organisation provides this workshop for groups of elderly drivers. Some of the workshops are financed by federal provinces in Austria. SDG: SDG 3 (implicit)

THEORETICAL MODEL: Transtheoretical Model (TTM) by Prochaska and DiClemente

INTERVENTION CONTENT: Within the workshop the following topics are addressed: Mobility and road crashes, Age-related changes, Legal developments in road traffic, Safety factors when driving, Perceptual and decision-making skills in road traffic, Strategies for staying safe on the road. Methods: quiz, discussions, lecture.

OUTCOME/EFFECT EVALUATION METHOD: Pre-post-post measurement, no control group (survey: just before and after attending the workshop; 3 months later: telephone-interviews). 3 pilot-workshops: n=32, post-post-measurement n=26. Primary: implemented strategies for safe driving; secondary: self-awareness, self-assessment, self-efficacy; others: knowledge. Also + process evaluation.

EFFECT: The evaluation results show that the intended workshop objectives were achieved. As a result, participants' self-perception was improved and new strategies for driving safe were developed.

Just after the workshop more than 1/3 of the participants had specific plans to make changes to their driving habits in the future. After 3 months 2/3 stated that they applied one or more compensatory strategies whilst driving.

Post-post measurement: The elderly were difficult to reach three months after the workshop. There was a high dropout rate due to illness and other factors.

Process: Participants rated the workshop 'very good'. Particular emphasis was placed on addressing age-related changes and analysing traffic situations. The workshop was delivered in line with the teaching concept.

LEARNINGS - FACTORS LEADING/IMPEDING SUCCESS – REMARKS: Interactive elements were important and recommended to replace the lecture part.

Interventions in non-Western countries

Perego et al. (2018), Tanzania (single hazard perception intervention in school)

Perego, P., Biassoni, F., King, M. J., Ciceri, M. R. (2018) Perception of road hazards in a Tanzanian secondary school before and after a traffic psychology intervention. Journal of Transport and Health 10 (2018) 37-43.

GENERAL DESCRIPTION: Traffic psychology and hazard perception theory, focusing on cognitive processes involved in risk recognition and safe behaviour in traffic environments. Aim: To improve students' road safety culture by strengthening risk awareness, attitudes toward safe behaviour, and the ability to recognise hazardous traffic situations through interactive learning and discussion. The intervention was organised and implemented by a traffic psychologist from the Università Cattolica del Sacro Cuore (Italy), in collaboration with the management and teachers of Suma Secondary School in Engikaret (Arusha Region, Tanzania). Direct *target group*: students of a Tanzanian secondary school. Coverage: local, school level. The group was selected because young pedestrians and road users often have limited hazard perception and risk awareness in traffic environments.

THEORETICAL MODEL: Risk perception theory; hazard perception in traffic psychology.

INTERVENTION CONTENT: Interactive classroom session 2h based on the analysis of photographs of real traffic situations. Students were asked to identify potential hazards and discuss risky behaviours, linking perception, attention, and risk awareness to safe road user behaviour. The intervention was not combined with other road safety measures. Minor challenges included students' limited familiarity with interactive classroom methods and language barriers (English not being the first language), which were addressed with teacher support and translation.

OUTCOME/EFFECT EVALUATION METHOD: Design: pre–post evaluation. Method: quantitative hazard perception test based on traffic photographs. Sample: 211 secondary school students who completed both the pre- and post-training assessment.

EFFECT: Students showed a significant improvement in hazard perception after the training. The results suggest that traffic psychology–based educational activities can effectively increase risk awareness among young road users and should be further developed and tested in similar educational contexts.

LEARNINGS - FACTORS LEADING/IMPEDING SUCCESS – REMARKS: Interactive and participatory teaching methods help students better understand road risks and improve hazard perception. The intervention works better when supported by teachers and adapted to the local language and traffic context. Expert assessment by the traffic psychologist indicated that the intervention was effective and suitable for the local context, though future programmes should include longer follow-up and possibly a control group to strengthen evaluation. The intervention proved feasible and effective in a school setting. A key success factor was the use of simple, context-relevant materials and interactive discussion, which helped students reflect on real traffic risks they experience in everyday life.

Forward (2025), Zambia (infrastructure interventions around school)

Forward, S., Henriksson, P., Silvano, A. P., Miyoba, T., Sinkala, S., Mawele, S., & Mwamba, D. (2025). Increasing traffic safety at schools in Zambia: a before and after study. VTI report 1226A, Swedish National Road and Transport Research Institute, Linköping; Sweden <https://vti.diva-portal.org/smash/get/diva2:1930339/FULLTEXT01.pdf>

GENERAL DESCRIPTION: The aim of this study was to improve safety outside two Zambian schools using various interventions, pedestrian areas separated from vehicles by reflective bollards, speed limit signs

and signs informing drivers that they were entering a school zone. At one of the schools, a zebra crossing and a speed hump were also introduced. The study used both objective measures (i.e., vehicle speed) and subjective measures (i.e., surveys of children, parents, and teachers) to assess the impact. *Target group*: The main target group were school children, but surveys were also sent to parents and teachers. *Stakeholders*: The infrastructure changes at Daina Kaimba and Kizito Primary School were made possible through a close collaboration with multiple stakeholders. The Lusaka City Council, Road Development Agency plus The Road Transport and Safety Agency (RTSA) played a significant role in the planning and implementation of safety measures. The local corporate company foundation InBev provided financial support. *SDG*: SDG3 and SDG11

THEORETICAL MODELS: Inspired by TPB. Measured attitudes and control beliefs

INTERVENTION CONTENT: The interventions were multifaceted, including the installation of bollards to separate pedestrians from vehicles and signs indicating that drivers were entering a school safety zone with a speed limit of 30 km/h. Outside one of the schools a zebra crossing and a speed hump were installed.

(OUTCOME) EVALUATION METHOD: Quantitative pre and post evaluation with one control group. Total sample consisted of 150 pupils, 30 parents and 40 teachers. Not possible to control if the pre and post survey was completed by the same people, especially when it came to parents.

EFFECT: The results showed that the effect was greatest at the school where zebra crossings and speed humps were introduced. Pupils at this school felt significantly safer to cross the road in the after study than pupils at the other two schools. They also argued that it had become easier to cross the road. Pupils at the other two schools expressed more problems crossing in the after study compared to the before study. The study also demonstrated the potential for such interventions to be adapted and applied to other similar contexts, aiming to safeguard young lives on a broader scale. The study is anticipated to provide valuable insights into the effectiveness of further traffic safety improvements in school zones and inform future policy decisions and educational initiatives aimed at improving the safety of school children which in turn can be linked to a more general traffic safety culture.

LEARNINGS - FACTORS LEADING/IMPEDING SUCCESS – REMARKS: Relatively small changes to the infrastructure can increased children's perception of safety.

6.1.1.1. Biassoni et al., (2019), Madagascar (educational program)

Biassoni, F., Perego, P. et al. (2019) Evaluation of a road safety education intervention (ALFA Project) by assessing road crossing behaviour in students, Transaid. DOI: [10.13140/RG.2.2.34403.50728](https://doi.org/10.13140/RG.2.2.34403.50728)

GENERAL DESCRIPTION: Evaluation of the ALFA road safety education project implemented in public primary schools in Antananarivo, along the RN7 corridor and in Antsirabe (Madagascar), aimed at improving students' road-crossing behaviour and strengthening road safety culture by increasing children's awareness of traffic risks and safe pedestrian practices. The *objective* is to strengthen road safety culture among primary school students by improving knowledge, attitudes and behavioural norms related to safe road-crossing practices, and by reinforcing teachers' capacity to deliver road safety education and awareness activities in schools. *Target groups*: local – public primary schools (EPPs) in Antananarivo, along the RN7 corridor and in Antsirabe, Madagascar. The interventions targeted directly primary school students (approximately 9–12 years old) and indirectly their teachers were trained to deliver road safety awareness activities. The groups were selected because children walking to school are highly exposed to pedestrian road risks. *Stakeholders*: Implemented by the NGO Lalana with the support of Transaid, in collaboration with the Research Unit in Traffic Psychology of the Università Cattolica del Sacro Cuore (Italy) and with the involvement of the Ministry of National Education and local public primary schools (EPPs) in Madagascar. *SDG*: SDG 3.6: Reduce road traffic deaths and injuries; SDG 11.2: Safe and accessible transport systems.

