GECKO

GOVERNANCE FOR NEW MOBILITY SOLUTIONS

Final analysis of regulatory responses and governance models

REPORT COVERING THE FINDINGS OF THE ANALYSIS OF REGULATORY RESPONSES AND GOVERNANCE MODELS

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LIST OF ACRONYMS

AGTC – Agreement on Important International Combined Transport Lines and Related Installations

AGN – The European Agreement on Main Inland Waterways of International Importance

API – Application Programming Interface

CAV – Connected, automated vehicles

CCAM - Cooperative, connected, and automated mobility

CEF – Connecting Europe Facility

ECJ – European Court of Justice

ECOSOC – Economic and Social Council

EFSI – European Fund Strategic Investment

EC – European Commission

EU – European Union

EV – Electric Vehicles

GDPR – General Data Protection Regulation

GLOSA – Green Light Optimal Speed Advice

GPS – Global Positioning system

ISO – International Organization for Standardization

ITC – Inland Transport Committee

ITF – International Transport Forum

ITS – Intelligent transport system

LEZ – Low Emission Zone

MaaS – Mobility as a Service

MoU – Memorandum of Understanding

OECD – Organisation for Economic Co-operation and Development

PHV - Private hire vehicle

SDG – Sustainable Development Goals

SUMP – Sustainable Urban Mobility Plan

STRIA – Strategic Transport Research and Innovation Agenda

TfL – Transport for London

TM – Traffic Management

TNC – Transportation Network Company

ULEZ - Ultra-Low Emission Zone

UN – United Nations

UNECE – United Nations Economic Commission for Europe

UVAR – Urban Vehicle Access Regulation

WP – Work Package

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EXECUTIVE SUMMARY

The goal of the GECKO project is to support authorities with tools and recommendations for the development of new regulatory frameworks that will be efficient in the new mobility era. An important part of the project is to build evidence through research regarding existing regulatory responses and governance models related to disruptive innovation for mobility. This document aims at mapping of the regulatory responses and governance models in the European Union (EU) and other key countries. This has been done through building and analysing an extensive database of relevant regulations and governance tools applied to govern disruptive mobility solutions in the EU and worldwide. Another source of data for the results presented in this report include consultations with project stakeholders through workshops and other means.

The first part of the report (section 2) focuses on how mobility is governed in general and presents concrete implications for the governance of disruptive mobility innovations. There is a number of various aspects that arise as many disruptive innovations enter the mobility sector. With the appearance of new data-driven business models in transport, the questions of data security and privacy, data quality, interoperability and data ownership have become more relevant than ever. The complexity of technological innovations brings forward the issues of compatibility of various systems and technologies and often leads to consumer and vendor lock-ins. Further, the environmental impact and the impact on equity and accessibility for various social groups might be not apparent when a new technology or business model is introduced. To achieve the expected benefits of mobility innovations, it is often crucial to establish collaboration between public and private parties as well as motivate private solution providers to cooperate and share data, as in the case of Mobility as a Service. Besides promoting and supporting the deployment of mobility innovations, policy-makers also need to ensure the safety of the users as well as society at large, and achieve smooth integration of innovations in existing transport systems so that the goals of smart and sustainable mobility are achieved. It is a challenge for policy makers to address these and many other aspects related to the introduction of disruptive mobility solutions.

There is an established framework of mobility governance that addresses at least part of the aspects outlined above. Issues such as road safety and sustainability of transportation are governed at international level through, for example, international conventions. Frameworks for other aspects such as public procurement, fair competition and liability are set at EU level. Certain disruptive innovations, however, require updates to existing regulations, as in the case of autonomous vehicles. National and city level governance allows for more flexibility in adopting and coordinating the entrance of new mobility solutions through experimentation, pilots and taking a holistic approach towards building local transportation systems.

Apart from the different governance levels, there are different governance models and regulatory approaches that are suitable at different stages of implementing a mobility innovation or depending on the innovation in question. For example, hierarchical governance through binding rules is more appropriate for setting long-term policy objectives or addressing questions of cybersecurity, while network governance through e.g. regulatory sandboxes is a suitable

approach for assessing the impact of more disruptive innovations and adapting governance frameworks accordingly.

Next, we discuss disruptive mobility innovations in more detail (section 3) and analyse the governance instruments at different governance levels relevant for several disruptive mobility innovations (section 4). In the scope of this research, disruptive innovation is defined as a process by which a product or service initially takes root in some specific, overlooked segments and provide suitable functionality eventually conquering mainstream consumers and displacing established competitors[1][2]. In the mobility sector, the most apparent drivers for disruptive innovations include platform and shared economy. Thus, in section 4 we focus on the mobility innovations divided into four categories:

- Cooperative, connected and automated vehicles;
- Infrastructure, network and traffic management;
- MaaS and MaaS platforms;
- Shared and on demand mobility.

With the help of the case studies, we highlight general patterns that are common to the governance of disruptive innovations across different countries. There are examples of the use of soft law, or the use of scientific research framework to proceed with testing certain innovations such as urban air mobility or autonomous vehicles. There are also the efforts to address the last mile issue through, for example, putting certain conditions in calls for tenders in order to direct the benefits of new mobility solutions. The fact that the services provided through most of these innovations mostly differ from traditional mobility by their business models and their way to reach customers is also important to highlight.

The governance of the multitude of disruptive mobility innovations is challenging because it is not immediately apparent what are their actual benefits for the society and whether there will be negative externalities that need to be accounted for. Currently ongoing COVID-19 pandemic has brought additional uncertainty into the mobility sector. In section 5, we list a number of governance responses to the COVID-19 pandemic that affect mobility in general and governance of disruptive mobility innovations in particular. For example, the switch to individualised transport has resulted in policies to support micromobility through e.g. infrastructure development. Then, post pandemic recovery plans in many European countries stress the need for sustainable mobility more than ever and thus favour mobility innovations that promise cleaner transportation. At the same time, the implementation of other mobility innovations such

[1] Christensen, C., Raynor, M. E., & McDonald, R. (2013). *Disruptive innovation*. Harvard Business Review.
[2] Ab Rahman, A., Hamid, U. Z. A., & Chin, T. A. (2017). Emerging technologies with disruptive effects: a review. *Perintis eJournal*, *7*(2), 111-128.

as Intelligent Transport Systems is obstructed due to pilot projects put on hold due to the pandemic.

We conclude this report with the discussion of how different aspects related to disruptive mobility innovations are currently governed, i.e. which governance instruments and models are applied (see the Appendix for a detailed summary). This work serves as an input for further research within the GECKO project. Particularly, the GECKO project aims to develop policy guidelines either to support the elaboration of a European regulatory framework around disruptive innovation related to mobility, or to adapt existing regulation if necessary.

1. INTRODUCTION

"Why dinosaurs will keep ruling the auto-industry?"[3], "How can regulation keep up as technological innovation races ahead?[4]", "How disruptive technologies are disrupting regulators[5]", "Policy makers face challenges in designing the appropriate legal and regulatory framework so that new technologies are used properly and for the benefit of society[6]". As we can see from these newspaper titles, designing adequate regulatory frameworks around innovation is an overwhelming challenge for regulators and policy makers. The GECKO project arises from this unanimous observation.

The sector of mobility and transport is facing a change comparable to the mass adoption of automobile vehicle, the 'automobile transition' of the 20th century. While we are no longer at the stage of the 'automobile transition', we are facing the transition to Smart Mobility[7], which has been defined as a transition from ownership to usership on a background of urbanisation and connectivity[8]. Smart Mobility can also be defined as "a way to move people and goods using new technology that is faster, cleaner, more accessible and less expensive than traditional options"[9].

Regulation plays a key role in supporting innovation, and keeping a fair balance between innovation and regulation is not always easy. Regulators have to keep up with the pace of innovation, which proves challenging when it comes to disruptive innovations[10]. Disruptive innovation can be briefly defined by two criteria:

- The disruptive innovation should have the "potential to drastically alter markets and their functioning"[11];
- The innovation should not only "involve a new product or process, but should also involve the emergence of a new business model"[12].

The goal of the GECKO project is to support authorities with tools and recommendations for the development of new regulatory frameworks to support the transition towards the new mobility era. To reach this goal, a strong stakeholder engagement and consultation process has been organised and evidence-based research was done on topics such as existing regulatory responses, economic, social and political effects of the new services and technologies for passenger and freight, and also the question of public-private partnerships. Stakeholder engagement has resulting in engaging more than 170 experts from public, private, research and

[3] Why dinosaurs will keep ruling the auto-industry, John Paul MacDuffie, and Takahiro Fujimoto, Harvard Business Review.
[4] Finance Monthly, How can regulation keep up as technological innovation races ahead?
[5] Keep calm and regulate: How disruptive technologies are disrupting regulators, Conventus law.
[6] Briefing, European parliamentary research service.
[7] The Governance of Smart Mobility, transportation research part A, Elsevier.
[8] Future of Personal Mobility- life with or without ownership of cars, Forbes.
[9] Daniel Lyons, Director, TMT Advisory, EY, Smart mobility: How tech is transforming transport.
[10] EPSC Strategic note, Toward an Innovation Principle Endorsed by Better Regulation.
[11] OECD, Key points of the hearing on disruptive innovation, 16-18 June 2015
[12] See supra.

other sectors related to mobility, representing most European countries as well as a number of countries outside Europe (such as the US, Israel, Singapore and Canada).

A regulatory database was set up to get knowledge about governance models and policy instruments used to regulate disruptive mobility innovations. It was structured to include the following information: description of the regulation or other governance tool, affiliated mobility innovation, jurisdiction, governance model, outcomes, expected benefits, negative impacts to look for, and issues addressed by the governance tool. To populate the database, the data on different governance tools for disruptive mobility innovations were collected through:

- **Surveys:** Two surveys were conducted to collect data. The first longer survey included the questions related to all the points mentioned above and was distributed among GECKO partners. It was also used to document the data obtained from interviews with experts, where different governance responses were discussed. The second shorter survey was conducted among GECKO stakeholders in order to ensure a massive participation. The idea was to collect case studies on relevant governance responses at the European scale and complete missing information afterwards with desktop research.
- **Interviews:** Three interviews with selected stakeholders have been performed to collect additional data regarding the governance of mobility innovations that did not get sufficient coverage in the survey.
- **Desktop research:** More regulations and governance instruments used for governing disruptive mobility innovation were identified during a desktop research of, for example, newspaper articles, press releases, research reports and reviews of how individual mobility innovations are regulated in specific countries[13,14,15,16].

As a result, 210 governance responses were listed in the regulatory database at the moment of writing this report. In addition, a stakeholder workshop was organized in London in October 2019 in order to consult the stakeholders regarding their vision about some policy instruments (pros and cons, in which context this instrument is more appropriate), relying on their expertise and background on disruptive mobility solutions. This supported our analysis of the regulatory database.

This document presents the analysis of the regulatory responses and governance models in the European Union and in other key countries. This research covers freight and passenger transportation with a focus on road transport in urban areas. The findings of this study serve as

[13] https://www.unmannedairspace.info/latest-news-and-information/drone-delivery-operations-underway-in-26-countries/#:~:text=While%20the%20countries%20of%20sub,more%20commercial%20drone%20delivery%20operations.

[14] https://static1.squarespace.com/static/59f9cdc2692ebebde4c43010/t/5b49c292aa4a9974b212fa16/1531560603865/20180710_D1.2_Big+Data+Policies_LeMO.pdf

[15] https://www.acea.be/uploads/publications/SAG_Report_-_Car_Sharing.pdf

[16] https://www2.deloitte.com/content/dam/Deloitte/de/Documents/consumer-industrial-products/CIP-Automotive-Car-Sharing-in-Europe.pdf

an input for providing guidance and developing support tools for regulators and policymakers in navigating and shaping the rapidly changing mobility sector, which are the ultimate outcome of the GECKO project.

In order to present existing regulatory responses and governance models, we have structured the report as follows:

- In **section 2 "Regulation and governance"**, we present the various aspects related to disruptive mobility innovations that usually require governance intervention, briefly present different governance levels, and provide an overview of various governance models in the context of mobility sector.
- In **section 3 "Disruptive innovation in urban mobility"**, we discuss what disruptive innovation is in general and in the context of smart mobility as well as review some key innovation trends related to, for example, shared mobility, big data and automation.
- In **section 4 "Case studies"**, we present detailed case studies of separate mobility innovations by analysing the regulatory environment around a specific innovation at international, national and local levels.
- In **section 5 "Impact of COVID-19** on the regulatory responses and governance models for disruptive mobility innovations", we provide an overview of how the ongoing pandemic has affected the governance of disruptive mobility innovations.
- In **section 6 "Conclusions"**, we summarise the main outcomes of this report and discuss implications for the governance of disruptive mobility innovations.

2. REGULATION AND GOVERNANCE

The term **regulation** can be defined in several ways. In GECKO, we have chosen the definition proposed by Organisation for Economic Co-operation and Development (OECD). In this document and in the whole project, regulation is defined as "any instrument by which governments, their subsidiary bodies, and supranational bodies set requirements on citizens and businesses that have legal force"[17].

Another term that is important to present is the notion of **soft law**, defined by OECD as "cooperation based on instruments that are not legally binding, or whose binding force is somewhat "weaker" than that of traditional law, such as codes of conduct, guidelines, roadmaps, peer reviews."[18] The use of soft laws seems to be the most suitable regulatory approach to disruptive innovation[19]. Soft law instruments are used to regulate autonomous vehicles, for example in the US where the Department of Transportation released several sets of guidelines around the topic[20]. In Europe, we can take the example of the Memorandum of Understanding (MoU) signed in 2016 between the Latvian ministry of Economics, Uber, and Taxify[21]. Similarly, AXA signed a MoU with Uber to set up standards of protection for drivers[22].

The reasons why soft law tools appeared to be the preferred regulatory tools around innovation is because they respond adequately to the regulatory challenges faced by regulators when it comes to developing the right ecosystem for innovations. These challenges are numerous but can be briefly summarized as the speed of change in many sectors, including mobility, blurring edges between different industries and business models, and diversity of innovations[23]. As previously mentioned, the pace, the speed of development of these innovations is one of the main challenges for regulators. Disruptive innovations and new business models have blurry edges and play with the limits developed by existing regulations. Is Uber a taxi company if they do not own cars? Finally, diversity, the wide range of innovations and new business models makes it difficult for regulators to develop an adapted regulatory framework for all of them.

Along with the notion of regulation, the term **governance** is also key in this research. Governance is defined by the OECD as "the exercise of political, economic and administrative authority necessary to manage a nation's affairs[24]." The definition can be broadened for the purpose of this research to the European and international levels and not be limited at the national level. Questions linked to the concept of governance are, "who has a voice in the decision process?"

[17] https://www.europarl.europa.eu/RegData/etudes/STUD/2020/658541/IPOL_STU(2020)658541_EN.pdf
[18] OECD, regulatory policies, soft law.
[19] Ryan Hagemann, Jennifer Huddleston Skees, Adam Thierer, 'soft Law' is eating the World, George Mason university, the bridge.
[20] Preparing for the future of transportation, U.S. Department of Transportation.
[21] Ministry of Economics, Latvia, The memorandum of Understanding with Uber and Taxify has been signed.
[22] International Finance, Uber and AXA to set a new standard for protection of independent drivers and couriers.
[23] Collaboration, Innovation … Regulation? The disruptive shifts taking our economy by storm, Deloitte.
[24] OECD Glossary of statistical terms.

"how are the decisions made?" and "who is accountable once a decision has been made?"[25]. A specific but relevant notion is that of **good governance**, which can be characterised by "participation, transparency, accountability rule of law, effectiveness, and equity etc."[26].

In the following section 0, we list the key challenging regulatory aspects around the question of disruptive innovation and mobility. Then, the various regulatory levels in the regulatory framework around disruptive mobility innovations are presented in section 0. Finally, the existing governance models and their main characteristics are summarised in section 0.

2.1. Policy and regulatory aspects related to disruptive mobility innovations

Given the challenges described above, there are several critical issues that governance at the EU, national level, and local level needs to take into account:

- **Timing**: considering the pace of development of innovation in mobility, the window for regulators to take over the governance from private actors might be short[27]. This is, however, necessary to prevent self-governance.
- **The regulation of data**: Smart mobility innovations process huge amounts of data; "data is the knowledge upon which the power to control the marketplace is built"[28]. The risk to which governments are exposed is that disruptors will get a significant knowledge regarding citizens living in their territories (including personal information on hobbies, religion, sexual orientation, etc.). Besides the significant power conferred to these private entities issued from these data, this data collection presents major risks for the travellers in terms of privacy if badly regulated. Then, in order to ensure the successful implementation of innovations such as Intelligent Transport system (ITS) and MaaS, the questions of data security, interoperability and data ownership need to be addressed.
- **The distributional impact**: ensuring equity and non-discrimination is part of a national government role. When mobility innovations are introduced, inequities might appear, like in the case when Uber algorithm offered a better service to certain neighbourhoods in Washington by means of surge pricing[29].
- **Financing** the development of disruptive innovations[30]: the question of how to balance taxes, subsidies, use of infrastructure and public interest still stands when more and more

[25] Institute of governance, defining, governance.
[26] OECD Glossary of Statistical term.
[27] G. Capoccia, D. Kelemen, the Study of Critical Junctures: Theory, Narrative, and Counterfactuals in Historical Institutionalism.
[28] Ian Docherty, Greg Masden, Jillian Anable, The governance of smart mobility.
[29] The Washington post, Uber seems to offer better service in areas with more white people. That raises some tough questions.
[30] Lindberg Gunnar, Fridstrøm Lasse, Working Paper, Policy strategies for vehicle electrification

mobility innovations are introduced. The problem of taxation of smart mobility as well as the use of public space need to be addressed by governments[31].

- **Changing role of citizens**: in Smart Mobility, citizens provide information to mobility actors and other citizens; they also provide services e.g. in peer-to-peer sharing. It is therefore important to raise awareness about the importance of data protection and to work on 'digital empowerment' of citizens.

