

MANTRA

Making full use of Automation for National Transport and Road Authorities

Workshop FFG Vienna 10 September 2019, Sandra Ulrich & Risto Kulmala

Overview of MANTRA work-package 4
Consequences of Automation on Infrastructure

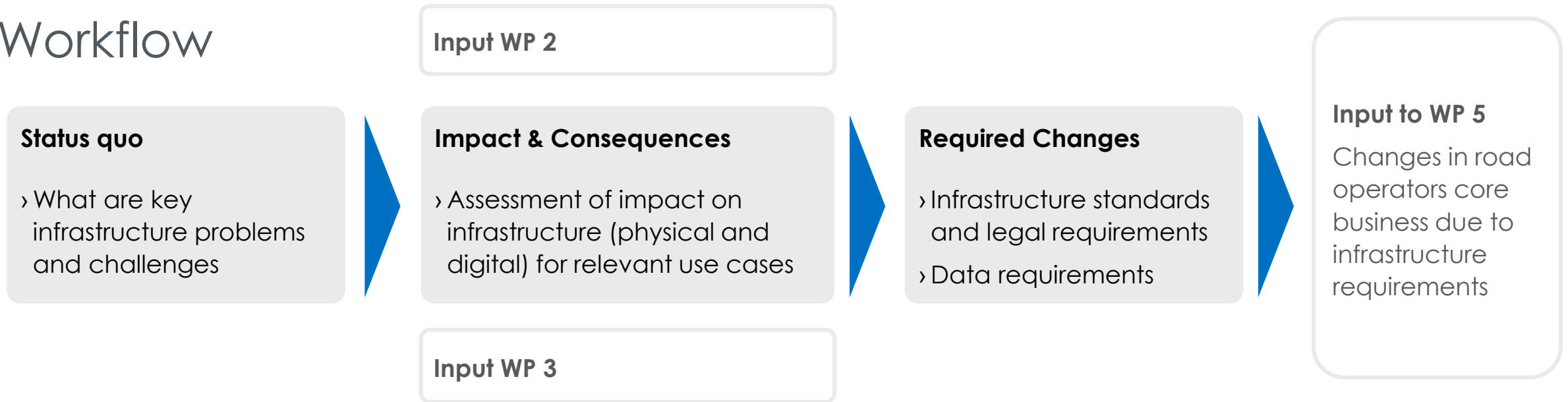
KEY TARGET

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To formulate concrete **consequences** of and **necessary changes** due to the selected automated functions to **infrastructure** and the **conservation*** of infrastructure


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Workflow



The impact and the resulting consequences and necessary changes to infrastructure will have various sources. In WP 4 at least the following will be analysed.

Impact, consequences and necessary changes to infrastructure due to...

What?	<p>1 Automated function's operation itself </p> <p>With deployment of various automated function's impact on infrastructure will change in terms of road design, maintenance assumptions and required ITS</p>	<p>2 The necessity to provide required ODD </p> <p>Digital Infrastructure will need to be defined and amended based on ODD requirements in order to facilitate CAD</p> <p>Incl. ISAD levels</p>	<p>3 The possibility to improve O&M </p> <p>Operation and maintenance (O&M) of infrastructure could benefit by means of CAD in terms of automation of work procedures and new data sources</p>
Who?	<p>ARNDT IDC Infrastructure & Development Consultants</p> <p>Supported by </p>	<p></p> <p>Supported by </p>	<p>ARNDT IDC Infrastructure & Development Consultants</p> <p>Supported by </p>

Impact, consequences and necessary changes to infrastructure 

13:30 – 13:50

Brief intro presentation on intermediate results and workshop objectives

13:50 – 14:10

Key note: Impacts of truck platooning on road pavement in Finland

14:10 – 14:55

Workshop Stream 1: ODDs
Evolution of ODD features on
different road categories

Workshop Stream 2: Automated Trucks
Single Automated Truck Scenarios and
their impacts on infrastructure assets