THEORETICAL MODELS: Traffic psychology and behavioural road safety education models, focusing on pedestrian behaviour, visual attention, and hazard detection during road crossing.

INTERVENTION CONTENT: Road safety education activities in primary schools including classroom awareness sessions, teacher training, and practical exercises on safe road-crossing behaviour. The programme used photo-based scenarios to analyse where children look before crossing and to reinforce correct pedestrian rules (look left–right–left). The intervention was combined with broader awareness measures such as educational materials, school activities, and communication campaigns.

(OUTCOME) EVALUATION METHOD: Comparative post-intervention evaluation between ALFA project schools and non-participating schools. It is a quantitative behavioural survey using photo-based road-crossing scenarios and teacher evaluation forms. The sample consisted of 1,150 students from 23 public primary schools and teachers from 6 ALFA project schools.

EFFECT: Students in ALFA project schools showed a significantly higher ability to apply correct road-crossing rules compared with students in non-participating schools. The results suggest that road safety education can improve children's pedestrian behaviour, but continued teacher support and reinforcement of training are recommended to maintain long-term impact.

LEARNINGS - FACTORS LEADING/IMPEDING SUCCESS – REMARKS: Road safety education can improve children's pedestrian behaviour, but its impact depends on continuous teacher engagement and reinforcement of activities. Teacher turnover in schools can weaken long-term sustainability and requires periodic retraining and support. The evaluation shows that behaviour-based assessment methods are useful to measure the real impact of road safety education. A key success factor is combining teacher training with practical learning activities that help children apply road-crossing rules in real situations.

Perego (under review), Saint-Lucia (multi-component campaign + education)

Perego, P. & Tripodi, A. (2025) Communication and enforcement under constrained conditions: evidence from a national road safety campaign in Saint Lucia, unpublished (internal communication)

GENERAL DESCRIPTION: The intervention consisted of a national road safety awareness communication campaign implemented in Saint Lucia as part of the Millennium Highway and West Coast Road Upgrade Project. Its overall goal was to promote safer road user behaviour—particularly regarding speeding, seatbelt use, and mobile phone use while driving—by reinforcing knowledge, shaping social norms, and encouraging responsible mobility practices through mass communication, school outreach activities, and stakeholder engagement. *Target groups:* The campaign targeted the general driving population in Saint Lucia, with particular focus on high-risk groups identified in the situation analysis, including young male drivers, motorcyclists, and frequent road users along the Millennium Highway and West Coast Road corridors. Indirect target groups included pedestrians, school children, and other vulnerable road users, addressed through school-based outreach activities and community communication. Coverage was national, with communication activities disseminated through mass media, social media, and community engagement, while educational components focused particularly on schools and local communities. The selection of target groups was directly linked to behavioural risks identified in the Pre-KAP survey and situation analysis, particularly speeding, distracted driving, and low seatbelt compliance. *Stakeholders:* The intervention was implemented through collaboration between public institutions, technical partners, and civil society organizations. The campaign was coordinated within the Millennium Highway and West Coast Road Upgrade Project by the Government of Saint Lucia, with technical support from FRED Engineering and collaboration from local stakeholders including the Royal Saint Lucia Police Force, ministries responsible for transport and education, media organizations, schools, and community groups. These partnerships supported campaign dissemination, school outreach activities, and the amplification of road safety messages across multiple communication channels. *SDG:* SDG 3.6: Reduce road traffic deaths and injuries; SDG 11.2: Safe and accessible transport systems.

THEORETICAL MODELS: The intervention was informed by behavioural approaches commonly used in road safety communication, particularly the Knowledge–Attitudes–Practices (KAP) framework, which guided the design and evaluation of the campaign. The campaign was also conceptually aligned with the Safe System approach, recognizing that road safety outcomes depend on the interaction between human behaviour, infrastructure, enforcement, and institutional context.

INTERVENTION CONTENT: The intervention consisted of a **multi-component** road safety communication **campaign** designed to influence knowledge, attitudes, and behaviours related to speeding, seatbelt use, and mobile phone use while driving. Campaign tools included billboards, social media communication, radio messages, audiovisual materials, school-based **educational** activities, competitions for students, and stakeholder outreach initiatives. The content was behaviourally informed and aligned with the Knowledge–Attitudes–Practices framework, aiming to strengthen risk awareness and reinforce social norms supporting safe road behaviour. The campaign was implemented as a behavioural complement to the Millennium Highway and West Coast Road Upgrade Project and therefore accompanied broader road safety measures related to infrastructure improvements and institutional road safety initiatives.

(OUTCOME) EVALUATION METHOD: Outcome evaluation assessed the effects of the campaign on road safety knowledge, attitudes, and self-reported behaviours. The evaluation used a **pre–post** design based on two independent cross-sectional Knowledge, Attitudes and Practices (KAP) **surveys** conducted before and after the campaign.

The main method was quantitative, relying on structured online surveys distributed nationally. The Post-KAP survey collected 479 responses, which were compared with the Pre-KAP results to identify changes in indicators related to seatbelt use, speed compliance, mobile phone use while driving, and perceptions of enforcement. Primary indicators focused on self-reported road user behaviours targeted by the campaign, particularly seatbelt use, compliance with speed limits, and reduced mobile phone use while driving.

Secondary indicators included factors influencing behaviour change, such as road safety knowledge, attitudes toward safe driving, perceived risk, and social norms regarding responsible road use.

Additional indicators included perceptions of traffic law enforcement and exposure to campaign messages, which are relevant for understanding how communication and institutional credibility contribute to behavioural outcomes. These measurements were directly linked to the campaign objective of strengthening safe road user behaviour and improving road safety culture.

EFFECT: The evaluation showed high levels of road safety knowledge and generally positive attitudes toward safe behaviours, with modest improvements in some self-reported practices, particularly related to seatbelt use and speed management. However, **behavioural changes were limited in magnitude, highlighting the structural limits of communication-only interventions.**

LEARNINGS - FACTORS LEADING/IMPEDING SUCCESS – REMARKS: The main recommendation is to **strengthen the integration between communication campaigns and visible enforcement**, particularly for speed control and seatbelt compliance. Future road safety initiatives **should adopt a Safe System approach, combining communication, enforcement, infrastructure improvements, and continuous monitoring to achieve more sustained behavioural change.**

(2) TSC: Scientific reviews

The global aim of this review was to identify road safety culture interventions in Western countries. These interventions had to have undergone rigorous evaluation to identify their strengths and weaknesses, the ultimate aim being to draw up recommendations on good and bad practices. In these reviews it was then searched specifically for interventions regarding traffic safety culture (implicitly related to culture). While 8 literature reviews addressed closely relevant themes, adequate interventions were found only in 3 as illustrated in Table 10.

The eight literature reviews identified were published between 2019 and 2025. The publication dates of the intervention studies included in the literature reviews range from 1980 to 2025. Two of them focus on distraction, one on gamification, another on adult education programmes, one on traffic advertisements, another on prosocial and altruistic behaviours, one on speed, and one on sustainable modes of transport.

It is also very rare for the impact on Traffic Safety Culture to be the main or part of the main research questions in the reviews. The main elements of Traffic Safety Culture explored are attitudes, subjective norms, perceived behavioural control and intentions. Sometimes, these elements are not explicitly mentioned in the abstract and are part of “factors influencing road users’ behaviours”. The literature reviews also highlight a high degree of heterogeneity in terms of study design (longitudinal or cross-sectional), methodology (survey, observation, experimentation) or outcomes.

