Intelligent Transport Systems: Current and future Research and Innovations trends

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Outline

- Transport policy goals
- Transport R&I orientations
- CAD – current R&I trends
- Large-scale CAD pilots
- CAD – future R&I trends

Transport - a crucial sector of economy

- Transport represents
  - 9 % of the total Gross Value Added of the EU economy (2015)
  - 9 % of the total EU employment (2015)
  - Around 1.2 million private and public companies in the EU
- 17.2 % of the EU's total exports of services - transport related (2016)
- However, transport also generates **negative societal effects** such as:
  - accidents, greenhouse gas, emissions, air pollution, noise and environmental effects
- EU transport policy of the 21st century **has to address the challenges** the sector is facing

Source: Transport in the European Union: Current Trends and Issues, April 2018, EC DG MOVE

Transport 2050

EC outlines ambitious plan to increase mobility and reduce emissions

- No more conventionally-fuelled cars in cities (50% by 2030, 100 % by 2050)
- Achieve essentially CO2-free movement of goods in major urban centres by 2030
- A 50% shift of medium distance intercity passenger and freight journeys from road to rail and waterborne transport

By 2050

60% cut in transport emissions

Close to zero fatalities in road transport

Main challenges to be addressed

- Creating a well-functioning Single European Transport Area, connecting Europe with modern, multi-modal and safe transport infrastructure networks
- Shifting towards low emission mobility, which also involves reducing other negative externalities of transport
- Societal challenges
  - Transport affordability* - refers to the financial burden households bear in purchasing transportation services, particularly those required to access basic goods and activities (healthcare, shopping, school, work and social activities)
  - Transport reliability** - how sharply the real travel time differs from the anticipated one
  - Transport accessibility*** - refers to people's ability to reach goods, services and activities, which is the ultimate goal of most transport activity

**Transportation Affordability, Evaluation and Improvement Strategies, Todd Litman, Victoria Transport Policy Institute, 2016*

*** Prof. Dr. Christoph Walther, Head of Global Research at the PTV Group, 2016*

**** Evaluating Accessibility for Transport Planning, Todd Litman, Victoria Transport Policy Institute, 2018*

Transport and Mobility

- Transport - getting from A to B
- Mobility - being able to access education, culture, employment and leisure using safe, swift, environmentally friendly and affordable transport options

Transport R&I orientations (1)

DECARBONISATION

- The push for making transport independent from fossil fuels and tackling climate change
- Expected to speed up in order to meet the EU target of achieving a 60% reduction of transport GHG emissions by 2050 compared to 1990 levels

Transport R&I orientations (2)

DIGITALISATION

- Technological disruption which sees the increasing merging of the mobility sector with ICT
- Rebranded under the sweeping terms Intelligent Transport Systems (ITS), or ‘Smart Mobility’
- Solutions target all parts of the transport system:
  - real-time and multimodal data monitoring for traffic and infrastructure management
  - end-user services such as mobility-as-a service (MaaS), car/bike sharing, carpooling or eco-driving apps
  - vehicle-specific technologies, particularly in terms of automation – CAD (Connected and Automated Driving)
  - ...

Transport R&I orientations (3)

DIVERSIFICATION

- Diversification in transport modes
- Small revolution in public transportation - various forms of bus rapid transit (BRT)
- Bicycles come-back
  - diversifying as well, with one-, two-, three- and four- light electric wheelers
  - attracting a wider variety of socio-demographic groups
- Diversification in ownership
  - sharing of cars, bikes and electric scooters
  - ride hailing
  - ride sharing
  - car pooling

CAD – current R&I trends

- Past and current R&I efforts in developing and demonstrating systems for CAD
- Significant progress in key technologies for innovative CAD functions and applications
  - advanced vehicle control
  - systems to detect vehicle location and environment (V2X – Vehicle to Everything)
  - data processing
  - artificial intelligence
  - human-machine interaction
- V2X - non line-of-sight sensing capability
  - which allows vehicles to detect potential hazards, traffic, and road conditions from longer distances and sooner than other in-vehicle sensors such as cameras, radar, and LiDAR (Light Detection and Ranging)
- Advanced V2X systems – gaining broad commercial acceptance with 2 competing technologies
  - commercially mature IEEE 802.11p/DSRC (Dedicated Short Range Communications) standard
  - relatively new 3GPP-defined C-V2X (Cellular V2X) technology which has a forward evolutionary path towards 5G

