Wayne State Distinguished Speaker Series

Autonomous Vehicle Policy: A driving test for self-driving cars?
Hello!

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  • Biosecurity & Bioterrorism (UNSW)
  • Robotics & Machine Vision (QUT)
Agenda

The Forum’s Role in Shaping the Future of Mobility

Policy Challenges in Autonomous Vehicles

SafeDI Framework: A Roadmap for creating scenario-based AV policy
About the Forum’s Technology Policy work
What is the World Economic Forum and who is involved?

The World Economic Forum is the international organization for public-private cooperation. Our mission is to improve the state of the world.

Focused on advancing change for business and society, we provide a global, independent, impartial and future-oriented platform for the world’s leaders to come together to shape the future.

The Forum focuses on multi-stakeholder cooperation, bringing together leaders from business, government, civil society, academia and youth to achieve impact together that they could not achieve alone. Stakeholders can also use the Forum as a platform to scale their own projects.
How Do We Achieve Change?

Introducing the Forum

Building awareness & cooperation
The Forum gathers leaders from business, government, international organizations, academia, civil society and youth to work together to drive positive change.

Shaping mindsets & agendas
Flagship reports, policy frameworks and strategies influence government priorities, business strategies and public opinion.

Driving collective action
Projects and collaborations started or supported by the Forum impact millions of people.
The Forum’s work spans industries, nations and communities to Improve the State of the World

### Our Platforms

**Shaping the Future of…**

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<th>Category</th>
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<td>Cities, Infrastructure Development and Urban Services</td>
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<td>Technology Governance (Data)</td>
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<td>Technology Governance (IOT, Robotics and Smart Cities)</td>
<td>Technology Governance (Block-chain and Distributed Ledger Technology)</td>
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<td>Cybersecurity and Digital Trust</td>
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### Regions

**Shaping the regional agenda and addressing critical challenges**

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<th>Region</th>
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<td>North America</td>
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<td>South Asia</td>
<td>Long-Term Investing</td>
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### Communities

**Interconnected communities of peers**

<table>
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<th>Community</th>
<th>Knowledge</th>
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<td>Family Business Community</td>
<td>Strategic Intelligence</td>
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<td>Global Shapers</td>
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<td>Young Global Leaders</td>
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<td>Schwab Foundation for Global Entrepreneurship</td>
<td>Schwab Foundation for Global Entrepreneurship</td>
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<td>Technology Pioneers</td>
<td>Technology Pioneers</td>
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Four focus industries and technologies

- Automotive and Autonomous Mobility
- Aerospace and Drones
- Aviation, Travel and Tourism
- Supply Chain and Transport
Platform For Shaping The Future of Mobility

Three objectives focused on ensuring that mobility is:

- **Safe & Secure**
  - Protection from collisions, accidents.
  - Enhance resiliency of transportation systems to cyberattacks

- **Clean & Sustainable**
  - Minimize the environmental impact of mobility systems by reducing greenhouse gas and other emissions, materials usage and waste

- **Inclusive & Efficient**
  - Introduce physical accommodations in transport systems for populations with diverse needs and provide affordable, reliable mobility solutions, particularly for underserved populations
Policy Challenges in Autonomous Vehicles
Automation is one of many transformations facing the automotive industry

**Product Focus:** the car
Customer **owns** the vehicle

**Personal:** Customer uses vehicle alone or with family and friends

**Driven:** Customer drives the vehicle

**Market Economy:** Innovation in house with trusted supply base

**Mechanical engineers** rule

**Linear production**

**Volume:** Sell more cars and achieve economies of scale

**Service Focus:** the mobility experience
Customer **uses** the vehicle

**Shared:** Customer shares vehicle with social network or strangers; high occupancy options

**Automated:** Algorithms drive the vehicle

**Platform Economy:** Innovation ecosystem with dynamic partnerships

**Software engineers** rule

**Circular economy**

**Value:** Deliver targeted profitable mobility solutions for people
The Potential Benefits of Autonomous Mobility

Socio-cultural
- Reduction in accidents & road fatalities
- Mobility for those that need it most
- Improved commuting

Environmental
- Fewer vehicles on the road
- Increased electrification
- Potential for more efficient driving
- Street space in urban environments can be re-purposed to become greener

Economic
- Creates jobs infrastructure & operations
- Creation of new business models
- Increased productivity
Automated Driving creates a number of Challenges for Policymakers