Because Traffic Safety Culture was rarely the main topic of the reviews or because there was a great heterogeneity in the interventions reviewed, the discussion was often not detailed enough for our purpose. The conclusions were often mixed results depending on the type of interventions, and strongly context specific. That’s the reason why we explored interventions included in each review and we identified some relevant interventions. Our research was limited to interventions implemented from 2010 onwards in the USA, Canada, Australia and Europe. However, methodological shortcomings make it often impossible to draw strong conclusions from the interventions that have been evaluated, either because of the small sample size, or because no control group was included or, in the case of pre-post studies, because the same individuals were not included at each time points of data collection. Among specific interventions we explored, evaluation often focuses solely on the outcomes of the intervention, whereas the intervention process itself is rarely evaluated.

Review	Theme	Key-learning	Cited interventions
	Teen distracted driving	Heterogeneity in intervention type, in delivery method (video, presentations, training programs, simulators, feedback studies...) Lack of longitudinal follow up	Adeola et al., 2016; Unni et al., 2017
	Accident prevention training courses	Important variability in the methodology in evaluation, in the evaluation technique or tool Lack of longitudinal design Evaluation often based on self-reported data (cognitive bias), importance to emphasize there are no right or wrong answers and importance of honest answers	Cuenen et al., 2016; Riaz et al., 2019
	prosocial and altruistic behaviours	The studies varied in scope (half on intervening behaviours, 4 on driver’s yielding behaviours at crosswalk, etc.) and evaluation methods (cross-sectional studies, observational studies, pre-post studies, controlled intervention). While methods diverge, there was a tendency for psychosocial factors (social/subjective norms, moral norms, PBC/self-	Kennedy et al. 2018; Lewis et al., 2021

Review	Theme	Key-learning	Cited interventions
		efficacy, and risk perception) to be positive predictors of willingness/intention to engage in prosocial behaviours.	
Other reviews: Avril et al. 2024; Classen et al. 2019 ; Faus et al. 2021 ; Magkafas et al. 2025 ; Makahleh et al. 2025 ; Nicolls et al. 2024.			

TABLE 10 |

(3) OSC: Interventions in road transport domain

Nævestad et al. (2018)

Author, year, country	Context	Content (intervention)	Evaluation method	Effect
Roberts et al. (2015), US – New York City Transit Authority	Extensive program of measures to improve safety culture in New York City Transit Authority.	Baseline set and needs analysed with safety culture survey, increased inclusion of employee representatives in accident investigations, multi-level cooperation at safety meetings, visible leadership and financial commitment, increased on-site inspections.	Two safety culture surveys in 2010 and 2013. Also focus on severe crashes, key statistics, employee views on safety and an FTA review.	Serious injuries appear to have declined. The second safety culture survey found improved reporting culture.
Roberts et al. (2015), US – Washington Metropolitan Area Transit Authority	Extensive program of measures to improve safety culture in Washington Metropolitan Area Transit Authority.	Safety prioritized in mission statements, increased investment in safety department, roles and responsibilities clarified, "lessons learned" bulletins, safety hotline, non-punitive reporting.	Focus groups and safety culture survey in 2007 (N = 756). Safety culture problems were found in the survey and measures implemented. Number of fatal crashes used as a measure of improvement.	Fatal crashes reduced from three every two years before program initiation, to two over nine years after program initiation.
Gregersen et al. (1996), Sweden	Effects of 4 organizational interventions on road safety among drivers in the Swedish company Televerket. Interventions expected to influence safety culture include (i) driver-led group discussions and (ii) a 1-year company road safety campaign.	Group discussions: drivers work together to discuss safety problems, identify solutions, make an action plan and act. Discussions and resulting measures evolve in several sessions over several months. Company safety campaign: presentations, information, visible campaign logo etc.	Robust, quasi-experimental prospective design, with measures of treatment and control groups for 2 years before and 2 years after the interventions. Five groups of company drivers (n = 900–1000 in each group), with 4 test groups and 1 control group.	Significant reductions in crash risks for driver training and group discussion interventions, from 0.16 to 0.08 crashes caused by company drivers per 10,000 km driven. Greatest crash cost reductions seen for group discussions.

Salminen (2008), Finland	Driver group discussion involving company electricians who drive cars and trucks for work.	As for Gregersen et al. (1996).	Before–after study of 172 electricians exposed to discussion group method. No control but compared with a similar group (n = 179) receiving driver training.	Large (72%) decrease in traffic crashes over 8-year follow-up period, despite no decrease in other work accidents. However, general traffic safety trends not accounted for. Cost-benefit analysis showed savings; also improvements in safety audit outcomes, up to 2 years following driver training.
Murray et al. (2009), UK	Descriptive case study detailing comprehensive, “holistic” 5-year occupational road safety program targeting drivers-for-work employed by large company, Wolsey.	Program of events with several structural and cultural elements (e.g. competition, handbooks, focus groups, health training, eye checks, safety climate), involving researchers in collaboration with transport industry, and a champion in a health and safety role.	Study analyses effect of program on fleet audit results based on crash data from 7000 heating and plumbing distributor drivers (3000 vehicles).	Almost 2-fold reduction of third-party collisions per vehicle, and £500k savings on uninsured cost recoveries. The target company perceived many benefits of the program (e.g. improved compliance, performance management), but lacked supportive data.
Murray et al. (2012), Australia	Comprehensive 5-year attempt to improve road safety management through range of proactive, fleet manager, insurance and risk-led initiatives in drivers-for-work at Roche.	Mix of cultural and structural elements, but improving safety culture central. Key initiatives: driver risk assessment, monitoring and improvement; policy development and communication; process and outcomes evaluation; continuous review and refinement of policies, processes, programs. Intervention targets fleet managers, drivers, risk managers and those who train and recruit drivers.	Case-study type quantification of development of various safety behaviour and outcome measures over time.	100% compliance with risk assessment and improvement process. Reduction in insurance claims costs (56%), collision costs (55%) and claims per vehicle (down from 36 to 28%) from 2004 to 2009. No accounting for external trends or which measure contributed most.
Wallington et al. (2014), UK	Case study of long-term, data-driven extensive program targeting road safety in British Telecommunications (BT), with a	Risks and costs established, and subsequent process structured by occupational Haddon matrix, with risk analyses and mitigation based	Case study of long-term trends in collision numbers, rates and claims in British Telecom based on data from up to 95,000 workers.	Overall claim rate (per 1000 vehicles) per year decreased notably and gradually from program initiation in 2001–2012,

	fleet of approximately 35,000 vehicles.	on occupational health and safety principles. Effects of control measures (e.g. managers responsible for 5 or more drivers participate in a fleet safety coaching workshop) are monitored, and the measures are evolved accordingly. Measures cover management culture and leadership, journey management, people, vehicle, and society/community.	Company traffic safety trend compared to national trend.	compared with the general downward trend in the number of killed or severely injured in collisions in Great Britain in the same period.
Goettee et al. (2015), US	Federal Motor Carrier Safety Administration (FMCSA) initiated training of new transport companies in the U.S., intended to foster a safety culture, based on research indicating that small entrant carriers were less safe than established ones.	Training / mentoring and testing carrier managers to improve understanding of applicable rules and regulations, and improve company compliance. Authority also guides and supports on record-keeping activities.	Cross-sectional design using a test group and a matched control group. "Dose-response." Conducted from 2009 to 2013. N = 117 in the first period and 177 in the second period. Self-selection challenge, as participation in test group was voluntary.	Carriers that took part in the program had better safety outcomes than those who did not. Improvements were identified in the number of safety audit failures, roadside violations and crashes (up to 84% reduction).
Newnam and Oxley (2016), Australia	"Safety Management for the Occupational Driver" (SMOD) research-based program, focusing on manager's role in work-related road safety in a small-scale implementation case study.	Program focuses on four supervisory skills: motivation to improve driver safety ("prosocial motivation"), mindfulness (creating a safety climate where driver safety is prioritized and valued), role clarity, and self-efficacy. Supervisors are trained in safety management of drivers, by teaching them to identify situations that pose increased risk to drivers, and effectively manage these situations. Program runs in monthly 3–4-hour sessions covering safety leadership styles, feedback from a 360-degree	Before–after study (N = 36) without a test group. Only 8 respondents answered the after study.	Improved safety climate. Improvements were also recorded on the four elements of the supervisory skills. However, low number of participants, especially in the after study.