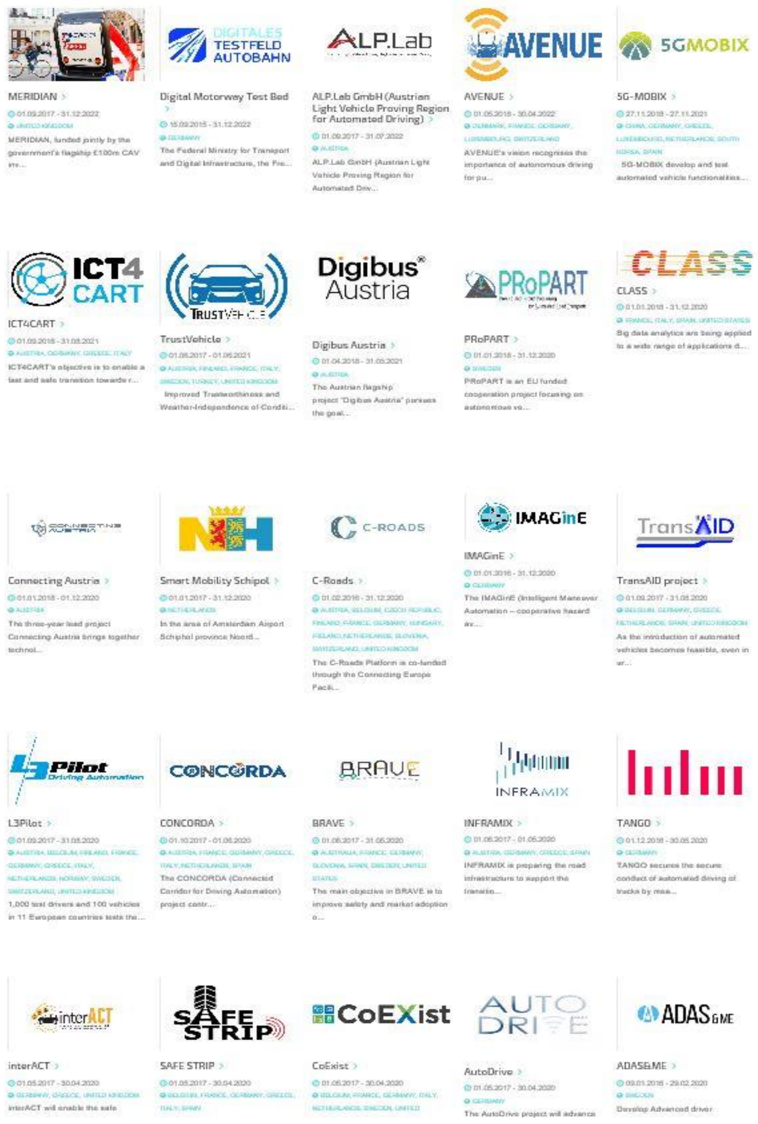
Toyota and GM
IEEE 802.11p-based V2X technology in Japan and North America

Volkswagen
will begin deploying IEEE 802.11p on volume models in Europe starting from 2019

BMW, Daimler, Volkswagen's subsidiary Audi, and Volvo Cars
already deliver certain V2X-type applications through wide-area cellular connectivity

Large-scale CAD pilots in Europe and outside

- EC places a high priority on the deployment of CAD
- H2020 ARCADE project - to ensure that connected automated technologies are deployed in a coordinated and harmonised manner,
- Joint stakeholders forum - to coordinate and harmonise automated road transport approaches at
  - European level (e.g. strategic alignment of national action plans for automated driving)
  - international level (in particular with the US and Japan)