Facilitating safe field trials (FoTs) of automated vehicles in the near term to enable development & innovation

Many current automotive regulatory frameworks and definitions are inadequate for automated vehicles

Consumer trust, proper use and acceptance

Suitability of roads, cities and infrastructure for greater numbers of connected & automated vehicles
Other questions emerge as regulators scramble to prepare for AVs

- How do we issue a license to a car driven by software?
- How safe is “safe enough”?
- How can we measure this?
- Where should we allow them to operate?
- How can we create common requirements between markets?
Comparing the US to other approaches

**United States: Federal Automated Vehicle Policy**
- DOT/NHTSA provides overall guidance, reference terms & framework for self-certification
- FMVSS selectively applied or exemption required
- States responsible for licensing/permitting
- Pilots led by industry

**UNECE Type Approval Requirements**
- Requires manufacturers to demonstrate compliance with harmonized standards across markets
- Working on separate regs for L3 Highway applications & up to L4, L5 systems
- Working groups tasked to functional requirements, assessment methods

**National Initiatives**
- Industrial strategy for Mobility
- Policy roadmaps
- Codes of Practice
- Centres of Excellence
- Test-beds
Spotlight: UK AV Policy

To position the UK as a world leader in Connected & Automated Vehicles (CAV)

- Spurred the creation of new government /non-profit entities
- Allocated funding for CAV-related research, pilots, standards, test-bed etc.

Created by Zenzic, the UK Connected and Automated Mobility Roadmap provides detailed policy guidance for AVs

- Explores challenges, enablers and policy needs across 6 key areas, from Safety to Cyber Resilience
- Maps necessary standards, blueprints and protocols to deliver by 2030

Establishes broad requirements for testing AVs on UK roads, including:

- Vehicle Requirements
- Safety driver or teleoperation
- Public engagement
- Data recording
- Publication of a detailed safety case
Spotlight: Singapore AV Policy

Top-Level Strategy
To maximise the benefits of AVs in the future of Singapore’s mobility ecosystem
Encourage developers to create AVs suitable for the challenges of Singapore

Centre of Excellence for Testing & Research of Autonomous Vehicles
CETRAN - established in partnership between LTA & NTU Singapore
Develops test requirements and technical standards for AV deployment in Singapore

Structured Approach to Deployment
Established a graduated AV testing and approval program
Combines simulation, track-testing and on road tests:
Supported by scenario library, phased testing access to roads, Technical Reference standards
Success Factors in AV Policy

- **Cohesive vision**: Set out a clear ambition for the role of AVs in your future society, tied to existing mobility vision & industrial policy.

- **Multi-stakeholder engagement**: Engage with industry, academia, the public and other governments to holistically map present and future needs.

- **Agile regulatory tools**: As AV technology evolves, use flexible and open policy tools to enable broad solutions; resist the urge to be overly prescriptive.
Creating an effective AV policy environment requires a top-down approach, and engaging and supporting the industry to understand their needs and the technology

- Identifies key success factors in AV policy
- Features insights from interviews with a range of government stakeholders
- Maps best practice from global AV policies
- Recommends approaches to be considered to develop performance-based regulatory framework

Want to know more? Download our AV policy whitepaper

Available at: http://bit.ly/WEFAVpolicy
The Safe Drive Initiative: A Framework for Performance-Based AV regulations
The Safe Drive Initiative enables safe AVs through collaboration on a new approach to safety

Through the Safe Drive Initiative, the Forum will develop, pilot and scale a framework for scenario-based safety assurance, enabling a policymaker to develop data-driven, performance-based AV regulations.

With the support of our industry and government partners, this project has:

- Developed a shared library of scenario data (Safety Pool)
- Developed a scenario-based framework for safety assessment (SafeDI Framework)
- Created an implementation guide for other regulators to adapt and scale this approach
The Problem: How do we define a safe AV?

“The idea that the disengagement reports are useful is a myth”

We need greater clarity in assessing the evolution of AV technologies, for policymakers and industry alike.

The World Economic Forum believes that this can be achieved through a data-driven approach.

By engaging industry, government and civil society, the Forum believes we can achieve an agreed assessment of what is a safe automated vehicle.
How can a Scenario-Based approach help?

A vehicle’s safety can be evaluated by measuring its performance in key scenarios which are relevant in its deployment environment.