Naveh and Katz-Navon (2015), Israel	Intervention to improve organizational climate to improve road safety behaviour of drivers in diverse organizations, and their families.	survey, role play and group discussions. Intervention designed and supported by the national road authority in Israel, and carried out by designated teams at organizational “unit”-level. Three-tier comprehensive multi-measure long-term intervention: (i) ISO-39,001-driven policy change and data-driven risk analyses, action plans, manuals and training; (ii) visible management commitment and internal marketing supporting the policies (logos, tools, reward systems, road safety “ceremonies”); (iii) evaluation and continuous improvement.	Longitudinal before and after evaluation carried out by 51 units belonging to 11 organizations, including bus, truck, high-tech and administration companies. Additional company with 5 diverse units randomly selected as control group. Baseline survey of road safety climate administered 3 months prior to intervention, and 12 months following start.	Average 75% reduction in traffic safety violations in intervention units, compared with an increase in control units. Increase in ratings of unit road safety climate in intervention units (decreased in control units). Multivariate statistical analyses and controls confirmed the effects, and found that the reduction in violations was mediated by change in safety climate. Improvements spilled over to drivers’ safe driving outside work, but not to family members’ driving.
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TABLE 11 |

(4) OSC: Interventions in air, rail and sea transport domains

Nævestad et al. (2018)

Author, year, country	Context	Content (intervention)	Evaluation method	Effect
AVIATION				
Edkins (1998), Australia	Comprehensive program – INDICATE (Identifying Needed Defences In the Civil Aviation Transport Environment) – intended to improve safety performance in regional airlines.	Eight-month trial with 6 core activities: (i) appointment of operational safety manager responsible for training, coordination, evaluation and improvement; (ii) proactive hazard identification by focus group with management; (iii) confidential hazard reporting system; (iv) regular safety meetings to address identified hazards; (v) safety information database allowing managers to monitor threats identified and actions taken; (vi) internal safety marketing for visible management commitment.	Before and after 8-month trial with test group (N = 81) and control group (N = 72). Quantitative and qualitative assessment.	Improved safety culture; improved reporting rates; lower hazard perception; more actions taken on identified hazards.
Boedigheimer (2010), US	Pilot reliability certification intervention by expanding Crew Resource Management training in an air operator. Aim is to improve knowledge of and attitudes towards reducing human error in the cockpit.	Classroom or online training curriculum with six themes including resource management and personal error and awareness control.	Controlled, quasi-experimental survey evaluation of change in knowledge and attitudes towards human error in cockpit before and after implementation, in pilots in treatment (n = 41) and control (n = 62) groups.	Significant improvement in safety attitudes and knowledge but confounded by demographic differences between control and treatment group. Qualitative evaluation supported the result, and that the treatment group became more aware of minimal, yet critical lapses that may pass unnoticed.

Belland et al. (2010), US	Study of effect of increase in organizational safety commitment and support occurring from 1998 on, as result in “spike” of dangerous air incidents at US Navy air base.	Visible change in management commitment to safety, achieved by routine personal message on safety and command culture from Naval air commander, culture workshops, safety surveys, increased focus on HFACS and pilot qualification.	Retrospective analysis of mishap rate 10 years before and 10 years after the intervention.	27% reduction in “Class A” mishaps per 100,000 flight hours in a single carrier air wing aviator group at treatment base compared with fleet control.
Gałązkowski et al. (2015), Poland	Assesses effectiveness of a systemic training program on human, technical and organizational competencies required on replacing an older “analog” HEMS fleet with new EC135 helicopters containing a high level of electronics and automation.	Competencies trained by air instructors and simulator guidance. Training based on human, technical, and organizational causes resulting from incident analysis of before period.	Non-controlled prospective before–after study.	Overall decrease in contribution of human factors to incidents from before to after period, despite a rise in flight hours. However, increase in relative level of human errors registered, indicating an increase in threat levels. Effectiveness based on low numbers of incidents.
Teperi et al. (2015), Finland	Aim to change safety culture in air traffic control by changing “managers’ understanding of human risks, strengths and opportunities”.	Learning from incidents restructured, using a checklist tool that guides controllers and managers to consider systemic causes of incidents. Training in checklist lasts up to one day, with several minutes required for each subsequent incident analysis.	Survey with open questions to assess user experience at 27 units using the tool.	Frequency at which individual characteristics are attributed as causal factors decreases with increased use of tool and understanding. No validation of tool in terms of effects on culture or safety.
SEA				
Lappalainen et al. (2014), Finland	Introduction of ISM (International Safety Management) code for international shipping, with requirement on safety management systems (SMS).	SMS requirements include proactive risk assessment, with assessment of risks, establishment of control measures, documentation of this, and a requirement for masters to “periodically” review their vessel’s SMS and report deficiencies to shore-based management. Procedures for corrective action	(a) Literature review of previous studies of the ISM code, and (b) 94 interviews conducted with shipping companies, mariners and other maritime stakeholders in the Finnish shipping industry in 2008–2009.	Improved safety level; improved safety culture.

		include measures to prevent recurrence, and annual mandatory internal safety audits.		
Röttger et al. (2016), US	Officer training on Bridge Resource Management.	Training given to junior sea officers by officers experienced in Crew Resource Management for helicopters. Focus on leadership commitment, communication, coordination, performance under stress, decision making, situation awareness, attitudes and motivation that can lead to ineffective / unsafe bridge resource management.	Prospective before/after evaluation of effect of training on knowledge, skills, attitudes, along with ratings of safety behaviour during real world exercises. Pseudo-randomly assigned experimental group (n = 57) with control (n = 60) who receive non-relevant safety training course. Final statistical analysis only performed on 79 complete cases. No direct measure of effect on safety culture.	Significant increase in knowledge on BRM only for experimental group, but no increase on other measures. However, 79 is a little number when it comes to finding experimental effects. "Overall, BRM training effectiveness was rather low, which can most probably be attributed to the focus of training on generalizable knowledge, skills and attitudes at the expense of their specific application to the context of the real-world exercise."
O'Connor (2011), US	Officer training on Bridge Resource Management.	Similar to above, but less comprehensive. US Navy officers trained for 14 h in the classroom, with 20 h simulator training.	Change in knowledge, attitudes in response to training in 166 US Navy officers.	No significant changes.
RAIL				
Zuschlag et al. (2016), US	"Clear Signal for Action" intervention implemented in Union Pacific Railroad, after observations of negative safety culture. Based on safety culture theory of Reason (1997).	Implemented by Behavioural Science Technology (BST) Inc., to introduce non-disciplinary, proactive, systems-safety-analysis orientation, cooperative and sustainable practices. This was done by peer-to-peer feedback, continuous improvement through cooperation at all levels, and safety-leadership development.	Before and after pilot study with two experiment units and three control units. Study conducted 2005–2008. Safety culture measured quantitatively before (N = 195) and after (N = 112) and in qualitative interviews before, during and after (N = 53).	80% drop in at-risk behaviours; 81% drop in derailments; improved safety culture.
Amtrak (2015), US	Safe-2-Safer program in large US rail company, aimed at improving	Improved safety leadership and peer-to-peer observation process.	Safety culture measured by a biennial employee survey, focusing on 10 aspects of safety culture.	Small improvement in safety culture, reduction in unsafe working conditions (through peer-

TABLE 12	company safety culture, reducing costs and injuries.	Conducted from 2009 to 2013 (N = 11,700 in 2013).	to-peer observation), but increase in injuries.
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(5) OSC: Safety culture interventions from a regulatory perspective in three pioneering sectors

Nuclear Sector

The International Atomic Energy Agency (IAEA) was founded in 1957 as an autonomous organization reporting to the United Nations General Assembly and Security Council. Today, it comprises 168 member states.

As part of its mandate to promote nuclear safety, the IAEA develops and publishes safety standards that provide a comprehensive framework of fundamental principles, requirements, and recommendations. Several of these standards address safety culture, either directly or indirectly (IAEA, 1991, 1992, 1997, 2006, 2013).