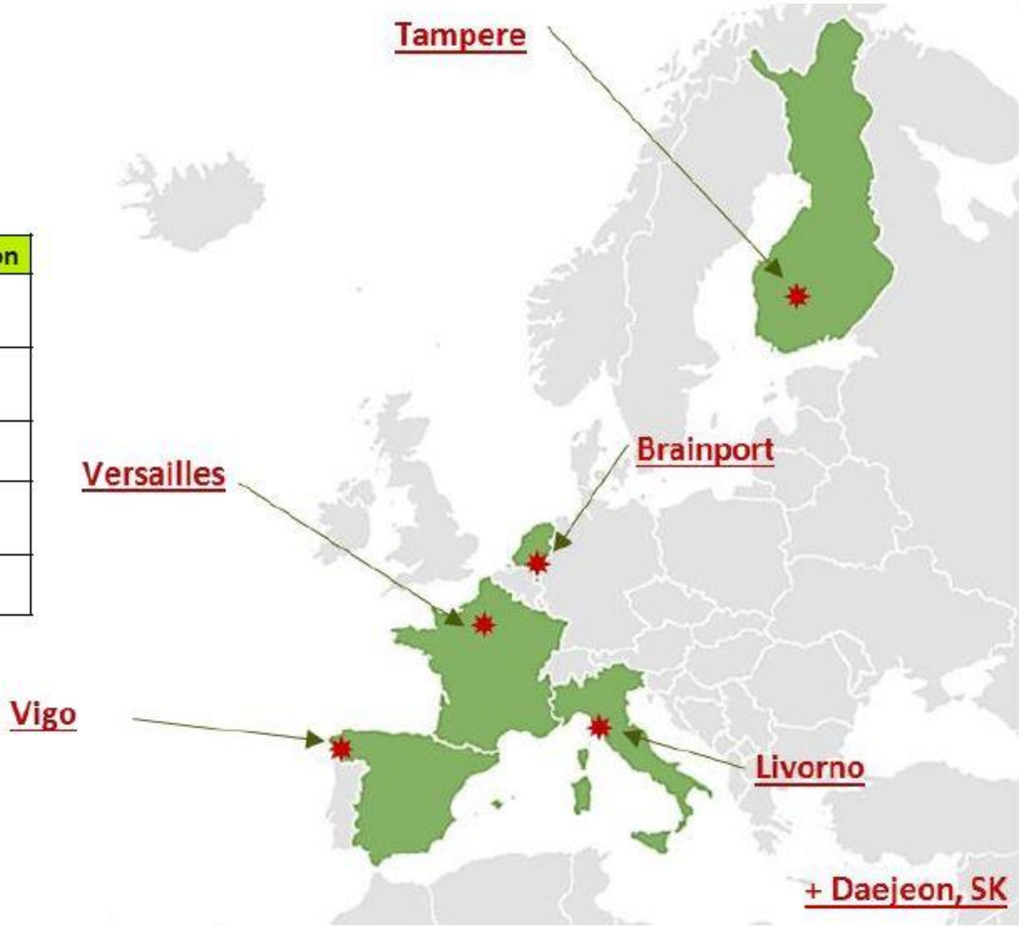


…and many others

Testing use cases
Ex: H2020 AUTOPILOT – using IoT

Pilot sites

Use cases	Tampere	Versailles	Livorno	Brainport	Vigo	Daejeon
Automated valet parking	X			X	X	
Highway Pilot			X	X		
Platooning		X		X		
Urban Driving	X	X	X	X	X	X
Car Sharing		X		X		



Source: https://autopilot-project.eu/pilot-sites/driving-modes/

CAD – future R&I trends / 1

- **Technological aspects**
  - automated driving in mixed conditions and complex environments
  - data collection and management
  - security and privacy aspects of sensitive data
  - communication technologies for higher levels of automation
  - safety validation methodologies
- **Social and economical aspects**
  - understanding how users perceive and value future use of CAD for specific purposes
  - assessing the short, medium and long term impacts, benefits and costs of the deployment of CAD vehicles

Source: http://southbaycities.org/sites/default/files/Metro%20Slow%20Speed%20Network%20Study.pdf

