T4: Technical devices alleviating distraction & T5: Costs, benefits and deployment

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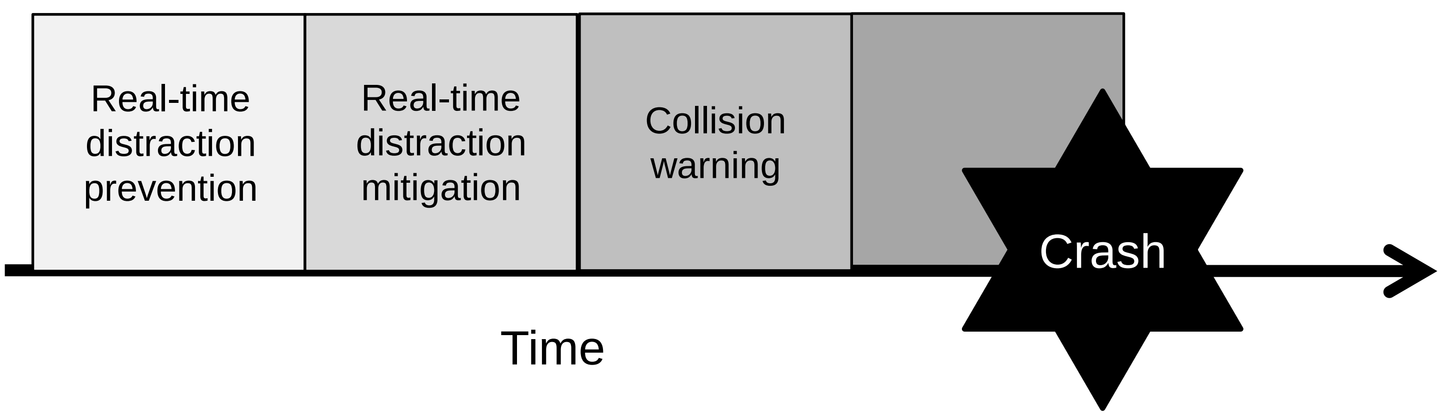
Approach

- 1. Overview and description existing systems (per road-user category, per phase in the process (prevention, mitigation etc.).
- 2. Rating of (relative) effects based on reported effects (if available) on: behavior parameters/distraction, acceptance, safety effects.
- 3. If effects of systems are not available, ratings are based on expert opinions.

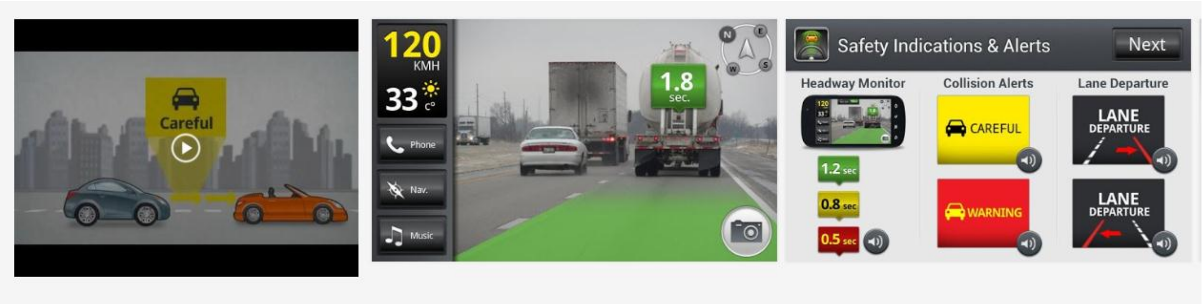


Real-time distraction prevention

- cell phone filtering/blocking applications
- workload managers: when the current state of a driver or driving environment is considered highly demanding the system intervenes either on secondary information flows or on driving performance itself e.g. Saab’s ComSense, Lexus’s Driver Monitoring System or Toyota’s Wakefulness Level Judging System.