There are many other considerations related to embedding individual new mobility solutions in existing transport networks and local public transportation systems. In Table 1, we list several aspects that are important to consider when mobility innovations are introduced. Some of them relate to data management, others to public safety, other issues actualise when new technologies enter the mobility mix and interact with other modes of transport. We provide a brief description and examples of how each aspect can create tensions that might require regulatory intervention or other governance. This list is not exhaustive but provides a wide overview of how multifaceted the challenge of governing disruptive mobility innovations is. Also, while certain aspects are relevant to any mobility innovations, others are more relevant only for specific innovations.

Table 1 Policy and regulatory aspects that are relevant for the governance of disruptive mobility innovations[32]

Policy and regulatory aspects	Brief description	Examples
Competition	Prevention of anti-competitive behaviour by correcting or constraining the acquisition of dominant power[33] Limitations on too much competition	Tension between UBER and licenced taxi drivers[34] Too many micromobility operators in one city creates chaos Reluctance to share data among competing MaaS operators
Cooperation	Required cooperation between different private and public parties in order to successfully implement a mobility solution	Need for cooperation and data sharing between cities and MaaS operators

[31] Ian Docherty, Greg Masden, Jillian Anable, The governance of smart mobility.
[32] This table is based on the findings of GECKO project, and more detailed overview of policy and regulatory aspects relevant for the governance of disruptive mobility innovations can be found in Deliverable D2.2 'Investigation of main economic, political and social variables'
[33] Ian Forrester, Disruptive innovation and implications for competition policy, European University Institute.
[34] Damien Gerardin, Should Uber be allowed to compete in Europe? And if so how? Competition Policy International.

Compatibility	The need to be compatible with existing technologies, infrastructure and business models	Ensuring electric vehicles (EVs) fit into local energy systems and do not pose security threats Question of whether e-scooters can be ridden on bike or car lanes
Complementarity	The need for other technologies, infrastructure, business models in order to realize the benefits of a mobility solution	Adoption of safe and secure ticketing systems to enable MaaS solutions
Data ownership and use	Clarity regarding who will own data collected as part of a mobility solution (traffic, payment, personal etc.), how it will be shared and what it will be used for. Users of mobility services need to remain in control of their own data	Smart cities become huge processors of data[35] and compete with mobility providers for the power these data provides
Data quality	For certain mobility solutions to work it is crucial that the data (e.g. traffic schedules, real-time vehicle locations, etc.) is precise and reliable	Benefits of MaaS are achievable only if they operate reliable and up-to-date data
Data integration	It is necessary to integrate the data generated by different actors in order for mobility solutions to realize their benefits	Poor data interoperability can be a barrier for successful implementation of Traffic Management Systems and MaaS
Data security and privacy	Data required for operation of various mobility solutions contains private information (e.g. credit cards, names, addresses, locations and movements), which needs to be properly protected. The question of protection of personal data is to find the right balance to define and then protect such data, without preventing business and innovation that need data to develop and operate	Personal and credit card data in MaaS; geolocation data in Uber and e-scooter schemes
Promotion of innovations	Economic instruments such as taxes, tax reliefs, subsidies, etc. impact new and existing mobility solutions, creating advantages and disadvantages for certain	Subsidies and taxes support the development of electric or low CO_2

[35] Data protection in a smart city bike system: the example of Turku. Vera Fovet.

	actors. Avoiding taxes is also creating unfair competition	emission vehicles in most of the member states[36]
Employment	Workforce structure shifts due to the introduction of new mobility solutions and protection of employees in newly created jobs	Working hours and minimum wages of Uber or crowdshipping drivers[37] Reductions in driver jobs due to automation
Environmental impact	The actual environmental benefit of a mobility solution can be only assessed when considering its lifecycle and potential shifts of environmental impact elsewhere The intended environmental benefits of a mobility solution might not be realised to a full extent	Autonomous vehicles, which are normally electric vehicles, are seen as a 'green' solution, while much more people can start riding cars due to increased access (those without driving licence, etc.) leading to increased number of cars on the roads
Equity and accessibility	New mobility solutions entail various level of accessibility and their use can be challenging for certain groups of people due to physical, economic or technological limitations	Hyperloop aimed at high-income travellers rather than solving mobility problems Difficulties for certain population groups to use digital mobility solutions
Ethical aspects	Certain new mobility-related technologies or business models bring up ethical issues that are difficult to resolve	Generation of personal data that can pose the risk of surveillance Choices made by autonomous vehicles in critical situations[38]
Cognitive-cultural aspects	The switch to new mobility solutions often requires a change in people's mindset, travel habits and revision of what has been taken for granted	Resistance to switching to shared economy and abandoning ownership of vehicles
Tragedy of the commons	Disregard and vandalism are often observed in relation to objects and infrastructures that are considered to be common or 'no one's'	Vandalizing autonomous cars, e-scooters, bike docking stations
Public health	While a mobility innovation can make transportation more accessible, it can lead to undesired effect on people's health	Decrease in walking due to wide adoption of micromobility

[36] CO^2 Based motors vehicle taxes in the EU, ACEA.
[37] Diane Kruzman, Some Uber drivers works dangerously long shifts, USA Today.
[38] Bonnefon et al., 2016. The social dilemma of autonomous vehicles

Safety	It is crucial to ensure safety of the users of new mobility solution (passengers) as well as the society in general (pedestrians, local population, etc.)	Road safety when autonomous vehicles, electric vehicles, and electric scooters[39] are introduced
Security (cybersecurity)	It is crucial to ensure security of the users of new mobility solutions as well as any affected stakeholders	Security of passengers using a shared mobility solution Possibility of 'hacking' into autonomous cars[40] or traffic management systems
Liability	In certain cases, it is unclear whose liability it is when an accident happens in the context of a new mobility solution	Blablacar, a platform of ridesharing, accepts no liability for rideshares[41] Unclear liability in case of an accident involving autonomous vehicles?[42] Unclear passenger rights in case a part of a journey arranged through MaaS fails

2.2. Regulation and governance of mobility at different levels

This section presents the existing regulatory frameworks related to mobility at the international, EU and local level. We present the key regulatory bodies and some of the most important regulatory texts at each level, as well as discuss the role of regulation and governance at different levels.

Key common themes that are applicable to most new mobility services and have a common regulatory framework relate to the protection of personal data, environmental concerns (mainly in terms of reducing emissions) and the safety of service for customers and other road users. Regulation ensures data standardization, data security and encourages transfer of knowledge to other countries in order to increase the success of future implementations. Standards and standardization are a horizontal aspect touching upon many other aspects related to governing

[39] European Commission, on the road to automated mobility: An EU Strategy for mobility of the future. Lime Scooter welcome, but speed limit essential, PressReader.

40 Caleb Kennedy, New threats to Vehicle Safety: How cybersecurity Policy will shape the future of Autonomous vehicles, Michigan Telecommunications and Technology law review.

41 European Comission, Exploratory study of consumer issues in online peer-to-peer platform markets, case study of Blablacar.

[42] Katie Chandler, Driverless cars and product liability.

mobility innovations. Standards can concern data protection, testing of autonomous vehicles, or even communication protocols for multi-brand platooning.

2.2.1. International governance

Key regulatory bodies

At the international level, the first regulatory body to mention is the Economic and Social Council (ECOSOC) of the United Nations (UN).

It was established in 1945 as one of the six main organs of the UN. ECOSOC can be described as "central platform for fostering debate and innovative thinking, forging consensus on ways forward, and coordinating efforts to achieve internationally agreed goals.[43]" In 1947, ECOSOC created the United Nations Economic commission for Europe (UNECE), composed of 56 members from Europe, North-Africa and Asia, with its major aim to promote economic integration[44]. The highest policy making body of the UNECE in the field of transport is the Inland Transport Committee (ITC). Within this intergovernmental forum UNECE members and other UN members work together to develop tools for economic cooperation and also adopt international legal instruments regarding inland transport. Within ITC there are several Working Parties.

World Forum for Harmonization of vehicle Regulations (WP 29) is a permanent working party in the institutional framework of the United Nations with a specific mandate and rules of procedure. It works as a global forum allowing open discussions on motor vehicle regulations[45].

The **International Transport Forum (ITF) at OECD** is an intergovernmental organisation with 59 member countries. It acts as a think tank for transport policy and organises the Annual Summit of transport ministers where questions critical for mobility sector governance are discussed.

International Telecommunication Union (ITU) and the **International Organization for Standardization (ISO)** as well as other standard developing organisations have been cooperating with **UNECE** through e.g. achieving the worldwide deployment of Intelligent Transport Systems[46], working on issues like policy harmonization, data security, liability issues, multimodal transport, and emerging technologies.

Regulatory texts and governance tools

At the international level, the **Vienna Convention on Road Traffic** is the most relevant text to this research and is key for the development of the regulatory framework for disruptive innovation in mobility. The Vienna convention is an international treaty agreed upon at the ECOSOC

[43] ECOSOC, United nations Economic and Social Council.
[44] UNECE, info, about UNECE, mission
[45] UNECE, https://unece.org/transportvehicle-regulations/wp29-world-forum-harmonization-vehicle-regulations-wp29
[46] https://unece.org/fileadmin/DAM/trans/doc/2020/wp29grva/GRVA-07-14e.pdf

Conference on Road Traffic in 1968 and concluded in Vienna on 8 November 1968. The aim of this treaty is to facilitate international road traffic and to increase road safety by establishing standard traffic rules among the 78 countries which ratified this convention. **The Geneva Convention on road traffic** (1949)[47] aims at promoting the development and safety of international road traffic by establishing certain uniform rules.

The international level of regulation and policy makers play an important role especially regarding the questions of environment, customs, harmonization and standardization.

Regarding the notion of international governance, the concept of the UN Sustainable Development Goals (SDG's) are important to be introduced. The SDGs were adopted in 2015 by all UN Member States and aim at becoming a shared plan for peace and prosperity for people and the planet, now and into the future. There are 17 components of the SDG's and several are linked with the question of governance of transport and the transition to smart mobility. The main one on sustainable cities and communities is SDG 11, but it is considered that all the 17 SDG's are somehow linked with the question of mobility[48]. The Inland Transport Committee, supported by the Sustainable Transport Division of UNECE, carries out a number of activities which have a direct impact on the achievement of the 2030 Sustainable Development Agenda[49]. These legal instruments are considered indispensable for developing efficient, harmonized and integrated, safe and sustainable inland transport systems[50].

While international governance and regulations provide the basis for Smart Mobility, national governments (and EU) are heavily involved in the governance of transport[51]. It is important to note that the intervention of the state tends to vary based on the culture of the country. For example, in continental Europe, where the culture of the welfare state is important, the state will tend to intervene in the governance of transport[52] more than in the countries with a more neo-liberal market tradition[53] such as the US and the UK.

2.2.2. European Union

Key regulatory bodies

The following regulatory bodies are active in regulating mobility at EU level:

- The European Parliament and its committee on transport and tourism (TRAN Committee);
- The European Commission;

[47] Convention on Road Traffic Geneva, 19 September 1949
[48] SDGs and the UN Transport Conventions
[49] Transport and the Sustainable Development Goals
[50] Inland Transport Committee
[51] Iain Docherty, Greg Masden, Jillian Anable, The governance of smart mobility.
[52] Constanzo Ranci, Competitiveness and Social Cohesion in Western European Cities
[53] Jamie Peck, Neoliberalizing states: thin policies/hard outcomes

- The European Court of Justice;
- The Council of the European Union (European Council);
- The European Committee for Standardisation (CEN);
- The European Committee for Electrotechnical Standardisation (CENELEC);
- The European Telecommunications Standards Institute (ETSI).

Regulatory texts

When it comes to the regulation of the mobility sector at EU level, it is important to note that certain regulations covering wider areas of economic activity are as relevant for the transport sector. For example, the following areas of governance are relevant in terms of mobility innovations:

- The **platform-to-business** directive: the proposal[54] for an EU regulation was put forward in April 2018 by the EC to promote fairness and transparency for business users of online intermediation services. This proposal is mainly directed at online intermediary service providers, regarding the payment of the service on the platform and the contractual relationship. Airbnb, Uber, Facebook, and Amazon among others would be affected by this directive[55]. However, this proposal will have an impact on platforms in mobility sectors as well.
- Regulatory texts regarding the questions of **subcontracting and liability**[56] will become even more relevant e.g. in case of on-demand shared mobility and crowdshipping where various issues regarding the employment of individual drivers (e.g. liability, minimum wages and social security payments) are still largely under-regulated.
- The regulation around **taxation** at the level of the European Union is also important to mention in the scope of this research. The EU has created a framework to encourage Member States to use taxation and infrastructure charging in the most effective and fair manner in order to promote the 'user pays' and 'polluter pays' principles[57].
- Regulation linked to **competition**, with antitrust regulation and the questions regarding state aid in relation with road transport and infrastructure. The Council of the EU sets out general antitrust procedural framework which applies to transport by road in the council regulation N°1/2003 along with the council regulation N°1017/68 presenting the applying rules of competition to transport by road, but not only. In addition, the Treaty on the Functioning of the European Union (TFEU) contains rules that aim to prevent restrictions on and distortions of competition in the internal market[58]. Regarding competition, it is also important to mention relevant regulations and guidelines on state aid, and transport infrastructure.

[54] Regulation on promoting fairness and transparency for business users of online intermediation services
[55] A proposed EU regulation for online platform-to-business relationships
[56] Study for the JURI committee, liability in subcontracting chains: National Rules and the Need for a European framework
[57] https://ec.europa.eu/transport/modes/road/road_charging/charging_hgv_en
[58] Competition policy, https://www.europarl.europa.eu/factsheets/en/sheet/82/competition-policy

- EU also sets the **public procurement** regulatory framework which is crucial to take into account when new mobility solutions are introduced[59,60].
- The European Regulation on the **protection of personal data** (GDPR / Regulation (EU) 2016/679) plays a significant role in the collection and management of data that users share with the platform or company operator. This Regulation should ensure the right to the protection of personal data. The data collected should be limited to the necessary minimum and used only for the purposes for which they are collected. In turn, the operator undertakes to take reasonable steps to safely store the data, prevent or suppress unauthorized or unlawful processing and accidental loss, destruction or damage, using appropriate technical or organizational measures.
- The **standardization of the collected data** at the European level is important for assessing and taking steps to improve transport infrastructure and mobility in general. The Intelligent Transport Systems framework, based on Directive (EU) 2010/40, regulates the collection and exchange of data and ensures uniformity. Moreover, INSPIRE directive 2007/2/EC lays down a framework for an infrastructure for spatial information in Europe that is geared to help to make spatial or geographical information more accessible and interoperable for a wide range of purposes supporting sustainable development.

Apart from regulation, it is worth mentioning policy documents that set the roadmap for the development of mobility sector in Europe and thus have a direct influence on disruptive mobility innovation deployment. **The 2011 Transport White Paper** fostered the goal of establishing the framework for a European multimodal transport information, management and payment system by 2020. The European Commission has recently also released a comprehensive **Strategy for a Sustainable and Smart Mobility**. This strategy was announced as part of the **European Green Deal**, and will supersede the 2011 Transport White Paper as the European Commission's vision for transport.

Standardisation has played a leading role in creating the EU Single Market. Each year the European Commission publishes an **Annual Work Programme for European standardisation**. The programme lays down the Commission's intentions to use standardisation in support of new or existing legislation and policies. These intentions may lead to formal standardisation requests (mandates).

Concerning financing instruments, **Connecting Europe Facility (CEF)** is a key EU funding instrument to promote growth, jobs and competitiveness through targeted infrastructure

[59] https://ec.europa.eu/growth/single-market/public-procurement_en

[60] https://ec.europa.eu/transport/themes/pso/land_en

investment at European level. It supports the development of interconnected trans-European networks in the fields of transport, energy and digital services[61].

As regards the mobility sector specifically, policy makers at the EU level play a key role regarding the questions of safety, environment, funding, social protection, standardization, and competition. Certain areas related to mobility require regulation at EU level rather than following the subsidiarity principle and having decisions taken at national or local level due to the specificity of the issue at hand. This includes issues that are not directly related to any specific type of mobility innovations or require harmonization at higher than national level (e.g. when it concerns supranational infrastructures). For example, the following topics have been predominantly governed at EU level (see Table 2).