The IAEA Safety Standards Series is structured into three categories:

- **Safety Fundamentals**, which outline overarching objectives, concepts, and principles
- **Safety Requirements**, which define the conditions that must be fulfilled to ensure safety
- **Safety Guides**, which offer recommended actions and procedures for meeting these requirements

It should be noted that these standards are not legally binding for member states. However, they may be voluntarily adopted and incorporated into national regulatory systems (IAEA, 2002).

The IAEA Safety Requirement GS-R-3 (IAEA, 2006) is explicitly related to safety culture. It requires nuclear organizations to establish management systems that foster and sustain a strong safety culture. This includes encouraging a questioning and learning-oriented mindset at all organizational levels, as well as ensuring continuous improvement (IAEA, 2006, p. 6).

Additionally, the IAEA identifies five key features of a strong safety culture (IAEA, 2009, 2016):

1. Safety is clearly recognized as a core value
2. Leadership for safety is well defined
3. Safety is embedded in all activities
4. Safety is driven by learning
5. Accountability for safety is clearly established

In the nuclear sector, safety culture is important because technical barriers and formal procedures alone are not sufficient to ensure safe operation. The reviewed studies show that the sector has treated safety culture as a core part of safety regulation ever since the concept gained prominence after Chernobyl, and that regulators have used a broad set of measures to influence it, including standards, audits, training, self-assessment tools, and continuous improvement processes. This reflects an understanding that safe performance depends not only on formal compliance, but also on shared values, questioning attitudes, learning processes, and everyday practices throughout the organization. The studies further indicate that safety culture in this sector is closely linked to organizational learning and the ability to identify weaknesses before they develop into serious events. At the same time, the evidence base is mainly indirect: positive effects are reported in terms of competence, awareness, self-assessment, and improvement processes, while direct effects on accidents are less frequently measured.

Author, year, country	Context	Content (regulatory intervention)	Evaluation method	Effect / results
Bernard (2018), Belgium	Case study of safety culture oversight in nuclear installations	Safety Culture Oversight (SCO) model; safety culture audits used by regulator to assess strengths and weaknesses	Case study	Provides regulator with better overview of strengths and weaknesses; supports monitoring and improvement of safety culture
O'Mara et al. (2015)	Training programme in nuclear context	Training based on IAEA Systematic Approach to Training (SAT) to improve competence	Quantitative survey before–after training	Improvement in skills and knowledge; safety culture assumed improved but not directly measured
Bernard (2014)	Conceptual development of regulatory approach	Development of SCO model as a regulatory tool between compliance- and performance-based regulation	Conceptual / descriptive	Emphasises a model where consensus, consistency, and fitness of frames are key.
Mod Ali (2008), Malaysia	Regulator-led programme for safety culture improvement	Training of company representatives to conduct self-measurement and self-development	Descriptive case	Results of the programme are not evaluated.

TABLE 13 |

Norwegian Petroleum Sector

In 2002, the Norwegian Petroleum Authority (PSA) introduced a specific requirement in its safety regulations stating that companies must maintain a sound Health, Safety, and Environment (HSE) culture.

Although Norwegian oil companies have generally achieved good safety performance over time, research indicates that HSE outcomes began to weaken in certain areas toward the late 1990s (Haukelid, 2008). In response, Norwegian policymakers emphasized the need for a stronger “cultural effort” within the petroleum sector.

This objective was reflected in the first White Paper on HSE in the Norwegian petroleum industry (White Paper No. 7, 2001–2002), as well as in the introduction of HSE culture requirements.

According to Kringen (2009), the PSA’s interest in safety culture was also influenced by its recognized role in safety management within the aviation and nuclear sectors. The HSE culture requirement was formulated as a functional requirement, leaving it to individual companies to define what constitutes a “sound HSE culture” and how it should be achieved. No explicit definition was provided in the regulations or accompanying guidelines (Bye et al., 2016).

Instead, the PSA communicated its intentions through seminars, publications, and other channels. It also issued an advisory booklet clarifying the relationship between culture and HSE, emphasizing that each company is responsible for defining what a sound HSE culture means in its own context (Antonsen et al., 2017).

In the Norwegian petroleum sector, the importance of culture emerged from a recognition that formal systems and generally good historical safety performance did not fully explain how work was actually carried out, or why some safety outcomes were weakening. The studies show that the HSE-culture

requirement helped direct attention to the informal aspects of safety: shared understandings, everyday practices, interpretations of risk, and the gap that can arise between procedures and actual work. In this sense, culture became important not because it could be precisely controlled, but because it provided a new perspective on organizational safety that traditional command-and-control regulation did not capture well. The petroleum studies also show that the concept stimulated reflection, dialogue, and organizational learning among both regulators and companies. However, they also demonstrate that culture is an ambiguous and demanding regulatory concept, often producing high interpretive costs and different company “translations” of what a sound HSE culture means in practice.

Author, year	Context	Content (regulatory intervention)	Evaluation method	Effect / results
Kringen (2009)	Introduction of HSE-culture requirement (2002)	Functional regulation requiring companies to have a “sound HSE culture”	Qualitative study, PhD-thesis	High interpretive costs, learning, frustration, discontinuities, weak integration
Karlsen & Valen (2010)	Implementation of HSE regulation	Regulatory requirement combined with follow-up and dialogue	Discourse analysis of key documents	Premature HSE concept hinders auditing standards; encourages impression management
Le Coze & Wiig (2013)	Analysis of regulatory influence on culture	Study of how culture requirements are interpreted and enacted	Qualitative interviews	Introduces learning, broader focus; but ambiguity makes regulation difficult
Bye et al. (2016)	Companies’ responses to HSE requirement	Analysis of how companies define and operationalize “HSE culture”	Qualitative interviews and document analysis	Double-edged: learning gains, but ambiguity enables varied, sometimes counterproductive interpretations
Kongsvik & Gjøsund (2016)	Organizational learning processes	Study of cultural change processes in companies	Qualitative interviews	Learning occurred, but outcomes varied by context and produced unintended consequences
Antonsen et al. (2017)	Regulatory practices and communication	Advisory activities (seminars, guidance, dialogue)	Qualitative interviews	Sensemaking drove learning but also produced unanticipated regulatory outcomes
Grote & Weichbrodt (2013)	Conceptual discussion of safety culture regulation	Analysis of regulation approaches (compliance vs. performance-based)	Conceptual & analytical discussion	Focus on culture may divert effort from more critical safety issues

TABLE 14 |

North American Rail Sector

The U.S. Federal Railroad Administration (FRA) has introduced several voluntary initiatives aimed at strengthening safety culture within the rail sector. Between 1998 and 2012, the FRA Office of Research and Development carried out a program focused on identifying and evaluating system-based safety culture interventions. This included supporting pilot projects and assessing their outcomes (Ranney et al., 2013).

The Rail Safety Improvement Act of 2008 required the FRA to develop additional safety regulations. In response, the FRA issued a rule in 2016 mandating that commuter and intercity passenger railroads implement Safety Management Systems (SMS), referred to as “system safety programs” (FRA, 2016).

These systems must include risk-based management processes and hazard analyses. They are also required to promote and support a positive safety culture (§ 270.101(b)). Railroad companies must describe their safety culture and explain how its effectiveness is evaluated.

The FRA recommends that companies base their assessments on ten elements considered essential for a strong safety culture. While companies are free to choose their own measurement approaches, these should be linked to actual safety performance outcomes. The regulation came into effect in March 2017 (FRA, 2017).

In Canada, the Railway Safety Act has required rail operators to implement and maintain SMS since 2001. Although the updated 2015 regulations do not explicitly focus on safety culture, related documents highlight it as both an objective and a prerequisite for effective SMS implementation (Lewis et al., 2007).

A comprehensive review of the Act in 2007 recommended that Transport Canada and the railway industry take concrete steps to strengthen safety culture (Lewis et al., 2007, p. 72). In response, an SMS working group developed additional tools to support implementation, including:

- Self-assessment instruments
- A safety culture checklist
- Examples of best practices
- Guidance on integrating key SMS principles
- A definition and description of a positive safety culture

However, no evaluations of these tools were identified.