Real-time distraction mitigation

- In general, distraction mitigation is supported by providing real-time feedback for immediate driving performance improvement. All these systems issue acoustic feedback. Some of them combine different distraction alert modalities such as acoustic and visual (Volvo’s Driver Alert Control and Mercedes-Benz’s Attention Assist) to enhance driver feedback reception. Some prototypes consider haptic modality of alerting as well.
- Also nomadic devices (e.g. MobilEye) and smartphone applications can warn the driver for unsafe distracted driving.



Collision warning systems

- *(Adaptive) Forward Collision Warning*
- *(Adaptive) Lane Departure Warning*
- *(Adaptive) Curve Speed Warning*

- Mixed results for behavioural adaption concerning this systems i.e. long-term behavioral adaptations, indirectly related to the system, that might affect safety (or even counteract the original purpose of the system) need to be considered.

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Automated driving

With increasing automation the distraction potential of infotainment increasingly depends on how automation worsens or mitigates effects of distraction, and an important aspect is how the transition of control from automatic to manual is supported.

Level	Name	Narrative definition	Execution of steering and acceleration/ deceleration	Monitoring of driving environment	Fallback performance of *dynamic driving task*	System capability (*driving modes*)	BASt level	NHTSA level
***Human driver* monitors the driving environment**								
0	**No Automation**	the full-time performance by the *human driver* of all aspects of the *dynamic driving task*, even when enhanced by warning or intervention systems	Human driver	Human driver	Human driver	n/a	Driver only	0
1	**Driver Assistance**	the *driving mode*-specific execution by a driver assistance system of either steering or acceleration/deceleration using information about the driving environment and with the expectation that the *human driver* perform all remaining aspects of the *dynamic driving task*	Human driver and system	Human driver	Human driver	Some driving modes	Assisted	1
2	**Partial Automation**	the *driving mode*-specific execution by one or more driver assistance systems of both steering and acceleration/deceleration using information about the driving environment and with the expectation that the *human driver* perform all remaining aspects of the *dynamic driving task*	**System**	Human driver	Human driver	Some driving modes	Partially automated	2
***Automated driving system* ("system") monitors the driving environment**								
3	**Conditional Automation**	the *driving mode*-specific performance by an *automated driving system* of all aspects of the *dynamic driving task* with the expectation that the *human driver* will respond appropriately to a *request to intervene*	System	**System**	Human driver	Some driving modes	Highly automated	3
4	**High Automation**	the *driving mode*-specific performance by an *automated driving system* of all aspects of the *dynamic driving task*, even if a *human driver* does not respond appropriately to a *request to intervene*	System	System	**System**	Some driving modes	Fully automated	3/4
5	**Full Automation**	the full-time performance by an *automated driving system* of all aspects of the *dynamic driving task* under all roadway and environmental conditions that can be managed by a *human driver*	System	System	System	**All driving modes**	-	

Motorcyclists

- *Advanced Driver Assist*: This system provides riders with information to counteract safety-critical behaviors. This emerging technology is for example used in the Yamaha ASV-2 and ASV-3 in which a range of telematics and vehicle control systems.
- *Helmet mounted displays*: A display is integrated in the helmet, in order to be able to keep the eyes on the road.
- *Driver Status Monitoring systems*, such systems are to our knowledge currently not available on powered two wheelers. But introducing these systems for Motor cyclists entails specific application problems, particularly concerning eye tracking devices.


Cyclists

- Smartphone applications that blocks or guides smartphone use during cycling.
  - An example of such an application is: De Fietsmodus (www.fietsmodus.nl). This application was developed in assignment of the Dutch government in order to decrease hazardous smartphone use on the bicycle. With an activated app you can collect points based on your smartphone use: the less you make use of your smartphone during cycling, the more points you can collect .
- An information system integrated in the cycling helmet.
  - For example: the smarthat (www.smarthat.info). This system, which is still under development, contains an in-helmet display, to provide safety-relevant as well as navigation information to the cyclist. This way a cyclist can receive information without having the eyes of the road.