Table 2 EU level regulation of different aspects related to disruptive mobility innovations

Area related to mobility	Examples of regulations at EU level	Regulatory body
Data management: big data and personal data handling	• Directive (EU) 2019/1024 on open data and the re-use of public sector information • Proposal for a regulation on electronic freight transport information COM/2018/279 • Directive 96/9/EC on the legal protection of databases • Directive 2002/58/EC concerning the processing of personal data and the protection of privacy in the electronic communications sector • Directive 2003/98/EC on the re-use of public sector information • General Data Protection Regulation (EU) 2016/679	European Parliament European Council European Commission
New and complex technological solutions in mobility	• Commission delegated regulation C/2019/1789 supplementing Directive 2010/40/EU of the European Parliament and of the Council with regard to the deployment and operational use of cooperative intelligent transport systems • Urban Air Mobility Initiative of the European Innovation Partnership in Smart Cities and Communities (EIP-SCC)[62] • Regulation 219/2007 on the establishment of a Joint Undertaking to develop the new generation European air traffic management system (SESAR)	European Commission European Council European Parliament

[61] The Connecting Europe Facility.
[62] https://eu-smartcities.eu/initiatives/840/description

	• Council Regulation (EU) No 642/2014 of 16 June 2014 establishing the Shift2Rail Joint Undertaking	
Multimodal transport infrastructures and traffic management	• Regulation 2015/962 supplementing Directive 2010/40/EU of the European Parliament and of the Council with regard to the provision of EU-wide real-time traffic information services • Regulation 2017/1926 supplementing Directive 2010/40/EU with regard to the provision of EU-wide multimodal travel information services • The changing roles of Road Authorities and Service Providers in Traffic Management 2.0 deployment: A Guidelines Document • Regulation No 1315/2013 on Union guidelines for the development of the trans-European transport network	European Parliament European Council
Road, passenger and pedestrian safety	• Directive 2008/96/EC on road infrastructure safety management • The revised General Safety Regulation (EU) 2019/2144 • The Product Liability Directive 85/374/EEC • Regulation (EU) 2018/858 type-approval rules for safer and cleaner cars	European Parliament European Council
Financial support	• Regulation (EC) No 1692/2006 establishing the second Marco Polo programme for the granting of Community financial assistance to improve the environmental performance of the freight transport system (Marco Polo II) • Regulation (EU) no. 1316/2013 establishing the Connecting Europe Facility (CEF) • Regulation (EU) No 1315/2013 on Union guidelines for the development of the trans-European transport network (TEN-T)	European Parliament European Council
Environmental impact of transportation	• Communication on The European Green Deal • Communication on the Sustainable and Smart Mobility Strategy – putting European transport on track for the future • Directive 2011/76/EU amending Directive 1999/62/EC on charging heavy goods vehicles for the use of certain infrastructures	European Parliament European Council

	• Council Directive 2003/96/EC restructuring the Community framework for the taxation of energy products and electricity	
Public procurement and public transport	• Directive 2014/24/EU on public procurement • Regulation (EC) No 1370/2007 on public passenger transport services by rail and by road • Directive (EU) 2019/882 on the accessibility requirements for products and services • Regulation (EU) No 181/2011 concerning the rights of passengers in bus and coach transport • Regulation (EC) No 1371/2007 on rail passengers' rights and obligations	European Parliament European Council

2.2.3. National and local governance

At the national level within the EU Member States, the relevant regulatory bodies and texts for the scope of this research vary from one country to another and depend on the governance models. The key areas where the national regulatory framework and authority play a key role are taxation, subsidies, funding, licensing, and access to infrastructure. We will analyse the governance of specific mobility innovations at national and local level in more detail in section 0.

At the local level, once again the texts and bodies vary from a local authority to another, according to the chosen governance model amongst other elements. The key areas where local regulatory framework and authority play a key role are licensing, subsidies, the use of public space and public infrastructure, public procurement, funding and granting access to the city.

The question of access to the cities and the regulatory element linked to it are also to be taken into account in the frame of this research. Many cities and towns in the EU are regulating around the question of access to the city (Urban Access Regulations - UVAR). UVAR are where certain types of vehicles are restricted from entering a part of an urban area with the aims to resolve issues such as air pollution, congestion, road safety and noise while supporting the attractiveness of cities. There are three main identified schemes adopted by the cities to regulate around access to the city.

- Low Emission Zone (LEZ) define areas where the most polluting vehicles are regulated. Usually this means that vehicles with higher emissions cannot enter the area[63]. A LEZ

[63] Urban Access Regulation in Europe, Low Emission Zone.

scheme has already been adopted in Germany, The Netherlands, France, Belgium and England amongst other European countries.

- Urban Road Tolls, where entry to an area is subject to payment. In most cities this money is usually spent on improving transport in and around the city[64]. The most well-known examples of urban road tolls are London[65] and Stockholm[66].
- Urban Access Regulation is the case where access is regulated by other requirements, for example when a permit is required to enter an area, or access allowed at certain times of the day[67].

Metropolitan areas strive to reduce emissions and create separate programs to regulate them within the city. For example, **London** has developed an Ultra-Low Emission Zone (ULEZ) program and introduced a city centre entry fee throughout the year. Cars that meet the ULEZ criteria are exempt from the tax. Such programs also stimulate the transfer of residents from private cars to public transport or the use of micro mobility (**Madrid**).

At the regional level, security and transport incidents between different modes of transport are also analysed, which affect the newly introduced regulation. For example, **Madrid** aims to reduce vehicle emissions, make better use of parking space, and increase pedestrian zones.

Large operating companies or professional new mobility societies are able to initiate the development of regulation or legislation for the benefit of business and society. In most cases this occurs at the city level, however, it can gradually move to the national level as well. For example, **Stockholm**, together with VOI, signed a memorandum on compliance with the rules for the use of transport infrastructure, parking, etc. Business is interested in the formation of a positive perception of new services on the part of society. Policymakers, in the face of a lack of experience and novelty of service, perceive this as a transitional stage as well as a basis for further development of regulation (**Lisbon**).

Prioritizing the use of low-emission vehicles or electric vehicles is affecting the development of pedestrian zones and parking spaces. Cities reduce the ability to enter the central part of the city (**London**), introduce fares for the use of infrastructure, reduce parking places or ban free parking (**Stockholm**, **Portland**).

In turn, the growth in the number of bicycles and scooters is forcing cities to introduce rules for their movement and parking. Most cities are faced with cluttered dockless bikes and e-scooters. The introduced rules often oblige users to park bicycles at a distance from houses, not to interfere with the passage of pedestrians, etc. Incorrectly parked vehicles must be moved within a certain

[64] Urban Access Regulation in Europe, Urban Road Tolls.
[65] Urban Access Regulation in Europe, Urban Road Tolls, London.
[66] Urban Access Regulation in Europe, Urban Road Tolls, Stockholm.
[67] Urban Access Regulation in Europe.

time after the shared bike or e-scooter operator receives a notification from the city (**Barcelona**, **Munich**).

Data sharing is another issue that can be governed at national level, and thus different approaches exist in different EU countries**. Finland** has made significant steps and can rightly be considered a forerunner in the field of MaaS[68] and open data. In 2018, The Act on Transport Services in Finland brought together legislation on transport markets, a part of which ensures that regardless of the mode of transport, a provider of passenger mobility services shall ensure that essential, up-to-date data on its services is freely available from an information system (open interface). In the Netherlands, a framework agreement for piloting MaaS in the country creates a standardised approach with the ambition to set up a (inter)national MaaS ecosystem that can be sustainable for all stakeholders.

2.3. Governance models

2.3.1. Governance models for regulating disruptive innovations

Governance models can be defined as the approach adopted to regulate disruptive mobility innovations. Governance models can be divided into three categories, for which several policy instruments can be employed[69]:

- **Hierarchical**: a top-down approach relying on binding rules or procurements.
- **Market governance**: influence on economic variables to achieve policy goals.
- **Network governance**: new model relying on the collaboration between the stakeholders in the decision-making process.

Network governance includes five new approaches that can be implemented to regulate fast evolving technologies and business models, such as disruptive mobility innovations: the adaptive regulations, regulatory sandboxes, outcome and risk-based regulations, and collaborative regulation. These governance models are presented in Table 3.

Table 3 Governance models and regulatory approaches to disruptive mobility innovations[70]

Category	Governance model -	Definition	Example of policy instruments	Example for mobility

[68] https://whimapp.com/
[69] See GECKO report D2.4 'Regulatory schemes and governance models for disruptive innovation' for more information
[70] Based on GECKO deliverable D2.4 'Regulatory schemes and governance models for disruptive innovation'

	Regulatory approach			
Hierarchical	Binding rules	Legislative acts, 'traditional' laws or directives	EU Directives and Regulations National/ regional /local laws	Directive 2010/40/EU related to the deployment of Intelligent Transport Systems[71]
Market	Market	Influence on economic variables to achieve policy goals	Taxes/charges Call for bids	Dynamic fees regarding parking, like in San Francisco[72]
Network governance	Adaptive regulation	Policy that can be adjusted over time, relying on data collection and analysis	Self/co-regulations Adaptive licensing	The SUMP (Sustainable Urban Mobility Plan) process
	Regulatory sandboxes	Deployment of the innovation on restricted and controlled conditions for impact analysis	Subsidies and incentives	Automated vehicles experimentations, pilot zones
	Outcome-based regulations	Stakeholders impacted by the regulations achieve policy goals without constraints on the process	Self-regulations	GDPR set up a list of objectives to relevant stakeholders (e.g. Art. 17)
	Risk-based regulation	Regulatory activities and resources activities allocated on evidence-based assessment risks	All policy instruments can be used	Commission Implementing Regulation (EU) 2019/947 of 24 May 2019 on the rules and procedures for

[71] https://eur-lex.europa.eu/legal-content/EN/TXT/HTML/?uri=CELEX:32010L0040&qid=1555677931095&from=EN
[72] http://www.eltis.org/sites/default/files/report_summary_reviews_of_measures.pdf

				the operation of unmanned aircraft
	Collaborative regulation	All stakeholders involved in the definition of the regulation/policy	Co-regulation	Memorandum of Understanding in Lisbon to regulate shared mobility

2.3.2. Applicability of different governance models

Each governance model has advantages and disadvantages, either in terms of flexibility, implementation costs, or inclusion of stakeholders in the decision-making process. Taking advantage of each governance model helps to define which approach is most appropriate. Table 4 presents the advantages and disadvantages of different governance models in the context of mobility.

Table 4 Applicability of different governance models[73]

Governance model - Regulatory approach	**Pros**	**Cons**	**Where could it work best?**
Binding rules	Clear chain of command Efficiency regarding long-term actions	Poor flexibility Exclusive approach Risks of lack of acceptancy	Long-term policy objectives Definition of standards Cybersecurity, environmental data Transnational mobility Solution operation
Market	Innovation enhancement	Risk of market failure, disequilibrium of the ecosystem	Negative externalities Behaviours (e.g. ULEZ incentivize behavioural changes such as shift towards e-vehicles or other sustainable modes)

[73] The contents of this table are based on desktop research and discussions at the second GECKO workshop with stakeholders in London in October 2019

Adaptive regulation	High flexibility Compliant with fast evolving framework	Higher cost for impact assessment	Impact assessment
Regulatory sandboxes	Innovation fostering Reduced time-to-market Higher acceptancy	High costs Risks for consumers testing the solution	Pilot projects Impact assessment
Outcome-based regulations	High flexibility Higher acceptancy	Lack of guidance Higher cost for impact assessment	Impact assessment
Risk-based regulations	Better decision-making	Higher cost for impact assessment	Pilot projects Impact assessment
Collaborative regulation	Inclusive approach, sharing of knowledge and resources	Time consuming No clear leadership	Definition of standards

Thus, various governance models appear to be suitable depending on the context. Depending on the stage of deployment of the solution in the market, the choice of appropriate governance model can be different, as illustrated in Figure 1. Various governance models can be applied during different stages of the implementation of a mobility innovation.

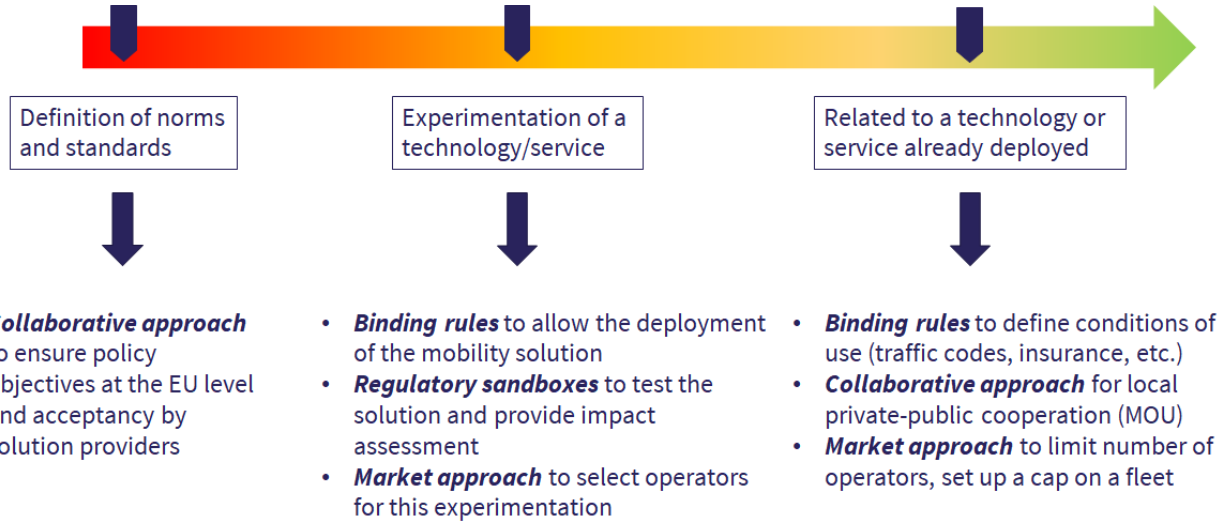

Figure 1 Examples of suitable governance models for mobility innovations based on Regulation Readiness Level[74]

[74] See GECKO deliverable D2.4 'Regulatory schemes and governance models for disruptive innovation' for more details on Regulation Readiness Level

3. DISRUPTIVE INNOVATION IN URBAN MOBILITY

3.1. Definition of disruptive innovation

According to the Christensen Institute[75], disruptive innovations have the potential to be an incredibly positive force in the world. If there is no uniformly accepted definition of disruptive innovation, at least some criteria to qualify an innovation as a disruptive one can be identified. It is important to start by presenting what disruptive innovations are not[76]: disruptive innovations are not new technologies that make good products better[77].

The commonly accepted definition of disruptive innovation is the definition from Clayton Christensen[78] according to which disruptive innovation is a "process by which a product or service initially takes root in simple applications at the bottom of a market, typically by being less expensive and more accessible, and then relentlessly moves upmarket, eventually displacing established competitors[79]." According to this conception, the first car developed by Carl Benz in 1886 would not be qualified as a disruptive innovation because the vehicle was targeting exclusive consumers, a training was required to learn how to use it, and it included high-end features, while the Ford model T from 1908 is considered disruptive because it was affordable, easy to use and included only basic features. According to the Christensen institute there are three elements to qualify innovation as disruptive:

- First there must be an enabling technology, an invention that makes a product more affordable and accessible to a wider population. The smart phone or the internet are key examples of an enabling technology.
- The second element is an innovative business model which according to this definition targets non-consumers, new customers who previously did not buy a product, did not use a service in a given market or were the least profitable customers.
- The third element is a coherent value network, so a network in which suppliers, partners, distributors, and customers are each better off when the disruptive technology prospers. These criteria can also be aligned with the one from the OECD definition previously mentioned[80].

[75] Disruptive innovations, Clayton Christensen institute.
[76] Harvard business school online, 4 keys to understanding Clayton Christensen's theory of disruptive innovation, Chris Larson.
[77] Disruptive innovations, Clayton Christensen institute.
[78] Harvard business institute, what is disruptive innovation?
[79] See supra.
[80] OECD, key points of the hearing on dispute innovation, 16-18 June 2015

3.2. Platform and shared economy

In the context of mobility sector, biggest catalysers of disruption are **platform economy** and the complementary concept of **shared economy**. They also pose challenges to regulation.

Platform economy has appeared with the rise of digital platforms that use the internet to connect dispersed networks of individuals to facilitate digital interactions between people. Such multisided digital frameworks connect multiple customers with multiple sellers (of products, services, software etc.) and shape the terms on which participants interact with one another[81]. **Shared economy** is an economic system based on people sharing possessions and services, either for free or for payment, usually using the internet or more often a platform to organize it[82].

These two terms are closely interrelated as platform economy is an enabler of shared economy and vice versa. These economic models are enabled by the technological advancement of internet combined with democratisation of use and ownership of smartphones. The interconnection of these two is so strong that the European Commission (EC) actually uses the term "collaborative economy" and defines it as "business models where activities are facilitated by collaborative platforms that create an open marketplace for the temporary usage of goods or services often provided by private individuals"[83].

These global trends lead to regulatory challenges. According to the platforms themselves, these only offer matchmaking services, whereas other stakeholders believe they act as a classic employer ('platform paradox'[84]). In the logic of this platform paradox, the platforms are not doing passive matchmaking, but instead rely on rating systems and algorithmic control to ensure that each aspect of the worker's task is completed in compliance with company policy and customer instructions.

This paradox plays a crucial role for purposes of EU law and the most relevant example is the Case C-434/15 *Asóciacion Professional Elite Taxi v Uber Systems Spain SL*[85]. In the frame of this judgement, Uber, a strong example of platform and collaborative economy, suggested that its platform was an 'information society service' so the rules of the EU's electronic commerce directive were to be applied. The European Court of Justice (ECJ) disagreed with the suggested reasoning given the tight control exercised by Uber over drivers. The company offers more than an intermediation service and offers also urban transport services via its platform. Several other important regulatory challenges around platforms remain: there is the question of labour law and the problematic of disguised self-employment, but also the question of taxation as they are dematerialised, and the question of data protection.

[81] Kenney, M., & Zysman, J. (2016). The rise of the platform economy. Issues in science and technology, 32(3), 61.
[82] Cambridge Dictionnary, Sharing economy.
[83] Communication from the European Commission, a European Agenda for the Collaborative economy.
[84] European Confederation of Trade Union, Collective voice in the platform economy: challenges, opportunities, solutions.
[85] Case C-434/15 Asóciacion Profesional Elite Taxi v Uber Systems Spain SL.

3.3. Disruptive innovations in urban mobility

As we saw in the precedent section with the example of Uber, the transport sector is far from being excluded from the trend of platform and shared economy. The development of this trend in transport as in all the other sectors is supported by the Internet, widespread availability of smartphones and also by the geolocation. Another impacting element is the parallel trend of declining vehicle ownership to more usership of the transportation means previously mentioned.

Data-driven business models go hand-in-hand with the innovations rooted in platform and shared economy, bringing up the questions of data security, data sharing and ownership into the list of governance challenges. Further, there are also technological innovations that open up unprecedented opportunities for urban mobility. These include, for example, autonomous vehicles, urban air mobility and Hyperloop. Most of disruptive mobility innovations rely on the interplay of several innovative elements. For instance, drone delivery relies on business model innovation, technological innovations and big data analysis, while MaaS relies on shared and platform economy.