In North American rail, safety culture is important because it has been treated not only as a general value, but as something that can be translated into concrete interventions, management systems, reporting practices, and employee involvement processes. Culture is important in rail because it influences how hazards are reported, how risks are discussed, how rules are followed, and how learning takes place across the organization. The sector also shows the importance of trust and non-punitive reporting: when employees can report close calls and incidents without fear of retaliation, organizations gain better information about risk and are better able to act on it. The studies from rail demonstrate how safety culture can be operationalized and evaluated as part of systematic safety management.

Author, year	Context	Content (regulatory intervention)	Evaluation method	Effect / results
Zuschlag et al. (2016)	Clear Signal for Action programme	Regulator-supported intervention with peer feedback, leadership, and system-based safety approach	Before–after with control groups	Improved safety culture, reduced unsafe behaviour and accidents
Amtrak (2015)	Safe-2-Safer programme	Safety culture programme including leadership and peer observation	Survey-based evaluation	Small improvement in safety culture, reduction in unsafe working conditions, but increase in injuries
FRA (2006)	Confidential Close Call Reporting System (C3RS)	Non-punitive reporting system to improve learning from incidents	Review of surveys, interviews, document analysis, focus groups	Improved scores; ISROP better identifies causes and corrective actions
FRA (2016)	System Safety Program rule (SMS)	Requirement for rail companies to implement risk-based SMS including safety culture elements	Regulatory implementation, interviews	More reporting, corrective actions taken; safety culture effects unmeasured
Ranney & Nelson (2004)	Early rail safety interventions	Pilot studies of system-based safety approaches	Case study, qualitative interviews and incident data	Evidence of culture impact; mixed, uncertain effects on incident rates. Interview data provided evidence for an impact on the safety culture. Analysis of incident data found a significant impact of the intervention on incident rates at one rail carrier, while incident rate declines at two other carriers could not be attributed to the intervention with confidence.
Lewis et al. (2007)	Canadian Railway Safety Act review	Development of SMS tools and safety culture guidance	Review and advisory development	Emphasises need to strengthen safety culture

TABLE 15 |

In North American rail, safety culture is important because it has been treated not only as a general value, but as something that can be translated into concrete interventions, management systems, reporting practices, and employee involvement processes. Culture is important in rail because it influences how hazards are reported, how risks are discussed, how rules are followed, and how learning takes place across the organization. The sector also shows the importance of trust and non-punitive reporting: when employees can report close calls and incidents without fear of retaliation, organizations gain better information about risk and are better able to act on it. The studies from rail demonstrate how safety culture can be operationalized and evaluated as part of systematic safety management.

Table 16 underneath sums up the intervention studies in the three sectors.

Sector	Type of interventions studied	Main positive results	Limitations / challenges	Strength of evidence
Nuclear	• Training programs- Safety culture audits (e.g. SCO) • Safety management systems (SMS) • Self-assessment and continuous improvement processes	• Improved safety culture indicators (e.g. index scores) • Increased competence, skills, and knowledge • Enhanced organizational learning and continuous improvement • Better identification of strengths and weaknesses in safety culture	• Safety culture often not measured directly • Limited evaluation of actual safety outcomes • Effects often assumed rather than demonstrated	• Moderate (mainly indirect and qualitative evidence)
Norwegian petroleum	• Regulatory requirement for "sound HSE culture" • Advisory activities (seminars, guidance, communication)	• Increased awareness and reflection on safety • Organizational learning and new perspectives • Greater focus on informal aspects of safety (how work is actually done) • - Development of company-specific interpretations and practices	• High interpretive costs and ambiguity • Unintended and variable outcomes across companies • Limited evidence of improved safety behaviour or reduced accidents • Risk of superficial compliance ("impression management")	• Weak–moderate (mainly qualitative evidence, little outcome measurement)
North American rail	• Pilot safety culture interventions • Safety Management Systems (SMS) • Reporting systems (e.g. C3RS) • Participatory rule revision • Training and employee	• Measurable improvements in safety culture scores • Large reductions in unsafe behaviours (e.g. ~80%) • Significant reductions in accidents (e.g. ~81%)	• Increased reporting may initially mask improvements • Some inconsistent results across interventions • Difficult to isolate causal effects in some cases	• Strong (quantitative studies with control groups and before–after designs)

Sector	Type of interventions studied	Main positive results	Limitations / challenges	Strength of evidence
	engagement programs	• Increased reporting and learning from incidents • Improved hazard identification and safety processes		

TABLE 16 |

Annex 5 | Additional (good) practice examples

This annex includes (links to) examples of considered 'good' practices in EU road safety projects and by ETSC. Assessment as a 'good' practice in these cases is not always based on robust outcome evaluation (e.g. only expert judgement). Interventions not formally evaluated should be considered as practice examples in the field.

(1) TSC: LEARN project "Traffic safety and mobility education" (ETSC)

(2021; www.trafficsafetyeducation.eu)

The LEARN project addressed traffic safety and mobility education, covering all measures that aim at positively influencing traffic behaviour patterns, with an emphasis on: Gaining knowledge and understanding of traffic rules and situations; Developing and improving skills through training and experience; Strengthening and/or changing attitudes and intrinsic motivations towards risk awareness, personal safety and the safety of other road users in order to contribute towards a safety-minded culture; Providing the tools necessary for a well-informed choice of transport mode.

ETSC (2020): **Key principles** for traffic safety and mobility education: www.trafficsafetyeducation.eu/key-principles The key principles (referring to schools) recommended in this publication were drawn up by the members of the LEARN! project expert panel. The expert panel consists of some of Europe's leading experts on road safety education.

ETSC (2020): The LEARN! **manual for developing and evaluating** traffic safety and mobility education activities: <https://www.trafficsafetyeducation.eu/wp-content/uploads/LEARN-Manual.pdf> The manual is envisaged as a starting point for those who design, test, implement and evaluate educational activities on traffic safety and mobility, and are embarking upon the creation of new, or updating existing, activities. It should also be useful to ministries, authorities, schools and organisations when deciding on which activities and projects to buy or fund. The guidelines reflect a list of minimum criteria that should be included or considered, in order to ensure high quality standards are maintained.

Best practice database with information on background, content, implementation, evaluation design and results: <https://www.trafficsafetyeducation.eu/database/>

Best practice examples:

- 'Be seen' project (Portugal): campaign for children 6-14 and 15+ with actions and educational activities to promote use of reflective material by pedestrians in periods of poor visibility and to raise awareness of the problem of pedestrians being run over (pre-post survey evaluation) <https://www.trafficsafetyeducation.eu/bestpracticeexamples/evaluating-the-be-seen-project/>
- Help The Helmetless activity which since 2016 has run every year in the autumn (normally in September) at universities and higher education institutions in Denmark to promote the use of cycle helmets. (pre and post measures, survey and observations) <https://www.trafficsafetyeducation.eu/bestpracticeexamples/evaluating-the-help-the-helmetless-activity/>
- In Denmark schools with pupils in Grades 8 to 10 (13 to 16 years old) can request, free-of-charge, to have a visit by persons who have been involved in severe traffic collisions. In the "Sikker Trafik LIVE" ("Road Safety LIVE") initiative, these persons are called "ambassadors" and their role is to tell pupils about their own collisions. Common to these ambassadors is that they have all been seriously injured in a collision, and that they themselves were (partly) to blame for the collision and injuries. (randomised controlled trial) <https://www.trafficsafetyeducation.eu/bestpracticeexamples/objectives-and-output->

[objectives-from-the-road-safety-live-initiative/](https://www.trafficsafetymedical.eu/wp-content/uploads/Report.-LIVE-Intervention-Lower-Sec.-Schools.-Danish-Road-Safety-Council.pdf) evaluation report:
<https://www.trafficsafetymedical.eu/wp-content/uploads/Report.-LIVE-Intervention-Lower-Sec.-Schools.-Danish-Road-Safety-Council.pdf>

(2) TSC: The European Road Safety Charter

The European Road Safety Charter is led by the European Commission (<https://road-safety-charter.ec.europa.eu/>). To date, more than 4.000 public and private entities have committed to the Charter and carried out road safety actions and initiatives targeted at their members, employees and the rest of civil society. These various entities form a community in which members can share expertise and actions. The Charter's community is made up of companies, associations, local authorities, research institutions, universities, schools and individuals. Its aims are to: (1) Encourage and support European associations, schools, universities, companies of all types and sizes, and local authorities to take actions for road safety in Europe; (2) Acknowledge contributions by civil society to road safety; (3) Facilitate civil society members in acquiring and sharing knowledge on road safety issues in the European Union; (4) Facilitate true dialogue for the transfer of road safety experiences and practices at all levels of governance in the European Union.