14:55 – 15:10

Coffee break

15:10 – 15:50

Workshop Stream 1: ODDs
Estimated costs and
responsibilities

Workshop Stream 2: Automated Trucks
Truck platooning impact on
infrastructure assets

15:50 – 16:00

Summary and Closing remarks

Workshop Stream 1 Operational Design Domains

- Common view on likely evolution of ODD features 2030 – 2040
- Common view on cost assumptions
- Common view on responsible stakeholders

Workshop Stream 2 Automated freight vehicles

- Common view on consequences of automated freight vehicles to different infrastructure assets
- Discussion of necessary changes for different infrastructure assets due to operation of automated freight vehicles

Workshop Stream 2

Automated Freight Vehicles



Of all use cases, automated freight vehicles are expected to have the biggest impact on infrastructure due to their operation. Following areas have been identified as most crucial

Pavement

- Faster deterioration due to higher loads and convoys
- Focus on complex areas of highways (junctions, merging lanes)
- Need for additional emergency bays and safe harbors
- Changing requirements/standardization for road marking

Tunnels

- Need for additional guiding functions (tunnel wall finishing)
- Lighting in exits/entries
- Total emergency systems: new requirements

Road furniture

- Most effects on ITS and telematics – will be assessed in a specific task on ODDs.
- International standardization of road signs – machine & human readable
- Toll plazas need automated lanes

Single automated trucks Level 4 on motorways

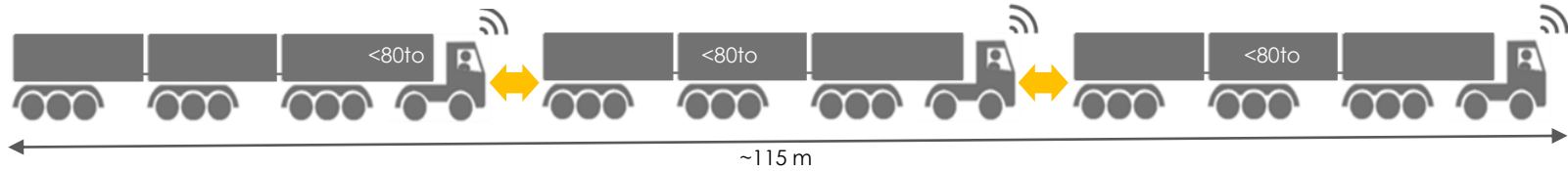
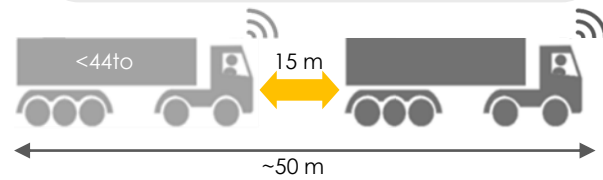
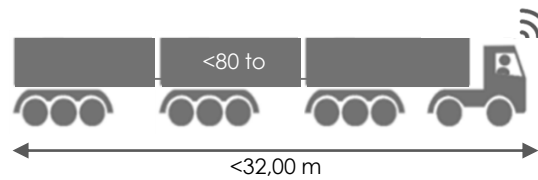
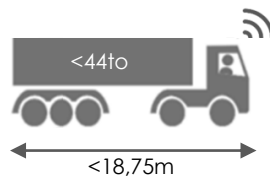
Truck Platoons on motorways