Pedestrians

- Smartphone applications that blocks incoming messages during walking. For example: the Japanese mobile provider Docomo has developed a pedestrian safety mode, that blocks incoming messages and calls while walking.
- Apps that make use of camera technology to see ahead. For example:
  - WalkSafe. Based on the camera input WalkSafe figures out whether moving cars in the environment of the pedestrian provide a threat to a distracted smartphone user.
  - Walk n text: which provides a transparent screen- see what is going on in front of you with the help of your back camera while using your smartphone.

Category	System	Road user	Phase	Maturity	Current pen.rat e	Acceptance	Safety impact
Information Blocking & guiding applications		Prof.	Prevention	+++	Medium	Medium	+++
		Priv.	Prevention	+++	Low	Low	+++
		Motor cyclist	Prevention	+++	Low	Low	+++
		Cyclist	Prevention	+++	Low	Low	+++
		Pedestrian	Prevention	+	Low	Low	++
Workload estimator		Driver	Prevention	++	Low	Low	+++
		Motor cyclist	Prevention	+	Low	Low	+++
Real-time mitigation systems		Prof.	Mitigation	+++	Low	Medium	++
		Priv.	Mitigation	+++	Low	High	++
(Collision) warning systems	FCW	Prof.	Warning	+++	Medium	High	+++
		Priv.	Warning	+++	Medium	High	+++
		Motor cyclist	Warning	+	Low	Low	-
	LDW	Prof.	Warning	+++	Medium	Medium	++
		Priv.	Warning	+++	Medium	Medium	++
		Motor cyclist	Warning	+	Low	Low	+
	CSW	Prof.	Warning	+++	Low	Medium	++
		Priv.	Warning	+++	Low	Medium	++
		Motor cyclist	Warning	++	Low	Low	++
Retrospective feedback systems		Prof.	Prevention	+++	High	Medium	++
		Priv.	Prevention	+++	Low	Low	++
Automated driving technology	Semi-autonomous	Prof.	Mitigation	++	Low	Medium	++
		Priv.	Mitigation	++	Low	Medium	++
	Fully automated	Prof.	Prevention	+	Low	-	+++
		Priv.	Prevention	+	-	-	+++

Conclusions

- Preferred are distraction prevention systems.
- Vehicle countermeasures to manage driver workload, warn drivers of risky situations, or monitor driver performance have the potential to improve safety for all road users, not just distracted drivers.
- More (telematics) distracting activities and more opportunities to engage in those activities (semi-autonomous driving) → attention to impact on traffic safety.
- Collision warning may have negative effect and lead even to more involvement in non-driving related tasks.
- Future integration of systems require universal platform to manage HMI (information manager, workload manager).

Deployment, costs and benefits

Goals

- Develop deployment scenarios for selected interventions
- Analyse their costs and benefits

- Analysis is qualitative
- Based on literature review

Case: products raising road user alertness

- E.g. drowsiness warning (DW), lane departure warning (LDW)
- Summary of impacts on distraction per type:

Intervention	Visual	Auditory	Biomechanical	Cognitive
Promote				1
Mandate	-1	-1	-1	1

- Literature shows the following approximate estimates:

Intervention	Accident reduction	Benefit-cost ratio	Break-even cost
DW	3-10%		€700 per vehicle
LDW	2-10% (+ mitigation)	1.7-2.1	

Next steps

- Literature review for other interventions
  - Main sources so far: ECORYS (DG-TREN 2006), eIMPACT, TRL (LDW, 2008), VTI (countermeasures, 2012), …
  - Your inputs and views are welcome!
- Identification of deployment issues
  - Later today
- Multi-criteria analysis to rank by impact, benefit, cost, ease and time of deployment, …

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Thank you for your attention