ERSC practice examples

We selected 8 submitted proposals of actions from Member States in the 2024 and 2025 ERSC awards, based on the scope (at least awareness raising or education) and a high mean experts' score on road safety impact. These should be considered as examples in case of lacking robust outcome evaluation. Information on content, implementation, evaluation, effect and the provider argumentation of why it is a good practice can be found following the links.

- **FlineBox: The first interactive breathalyser terminal designed for nightlife prevention (awareness raising)**
 - <https://road-safety-charter.ec.europa.eu/content/flinebox-first-interactive-breathalyzer-terminal-designed-nightlife-prevention>
 - Target group: Public authorities, Adults, Car drivers.
 - Country: Belgium
 - FlineBox is a self-service breathalyser placed in nightlife venues to help people check their alcohol level before driving. It encourages safer decisions, with over 1 million tests already changing behaviours across Europe.
- **The Signposting Grant Program (education)**
 - <https://road-safety-charter.ec.europa.eu/pl/content/program-grantowy-drogowskaz-0>
 - Target group: Children
 - Country: Poland
 - This program funds local road safety education for children, especially in rural areas, through workshops, mobile traffic towns, and community events. It reached over 20,000 children and is expanding with strong local engagement and measurable impact.
- **Look instead of looking away – E-scooter training as a contribution to road safety (education/awareness raising)**
 - <https://road-safety-charter.ec.europa.eu/de/content/hinschaufen-statt-wegschaufen-e-scooter-ausbildung-als-beitrag-zur-verkehrssicherheit>
 - Target group: Children 0-16, Young adults 17-25
 - Country: Austria
 - This project offers hands-on e-scooter training to reduce crashes among young users, now a high-risk group. It builds practical skills and awareness, reaching thousands through schools and public events.

- **National Technical University of Athens campaign of 30 marathons in 30 months for 30 km/h speed limit in cities (awareness raising)**
 - <https://road-safety-charter.ec.europa.eu/content/ntua-campaign-30-marathons-30-months-30-kmh-speed-limit-cities>
 - Target group: Drivers, policy makers/local authorities
 - Country: Greece
 - This global awareness campaign combined marathon running with advocacy for 30 km/h urban speed limits to protect vulnerable road users. It sparked policy change and public debate, backed by scientific research and widespread media reach.
- **The Week of the Just Street (awareness raising)**
 - <https://road-safety-charter.ec.europa.eu/content/week-just-street>
 - Target group: All road users
 - Country: The Netherlands
 - This nationwide movement reframes street safety as a matter of fairness and inclusivity, encouraging cities to design roads for all users. Through media, events, and a manifesto, it mobilizes citizens and policymakers to create human-centered, just streets.
- **Bologna City 30: more safety and more space for people (awareness raising, legislation, infrastructure, enforcement)**
 - <https://road-safety-charter.ec.europa.eu/it/content/bologna-city-30-more-safety-and-more-space-people>
 - Target group: All road users
 - Country: Italy
 - Action plan to make Bologna a 30km/h city: new traffic rules, redesign of urban space, inclusion of citizens via questionnaires and representatives, and police controls.
- **The school cup (education, awareness raising)**
 - <https://road-safety-charter.ec.europa.eu/fr/content/school-cup>
 - Target group: Children
 - Country: Luxembourg
 - A school cup organised for children aged 10-11 where they can do theoretical and practical tests to win a prize.
- **DriveArse - awareness campaign about aggressive drivers (awareness raising)**
 - <https://road-safety-charter.ec.europa.eu/content/dont-let-it-get-you-down-awareness-campaign-about-aggressive-drivers-nenechte-se-rozladit>
 - Target group: Car drivers
 - Country: Czech Republic
 - Awareness campaign (website, leaflets, videos, quiz) to motivate drivers to not respond on aggressive behaviour on the road.

(3) OSC: PRAISE project “Preventing Road Accidents and Injuries for the Safety of Employees”

(ETSC) <https://archive.etsc.eu/PRAISE.php.html>

PRAISE iC (Preventing Road Accidents and Injuries for the Safety of Employees) is an ETSC project than run from 2009 until 2019 (<https://etsc.eu/projects/praise/>). It addressed the safety aspects of **driving at work and driving to work**. The project aimed at advancing work-related Road Safety Management and providing the know-how to employers who have to take on that challenge. It also aimed to present the work-related road safety standards of EU Member States and carried out advocacy work at the EU level.

Best practice was promoted in order to help employers secure high road safety standards for their employees.

- Handbook for Preventing Road Accidents and Injuries for the Safety of Employees: https://archive.etsc.eu/documents/praise/PRAISE_Handbook.pdf
- Infographics for organisations: <https://etsc.eu/projects/praise/>
- Awards in recognition of organisations that have made an outstanding commitment to improving work-related road safety: <https://archive.etsc.eu/PRAISE-award.php.html>
- <https://etsc.eu/17-october-2018-european-conference-on-work-related-road-safety-brussels/>
- https://archive.etsc.eu/documents/Road_safety_in_Shell.pdf
- https://archive.etsc.eu/documents/Richard_Hill_VolkerRail_SME_Winner_25.04.2012.pdf

(4) OSC: Summary of considered good OSC practices in a case-study analysis (Newnam & Muir, 2019)

Newnam & Muir (2019) analysed 24 reports from organisations that have implemented a recognized workplace road safety program and were included in the Australian National Road Safety Partnership Program (NRSPP) knowledge bank of “best practices” in workplace road safety. This concerns 24 organisations with big heavy and/or light vehicle fleets. The reports are based on structured interviews with the organizations on the implementation and *self-reported* success of the workplace road safety program.

They found that “**third-party regulation**”, “**internal workplace road safety policy**” and “**corporate social responsibility**” form the base of workplace safety practices. While the first requires compliance by law, investment in the latter two depends on the organization’s strategic priorities and availability of resources. Heavy vehicle fleets are subject to intensive regulation, notably the Chain of Responsibility legislation (cfr the Safe Systems approach), which holds every level of an organization accountable for safety compliance (e.g. unsafe driving can be related to imposed tight deadlines). Legislated driver record-keeping and monitoring is another example here. For light vehicle fleets, there is a lack of such regulation. Internal policies, and examples of reported success strategies within these, mainly refer to 4 levels: **equipment standards**, e.g. electronic safety technologies, frequent fleet renewal; **personnel behaviour management**, e.g. driver training and assessment, driver fatigue management, zero-alcohol tolerance, but also the use of telematics to impact road safety, e.g. speed tracking, driver rest notifications (less in light fleets so far); **operations management** strategies, e.g. journey planning, incident and telematics data collection; and **culture management** strategies, e.g. focus on education rather than punishment, identifying a chain of responsibility, identifying safety as a clear priority over deliverable. Corporate social responsibility refers to organisations’ efforts beyond internal policies: some larger organizations try to influence road safety outcomes of the wider industry and community, e.g. setting best practice guidelines for the industry, public driver education.

According to the organisations in the study, the implementation of road safety policies has many advantages: reduction of incidents/crashes saves costs and improvement of the reputation of the organisation. The analysis showed that prevailing “culture and attitudes towards the safety initiatives” (policies) make them effective in the longer-term. If employees genuinely believe in the need and advantage of the initiatives, they are more likely to accept them. These attitudes need to be evident throughout an organisation’s management structure, driven from the top in order to prominently place employee safety as the most important organisational priority. All case-reports indicated that developing a “safety-first culture” in the workplace is highly important. It remained unclear which practices are the most effective. They concluded that “**best practice**” is best achieved when “**integrated within a culture that values and prioritizes safety**”, rather than implemented in isolation to other elements in the workplace system and express several recommendations for organisations to build a strong safety

culture: 1. A strong safety culture should be the focus of a workplace road safety program; interventions to challenge the key beliefs of drivers regarding unsafe driving behaviour; 2. develop the skills of supervisors in identifying and managing situations in which drivers are at risk on the road; develop effective safety leadership but define the roles and responsibilities of supervisors in the safety management of drivers; learn to effectively integrate objective behavioural data into safety management practices, particularly those that align with motivating safety through reward rather than punishment.

