



The core results of the work undertaken in the "Infrastructure" Work Package, on the basis of the SafetyCube methodology, aiming to develop the "Inventory of road infrastructure risks and measures", which populates the Road Safety Decision Support System (DSS).



- ✓ **240 coded studies** on infrastructure **risk factors** and **260** studies on infrastructure **measures**.
- ✓ Overall **50%** of the studies were published after 2012, **75%** after 2007
- ✓ **28%** of risk factor studies and **43%** of measures studies originated from Europe
- ✓ **39 synopses** (5 meta-analyses) for infrastructure **risk factors**, **48 synopses** (>35 meta-analyses) on infrastructure **measures**
- ✓ **19 Cost Benefit Analyses** on selected measures

Red (Risky)	Yellow (Probably risky)	Grey (Unclear)	Green (Probably not risky)
! Effect of Traffic Volume on safety	! Congestion as a risk factor	? Risks associated with Traffic Composition (HGVs only)	✓ Poor Visibility - Darkness (cars only)
! Risks associated with Traffic Composition (VRUs only)	! Occurrence of Secondary crashes	? Risks associated with the distribution of traffic flow over arms at junctions	
! Road Surface - Inadequate Friction	! Alignment deficiencies - Absence of Transition curves	? Adverse weather - Rain (other road users only)	
! Poor Visibility – Darkness (pedestrians only)	! Road functional class	? Adverse weather - Frost and snow	
! Adverse weather – Rain (motor vehicles only)	! Poor Visibility - Darkness (all and two-wheelers only)	? Alignment deficiencies - Frequent curves	
! Workzone length	! Poor visibility - fog	? Alignment deficiencies - Densely spaced junctions	
! Alignment deficiencies - Low Curve Radius	! Adverse weather - Rain (all)	? Interchange deficiencies - Ramp Length	
! Cross-section deficiencies - Number of Lanes	! Workzone duration	? Interchange deficiencies - Acceleration / deceleration lane length	
! Shoulder and roadside deficiencies - Absence of paved shoulders	! Alignment deficiencies - High grade	? Poor junction readability - Absence of road markings and crosswalks	
! Shoulder and roadside deficiencies - Narrow Shoulders	! Presence of Tunnels		
! Interchange deficiencies – absence of access control	! Cross-section deficiencies - Superelevation		
! At-grade junction deficiencies - Risk of different junction types	! Cross-section deficiencies - Narrow lanes		
! At-grade junction deficiencies - Gradient	! Undivided road		
! Uncontrolled rail-road crossing	! Cross-section deficiencies - Narrow median		
	! Shoulder and roadside deficiencies - Risks associated with Safety Barriers and Obstacles		
	! Shoulder and roadside deficiencies - Sight Obstructions (Landscape, Obstacles and Vegetation)		
	! At-grade junctions deficiencies - Number of conflict points		
	! At-grade junction deficiencies - Skewness / Junction angle		
	! At-grade junction deficiencies - Poor sight distance		
	! Poor junction readability - Uncontrolled junction		

Focus: Infrastructure

		Risks
High effect*		Workzone Length Low Curve Radius Alignment deficiencies - Absence of transition curves Alignment deficiencies - High Grade Presence of Tunnels Shoulder and roadside deficiencies Absence of paved shoulders Shoulder and roadside deficiencies Narrow shoulders Shoulder and roadside deficiencies associated with safety barriers and Shoulder and roadside deficiencies Sight obstructions (Landscape, Obst Vegetation) At-grade junctions deficiencies - Number of conflict points Risk of different junction types At-grade junction deficiencies - skewness / junction angle At-grade junction deficiencies - Poor Sight Distance
	Low effect	Workzone duration Alignment deficiencies - Frequent c Alignment deficiencies - Densely sp junctions