In this report, we focus on a number of disruptive mobility innovations and explore how they are governed at different levels and in different locations (see section 0 ‘Case studies’). These innovations are divided into the following four categories:

- Cooperative, connected, and automated mobility (CCAM)
- Infrastructure, network, and traffic management
- MaaS and MaaS platform
- Shared and on-demand mobility

Cooperative, connected and automated mobility

A connected vehicle is defined as a motor vehicle “that connect to other vehicles and or devices, networks and services outside the car including the internet, other cars, home, office or infrastructure”[86]. In the future, they might directly interact with each other and with the road infrastructure. This interaction is the domain of cooperative mobility, which is enabled by digital connectivity between vehicles and between vehicles and transport infrastructure[87]. Example of disruptive innovations in this category includes connected and autonomous vehicles, passenger urban air mobility, and drone last mile delivery.

Infrastructure, network and traffic management

[86] Gowling WLG, 2016. Are you data Driven?

[87] European Commission, 2019. Intelligent transport systems. Cooperative, connected and automated mobility (CCAM)

Mobility innovations regarding infrastructure can be defined as innovations in new types of transport infrastructure, infrastructure management, pricing, taxation and finance, digitalization and integration[88]. Network and traffic management "provides guidance to the European traveller and haulier on the condition of the road network. It detects incidents and emergencies, implements response strategies to ensure safe and efficient use of the road network and optimises the existing infrastructure, including across borders. Incidents can be unforeseeable or planned: accidents, road works, adverse weather conditions, strikes, demonstrations, major public events, holiday traffic peaks or other capacity overload"[89]. Example of disruptive innovations in this category includes big data for fleet management and logistics, TM 2.0 (Traffic Management 2.0), and ultrafast trains such as Hyperloop.

MaaS and MaaS platforms

"Mobility-as-a-Service is a user-centric, intelligent mobility management and distribution system, in which an integrator brings together offerings of multiple mobility service providers, and provides end-users access to them through a digital interface, allowing them to seamlessly plan and pay for mobility."[90] MaaS Platforms are therefore the IT structures that are used by the MaaS operators to provide the final service of mobility to the end-users.

Shared on-demand mobility

Shared mobility and on-demand mobility are two trends that emerged as a response to the change in traveller need for cheaper transport (e.g. sharing the cost of travel) and the need for easy access to a transport (service) at a given moment. Shared mobility can be defined as usage of shared resources, in this case cars, bikes or scooters, which are made available to registered users at various locations in the city. On-demand mobility, on the other hand, is service provided 'on-demand', when requested by the customer, and not based on a fixed schedule. Examples of disruptive innovations in this category include car-pooling, bike sharing, e-scooter sharing or micromobility, ride-hailing and Transportation Network Companies (TNC) like Uber or Lyft.

[88] European Commission, 2017. Transport Infrastructure Expert Group Report
[89] European Commission, 2019. Intelligent Transport Systems, Traffic Management
[90] Kamargianni et al., 2018. The MaaS Dictionary. MaaSLab, Energy Institute, University College London

4. CASE STUDIES

4.1. Cooperative, connected and automated mobility

4.1.1. Connected and Automated Vehicles

Introduction
Connected and automated vehicles are able to connect to other vehicles and/or devices, networks and services outside the car and to assist the driver so that elements of the driving task can be transferred to a computer system. In case of autonomous vehicles at autonomy level 5, they can perform all driving functions without any human intervention[91]. Such a disruptive innovation creates a significant number of questions and requires governance intervention in terms of, for example, the following issues: • Public safety on roads and interaction with other road users • Passenger safety • Promotion of shared CCAM to address some transportation challenges such as congestion and pollution • Data security and privacy • Liability in case of accidents
International Governance
At the international level, several regulatory texts and regulatory bodies are important to highlight. **The Geneva Convention on road traffic** (1949)[92] aims at promoting the development and safety of international road traffic by establishing certain uniform rules. **The Vienna Convention on Road Traffic** (1968) aims to increase road safety. This convention is stricter than the Geneva Convention regarding the obligations of the driver. The US have not ratified the Vienna convention, which makes it easier for them to allow autonomous vehicles on roads. One of the main elements of the Vienna convention linked to the question of automated vehicles is the article 8[93]. It states that "Every moving vehicle or combination of vehicles shall have a driver" and that "Every driver shall at all times be able to control his

[91] European Parliament, Briefing January 2016, Automated Vehicles in the EU.
[92] Convention on Road Traffic Geneva, 19 September 1949
[93] The Vienna Convention, the convention on Road Traffic of 1968.

vehicles". This restrictive definition has been slowing down the deployment of cooperative, connected and automated vehicles.

In 2014, the Working Party on Road Traffic Safety (UNECE) started working on an amendment of the Vienna convention to make the definition of vehicles broader and more flexible in order to incorporate autonomous vehicles. The amendment entered into force on March 23, 2016 and allowed the transfer of driving tasks to the vehicle itself, provided that the technologies used are in conformity with the United Nations vehicle regulations or can be overridden or switched off by the driver[94]. It is also important to highlight that this question is now a priority of the World Forum for Harmonization of vehicle Regulations (WP 29)[95].

The **International Transport Forum (ITF) at OECD** is an intergovernmental organisation with 59 member countries. It acts as a think tank for transport policy and organises the Annual Summit of transport ministers. The question of automated and connected mobility is highly debated at the forum as well.

The UNECE with the adoption in October 2018 of the **Resolution on the deployment of highly and fully automated vehicles in road traffic** offers recommendations to ensure a safe interaction between automated vehicles, other vehicles and more generally all road users[96], and stresses the key role of human beings, be they drivers, occupants or other road users[97].

European Governance

The question of data is a recurrent challenge when it comes to the development and the implementation of disruptive innovation as Smart mobility. Different elements imposed by the **GDPR[98]** link to the management of data produced by Connected and automated vehicles (CAVs). Constructors of CAVs will have to define very precisely the exact data they need to process. This question of data protection regarding the development of CAV's raises concerns such as ethical issues, safety, security and consequently user trust.

The declaration of Amsterdam (14th April 2016)[99] is another key component of the existing EU level regulatory framework the European Commission and private sector have agreed on with joint goals and actions to facilitate the introduction of connected and automated driving on EU roads and prevent a patchwork of rules and regulations arising within the EU, which would be an obstacle to both manufacturers and road users[100].

[94] UNECE paves the way for automated driving by updating UN international convention
[95] Consolidated and updated provisional agenda for the first session of the working party on automated/autonomous and connected vehicles.
[96] Report of the global forum for road traffic safety on its seventy-seventh session
[97] UNECE adopts resolution on the deployment of highly and fully automated vehicles in road traffic – 9th October 2018.
[98] EUGDPR.
[99] The Declaration of Amsterdam.
[100] Government of the Netherlands, the declaration of Amsterdam.

The question of liability and insurance at the EU level is another important aspect. **The Motor vehicles liability insurance Directive 72/166/CEE**[101] does not really deal with the question of responsibility, the only obligation is to be insured. There is no major change related to automation. Next, according to **Directive 85/374/EEC on product liability**[102], the producer will be liable if its product is considered defective (it does not provide the safety level the consumer is entitled to expect). In the frame of this directive insurer and manufacturer will share the responsibility, and there is no major change when it comes to CAV's. The only consequence is a stricter responsibility on the victim who has to prove that the accident was caused by an error of the vehicle and not from a negligence. This becomes problematic with autonomous vehicles as there is a need to access the black box, which has to be done by the manufacturer.

The directive 2007/46/EC[103] on type-approval of motor vehicles and their trailers, and of systems, components and separate technical units intended for such vehicles, is also relevant to mention as it provides a common set of rules. It makes type-approval compulsory for all categories of whole vehicles, including those built in several stages. It lays down a harmonised framework with general technical requirements for the type approval of new vehicles and of systems, components and technical units designed for such vehicles, so as to facilitate their registration, sale and entry into service in the EU; it also outlines rules regarding the sale and entry into service of vehicle parts and equipment.

Next, there are the **declaration of Transport Minister of the G7**[104] at the global level and mission letter to the EU commissioner for transport at the EU level[105], according to which the EU commissioner for transport shall work coordinating research, promoting international standardisation within an international regulatory framework, evolving technical regulations and ensuring data protection and cyber security. As previously mentioned, the development of automated vehicles at the European level is closely linked with the performance of infrastructure.

Horizon 2020 is also an important element as several projects are financed by the EU to work on this topic (e.g. Ensemble[106] project, SHOW[107], Drive2thefuture[108], FABULOUS[109] and AVENUE[110]). In particular, within Horizon 2020 work programme, there were issued several calls under the topic "Digitising and Transforming European Industry and Services: Automated Road Transport", a research and innovation action whose overall objective is "to promote a wide

[101] Motor Vehicle liability insurance
[102] Directive 85/374/EEC, product liability.
[103] Directive 2007/46/EC.
[104] The declaration of Transport Minister of the G7
[105] https://ec.europa.eu/commission/commissioners/sites/comm-cwt2019/files/commissioner_mission_letters/mission-letter-valean-2019-2024_en.pdf
[106] Ensemble, European Project, Horizon 2020.
[107] https://show-project.eu/
[108] http://www.drive2thefuture.eu/
[109] https://fabulos.eu/
[110] https://h2020-avenue.eu/

market introduction of highly automated driving systems towards SAE level 4[111]", namely a high driving automation. To reach this aim, Horizon 2020 encourages cooperation and cross-fertilisation of concepts and technologies, with particular regard to the 5G technology. The group of experts on Ethics of Connected and Automated Vehicles (CAVs) is also dedicated to the EU's safe and ethical transition to driverless mobility[112]. The Task Force on Ethical Aspects of Connected and Automated Driving project[113] covers issues such as data use, the distribution of responsibility between the manufacturer, owner and driver in the event of a traffic accident, the interaction of CAVs with pedestrians and cyclists. The same research line is to be continued in the forthcoming work programme funded by Horizon Europe.

Another key element are the **guidelines published by DG Grow** on the 26th of October 2018. The EC announced its intention to work with EU countries in 2018 on guidelines to ensure a harmonised approach for exemption procedure for the type- approval of automated vehicles[114]. The main goals of the guidelines are to promote new technologies, to harmonize the practice on **Article 20 of Directive 2007/46/EC** and to ensure fair competition and transparency.

As part of the **2001 White Paper on Transport**, the EC adopted on 16/12/2008 the ITS Action Plan, which led to the adoption on the 7/07/2010 of the "**ITS Directive" 2010/40/EU** and a number of other relevant regulations:

- Directive 2010/40/EU of the European Parliament and of the Council of 7 July 2010 on the framework for the deployment of Intelligent Transport Systems (ITS) in the field of road transport and for interfaces with other modes of transport: ITS Directive
- Regulation 886/2013 on road safety traffic information
- Regulation 2015/962 on EU-wide real-time traffic information Services
- Regulation 2017/1926 on MultiModal Travel Information Services (MMTIS)
- Standardisation programme for ITS // Implementing Decision (EU) No 2016/209
- C-ITS Security Description of the CPOC Protocol in the EU C-ITS Security Credential Management System (EU CCMS) - Study
- C-ITS Security - Certificate Policy for Deployment and Operation of European Cooperative Intelligent Transport Systems (C-ITS)
- C-ITS Security - Security Policy & Governance Framework for Deployment and Operation of European Cooperative Intelligent Transport Systems (C-ITS)
- C-ITS Platform Phase II final report of September 2017; Annexes to the C-ITS Platform Phase II final report of September 2017;

[111] Horizon 2020 Work – Programme 2018-2020
[112] https://ec.europa.eu/info/news/new-recommendations-for-a-safe-and-ethical-transition-towards-driverless-mobility-2020-sep-18_en
[113] https://www.bmvi.de/SharedDocs/EN/publications/report-ethics-task-force-automated-driving.pdf?__blob=publicationFile
[114] DG, Grow guidelines, publication

A number of relevant regulations concern the use of Artificial Intelligence in autonomous vehicles, the issues of connectivity, and data security:

- Communication from the Commission to the European Parliament, the European Council, the Council, the European economic and social Committee and the Committee of the Regions: "Artificial Intelligence for Europe"
- Communication on Building Trust in Human-Centric Artificial Intelligence following the work of the high-level group on the Ethics Guidelines for Trustworthy AI
- Proposal for a Regulation of the European Parliament and of the Council concerning the respect for private life and the protection of personal data in electronic communications and repealing Directive 2002/58/EC: Regulation on Privacy and Electronic Communications
- Directive (EU) 2016/1148 of the European Parliament and of the Council of 6 July 2016 concerning measures for a high common level of security of network and information systems across the Union: NIS Directive
- Regulation (EU) 2019/881 of the European Parliament and of the Council of 17 April 2019 on ENISA (the European Union Agency for Cybersecurity) and on information and communications technology cybersecurity certification and repealing Regulation (EU) No 526/2013: Cybersecurity Act
- Communication on 5G for Europe: An Action Plan

It is worth mentioning the 2017 **EU Commission final report on *Public Support Measures for Connected and Automated Driving***[115], as it suggests some regulative measures to undertake for a proper development of European CAVs' market. More specifically, by analysing the legislative measures on CAVs undertaken within the EU by each Member State, the report identifies some legal barriers to be broken down. The suggestion is to set sat EU level some regulative measures dealing with the liability (establish whether the responsibility for accidents should be on the manufacturer or on the driver; on this point EU Parliament has delivered a focused study[116]), the insurance policy (that only if the driver should bear a certain degree of responsibility for accidents), the registration of vehicles and data protection. Also, it is suggested to harmonize the existing national measures for the CAVs testing.

Concerning these issues, some suggestions for policymakers are remarked by the independent group of experts on ***Ethics of Connected and Automated Vehicles***[117], published by the EU Commission in September 2020. The independent group strongly recommend to legislators throughout the report to establish suitable consumer protection measures to leverage

[115] EU Commission final report on *Public Support Measures for Connected And Automated Driving*.
[116] EU Parliament – A common EU approach to liability rules and insurance for connected and autonomous vehicles (European Added Value Assessment Accompanying the European Parliament's legislative own-initiative report).
117 Ethics of Connected and Automated Vehicles – Independent Expert Report.

competition and consumer law to counteract monopolies and enable user choice for CAV services.

The European strategies for CAVs will be further strengthened in the next years as this topic has been included in the Sustainable and Smart Mobility Strategy[118] under the FLAGSHIP 6: Making connected and automated multimodal mobility a reality.

National Governance

France published in May 2018[119] a strategic framework on French government's policy actions dedicated to the development of automated or driverless vehicles, covering modes of use and local expectations, safety, acceptance, competitiveness and employment, and EU and international cooperation[120]. Similar changes to the legislation were introduced in **Germany** (Straßenverkehrsgesetz) and **Italy** (Smart Road Decree). These traffic code amendments allowed testing autonomous vehicles at the local level.

Germany has established a growing number of test beds for technologies, systems and vehicles. Currently 15 exist, allowing the testing and validation of automated driving functions and intelligent infrastructures on a variety of different road categories in real traffic situations and under real-life conditions[121].

In the **UK**, in 2015 the government founded the Centre for Connected and Autonomous Vehicles (CCAV30) to secure the UK's position at the forefront of this change, focussing on the safe development, production, deployment and use of CAVs and their related technologies[122]. In **Austria**, in autumn 2018 the Action Programme on Automated Mobility covering the period 2019-22 was released. Additional 65 million Euro of public funding have been dedicated to follow-up actions on automated and connected mobility[123]. In February 2019, by the collaboration between the Centre for Connected and Automated Vehicles and the **UK** Transportation Department, the *Code of Practice: Automated vehicle trialling*[124] was delivered. Later, with regard to CAV skills in motorsport and automotive excellence, the UK Government has invested £ 400 million for 2020-2021[125].

In **Finland,** as well several measures are being adopted to support the development of the automated, connected and cooperative vehicles. For example, the 75 km Aurora test section with a specifically equipped 10 km instrumented section along E8 in Northern Finland is in active use and automated public transport shuttles and buses as well as MaaS solutions are

[118] https://ec.europa.eu/commission/presscorner/detail/en/ip_20_2329
[119] National Strategy for the Development of Autonomous Vehicles
[120] ERTRAC, Automated Driving Road Map, 2019.
[121] ERTRAC, Automated Driving Road Map, 2019.
[122] ERTRAC, Automated Driving Road Map, 2019.
[123] ERTRAC, Automated Driving Road Map, 2019.
[124] Code of Practice: Automated vehicle trialling.
[125] UK Government *Innovation is Great* – Connected and Automated Vehicles.

being evaluated in several cities to assess and improve their technical performance, impacts, benefits and costs[126].

Greece has decided to allow the circulation of fully automated driverless vehicles in urban areas and on public roads for research/pilot implementations. The framework requires a thorough analysis of the proposed routes, a certification process for the vehicles, a proper training for the operators (remote or on-board), a supervision by appropriate specialized research or academic bodies and an active support by local authorities. Greece is in the process of further adaptation of its legal framework to support and facilitate the permanent circulation of autonomous vehicles[127].

In the **Netherlands**, national regulation sets a frame for testing autonomous vehicles. In 2015, the regulation was modified to allow testing on public roads for automatic vehicles with the driver inside. In 2018 an amendment of the Road traffic Act of 1994 was voted that allows testing of automated vehicles without driver inside but with an operator who can be outside of the vehicle. Before being allowed to experiment on public road, there is a strict system of control and evaluation, for example a permit from the ministry is required, and there is also an evaluation of the vehicle, of the driver and of the infrastructure. Insurance is mandatory for any vehicle included autonomous vehicles and is required for testing of autonomous vehicles. The experiment in itself should be insured. The insurance is checked by the ministry and the National Vehicle Authority.