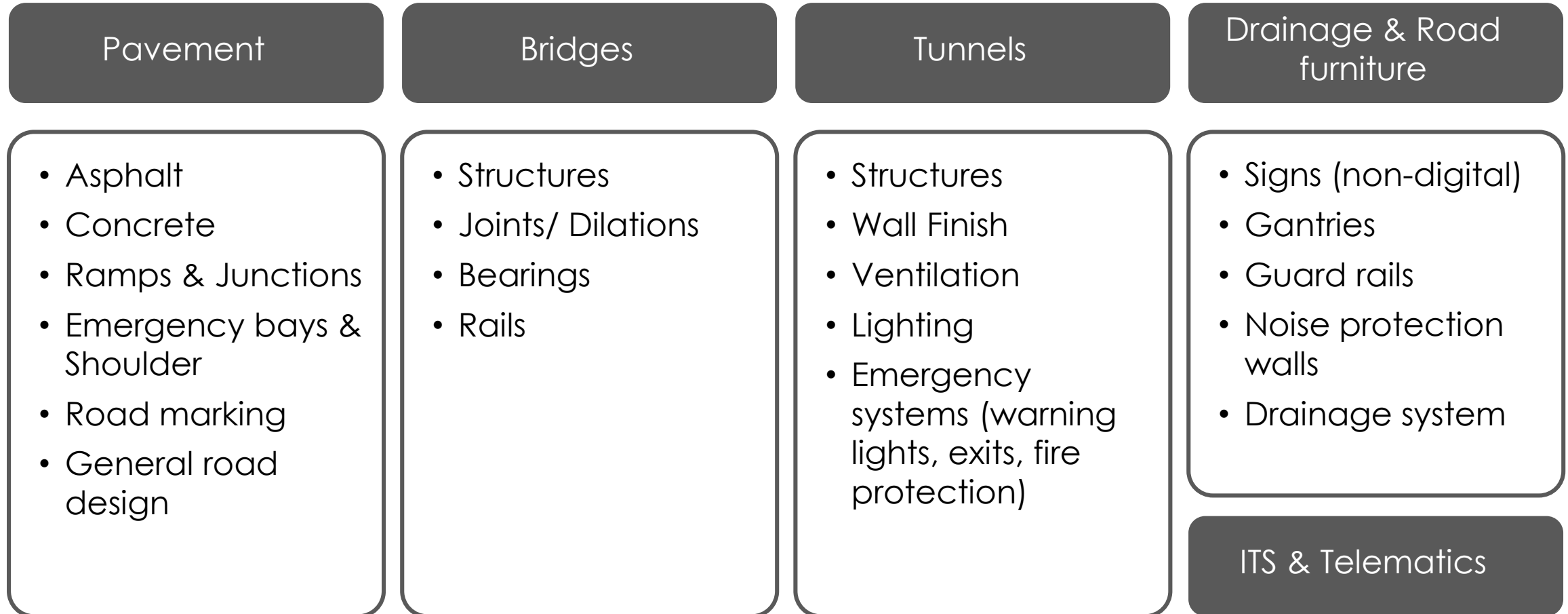
1 Common truck+trailer
current standard weight & size commonly 5 axles

2 Future HCV
higher & longer vehicles, up to 11 axles, axle loads not to exceed current loads

3 Platoon of 2 current truck+trailers
with current standard weight & size
Lead: L2, Follow: L4
Follow distance: 15m

4 Platoon of 3 Future HCV trucks
higher & longer vehicles, up to 7 axles
All trucks: L4
Follow distance: 5-10m





Input

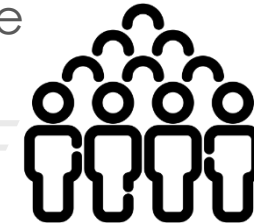
MANTRA has prepared expected impacts due to the operation of automated freight vehicles



Workshop
Part 1

Single automated trucks

Common view on consequences to different infrastructure assets and discussion of necessary changes



Workshop
Part 2

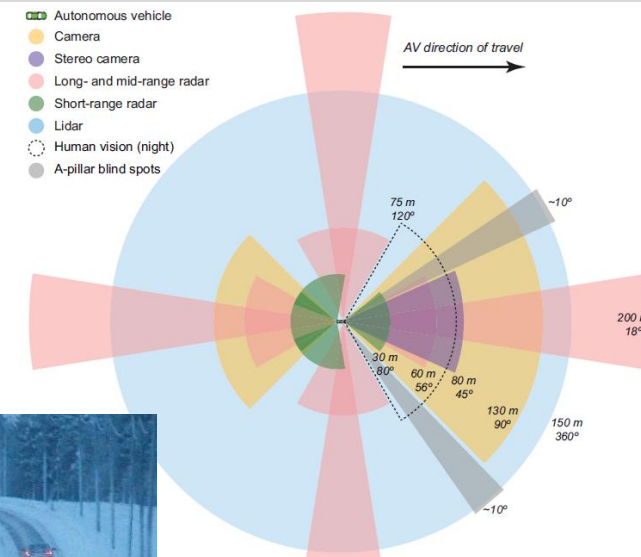
Automated truck platoons

Common view on consequences to different infrastructure assets and discussion of necessary changes