- **A scenario is defined as:** A traffic situation within the vehicle’s operational design domain.
- A scenario-based evaluation can be tailored to the specific needs of the operating environment.
- Regulators can set requirements for safe behavioral competences and evaluate them prior to deployment.
- AV companies can test and demonstrate this performance in simulation.
The SafeDI Framework creates a safety assurance program based on policymakers’ goals

**Set a Vision**
What is the future role of AVs in your mobility ecosystem?

**Define Horizon Operational Domain**
What is the geographic area that you want to permit AVs to operate in?

**Define Interim Milestones**
Select incremental environments which represent increasing complexity for testing and deployment

**Select Scenarios to demonstrate Safe Operation at Each Milestone**
For each milestone, consider the behaviors needed to demonstrate a suitable level of operational safety in the given environment, using a logical or data-driven approach

**Simplified Example**
To create an autonomous trucking corridor
All class 1 highways between ports and cities in nation
1. Remote rural highway section
2. Test bed between City A and Port B
3. Trial loop between Cities A, B and C
Highway merge
Emergency stop
Safe harbor maneuver …etc.
Graduated milestones are used to demonstrate a positive risk balance as development progresses.

Each milestone will represent increased expectation for the AV to demonstrate safe operation, by increasing the complexity of scenarios assessed against, while simultaneously increasing the environmental complexity along with the expected functionality of the system.

<table>
<thead>
<tr>
<th>Step</th>
<th>Deployment ODD</th>
<th>Limited test area</th>
<th>Geofenced public roads</th>
<th>All roads (within ODD)</th>
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<tr>
<td>i</td>
<td>Match between milestone ODD and deployment ODD</td>
<td>Controlled environment</td>
<td>Limited test area</td>
<td>All roads (within ODD)</td>
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<tr>
<td>ii</td>
<td>Demonstrates basic competency of AV system to work in limited conditions and to safely return control to operator when if outside of ODD</td>
<td>Allowing basic testing on public roads in a very limited area and ODD</td>
<td>Allowing testing in geographic area with other road users that is more representative of target ODD</td>
<td>Allows testing in full target ODD – AV should be able to handle all expected situations within target ODD</td>
</tr>
<tr>
<td>iii</td>
<td>Increasing Abstract Scenario Complexity</td>
<td>Expanding ODD</td>
<td>Increased Functionality</td>
<td>Reduced Intervention</td>
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<tr>
<td>iv</td>
<td>Commercial launch</td>
<td>System maturity</td>
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In this Framework, we provide an approach to scenario derivation, by starting with the deployment environment at each milestone.

**Specify requirements**

- **ODD Taxonomy**: E.g. NHTSA taxonomy, BSI
- **Location**: A particular context in which the behaviour will need to be performed, parameterized by ODD taxonomy
- **Behavioural Competency**: The ability of an AV to operate in traffic conditions it will regularly encounter

**Create test cases**

- **Qualitative scenario**: A formal (but abstract) description of a traffic situation within the AV's ODD
  - Specified by the regulator
  - Vehicle in traffic on a three-lane curved motorway in the summer
  - Lane width: 2.3-3.5 m
  - Traffic speed 0-30 km/hr
  - Temperature: 10-40 °C.

- **Logical scenario**: A qualitative scenario that has been parameterized, including possible value ranges for each parameter
  - Parameterized by the AV developer

- **Concrete scenario**: An instance of a logical scenario with specified values for each parameter
  - Parameterized by the AV developer
  - Lane width: 2.3 m
  - Traffic speed: 30 km/hr
  - Temperature: 23 °C

**Conduct test**

- **Test Case**: A concrete scenario that has been implemented in a test modality, along with specific metrics that determine success or failure
  - E.g., Simulation, on-road testing

**Definition**

- **ODD Taxonomy**: E.g. NHTSA taxonomy, BSI
- **Location**: A particular context in which the behaviour will need to be performed, parameterized by ODD taxonomy
- **Behavioural Competency**: The ability of an AV to operate in traffic conditions it will regularly encounter

**Example**

- **Example**: The intersection of Main St and E Liberty St.
- **Turn left**

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1 Example based on Pegasus Project: [https://www.pegasusprojekt.de/files/tmpl/PDF-Symposium/04_Scenario-Description.pdf](https://www.pegasusprojekt.de/files/tmpl/PDF-Symposium/04_Scenario-Description.pdf)
Would you like to know more?

Download your copy of the framework at: https://bit.ly/AVsafety
Thank You

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