Local Governance

Nobina, a private company operating autonomous buses in **Stockholm**, started a pilot for autonomous buses in closed areas in 2016. Without pre-existing processes on the approval of testing autonomous vehicles on public roads, they started from a blank page and engaged into a dialogue with the Swedish transport agency, the government, and other relevant stakeholders. They solved the issue of qualifying the buses as vehicles despite the criteria from the Vienna convention, and their autonomous buses passed the driving test (just like a human driver would do) and got the final approval to have the autonomous buses on the road. As a result, they defined a regulatory framework to allow autonomous buses to be tested on public roads. The approval was given for a fixed route in the first place but then approved for an area so the buses gained in flexibility. Now pilots have been carried out on public roads in **Stockholm** and **Copenhagen**[128]. In **Oslo**, self-driving minivans will be piloted as an integrated part of the public transport service during 2021 in order to ensure the reliability of autonomous driving in challenging Nordic conditions. Two vehicles will first map the area and then carry out five hundred hours of test operation without passengers on board as required by the Norwegian

[126] ERTRAC, Automated Driving Road Map, 2019.
[127] ERTRAC, Automated Driving Road Map, 2019.
[128] https://www.nobina.com/en/press/archive/nobina-in-new-major-pilot-project-with-autonomous-vehicles-in-greater-copenhagen/

road authorities. The citizens will be allowed to use the 'autonomous line' in the first quarter of 2021[129].

In **Luxembourg**, a different approach to piloting autonomous vehicles has been taken. The Luxembourg Ministry of Transport gave a temporary permit to operate a fully autonomous shuttle strictly on dedicated roads under the existing Luxembourg regulation called '*essai scientifique*' (scientific testing). This allows the shuttles to operate a vehicle, which as such, is not in 100% conformity with the current regulation, e.g. the shuttle does not have a steering wheel, no brake pedal, no driver seat, no rear-view mirrors, lights are not in full accordance with legislation, etc. A number of rules applied for the vehicles were in place, including the maximum speed on 25km/h, presence of the driver on-board who could take control over the vehicle and a sign on the front and rear side of the vehicle saying '*essai scientifique*'. Luxembourg was not willing to set up own rules for full autonomous vehicles, but rather planned to adopt the rules that the EU will set up in the future.

The port of **Rotterdam** is a pioneer regarding the development of automation, it was the first port in the world with automated guided vehicles (AGVs), and the first with automated terminals[130]. Since the roads in the port area are not public roads and are not publicly accessible, the port could have the automated cargo chassis run freely in the area. This allowed a straightforward pilot to be carried out at the premises avoiding the compliance measures required for autonomous vehicles on public roads in the **Netherlands**, as described earlier.

Many other pilots are running in CAVs sectors for collective and individual transport. It is worth to mention the Fabulos Robot-bus[131], tested in several cities in **Estonia**, **Finland**, **Greece**, the **Netherlands** and **Norway** alongside with user acceptance surveys. SHOW is the largest European project for the development and application of automated transport in urban areas. It is attended by 13 **EU countries** with the support of the participation of companies and organizations from the **USA**, **China**, **Korea** and others[132].

4.1.2. Passenger urban air mobility

Introduction
Urban air mobility can contribute positively to a multimodal transport system.[133] It refers to the use of aerial autonomous vehicles or vertical take-off and land (VToL) vehicles to transport people living in populated urban areas. Indeed, especially in mega-cities, this new mobility

[129] https://www.intelligenttransport.com/transport-news/112949/oslo-self-driving-trial/
[130] New standard in container terminals and services.
[131] https://fabulos.eu/
[132] https://show-project.eu/
[133] Airbus Urban Mobility

service can contribute to solve urban congestion issue. VToL's success can be determined by the fact that this service allow passengers to arrive directly to their final destination. Businesses active in this area include, for example, UberAIR, which is a platform that offers a drone hailing service for individuals. There are other urban air mobility services developed now, such as Airbus urban mobility, SkyGrid, and Aeromobil.

A proper development of Urban air mobility requires regulators and policymakers to create sound policies and set both suitable and flexible regulations, which have to address a number of issues mostly related to public safety:

- definition of guidelines and standards for the manufacturing of vehicles (via certifications)
- the introduction of licenses for those operators who want to enter into the VToL's market
- Currently, worldwide, these measures or other measures related to VToL lack or are at an embryonic status. Another relevant regulatory issue is the protection of passengers against potential privacy violations.

European Governance

Mobility Packages:

- Mobility Package n°1: clean, competitive and connected mobility. An agenda for a socially fair transition towards lean, competitive & connected mobility for all is mentioned in the communication.
- Mobility Package n°2: clean mobility. The Clean Vehicles Directive contains elements on new CO_2 standards and a review of Regulation 1073/2009 aimed at liberalizing road passenger transport services across the EU.
- Urban Air Mobility Initiative is a forum for diverse stakeholders already involved or to be involved in urban air mobility at intra-city and inter-city level[134].

Digital Single Market:

- Proposal for a Regulation of the European Parliament and of the Council concerning the respect for private life and the protection of personal data in electronic communications and repealing Directive 2002/58/EC: Regulation on Privacy and Electronic Communications.
- Communication from the Commission to the European Parliament, the European Council, the Council, the European economic and social Committee and the Committee of the Regions: "Artificial Intelligence for Europe"
- Communication on Building Trust in Human-centric Artificial Intelligence following the work of the high-level group on the Ethics Guidelines for Trustworthy AI.

[134] https://eu-smartcities.eu/initiatives/840/description

EASA special condition for small-category VTOL aircraft[135]:

- Prescription of a set of special technical specifications for person carrying VToL aircrafts, as there is not a certification process that has been defined;
- Creation of a specific type certificate for a person carrying VTOL aircraft with lift/thrust units used to generate powered lift and control.

National Governance

In the **United States**, the Aeronautics Research Mission Directorate has assessed[136] the regulatory barrier to the development of Urban air mobility and Unmanned Aircraft Systems (UAS), due to the fragmentation between State and local government regulations.

Indeed, this assessment shows that "the remotely piloted and autonomous Air Taxi, Ambulance, and Airport Shuttle UAM markets share common regulatory barriers" and that "state and local laws range from disallowing drones to protecting UAS operations".

To solve this law fragmentation, it has been elaborated the *UAS Integration Pilot Program* (*UAS IPP*). More in detail, the UAS IPP encourages the FAA (Federal Aviation Administration) to work closely with State, local, and Tribal governments and private entities as the UAS operators or manufacturers, so to boost a safe UAS integration. This way, the FAA will be facilitated in setting new rules that allow more complex operations regulating the carriage of passengers and flights over people. This process was started in November 2017.

4.1.3. Drone last mile delivery

Introduction

Besides passenger transportation, drones have been also used for delivery purposes, to distant locations as well as 'last mile' delivery. An example of such service is AHA – a supplier which makes drone deliveries on behalf of restaurants and shops in Iceland's capital Reykjavik, in collaboration with Flytrex, an Israeli drone-service company.

For the use of drones (for delivery purposes), the issues that require governance intervention are similar to those for case study on urban air mobility. Among other things they include aspects such as ensuring safety, security, privacy, protection of personal data and environment as well as fostering innovation. The autonomous operation of such drones, however, poses yet another regulatory challenge.

[135] Special Condition for small-category VTOL aircraft.
[136] A Legal and Regulatory Assessment for the Potential of Urban Air Mobility (UAM) – Final Report.

International Governance
While most if not all governance interventions related to drones are seen at the EU and/or National level, it is still important to mention the soft law or guidance approach adopted by international bodies such as the International Civil Aviation Organization (ICAO), which have developed model regulations for unmanned aircraft systems as well as a toolkit to guide regulators.
European Governance
MOBILITY PACKAGE N°1: Clean, competitive and connected mobility • Communication: An agenda for a socially fair transition towards clean, competitive & connected mobility for all. **Digital Single Market** • Proposal for a Regulation of the European Parliament and of the Council concerning the respect for private life and the protection of personal data in electronic communications and repealing Directive 2002/58/EC: Regulation on Privacy and Electronic Communications • Communication from the Commission to the European Parliament, the European Council, the Council, the European economic and social Committee and the Committee of the Regions: "Artificial Intelligence for Europe" • Communication on Building Trust in Human-Centric Artificial Intelligence following the work of the high-level group on the Ethics Guidelines for Trustworthy AI. **EASA *Drones - regulatory framework*** [137] • Commission Implementing Regulation (EU) 2019/947, which is fully applicable since December 30, 2020, caters for most types of operation and their levels of risk. It defines three categories of operations: the 'open', 'specific' and 'certified' categories. • Commission Delegated Regulation (EU) 2019/945, focuses on unmanned aircraft systems and on third-country operators of unmanned aircraft systems. The regulations adopt a risk-based approach, and as such, do not distinguish between leisure or commercial activities. They consider the weight and specifications of the drone and the operation it is intended to undertake. In addition to the above, the management of traffic for drones is intended to be ensured through "U-space". The U-Space regulatory framework is currently under discussion, with publication planned for 2021.
National Governance

[137] Drones - regulatory framework background.

The above-mentioned drone regulatory framework at the EU level is intended to replace the existing national rules in EU Member States.

Outside the EU, for many countries, governance interventions related to use of drones are implemented at the national level, which employ either restrictive or permissive approaches for the use of drone for commercial purposes. For example, in the **US**, all drones that travel further than the operator's visual line of sight require unmanned traffic management (UTM)[138]. Recently the Federal Aviation Administration (FAA) and Unmanned Aircraft Systems (UAS) stakeholders created the Low Altitude Authorization and Notification Capability program, which provides UAS access to controlled airspace near airports by processing airspace authorizations at low altitudes in near real time[139]. The most recent regulation (December 2020) by Federal Aviation Administration require UAS to broadcast identification or location information, thereby eliminating the requirements that drones be connected to the internet to transmit location data. Also, operators of small drones can fly over people and vehicles, and at night under certain conditions without obtaining a waiver as was required previously. This is an important step in developing UAS traffic management systems that can work alongside the existing air traffic control system for manned aircraft.[140]

Similarly, in countries like **Australia**, **Japan** and the **United Kingdom** a relatively permissive approach is adopted and exceptions to constantly maintaining a visual line of sight while flying a drone are allowed with certain restrictions and pilot ratings.

4.2. Infrastructure, Network and Traffic Management

4.2.1. Infrastructure

Introduction
Transport infrastructures are the facilities necessary for the deployment of mobility solutions, and can include roads, railways, waterways, etc. The most disruptive innovations in this category include, for example, ultrafast trains and hyperloop. Several technological approaches were so far developed today, Maglev (magnetic levitation), air cushions, and partial vacuum tubes (Hyperloop). Ultrafast trains allow sustainable ultrafast medium-range

[138] A system of radar, beacons, flight-management services, communication systems, and servers that coordinate, organize, and manage all UAS traffic in the airspace

139 Air-mobility solutions: What they'll need to take off (McKinsey&Company), 2019

[140] https://www.freightwaves.com/news/new-faa-rules-put-drone-delivery-closer-to-reality?TrucksFoT

transportation (700 km/h), at low cost, which challenges air transport and has a great potential to change the way we will commute and travel. Hyperloop is at the intersection of several transport technologies (aeronautics and railways) and does not fit any existing regulatory framework.

At the same time, transport infrastructure is facing the need for harmonization and standardization at the EU and international level considering the development of other mobility innovations such as traffic management, autonomous vehicles, e-mobility, etc. For the scope of this research, this category of infrastructure can be defined as innovations in infrastructure management, pricing, taxation and finance, digitalization and integration (syncromodality, intermodality, interoperability and integration of transport systems), and life cycle optimisation.

International Governance

At the international level, the UNECE is working on the question of the transport infrastructure development[141]. Its **International Transport Infrastructure Observatory**[142] aims to enhance cooperation among different transport infrastructure initiatives in Europe and Asia and to create economies of scale and maximize efficiency by helping governments and organizations to achieve more by spending less.

The key main agreements from the UNECE include the following:

- The **European Agreement on Main International Traffic Arteries** (AGR, 1975)[143], provides UNECE Governments with the international legal framework for the construction and development of a coherent international road network with a view to the development of international road transport and traffic throughout the UNECE region.
- The **European Agreement on Main International Railway Lines** (AGC, 1985)[144], provides a legal and technical framework for the development of a coherent international rail network in the region.
- The **European Agreement on Important International Combined Transport Lines and Related Installations** (AGTC, 1991)[145] provides the technical and legal framework for the development of efficient international combined road/rail transport infrastructure and services. Combined road/rail transport comprises the transport of containers, swap bodies and entire trucks on railway wagons to and from especially equipped terminals.

[141] UNECE, transport infrastructure Development.
[142] The international Transport Infrastructure Observatory background document, ECE/TRANS/2018/4.
[143] The European Agreement on Main International Traffic Arteries.
[144] The European Agreement on Main International Railway Lines.
[145] The European Agreement on Important International Combined Transport Lines and Related Installations.

- The **European Agreement on Main Inland Waterways of International Importance** (AGN, 1996)[146], establishes the internationally agreed European network of inland waterways and ports as well as the uniform infrastructure and operational parameters to which they should conform. It focuses on building a strong Europe-wide network[147].

European Governance

Transport infrastructure is one of the key priorities of the **Strategic Transport Research and Innovation agenda (STRIA)**[148]. According to the STRIA Roadmap, the EU transport infrastructure key challenges with regard to governance network are pricing, taxation and finance; syncromodality, intermodality, interoperability and integration of transport systems; life cycle optimisation; and infrastructure operation[149].

Connecting Europe facility (CEF), key EU funding instrument to promote growth, jobs and competitiveness through targeted infrastructure investment at European level. It supports the development of high performing, sustainable and efficiently interconnected trans-European networks in the fields of transport, energy and digital services. CEF investments fill the missing links in Europe's energy, transport and digital backbone[150].

European Fund Strategic Investment (EFSI) for transport, a central pillar of the Investment Plan, or so-called Juncker Plan[151].

ITS directive, (2010/40/EU)[152], adopted on 7 July 2010 to accelerate the deployment of innovative transport technologies across Europe. The Directive is an important instrument for the coordinated implementation of ITS in Europe. It aims to establish interoperable and seamless ITS services while leaving Member States the freedom to decide which systems to invest in[153]. Relevant delegated regulations are for instance **regulation 886/2013 on road safety traffic information**, **regulation 2015/962 on EU-wide real-time traffic information Services** and **regulation 2017/1926 on MultiModal Travel Information Services** (MMTIS)

The **TEN-T Policy** works on the question of harmonization of transport infrastructure in the member States of the European Union. It promotes and strengthens seamless transport chains for passenger and freight, while keeping up with the latest technological trends[154].

Other relevant regulatory texts include the following:

[146] The European Agreement on Main Inland Waterways of International Importance.
[147] Infrastructure - TEN-T - Connecting Europe.
[148] Strategic Transport Innovation Agenda.
[149] STRIA, Infrastructure Roadmap.
[150] The Connecting Europe Facility.
[151] The European Fund Strategic Investment.
[152] Directive 2010/40/EU
[153] ITS, Action Plan and Directive.
[154] The pillars of the Ten-T policy.

- The Road Infrastructure Safety Management Directive, Directive 2008/96/EC[155].
- The DIRECTIVE 2014/94/EU on the deployment of alternative fuels infrastructure[156].
- The INSPIRE directive (2007/2/EC) of the European Parliament and of the Council establishes an infrastructure for Spatial Information in the European Community.
- The Mobility Package n°1 with the proposal for a Directive on the Interoperability of electronic road toll systems and facilitating cross-border exchange of information on the failure to pay road fees in the Union (recast).
- The Mobility Package n°3 includes an integrated policy for the future of road safety with measures for vehicle and infrastructure safety.
- Communication on 5G for Europe: An Action Plan.

As regards more specific innovations related to infrastructure, efforts are currently carried out to standardize ultrafast trains. At the EU level, in February 2020, a consortium of European and Canadian Hyperloop companies (Hardt Hyperloop/Netherlands, Hyper Poland/Poland, Transpod/Canada – Italy - France, Zeleros/Spain) created a **Joint Technical Committee** in order to define a regulatory framework for this transportation system, ensuring their interoperability with high safety standards[157]. In July 2020, Tüv Süd published some guidelines to ensure safe deployment of this technology[158].

National Governance

Transport infrastructure is closely linked with the deployment of autonomous vehicles and E-mobility innovations. Since it is challenging to invest in everything at once, the question for **Member States** is to decide what they want to invest first: in infrastructure or the development of autonomous, connected vehicles[159]. However, infrastructure is a key element linked to security and automation. Member States are making different decisions regarding this question. For example, in January 2018 the **UK** Government announced that it will boost its digital infrastructure with over £1 billion of public investment[160].

As regards such disruptive innovations and ultrafast trains and Hyperloop, it is most critical to validate the technology in real environment. Therefore, local authorities over the world collaborate with ultrafast train companies to deploy the technology over test tracks (e.g. in **India**, **Saudi Arabia**, **United States**, **Spain**).

[155] Directive 2008/96/EC
[156] https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32014L0094&from=en
[157] https://zeleros.com/2020/02/11/european-countries-agree-to-establish-common-standards-for-hyperloop-systems/
[158] https://www.businesswire.com/news/home/20200714005275/en/Hyperloop-Transportation-Technologies-T%C3%9CV-S%C3%9CD-Announce-Publication
[159] WSP, Adapting Infrastructure for a Driverless Future.
[160] Reshaping infrastructure for autonomous vehicles the road to nowhere?

In the **US**, Hyperloop was recently officially recognized in the US Code of Transportation[161], the Non-Traditional and Emerging Transportation Technology (NETT) Council recently published a guidance document that defines the strategy to define standards, a regulatory framework and best practices regarding the deployment of disruptive transport technologies[162] (cooperative models, policy incentives with subsidies, etc.).