Green (clearly reducing risk)	Light green (probably reducing risk)	Grey (Unclear)
✓ HGV traffic restrictions	✓ Road safety audits & inspections	? Implementation of woonerfs
✓ Speed limit reduction	✓ High risk sites treatment	? Installation of median
✓ measures to increase road safety	✓ Implementation of narrowings	? Increase number of lanes
✓ Dynamic speed display signs	✓ School zones	? Increase lane width
✓ Installation of section control & speed cameras	✓ Installation of traffic calming schemes	? Change shoulder type
✓ Installation of speed humps	✓ Road surface treatments	? Installation of cycle lane and cycle path
✓ Implementation of 30-zones	✓ Increase median width	? V2I schemes
Installation of lighting & improvement of existing lighting	✓ Change median type	? Improve skewness or junction angle
✓ Workzones: Signage installation and improvement	✓ Shoulder implementation (shoulder type)	? Convert 4-leg junction to staggered junctions
✓ Implementation of rumble strips at centreline	✓ Increase shoulder width	? STOP / YIELD signs installation / replacement
✓ Installation of chevron signs	✓ Safety barriers installation; Change type of safety barriers	? Implementation of marked crosswalk
✓ Traffic sign installation; Traffic sign maintenance	✓ Create clear-zone / remove obstacles & Increase width of clear-zone	? Traffic signal reconfiguration
✓ Convert at-grade junction to interchange	✓ Road markings implementation	? Convert junction to roundabout (cyclists)
✓ Sight distance treatments	✓ Implementation of edgeline rumble strips	
✓ Automatic barriers installation	✓ Variable message signs	
✓ Dynamic speed limits	✓ Convert junction to roundabout	
✓ Creation of by-pass roads	✓ Channelisation	
	✓ Installation of rail-road crossing traffic sign	
	✓ Traffic signal installation	
	✓ 2+1 roads	

		Hot topic	
		Risks	Measures
High effect*	Workzone Length	Dynamic speed limits	
	Low Curve Radius	Dynamic speed display signs	
	Alignment deficiencies -	Installation of lighting & Improvement of	
	Absence of transition curves	existing lighting	
	Alignment deficiencies - High Grade	Workzones: Signage installation and	
	Presence of Tunnels	improvement	
	Shoulder and roadside deficiencies -	Shoulder implementation (shoulder type)	
	Absence of paved shoulders	Increase shoulder width	
	Shoulder and roadside deficiencies -	Safety barriers installation; Change type of	
	Narrow shoulders	safety barriers	
	Shoulder and roadside deficiencies - Risks	Create clear-zone / remove obstacles &	
	associated with safety barriers and obstacles	Increase width of clear-zone	
	Shoulder and roadside deficiencies -	Traffic sign installation; Traffic sign	
	Sight obstructions (Landscape, Obstacles and	maintenance	
	Vegetation)	Variable message signs	
At-grade junctions deficiencies -	Sight distance treatments		
Number of conflict points			
Risk of different junction types			
At-grade junction deficiencies -			
skewness / junction angle			
At-grade junction deficiencies -			
Poor Sight Distance			
Low effect	Workzone duration	Improve skewness or junction angle	
	Alignment deficiencies - Frequent curves		
	Alignment deficiencies - Densely spaced		
	junctions		

Measure	Benefit-to-cost ratio (best estimate)	Benefit-to-cost ratio (low measure effect)	Benefit-to-cost ratio (high measure effect)
Road safety audits - Light measure case	21.7	16.4	27.0
Road safety audits - Heavy measure case	2.9	2.2	3.6
High risk sites treatment	16.1	13.2	18.4
Dynamic speed limits	1.1	-2.3	3.6
Section control	19.5	14.7	23.0
Installation of speed humps	18.2	8.6	26.8
Implementation of 30-zones	1.6	0.6	2.5
Installation of lighting & Improvement of existing lighting	0.7	0.5	0.9
Implementation of rumble strips at centreline	9.1	7.6	10.3
Installation of chevron signs	2.7	1.4	5.5
Channelisation	8.4	1.2	14.0
Automatic barriers installation	0.05	0.04	0.06
Installation of traffic calming schemes	0.4	0.3	0.4
Installation of traffic calming schemes (b)	0.2	-	-
Road surface treatments	-	-	-
Winter maintenance	6.0	-	-
Safety barriers installation	19.5	10.6	25.4
Convert junction to roundabout	9.2	8.1	10.2
Traffic signal installation	1.1	0.5	1.5
Traffic signal installation - highways	3.7	1.8	5.2

		Costs (per unit)	
		Low [Costs < 100.000 €/unit]	High [Costs ≥ 100.000 €/unit]
Effectiveness	Low [CBR < 2.0]	Installation of chevron signs	Automatic barriers installation
		Traffic signal installation	Installation of traffic calming schemes
		Installation of lighting & Improvement of existing lighting	Installation of traffic calming schemes (b)
			Dynamic speed limits
			Implementation of 30-zones
	High [CBR ≥ 2.0]	Road safety audits - Light measure case	Road safety audits - Heavy measure case
		Winter maintenance	Traffic signal installation - highways
		Safety barriers installation	Channelisation
		High risk sites treatment	Convert junction to roundabout
		Implementation of rumble strips at centreline	Section control
		Installation of speed humps	