CAD – future R&I trends / 2

- **Ethical aspects**
  - Dilemma-based situations - an automated vehicle has to decide which of two evils it necessarily has to perform*
  - Responsibility - Who would be responsible in case of an accident: the software engineer, the manufacturer, third-party providers, (telecommunications) operators and/ or even the passenger
  - Cybersecurity - the ethical case around cyber security is a combination of
    - ❖ taking reasonable steps to prevent attacks, especially those that could exploit known vulnerabilities;
    - ❖ being able to detect attacks and react to them when they do occur
    - ❖ having plans in place to minimise, contain, and recover from them

Source: https://www.nature.com/articles/d41586-018-07135-0

** Federal Ministry of Transport and Digital Infrastructure (Germany): Report of the Ethics Commission on Automated and Connected Driving. http://www.bmvi.de/SharedDocs/EN/publications/report-ethics-commission.pdf?__blob=publicationFile (2017), p. 17*

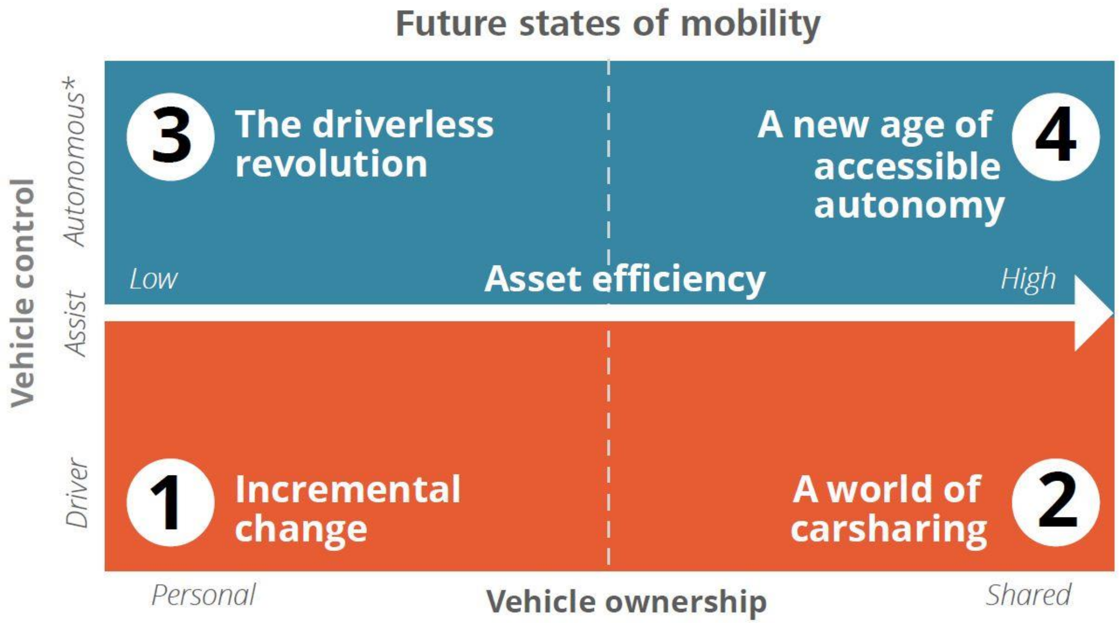
Future Mobility Ecosystem

Frictionless, automated, personalized travel on demand

… seamless intermodal journey will require a future mobility ecosystem that is much more complex than today’s extended automotive industry*.

Extent to which autonomous vehicle technologies become pervasive:

- Depends upon several key factors as catalysts or deterrents—e.g., technology, regulation, social acceptance
- Vehicle technologies will increasingly become "smart"; the human-machine interface shifts toward greater machine control



Extent to which vehicles are personally owned or shared:

- Depends upon personal preferences and economics
- Higher degree of shared ownership increases system-wide asset efficiency

*Fully autonomous drive means that the vehicle’s central processing unit has full responsibility for controlling its operation and is inherently different from the most advanced form of driver assist. It is demarcated in the figure above with a clear dividing line (an “equator”).

Source: Deloitte analysis.

Graphic: Deloitte University Press | DUPress.com

** The future of mobility: What’s next? Tomorrow’s mobility ecosystem—and how to succeed in it*

Part of a Deloitte series on the future of mobility, 2016

Thank you

questions&feedback:

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