4.2.2. Network and traffic management

Introduction
Traffic management provides guidance to the travellers and hauliers on the condition of the road network (incidents, emergencies, weather conditions, etc.), which is detected and/or predicted to ensure safe and efficient use of the road network and optimise the use of existing infrastructure.[163] Intelligent Transportation Systems allow road vehicles to communicate with other vehicles, with traffic signals and roadside infrastructure as well as with other road users. The systems are also known as vehicle-to-vehicle communications, or vehicle-to-infrastructure communications[164]. Since the 1960-s, many initiatives have been setup to deal with traffic management[165], from the first guidance highway programmes in the beginning of the 70s, which led to the first Traffic Management Centers, to the current innovations brought by the development of Intelligent Transport Systems (ITS) due to the digitization of market sectors. Regarding Traffic Management Systems, the data integration and processing is challenging in order to adopt a data-driven approach, as they are miscellaneous and coming from many sensors[166]. Data needs to be standardized, synchronized, and exploited properly (with new traffic models) to bring valuable information and improve traffic information quality, and give appropriate alternative route guidance[166]. The traffic management plans are elaborated by the road authorities, relying on information given by service providers, but not in collaboration with them. However, this management is changing, going towards transport open data and collaboration between public and private stakeholders.
International Governance

[161] https://www.globalrailwayreview.com/news/103742/hyperloop-industry-united-states-code/
[162] https://www.transportation.gov/sites/dot.gov/files/2020-08/NETT%20Council%20Report%20Digital_Jul2020_508.pdf
[163] https://ec.europa.eu/transport/themes/its/road/application_areas/traffic_management_en
[164] C-ITS Platform, final report, January 2016.
[165] http://www.panorama-ifpen.fr/systeme-de-transport-intelligent-mobilite-3-0-definition-enjeux-acteurs/
[166] Traffic Management Systems: A classification, review, challenges and future perspectives, A. M. de Souza & al., *International Journal of Distributed Sensor Networks* 2017, Vol 13(4).

The United Nations Economic Commission for Europe (**UNECE)** was one of the pioneer organizations that set up **traffic management initiatives**[167], initially through the working group on the prevention of road accidents in 1950. In 2017, **Global Forum for Road Traffic Safety**, an intergovernmental body was established. This commission generated harmonized international agreements and conventions regarding traffic through the 20th century, such as:

- Convention on Road Traffic (September 1949 and November 1968)
- Convention on Road signs and signals (September 1949 and November 1968)
- Agreement on minimum requirements for the issue and validity of driving permits (April 1975)

Vienna convention has been continuously updated since its first publication in order to adapt to evolving technologies and road traffic frameworks. As mentioned before, in 2016 there was an important amendment allowing the transfer of driving tasks to the vehicle[168].

Roadmaps were also designed for the worldwide deployment of Intelligent Transport Systems (the most recent one was released in September 2020[169]), covering policies harmonization, data security, liability issues, multimodal transport, emerging technologies (V2V, V2X communications, etc). The Action 8 promotes close cooperation between UNECE, the International Telecommunication Union (ITU), the International Organization for Standardization (ISO) and potentially other standard developing organisations in order to implement cooperative systems.

There is also the **Working Party on Road Transport SC.1 (UNECE)** that aims at harmonizing and simplifying the rules and requirements of transport, through the management and update of international instruments[170].

UNECE aims at implementing a regulatory framework to improve road safety, leading, for example, to the amendment to Vietnamese Road Traffic Law (2008) in 2014 that allowed a decrease of road traffic fatalities[171]. The Global Forum for Road Traffic Safety instituted in 2017 is a working group to develop UN legal instruments and update the 1968 Vienna Convention. Action plans are also designed such as the ECE/TRANS/2012/4 that have been used during the 2011-2020 decade[172] to draw specific attention to and stir action to improve road safety.

European Governance

[167] http://www.unece.org/trans/roadsafe/rsabout.html
[168] https://unece.org/fr/node/1599
[169] https://unece.org/fileadmin/DAM/trans/doc/2020/wp29grva/GRVA-07-14e.pdf
[170] http://www.unece.org/trans/main/sc1/sc1_about.html
[171] https://unece.org/fr/node/1599
[172] https://unece.org/about-us-15

EU is currently setting up directives in order to deploy **Intelligent Transport Systems (ITS)**. Among these directives, we can quote 2010/40/EU[173], which is a first step towards the interoperability and standardization of the data regarding traffic. **Regulation 886/2013 on road safety traffic information** followed the ITS directive.

In 2014, **the Commission Delegated Regulation (EU) 2015/962 on the provision of EU-wide real-time traffic information services**[174] was also adopted, detailing requirements in order "to ensure the accessibility, exchange, re-use and update of road and traffic data by road authorities, road operators and service providers for the provision of EU-wide real-time traffic information services". **Datex II** was adopted as a standard for the traffic data. The delegated regulation 2015/962 (EU) ensures that road authorities and operators provide static road data in a standardized format.

These initiatives were followed by a communication note from European Parliament on 2016 (COM (2016) 766) that listed the required actions in order to setup C-ITS platforms by 2019, such as:

- EU will support Member States and Industries for the deployment of ITS and provide funding for R&D projects regarding this topic, promoting international cooperation.
- EU will work on "a common security and certificate policy"[175] for deployment and operation of C-ITS. Regarding privacy protection, the General Data Protection Regulation was setup on May 2018.
- EU will ensure the data interoperability, with a hybrid communication approach, through a procurement framework and will define C-ITS telecommunication frequency
- EU will setup a compliance assessment process in order to ensure security.

In 2017, the Commission adopted the regulation 2017/1926 on MultiModal Travel Information Services (MMTIS) as part of its first Mobility Package.

A delegated regulation supplementing 2010/40/EU directive (C/2019/1789) was published, which lists priority services established, including vehicle-to-vehicle service and infrastructure-to-vehicle service[176], for which requirements regarding data that have to be collected and triggering conditions and message parameters were specified.

Moreover, a certificate policy was setup to define an **EU C-ITS trust model**, with the establishment of root **CAs (Certification Authorities)** and conformity assessment procedures, relying on existing norms, such as ISO 27001 (security management of information technologies).

[173] https://eur-lex.europa.eu/legal-content/EN/TXT/HTML/?uri=CELEX:32010L0040&from=EN
[174] https://eur-lex.europa.eu/legal-content/EN/TXT/HTML/?uri=CELEX:32015R0962&from=EN
[175] https://eur-lex.europa.eu/legal-content/EN/TXT/HTML/?uri=CELEX:52016DC0766&from=EN
[176] https://eur-lex.europa.eu/legal-content/EN/TXT/HTML/?uri=PI_COM:C(2019)1789&from=FR

At the same time as these regulations are being established, EU has already started the implementation of the traffic management policy through the financing of several national/international projects in the framework of the deployment of the National Traffic Management System on the TEN-T network[177] such as:

- CROCODILE: setup of a data exchange infrastructure (Austria, Cyprus, Czech Republic, Germany, Greece, Hungary, Italy, Poland, Romania, Slovenia)
- Next-ITS: real-time traffic information and road safety related traffic information on the Nordic section of the Scandinavian-Mediterranean Corridor (Denmark, Finland, Germany, Sweden)
- MedTIS: development of interoperability services to inform travellers on traffic and driving conditions (Spain, France, Italy, Portugal)
- Scoop@F: development of C-ITS (France, also partners in Spain, Portugal, Austria)[178]

Other relevant regulations include the following, especially related to the **data layer** of network and traffic management innovations:

- The INSPIRE Directive (2007/2/EC) of the European Parliament and of the Council establishing an Infrastructure for Spatial Information in the European Community also defines MetaData.
- Proposal for a Regulation of the European Parliament and of the Council concerning the respect for private life and the protection of personal data in electronic communications and repealing Directive 2002/58/EC: Regulation on Privacy and Electronic Communications.
- Directive (EU) 2016/1148 of the European Parliament and of the Council of 6 July 2016 concerning measures for a high common level of security of network and information systems across the Union: NIS Directive
- Regulation (EU) 2019/881 of the European Parliament and of the Council of 17 April 2019 on ENISA (the European Union Agency for Cybersecurity) and on information and communications technology cybersecurity certification and repealing Regulation (EU) No 526/2013: Cybersecurity Act
- Communication on 5G for Europe: An Action Plan.
- Communication from the Commission to the European Parliament, the European Council, the Council, the European economic and social Committee and the Committee of the Regions: “Artificial Intelligence for Europe”
- Communication on Building Trust in Human-Centric Artificial Intelligence following the work of the high-level group on the Ethics Guidelines for Trustworthy AI

[177] Complete list can be found in the following list: https://ec.europa.eu/transport/sites/transport/files/themes/its/road/doc/2013_its_ten_t_projects.pdf

[178] http://www.scoop.developpement-durable.gouv.fr/presentation-du-projet-scoop-a29.html (French)

National Governance
At the national level, EU member states transposed the **European policy (directive 2010/40/EU) on the deployment of traffic management ITS**. Public progress reports are available on the EC website[179]. Several regulatory texts were implemented, as well as subsidies regarding: • Road infrastructure, devices for traffic monitoring or traffic management centres (e.g. PEREX 4.0 in **Belgium**, the Automatic Traffic Monitoring Centre CANARD[180] in **Poland**); • National projects: for instance, C-Roads (**France**, **Czech Republic** and other countries), "Paso del Estrecho" Special Traffic Operation (**Spain**) At the local level, the European cities define the mobility policy they want to implement in their cities, and are often responsible of road traffic management (for instance, Traffic Management Act in **UK**[181]). In the framework of National/European projects, some European cities were volunteers for being pilots for the implementation of intelligent traffic management systems, such as, for instance, **Bordeaux** and **Helmond** (C-The Difference European project[182]), ***Portsmouth*** (implementation of a Cloud based traffic management system[183]), etc.
Local Governance
Socrates 2.0[184] is a European project which relies on TM2.0 initiative gathering 11 public and private partners in order to provide new traffic management services, tested over 4 pilot cities: **Amsterdam**, **Antwerp**, **Copenhagen** and **Munich**. The cooperative models and data interface developed in the project allow the following C-ITS (see Figure 2), with the red boxes corresponding to the exchange, process and coordination of

[179] https://ec.europa.eu/transport/themes/its/road/action_plan/its_national_reports_en
[180] Centrum Automatycznego Nadzoru nad Ruchem Drogowym
[181] https://www.gov.uk/government/publications/traffic-management-act-2004-summary/traffic-management-act-2004-summary
[182] See GLOSA (Green Light Optimal Speed Advice) case study
[183] https://ec.europa.eu/transport/sites/transport/files/2018_uk_its_progress_report_2017.pdf
[184] https://socrates2.org/

actions between public and private stakeholders.

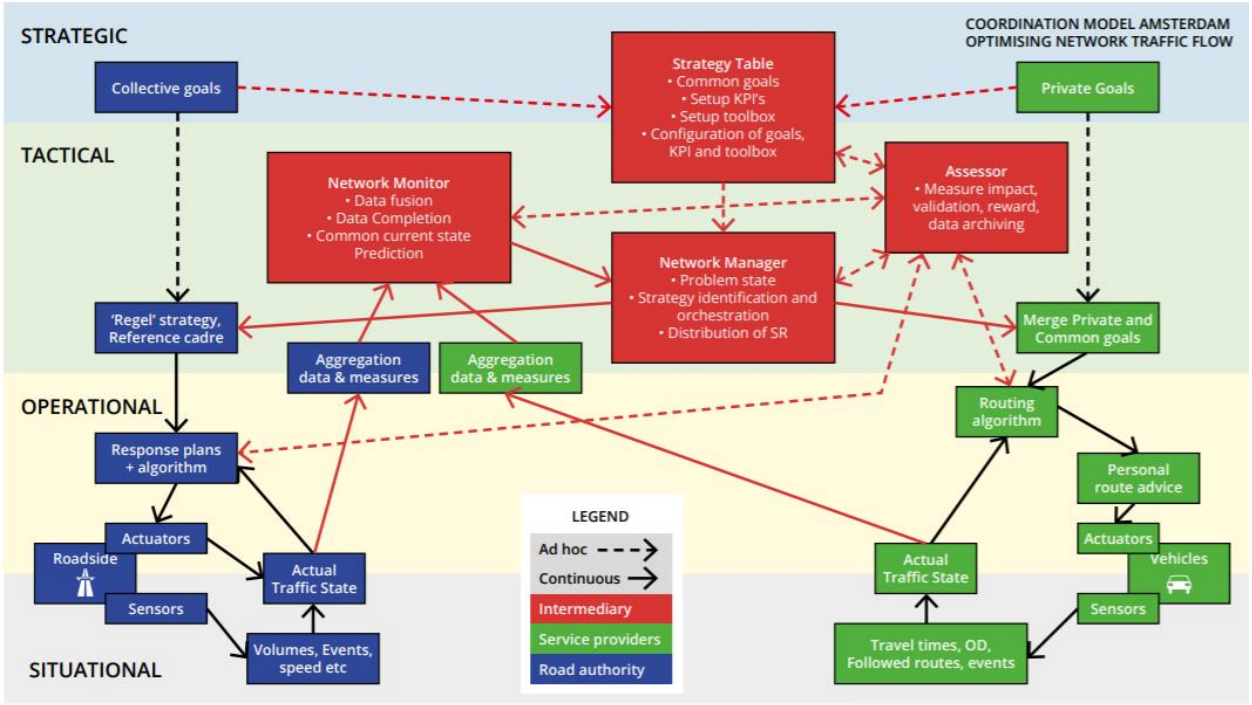

Figure 2 Example of the coordination model for optimising network traffic flow in Amsterdam[185]

A pilot was launched in **Amsterdam** in December 2019[186]. The global lockdown due to Covid-19 pandemic did not allow the case studies to be carried out as road traffic has fallen drastically[187].

The C-Roads platform[188] aims at harmonising the deployment of C-ITS initiative over Europe. This initiative is driven by member states' authorities and operators. This allows the deployment of pilot projects, carried out by each member state involved, with the objective to collect feedback at the EU level to adapt the policy for C-ITS, such as the definition of new standards (communication, security, etc.). Already 43 European cities over 18 European states are undertaking pilot projects.

[185] Source: https://socrates2.org/application/files/6315/5505/2546/socrates_rapport_interactive_traffic_management.pdf
[186] https://socrates2.org/news-agenda/amsterdam-pilot-launched-improved-navigation-service-testers-sought
[187] https://socrates2.org/news-agenda/news/socrates20-and-corona-virus
[188] https://www.c-roads.eu/platform.html

4.3. Mobility-as-a-Service (MaaS) and Platforms

Introduction

MaaS is the integration of, and access to, different transport services (such as public transport, ride-sharing, car-sharing, bike-sharing, scooter-sharing, taxi, car rental, ride-hailing and so on) in one single digital mobility offer with active mobility and an efficient public transport system as its basis. This tailor-made service suggests the most suitable solutions based on the user's travel needs. MaaS is available anytime and offers integrated planning, booking and payment, as well as en route information to provide easy mobility and enable life without having to own a car (see Figure 3).

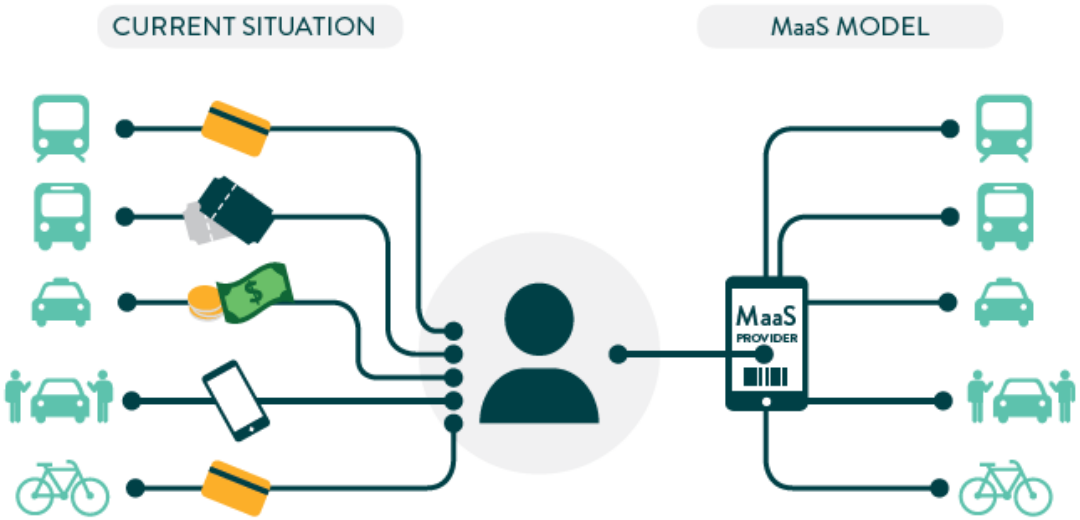

Figure 3 The benefits of MaaS to the user[189]

The MaaS Platform(s) is the IT structure that is used by the MaaS Operator(s) to provide the final service of mobility to the end-users. This platform manages all the data and functionalities needed for MaaS operators to offer services.[190] The MaaS platforms can be developed by MaaS operators or IT providers. Examples of MaaS solution providers include Whim, Moovit, Immense, and Valerann.

Governance of MaaS and MaaS platforms addresses the following issues:

- MaaS as a solution to promoting public transportation
- Secure and unified ticketing and payment systems
- Data interoperability and sharing for enabling MaaS

[189] Source: M. Kamargianni and M. Matyas, 2016. Cited in UITP. 2019. Report: Mobility as a Service
[190] Mobility as a Service (MaaS) and Sustainable Urban Mobility Planning (SUMP)

- Deployment of intermodal transportation
- Transparency and fairness of service provision
- Competition
- Liability
- Effect on equity and environment

European Governance

At the EU level, since the 2001 White Paper on transport policy, the European Commission has supported the integration of transport modes. Subsequently, the European Commission undertook several legislative initiatives and contributed to shaping the relevant legal framework for integrated ticketing and payment services. **The 2011 Transport White Paper** fostered the goal of establishing the framework for a European multimodal transport information, management and payment system by 2020. The relevant legislation in place at the EU level consists in the following acts.

Directive (EU) 2010/40 on the framework for the deployment of Intelligent Transport Systems in the field of road transport and for interfaces with other modes of transport (ITS Directive).
The ITS Directive aims to accelerate the coordinated deployment and use of intelligent transport systems in road transport (and interfaces with other modes) across Europe.

Article 2 of the Directive identifies four priority areas: optimal use of road, traffic and travel data; continuity of traffic and freight management ITS services; ITS road safety and security applications; and linking the vehicle with the transport infrastructure. In addition, the Directive identifies priority actions and priority areas including the provision of EU-wide multimodal travel information services.