(5) OSC: ETSC recommended practice examples in the road domain

ETSC (2025), Tapping the potential for reducing work-related road deaths and injuries (PIN Flash 49)

- https://etsc.eu/wp-content/uploads/ETSC_PINFLASH_49-FINAL.pdf; <https://www.monozakelijk.nl/default.aspx>:
In the Netherlands, 'Monozakelijk' is an initiative of the Ministry on Infrastructure and Water Management and 19 partners aiming at **awareness rising and supporting employers** about the importance of safe, smart and sustainable mobility. It encourages businesses to improve the road safety (and sustainable mobility) of their employees. 'Monozakelijk' is a one-stop shop for **training, advice, resources, apps and technology** (toolkit road safety with tips, advice bureaus, simulations/trainings/workshops, tools (ppts, flyers, tools), apps & technology, for employers. 'Monozakelijk' also aims to inspire by appointing **ambassadors** – businesses that have already taken significant steps to improve their road safety and have seen the benefits (shared best practices). For example, online grocery delivery company, Picnic, trains all its delivery drivers before they start driving and data gathered by Picnic vehicles (the so-called 'driver coach') are used to score driving behaviour. In-vehicle technologies also encourage safer driving, such as beeps to warn of low-hanging balconies. Good driving behaviour is rewarded by the company. The company reported that three months after introducing the technology, they saw an 80% reduction in incidences of damage.
- <https://drivingforwork.ie/>
In Ireland, the Road Safety Authority, the Health and Safety Authority and An Garda Síochána (the Irish Police) have developed a number of **resources to help employers to develop and implement safe driving practices** in their company or organisation. This website includes a comprehensive collection of information and resources regarding driving for work (employer resources: e.g. "Driving for work – employer **guidelines**", "My responsibilities – information sheet", "Risk assessment **checklist** forms", "Safe driving policy – sample", "Driving for work – driver **declaration**"; driver management e.g. "Safe driving for work **handbook**"; vehicle management...). It also presents **case studies** (not always evaluated), e.g. <https://drivingforwork.ie/wp-content/uploads/2020/12/HSA-Case-Study-FINAL-2020.pdf> (Wexford Bus, a privately-owned public transport provider) presenting safety measures undertaken and results after implementation.
- <https://www.dgt.es/conoce-la-dgt/que-hacemos/conocimiento-e-investigacion/guia-orientativa-sobre-la-incorporacion-de-la-seguridad-vial-en-la-rsc/index.html>
In 2025 the Directorate-General for Traffic in Spain published a **guide to incorporating road safety into corporate social responsibility (CSR)**. The guide includes **case studies**, e.g. case study 15 "Implementation of a safety culture programme (example of the company Boeringer Ingelheim Espana): big vehicle fleets travelling a large number of kilometres. The activities include: a behavioural survey as a preliminary analysis to identify the risks faced by workers (individual and global level), classifying these by level of risk. Based on these various measures were adopted to address the crash rate: Reviewing the mobility plan to regulate and manage worker travel ; MIRA (Comprehensive Method for Accident Reduction) training in the use of defensive driving techniques to prevent crashes and infringements, changing conduct and behaviour ; Training for all area managers to foster attentive driving and help their teams identify risks, develop behaviour and skills to prevent crashes and identify critical maintenance points before operating vehicles ; Establishing minimum safety requirements for the vehicle

fleet; Publishing a quarterly newsletter on road safety issues, distributed electronically to all company employees (email and corporate intranet). Implementation of the various practices led to a reduction of over 50% in traffic crashes, from 31 in 2017 to 14 crashes in 2018. References to case study 15: <https://www.asepeyo.es/wp-content/uploads/Monografia-2020.pdf>; <https://www.boehringer-ingelheim.com/sites/default/files/2024-07/Informe-Sostenibilidad-2023-25072024.pdf>, <https://www.boehringer-ingelheim.com/es/pdf/dossier-sostenibilidad-2021-v2>

This commitment to workplace safety has continued through the BeSafe initiative, launching schemes to ensure safe environments for employees, stakeholders and customers and/or visitors. <https://www.boehringer-ingelheim.com/about-us/sustainable-development/more-potential/our-health-and-safety-initiative-be-safe>

(6) OSC: DeepBlue recommended OSC practice examples in air, rail and sea transport domains

Some good practice examples in the air, rail and sea transport domains were provided based on a mixed-source approach integrating findings from peer-reviewed academic research on interventions to support safety climate, grey literature (e.g. ERA safety climate survey, official data from regulatory bodies), and established industry good practices (e.g. use of safety management system).

Aviation

In the aviation domain, a fundamental good practice is the implementation of the so-called Safety Management System (SMS) that moves beyond theoretical values to support observable safe behaviours. This is achieved through a multilayered reporting infrastructure that includes confidential, mandatory, and administrative channels, ensuring that unsafe events are detected early regardless of their nature. Central to this is the cultivation of a "Just Culture," which provides clear definitions to distinguish honest errors from straight up negligence, thereby encouraging staff to report incidents without fear of unfair punishment. Furthermore, using structured analytical tools like the "5 WHY?" method allows organizations to perform deep root cause analysis and eliminate systemic risks (Mumlu Karanfil, 2025).

Different studies also address training interventions, focusing on the psychological profile of the pilot; for example, specialized workshops are used to target and reshape "hazardous attitudes", such as impulsivity or anti-authority, while high-fidelity simulations are employed to improve spatial disorientation recognition and aeronautical decision-making (Szawranskyj & Choudhury, 2025), in order to strengthen the safety culture within the aviation domain.

Rail

A key good practice is the use of the European Railway Safety Culture Survey (ERA-SCS), which has a balanced design of 48 safety statements (items) to move the industry beyond simple regulatory compliance and into a deeper understanding of human factors. This can help to create a "photograph" of the current situation, understand which are the weaknesses, and therefore create some mitigation actions (ERA, 2021a).

On an operational level, a study in high-speed rail in China used formal mentoring as a vital mechanism for "cultural transmission". By utilizing Self-Expansion Theory, experienced mentors help new rail operators internalize a safety-first identity, transitioning the organizational culture from a stage, where rules are followed only to avoid trouble, to a stage where safety is a shared, intrinsic value. This mentoring also acts as a psychological buffer against work-related stress and aims to decrease the "Power Distance," ensuring that rigid hierarchies do not prevent the mutual trust required for a proactive safety culture (Liu et al., 2021).

In the rail domain, like in the aviation domain, another good practice is the implementation of a Safety Management System (SMS) which enhances safety behaviours, related also to Just Culture and Reporting events (ERA, 2021b).

Maritime

Good practices in the maritime industry are increasingly defined by a shift from the reactive perspective to the proactive approach, which views human adaptability as a primary source of safety. A good practice, like in the rail domain, involves the use of assessment frameworks (e.g. questionnaires, interviews, etc.) to identify specific gaps in safety attitudes, such as disparities in trust between shore-based staff and sea-bound crew. To address these gaps, the industry has adopted Resilience Engineering (RE) principles, which focus on four key abilities: responding, monitoring, anticipating, and learning (Arslan et al., 2016).

Educationally, the "Rotterdam Approach", which was deployed in the Rotterdam Mainport Institute, represents a fundamental standard by integrating technical skills with non-technical skills (NTS) over a four-year curriculum rather than through isolated short-term courses. This strategy follows the Kolb Learning Cycle, encompassing experience, observation, conceptualization, and experimentation, and emphasizes "Work-As-Done" (real-world operations) over "Work-As-Imagined" (written procedures). By spreading training over 80 hours across several years, these programs successfully address the typical decline in safety attitudes that often occurs shortly after standard short-term training (Griffioen et al., 2021).