Workshop Stream 1

Operational Design Domains

- Operational Design Domain
- Differs between use cases
- Differs between vehicle manufacturers, competitive factor, "ODD wars" forecasted
- Evolution in time: ODDs of 2040 might be very different from those in 2020 or 2030
- Evolution means added uncertainty to road authorities and operators
- Workshop on ODD evolution in Torino on 1-2 October 2019
- More information: <https://its.sina.co.it/WSAutomatedDriving2019/index.php>



ODD attribute	Physical / Digital infrastructure	Static / Dynamic
Road	Physical	Static
Speed range	Physical	Static
Shoulder or kerb	Physical	Static
Road markings	Physical	Static
Traffic signs	Physical	Static
Road furniture	Physical	Static
Traffic	-	Dynamic
Time	-	Dynamic
Weather conditions	-	Dynamic
HD map	Digital	Static
Satellite positioning	Digital	Static
Communication	Digital	Static
Information system	Digital	Static

- Common view on likely evolution of ODD features 2030 – 2040
- Coverage of ODDs 2030 and 2040

Motorways

ODD attribute	2030	2040
roads covered	Most motorways with severe congestion to mitigate against possible capacity reduction	60% of motorway network covering the ones with highest accident rates
shoulder or kerb	Safe refuges on all roads selected, half suitable for freight as well	Safe refuges on all roads selected, half suitable for freight as well
road markings	Enhanced maintenance to ensure consistent and minimum quality of solid or dotted lines and symbols painted on the pavement	No enhanced maintenance due to automated vehicles
traffic signs/	Enhanced maintenance to ensure traffic	Temporary regulatory and traffic

Common view on estimated costs (cost ranges) for deployment, management and operation of ODD features

Note: ODD evolution means that some costs may be irrelevant in 2040 or even 2030

Costs of establishing ODD/

Odd attribute	Detailed feature	Unit cost range estimate (deployment)	Maintenance, operation annually
Shoulder or kerb	Safe "harbours" (broad shoulders, lay-bys etc.)	20-50 k€/safe harbour; or 40-100 k€/km on sections where needed (every 500 m)	8 %
	Passenger pick-up/drop-off point (markings, bench, shelter)	2-5 k€/point depending on level of services	10 %
Markings and signs	enhanced maintenance of road markings and traffic signs & signals	0.1-0.2 k€/km/a	included
Road furniture	Landmarks for positioning enhancement	4-6 k€/km (where needed)	10 %
	Signs and/or barriers for access control	30-90 k€/sign; 40-80 k€/gate or barrier; 15-90 k€/km	8 %
Traffic management	Standardized marking and efficient management of road works zones, incident/event sites, and toll plazas/gates	3-5 k€/km/a	included
	Adaptation of traffic centres, systems and services to automated	10-90 k€/km	8 %

- Common view on responsible stakeholders for deployment, management and operation of the ODD features

ODD attribute	motorway, arterial or ring road, city or residential street, rural road	terminal area
shoulder or kerb	road operator	terminal operator
road markings	road operator/ maintenance contractor	terminal operator
traffic signs	road operator/ maintenance contractor	terminal operator
road furniture	road operator	terminal operator
traffic management	road operator/ traffic management operator	
maintenance	road operator/ maintenance contractor	terminal operator
HD map - non-LIDAR	road operator/ digital map providers	terminal operator/ digital map providers
- LIDAR	service operator/digital map providers	service operator/digital map providers
RTK stations	Land survey agency/ road operator	Land survey agency/ terminal operator

Enjoy the workshops!