Five delegated acts were adopted after the implementation of the ITS Directive. Among them is Regulation (EU) 2017/1926 on the provision of EU-wide multimodal travel information services.

Commission Delegated Regulation (EU) 2017/1926 supplementing Directive (EU) 2010/40 of the European Parliament and of the Council with regard to the provision of EU-wide multimodal travel information services (MMTIS)

The Delegated Regulation (EU) 2017/1926 of 31 May 2017 provides the necessary specification to ensure that EU-wide multimodal travel information services are accurate and available to ITS users across borders. The Regulation applies to the entire transport network of the Union. It requires Member States to set up a single national point of access for users, at least including the static travel and traffic data and historic traffic data of different transport modes (Article 3). Hence, the Regulation contains an obligation to provide static data and leaves the decision on dynamic data to the Member States. Requirements regarding the static and dynamic travel and traffic data of different transport modes apply to the data that is actually collected and available in machine readable format. The ITS Directive and the MMTIS Regulation are currently under revision.

Directive (EU) 2019/102491 of the European Parliament and of the Council of 20 June 2019 on open data and the re-use of public sector information (Open Data Directive)

The 'Open Data Directive' entered into force on 16 July 2019. It replaces the Public Sector Information Directive, also known as the 'PSI Directive' (Directive (EC) 2003/98) which dated from 2003 and it was subsequently amended by the Directive (EU) 2013/37.

The new Open Data Directive is very relevant since it increases the availability of the public data and it will foster the increase of data available to develop MaaS systems. Once fully transposed on the national level, the new rules will:

- Stimulate the publishing of dynamic data and the uptake of Application Programme Interfaces (APIs).
- Limit the exceptions which currently allow public bodies to charge more than the marginal costs of dissemination for the re-use of their data.
- Enlarge the scope of the Directive to:
- data held by public undertakings, under a specific set of rules. In principle, the Directive will only apply to data which the undertakings make available for re-use. Charges for the re-use of such data can be above marginal costs for dissemination;
- research data resulting from public funding – Member States will be asked to develop policies for open access to publicly funded research data. New rules will also facilitate the re-usability of research data that is already contained in open repositories.
- Strengthen the transparency requirements for public–private agreements involving public sector information, avoiding exclusive arrangements.

Regulation (EU) 2018/1807 on a framework for the free flow of nonpersonal data

The Regulation, which is applicable in all EU Member States as of May 2019, regulates a framework for the free flow of electronic non-personal data in the EU. It provides a definition of non-personal data: Non-personal data refers to machine generated data or commercial data, which are either non-personal in nature or anonymous. Under the Regulation, data localisation requirements are prohibited unless they are justified on the grounds of public security in compliance with the principle of proportionality. Member States shall repeal any existing data localisation requirements within a year from the date of application or notify the Commission of such requirements, including a justification. Furthermore, all Member States are required to make national data localisation requirements available on a single online information point, so that such information is readily available for users and service providers. It additionally encourages and facilitates the development of self-regulatory codes of conduct at the Union level, to contribute to a competitive data economy based on the principles of transparency and interoperability and taking due account of open standards.

Other relevant EU regulations include:

- Directive (EU) 2015/2366 on payment services in the internal market (PSD2)
- Regulation (EC) 80/2009 on a Code of Conduct for computerised reservation systems

- Regulation (EU) 2019/1150 on promoting fairness and transparency for business users of Online Intermediation Services

The European Commission has recently also released a comprehensive **Strategy for a Sustainable and Smart Mobility**. This strategy was announced as part of the **European Green Deal**, and will supersede the 2011 Transport White Paper as the European Commission's vision for transport.

In terms of the development of railway communication, it is worth noting the Shift2Rail project, which sets itself the goal of "to deliver, through railway research and innovation, the capabilities to bring about the most sustainable, cost-efficient, high-performing, time driven, digital and competitive customer-centered transport mode for Europe."[191]

National Governance

In 2018, The Act on Transport Services in **Finland** brought together legislation on transport markets. The aim of the legislative reform is to provide the users with better transport services and to increase freedom of choice in the transport market. Part of this act ensures that regardless of the mode of transport, a provider of passenger mobility services shall ensure that essential, up-to-date data on its services is freely available from an information system (open interface). The data should be provided in a standard, easy to edit, and computer readable format. At minimum, this essential data shall include information on routes, stops, timetables, prices, availability, accessibility as well as access to the sales interface of their ticket and payment systems - at least for single tickets[192].

The Ministry of Infrastructure and Water Management in the **Netherlands** secured a framework agreement which launches seven regional MaaS-pilots that can be scaled to a national level. The framework agreement attracted 41 consortia, 24 of which were awarded a contract. In this framework, a standardised approach is developed, with the ambition to set up a (inter)national MaaS ecosystem that can be sustainable for all stakeholders. The goal of the MaaS project is that passengers can plan, book and pay digitally for their journey, for all means of transport, including shared car, bicycle, (water) taxi, bus, metro and train.

Local Governance

Madrid

Launched in July 2018, MaaS Madrid is travel consolidation platform that works towards optimising travel organisation and developing a smoother mobility infrastructure specifically in the Madrid area of Spain. By providing not only travel bookings but raising awareness towards new types of alternative travel methods MaaS Madrid becomes one of the many

[191] https://shift2rail.org/
[192] Finish Ministry of Transport and Communications.

leaders in adapting and revolutionising Spanish Mobility[193]. Madrid City Council's Air Quality and Climate Change Plan was the catalyst behind the shared mobility app, MaaS Madrid. Launched by The Municipal Transport Company (EMT) of Madrid it combines public transport data and other transport service providers into a single app in a bid to drive both shared mobility and public transport use. Plan A is the Madrid City Council's air quality and climate change plan. It is Plan A because it targets the 'Air' we breathe and because there is no Plan B if we wish to build a sustainable city which assures the health of its inhabitants by meeting the challenge of pollution, and if we wish to protect the city against the impacts of climate change[194].

Antwerp

In 2017, the Belgian city of Antwerp has announced plans to pilot MaaS, which brings public transport, taxis, bike hire, and car sharing together in a single subscription-based service to provide a convenient alternative to the private car. This initiative is led by the Mayor of the city of Antwerp and more precisely it is the responsibility of the vice mayor of the city, who is in charge of mobility. The applications available in Antwerp include Smart ways to Antwerp and Whim.

Transport for the West Midlands

MaaS Global began piloting Whim in the West Midlands in August 2017[195]. The provision of a MaaS solution was a key part of the West Midlands Combined Authority transport strategy and delivery plan for 2026[196]. West Midlands Combined Authority and MaaS Global agreed commercial contracts with several transport operators. These include National Express West Midlands (bus and tram services); Enterprise (car hire); and Gett (taxi service)[197].

FluidHub

FluidHub is the platform technology for building MaaS offerings in cities and regions. FluidHub offers a comprehensive toolset for MaaS operators to develop and operate their intermodal mobility apps. Public authorities can also use FluidHub to orchestrate their B2B MaaS ecosystem.

An interesting initiative stemming from local governments has been observed e.g. in **Moscow**[198] and at national level in **Israel**[199], where different shared mobility service providers (e-scooters,

[193] Mobility as a Service Companies to Watch in Spain.
[194] Madrid City Council's Air Quality and Climate Change Plan.
[195] https://publications.parliament.uk/pa/cm201719/cmselect/cmtrans/590/full-report.html#fifth-heading-link
[196] http://data.parliament.uk/writtenevidence/committeeevidence.svc/evidencedocument/transport-committee/mobility-as-a-service/written/75903.html
[197] https://whimapp.com/uk/plans/whim-to-go/
[198] https://www.intelligenttransport.com/transport-articles/112057/moscow-maas-platform-unites-operators-into-single-service/
[199] https://www.calcalistech.com/ctech/articles/0,7340,L-3887037,00.html

car sharing and bike sharing) are called to join unified MaaS platforms and thus get integrated with local public transport systems.

4.4. Shared and on-demand mobility

4.4.1. Car sharing

Introduction
Car sharing is the service of renting cars among users (who are pre-registered to use them) and from car sharing companies for the desired amount of time flexibly. Car sharing systems can be classified along several typologies[200]: • Station-based (shared cars can be collected and left at designated parking spaces) or free-floating (shared cars are parked in public parking places and can be collected from and returned to different places within a pre-defined zone) • Cooperative model, Business-to-Consumer or Peer-to-peer Governance of car sharing addresses the following issues: • Promotion of car sharing as having a positive impact on environmental issues • Ensuring the contribution of car sharing to sustainable mobility • Integration of car sharing into local transport systems • Use of public spaces (especially parking in case of free-floating form) • Anti-competitive behaviour • Enforcing quality requirements on the service • Insurance and liability in service provision • Data security and management in online platforms Examples of car sharing solutions include free-floating car sharing providers based on manufacturing companies such as ShareNow (Daimler AG and BMW) and Maven (General Motors), but also station-based operators such as Cambio in **Germany** and **Belgium** and a cooperative Mobility Carsharing in **Switzerland.**
European Governance

[200] Bocken N. et al., 2020. Emergence of carsharing business models and sustainability impacts in Swedish cities. Sustainability 12(4), 1594

Car sharing is generally governed at national and local level. However, there are instances when the intervention at EU level has been required. Examples include the control of anti-competitive behaviour and the legislative frameworks for online platforms and data security.

The merger of two largest market players, car2go and DriveNow, owned by Daimler AG and BMW Group respectively, into ShareNow service required an intervention of European Commission, which approved the merger in November 2018[201] under certain conditions. The merger would likely provide the two services a monopolistic position on several geographic markets. In addition, Daimler owns Moovel, a platform and app for integrated mobility, which would after the merger have the incentive to offer only own services and disabling other integrated app providers to offer the two merged car sharing services. As a remedy, the Commission granted the merger with a condition that the interface (API) to the new merged car sharing service is made available to other potential integrators, and that other car sharing providers are granted presence on the Moovel app. The implementation of the decided measure is still ongoing.

Then, since latest innovations in car sharing are based on IT platforms and collect sensitive personal, payment and geolocalisation data, the following regulations at EU level are relevant:

- GDPR / General Data Protection Regulation (EU) 2016/679
- Directive 2002/58/EC concerning the processing of personal data and the protection of privacy in the electronic communications sector
- Regulation (EC) 80/2009 on a Code of Conduct for computerised reservation systems
- Regulation (EU) 2019/1150 on promoting fairness and transparency for business users of Online Intermediation Services

National Governance

Car sharing is often seen as a sustainable alternative to car ownership and is promoted through different support means. In **Sweden,** it is planned to reduce VAT for car sharing operators to 6% as they can be considered transport service providers, to exempt shared cars from congestion charging, to reserve separate lanes and parking spots for shared cars, and in general car sharing is marketed as convenient and sustainable transportation option among population. Also, as of May 2018 it is legal to reduce the taxable revenues by a mileage allowance (based on the distance driven by one's peer-to-peer customers) and commission fees that the car sharing platforms receive[202]. In April 2017, **Germany** adopted a 'Car-Sharing Law' regulating allocation of parking spaces specifically for car sharing nationwide[203]. Public parking spaces are allocated to fixed location-based services individually, whereas parking is

[201] Commission clears the creation of six joint ventures by Daimler and BMW, subject to conditions
[202] https://www.drivesweden.eu/en/new-tax-regulation-peer-peer-carsharing-sweden
[203] Germany enacts car-sharing law

shared for free-floating services. To make car sharing more appealing to the citizens, **Portugal** was one of the first to develop rules for digitalizing short-term car sharing contracts.

To ensure that car sharing contributes to sustainable mobility, many countries tie car sharing to clean vehicles. For example, in **Sweden,** the regulation emphasises sustainability and thus sets the plan for EVs to represent more than 50% share in car sharing fleets. In **France,** the national regulation regarding labelling of car sharing services authorises cities to deliver car sharing labels according to technical specifications, including environmental criteria.

The question of insurance and liability in car sharing has been governed through, for example, an act relating to personal vehicle sharing programs (**US**) that requires establishing program insurance policy.

Local Governance

The commercial car sharing services make use of the roads and parking spaces (e.g. station-based systems use especially designated parking spaces), and therefore need to get an approval from the city authorities. This also enables the city to exercise control over the deployment of car sharing in order to reduce the use of private cars, use public space more efficiently and reduce pollution.

In line with this, the region of **Lower Saxony** in Germany introduced a law that regulates the special use of public roads with the aim of reducing the need for parking space and reduce environmentally harmful effects of motorised private transport. Competent authorities are thus allowed to determine suitable areas for station-based car sharing vehicles based on e.g. the need for integration with public transport. Car sharing providers are selected for station-based operations and must meet certain criteria including environmental and accessibility criteria.

Several cities in France set labelling procedures for car sharing operators following the national regulation discussed earlier. For example, the city of **Lyon** obliges car sharing providers to use electric vehicles or comply with the latest Euro standard, have less than 20% diesel vehicles in the fleet, use renewable energy (for electric vehicles), and provide energy certificates. The city is also encouraging the use of subscription systems for continued use of the service and the phasing out ubiquitous car ownership. Similarly, Belgian cities **Ghent, Leuven** and **Bruges** set requirements on the quality of car sharing services and their contribution to sustainable mobility, which include, for example, transparency in pricing, availability of shared cars, adequacy of costs and promotion of sustainability. Car sharing operators must renew the license annually based on a public assessment of the activities and the number of complaints from users.

Due to the relative novelty of the service, city administrations avoid concluding long-term contracts with car sharing operators. The lack of a proper regulatory framework forces to sign short-term contracts between the city and the operators, which slows down the development of services and reduces the attractiveness for investments.

4.4.2. Carpooling

Introduction
Ride sharing or carpooling is the sharing of car journeys so that more than one person travels in a car. The idea of sharing a ride is not new, however the most recent innovations such as online platforms for online marketplaces and rating systems have changed the scale and quality of the service drastically. Governance of carpooling addresses the following issues: • Promotion of carpooling as a means to mitigate congestion and pollution by reducing the number of cars on the roads • Integration with local transport systems • Security of sensitive personal and geolocalisation data • Access to the labour market in case carpooling acquires features of ride-hailing Examples of carpooling solution providers include UberPool, Singu, Liftango, Liftshare, and Bla Bla Car.
European Governance
Carpooling is generally governed at national and local level. However, since recent carpooling solutions rely on digital platforms, the legislative frameworks for online platforms and data security appear to be relevant for this type of mobility innovation. **Platform regulation and data security** • GDPR / General Data Protection Regulation (EU) 2016/679 • Directive 2002/58/EC concerning the processing of personal data and the protection of privacy in the electronic communications sector • Regulation (EU) 2019/1150 on promoting fairness and transparency for business users of Online Intermediation Services
National Governance
Carpooling is often perceived as a means to reduce road congestions, need for parking spaces and decrease urban pollution. Promotion of carpooling usually occurs for both parties to the contract. For example, in **France**, passengers can receive a subsidy for the use of carpooling services, and in **Singapore**, drivers can be exempt from taxes and obtaining a license to carry out commercial activities in the case of 1-2 carpool rides per day. This also serves as a barrier for exploiting carpooling service as taxis, which would otherwise bring up the question of drivers' employment status and related rights and obligations.
Local Governance

In **Paris** area, several incentives for carpooling have been introduced by the local transport authority Île-de-France Mobilités during 2019204. These incentives are mainly based on the integration of the five carpooling services offered in the area into the local MaaS platform Navigo. Navigo annual subscribers can enjoy two free trips per day as long as they include carpooling in their trip. Drivers, in turn, receive a mileage allowance per trip depending on distance travelled.

Another incentive for using carpooling common in countries like the US and Canada is carpooling lanes or high occupancy vehicle lanes. This tool is not commonly used in Europe due to better public transport services and consequent focus on e.g. bus lanes and other bus priority measures.

4.4.3. Bike sharing

Introduction
Bike sharing system is a service that offers public bicycles on a short-term basis for a fee. There are two main systems available on the market: dock system and dockless (free-floating) system. A dock system allows customers to take the bike from certain parking places and obliges to return it also to specially designated parking lots. The dockless system (free-floating bikes) allows customers to start and finish the trip in any place, if this does not contradict with specific rules. Depending on a provider, bicycles may be powered by an electric motor, can be located using a dedicated app, unlocked, used, and left anywhere in the predefined area. Governance of bike sharing addresses the following issues: • Coexistence of bike sharing with other means of transportation • Use of public spaces • Promotion of bike sharing as a means to mitigate local congestion and pollution • Number of operators and vehicles in a municipality • Safety of road users and pedestrians • Platform regulation • Data security and management Examples of bike sharing solution providers include Lime, Ofo, oBike, Nixtbike, etc.
European Governance

[204] https://www.iledefrance-mobilites.fr/actualites/dispositif-covoiturage-evolue-encourager-mobilite-partagee-2019

Most of the regulations at the European level do not single out bike sharing systems. Regulatory acts mostly describe the rules of behaviour on the roads, the safety of pedestrians, drivers and vehicles, etc. European governance also includes acts that have been formed under the influence of new technologies such as online platforms.

Intelligent Transport Systems Directive and Delegated Acts

- Regulation 2017/1926 on MultiModal Travel Information Services (MMTIS) is especially relevant because bike sharing systems often become parts in MaaS and local intermodal transport systems.

Platform regulation and data security

- GDPR / General Data Protection Regulation (EU) 2016/679
- Directive 2002/58/EC concerning the processing of personal data and the protection of privacy in the electronic communications sector
- Regulation (EU) 2019/1150 on promoting fairness and transparency for business users of Online Intermediation Services

There is, however, a broad spectre of different 'soft governance' tools to promote and support the development of cycling in EU that have an impact on the development of bike sharing as well. A **Declaration on Cycling**[205] adopted in 2015 called upon the Commission, Member States and local and regional authorities to consider a number of actions in promoting cycling as a climate friendly transport mode. As a result, the Commission works on integrating cycling into the multimodal transport policy through, for example, increasing road safety in relation to cycling, encouraging cities to adopt **Urban Mobility Plans** which should address cycling, providing funding for the development of cycling infrastructure, and facilitating the exchange of expertise in terms of cycling among public and private parties[206].

National Governance

National regulation in most cases is based on local experience of using bike sharing systems and are often advisory in nature. The rules for choosing service operators, conditions of functioning and leaving the market can vary significantly depending on the city and are therefore governed at a local level.

Operators in **Singapore** are now obliged by the Ministry of Transport to hold a license, and ban users who continually refuse to park in designated spaces. The number of bicycles they can deploy has also been restricted. Those who do not comply face a heavy fine or risk having their license revoked.

[205] http://www.eu2015lu.eu/en/actualites/communiques/2015/10/07-info-transports-declaration-velo/07-Info-Transport-Declaration-of-Luxembourg-on-Cycling-as-a-climate-friendly-Transport-Mode---2015-10-06.pdf

[206] https://ec.europa.eu/transport/themes/clean-transport-urban-transport/cycling_en

Dockless bike sharing was first introduced in **Beijing** in August 2016 as one of the earliest adopters. Ofo and Mobike are the two largest players, although a range of emerging companies, such as Bluegogo, Hello, Youon, and Xiaoming, among others, have also emerged in recent months. With the city experiencing clogged public spaces and blocked sidewalks due to the number of dockless bikes, the first country-wide regulatory framework was established in **China** in 2017 as a means to resolve some of its issues. Beijing's municipal government also has issued regulations that relate to the parking challenge as the number of bikes continues to rise. To limit the oversupply of bikes, which is leading to parking and public space disturbances, Beijing has requested that companies agree to a cap on the number of bikes, and has established parking regulations by way of geo-fence technology. Furthermore, operators now must provide user insurance for each trip, as well as ensure that no child under the age of 12 uses the service. Other regulations in place include the protection of user safety deposits made through independent financial institutions that oversee operator accounts.[207]

It is also worth noting the national programs that integrate bike sharing with local railways, metro, buses, etc. in order to solve the "last mile" problem[208,209]. Moreover, these programs often rely on joint actions with other service providers like museums and designed to make the stay of tourists in the city more convenient (for example, Call a Bike in **Germany** and Santander Cycles in the **UK**).

There are also recommendations for how to organize bike sharing schemes (e.g. in the **UK**). In the absence of legislation and guidelines at the national level, operator companies often unite in associations and offer their own conditions and guidelines for market development.

Local Governance

Local governance of bike sharing usually addresses the licensing of shared bikes and tendering processes for bike sharing operations in a city in order to ensure the quality and safety of the service as well as control the number of operators and vehicles. The question of parking bikes is also addressed. Some cities (e.g. **Lyon, London** and **Paris**) develop publicly subsidised bike sharing services connected to local public transportation systems in pursuit to reduce the number of cars on the streets, thereby addressing issues like congestion, pollution, degradation of road infrastructure and public health[210].

Rome offers a 3-year license for bike sharing operators to carry out their activities. The operating conditions include 24-hour availability of bicycles and user support, immediate response to detected violations, compliance with safety rules. The operator is also obliged to inform and educate its customers on road safety rules. Operators receive evaluations from

[207] The Evolution of Bike Sharing: 10 Questions on the Emergence of New Technologies, Opportunities, and Risks
[208] https://www.ns.nl/deur-tot-deur/ov-fiets
[209] https://www.bluebikes.com/
[210] https://techcrunch.com/2020/11/20/how-four-european-cities-are-embracing-micromobility-to-drive-out-cars/

municipalities, which assess the company's performance. Such assessments play an important role in contract renewals. Similar operating conditions for operators can be found in most cities that have started testing bike sharing programs, for example, **Barcelona** or **Munich**.

Cities, faced with an uncontrolled increase in the number of operators and their bicycles, impose restrictions on their number in a city. First, the optimal number of participants is selected during tenders (for example, **Turin**). Second, a city can oblige companies to pay a certain amount for each bike and the use of urban infrastructure, remove bicycles that have not been used for a certain period of time (for example, **Canberra**). Third, a city (e.g. **Amsterdam**) can be divided into areas where not all operators can function. In this case, additional inconveniences for bicycle users may arise. Then, cities (e.g. **Vienna**) provide recommendation for parking rules.

4.4.4. E-scooter sharing

Introduction
E-scooter sharing is one of the fastest growing category of mobility innovations. Due to their increasing number, being parked on the sidewalks or being driven along other vehicles on the streets, they can be seen as the most disruptive modern means of transportation in the city. As such, they can be an ideal first or last mile transport mode, when the user would usually need to walk or cycle to e.g. a metro station. E-scooters have proven to be especially useful in cities with more hilly terrain, where traditional bikes require too much physical effort. The challenges emerge with the observance of the speed limit in different parts of the city, obligations to use protective equipment for the rider, vague rules for driving on pedestrian roads and parking. Governance of e-scooter sharing systems addresses the following issues: • Safety of pedestrians and other road users (e.g. operating speeds and equipment) • Safety of e-scooter riders (e.g. obligatory wearing of helmets, training requirements and minimum age of the rider) • Use of public spaces (where e-scooters can be driven and where they can be parked) Examples of e-scooter sharing solution providers include Lime, Voi, and Tier.
European Regulation
The rapid proliferation of e-scooter sharing services has resulted in the pressing need for local and national regulations and approaches to organise the market and keep public spaces tidy.

This has led to widespread but dissimilar amendments to national regulations[211]. There is no specific governance of e-scooter sharing at EU level, however some EU level regulations are relevant for this innovation.

Intelligent Transport Systems Directive and Delegated Acts

- Regulation 2017/1926 on MultiModal Travel Information Services (MMTIS)

Mobility Packages

- Communication: An agenda for a socially fair transition towards clean, competitive & connected mobility for all[212].
- Clean Vehicles Directive, new CO_2 standards and a review of Regulation 1073/2009 aimed at liberalising road passenger transport services across the EU.

Data security

- GDPR / General Data Protection Regulation (EU) 2016/679
- Directive 2002/58/EC concerning the processing of personal data and the protection of privacy in the electronic communications sector

European Transport Safety Council's report on **Urban Road Safety[213]** calls for the need for data and regulation for e-scooters and new forms of mobility to assess its impact on road safety and to reflect on national and city-level regulations and infrastructure adjustments.

National Governance

France has updated its traffic law to introduce measures that allows scooters on sidewalks if they have a maximum speed of 8 km/h and on roads or bike lanes with the maximum speed of 20 km/h. It is mandatory to wear helmets for users younger than 12. The national mobility bill hands local authorities the power to limit the number of vehicles and operators, and impose additional requirements on maintenance, noise and pollution. The legislators are also considering a new law, which will require the A1 type of driving licence to operate the faster e-scooters. **Germany** sets requirements on speed limits and equipping e-scooters with front lights, reflectors, two independent brakes and bell or signal as part of licencing procedure. **Italy**, where e-scooters were previously excluded from circulation in urban areas and on normal roads, has now allowed them on the streets with a set of limitations that include minimum age of the driver, maximum speed and areas of driving. Similar regulations were introduced at national level in **Sweden**, **Spain** and **Belgium**.

NACTO regulation emerged in the **US** in response to the growth of numerous micromobility services. This includes questions regarding the speed of movement, parking, payment for

[211] https://www.eltis.org/resources/case-studies/overview-policy-relating-e-scooters-european-countries
[212] https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A52017DC0283
[213] https://etsc.eu/wp-content/uploads/PIN-FLASH-37-FINAL.pdf

services, the city's rights to conclude and terminate an agreement with operators, and much more. The **UK**, where the use of e-scooters is only legal on private land remains one of the last countries in Europe where e-scooter sharing is illegal. The UK Government plans to review the regulation and governance of emerging transport modes, including e-scooters, beginning with a consultation on the use of e-scooters and trials in several municipalities in order to test whether e-scooter sharing can actually contribute to solving transportation problems[214]. **Italy** follows a similar strategy that first allows experimentation following certain strict rules.

Local Governance

Following national guidelines, many European cities adopt specific regulations regarding e-scooters on their streets. In **Paris**, e-scooter sharing is regulated in a number of ways. First, there are only three operators which are allowed to operate in the city with a limited number of scooters. Second, there are dedicated spots for parking e-scooters[215]. Third, the rules[216] do not allow the e-scooters to be used on sidewalks, the maximum speed is limited to 25 km/h, and driving on, for instance, bus lanes, requires the user to respect road traffic rules. Helmet is not mandatory, but highly recommended. Fines for not respecting the rules are set in the new regulation. Driving on a sidewalk can be fined by 135 EUR, the operators can face a fine of 50 – 65 EUR for not respecting the published guidelines. The rules apply also to 'hoverboards' and electric skateboards. The most recent development is the city authority's proposal for a taxation of free-floating e-scooters and other shared vehicles[217]. According to the proposal, e-scooters would be taxed at 50 EUR/year.

In cities, where the number of operators and e-scooters on the street increased very fast, this has caused discontent on the part of citizens and the city administration. The inconvenience is the need to use different applications to find and use scooters. Small towns prefer to have 2-3 simultaneous operators (**Turku**). Some cities can declare the desired number of operators in their tenders (**Boston**).

There are currently between 3000 and 3500 free-floating e-scooters and bicycles in **Brussels**[218], mainly provided by Troty, Lime, Dott, Flash, Tier, Bird, Billy and Scooty. These vehicles are gaining traction especially because of the hilly nature of **Brussels**. The city has already received complaints about the incorrectly parked e-scooters and has committed to monitor the issue, also concerning road safety. The city recently (1st February 2019) adopted a new regulation that requires e-scooter providers to acquire a licence to operate[219] in order to ensure a level

[214] https://www.gov.uk/government/publications/e-scooter-trials-guidance-for-local-areas-and-rental-operators/e-scooter-trials-guidance-for-local-areas-and-rental-operators#proposed-regulatory-changes-to-allow-trials
[215] https://techcrunch.com/2020/11/20/how-four-european-cities-are-embracing-micromobility-to-drive-out-cars/
[216] Paris : quelles sont les consignes à respecter pour circuler en trottinette électrique dans la capitale ?
[217] Paris va taxer les vélos et les trottinettes en libre-service
[218] How cities deal with shared micro-mobility (case study Brussels)
[219] Les trottinettes électriques partagées à Bruxelles

playing field for companies and to impose rules, e.g. prohibition on internal combustion engines. In addition, there are rules on parking. E-scooters cannot be parked on narrow pedestrian spaces – to counter this measure the city will help designate drop-off zones. Also, at certain locations the number of parked vehicles will be limited, and at certain locations parking will not be allowed. Helmets are not mandatory, but the speed is limited to 18 km/h on roads and 5 km/h on sidewalks, although the scooters can go up to 30 km/h in case of a descent. Fines for users speeding are set to 58 EUR. On the other hand, with the new law, service providers risk a 50 to 300 EUR fine for incorrectly parked e-scooters 24 hours after a warning, resulting in potential suspension of the licence in extreme circumstances. The city also set a limit on the number of available licences.

In July 2018, the city of **Madrid** banned the use of e-scooters (and similar vehicles) on sidewalks. In December 2018 the city revoked licenses for all three e-scooter operators (Lime, Wind, and VOI) following a change in the law concerning where these can operate and their maximum speed. At the beginning of 2019, the city adopted new rules that allow circulation for up to 8600 vehicles from 18 different providers (of the total 25 that applied for the permit to operate). These vehicles were also classified into different categories based on their technical characteristics such as weight and maximum speed. Currently, **Madrid** allows e-scooters to circulate only on bike lanes and not on the public roads if the user is younger than 16 (helmet is required), and their speed on sidewalks is limited to 5km/h. Minimum user age is 15 and maximum vehicle speed is 20 km/h. There are also certain requirements for parking e-scooters, obligatory equipment and number of passengers. **Vienna** has set rules for e-scooter operations such as a cap on the fleet and operation requirements.

Other cities chose collaborative rather than restrictive approach. For example, Memorandums of Understanding were signed in **Stockholm** and in **Lisbon** with the operators of e-scooters in order to set practices for their operations.

The city may provide support to low-income or disabled clients to encourage the use of scooters or the recruitment of certain categories of people for jobs, for example, maintenance and transportation services (**Portland**).

4.4.5. Ride-hailing and TNC

Introduction
‘Transactional platforms for the ride-selling’ or ‘ride-hailing’ are mobile applications that match customers’ demand for a ride with private drivers or drivers of vehicles for hire through Global Positioning system (GPS) tracking. Other relevant terms used for this mobility innovation are Transportation Network Companies (TNC), applications for ride sourcing, and private hire vehicle (PHV). Ride-hailing apps offer transport on demand, meaning that the ride is not planned in advance. Most of the time, destinations are not shared between the riders, making the trip more individualized than with carpooling. The original idea of ride-hailing is

that anyone with a driving license and a private car and fulfilling the specific criteria set up by the company, can sign up as a driver to chauffeur persons around, meaning the companies behind the ride-selling application do not own a fleet of cars[220].

Crowdshipping is also worth mentioning in this part of the report. The main difference from TNC is the delivery of parcels and letters by non-professionals within the same city, country or between countries. Senders and recipients communicate with each other on a platform and agree on delivery terms. Usually, such a form of interaction is cheaper than the use of traditional post and can include additional services, for example, purchasing goods before transportation, additional storage, delivery of non-standard goods. While crowdshipping is a distinct mobility innovation, many of the governance challenges are similar to those related to TNCs.

Governance of ride-hailing addresses the following issues:

- Security of sensitive personal and geolocalisation data
- Platform regulation
- Competition with more traditional taxi businesses
- Access to labour market and protection of new professional figures: 'Disguised' self-employment of car drivers

Examples of ride-hailing and TNC solution providers include Uber, Lyft, and Bolt.

European Regulation

Across the EU, an on-demand transport service, such as Uber, is now defined as "chauffeur-driven car hire" (or private-hire vehicles related services), intermediated via collaborative online platforms. As concluded in the judgement of the European Court of Justice in December 2017[221], following several litigations across the EU, and specifically a litigation between Elite Taxi (Barcelona) and Uber, there is a distinction between the transport service provided by the driver and the intermediation service provided by the intermediation platform. Nevertheless, in December 2017 the European Court of Justice has ruled that Uber (which in a way sets path for all ride-hailing solutions and will be mostly discussed in this chapter) is a transport services company rather than only an intermediation platform. This has created significant barriers for the company to enter European markets because ride-hailing companies were regulated as taxi companies in many European countries and had to abide by national transport laws. However, the recent (3 December 2020) ruling by the Court of Justice of the European Union regarding a Romanian ride-hailing company StarTaxi concluded that the company was an internet service provider rather than a transportation or taxi company. This can create a precedent so that ride-hailing apps are classified as internet companies (intermediation service platforms) if they

[220] UITP Combined Mobility Toolbox

[221] The judgment of the European Court of Justice in Case C-434/15 Asociacion Profesional Elite Taxi did not concern services of 'chauffeur-driven car hire', but the intermediation service offered by an online platform.

meet certain terms. In this case, they would then be regulated under the EU's e-commerce directive, which shields internet companies from direct liability for hosted content[222].

Apart from the ongoing litigations between ride-hailing and taxi companies, several EU-wide initiatives affect TNCs because these operate as online platforms. EC in June 2016 provided guidance on how EU laws apply to collaborative economy[223]. The regulation is addressing access to the market, as the collaborative economy-based businesses enter markets served by traditional players and proposes tools such as licensing, quality standards requirements and measures to ensure fair conditions.

In April 2018, the EC proposed a regulation on promoting fairness and transparency for business users of online intermediation services[224], which was adopted in February 2019. The regulation sets the rules that will help avoid unilateral trading practices that are harmful especially to small businesses that provide their service through online platforms, which have a much larger bargaining power. For example, an online platform with a substantial market power can set and change conditions and terminate collaboration with a business, and so far, there were no laws preventing them to act in such way.

Then, as an online platform, Uber has faced challenges also regarding data privacy and security. In September 2018 it was fined for 148 million USD for failing to report a data breach in 2016[225]. Some of the relevant EU regulations are listed below.

Intelligent Transport Systems Directive and Delegated Acts

- Regulation 2017/1926 on MultiModal Travel Information Services (MMTIS)

Platform regulation and data security

- GDPR / General Data Protection Regulation (EU) 2016/679
- Directive 2002/58/EC concerning the processing of personal data and the protection of privacy in the electronic communications sector
- Regulation (EU) 2019/1150 on promoting fairness and transparency for business users of Online Intermediation Services

To our best knowledge, there is no separate regulation for crowdshipping, however, most of the regulation and rules applicable to TNC can be in the future also applied to this area (for example, regarding the employment status of car drivers). Nevertheless, issues related to insurance for parcels or the transport of illegal goods still require additional attention.

National Regulation

[222] https://www.politico.eu/article/uber-europe-court-ruling-delivers-win-ride-hailing-apps/
[223] Communication of the Commission « European Agenda for collaborative economy » COM(2016)356 final.
[224] Platform-to-business trading practices
[225] Uber to cough up $148 million for hiding a data breach in 2016

While UBER is ubiquitous in the US and is clearly the best-known ride-hailing app in the world, it faced immense challenges in entering European market primarily due to the local regulations[226]. Following the ruling of the European Court of Justice discussed in the previous section, any European country could legally ban UberPop, which is the ride-hailing service of Uber that offers 'classic' ride-hailing by non-professional drivers as opposed to UberX which offers taxi-like services by professional drivers. Countries like **Italy**, **France**, **Finland** and the **Netherlands** at least partially banned Uber (its UberPop service) in the early stages of ride-hailing development in Europe as a reaction to protests from licensed taxi drivers and due to various safety concerns. **Bulgaria** and **Hungary** banned the company's services completely. After a wave of initial bans and tensions during 2014-2016, many European countries started revising their transport regulations in order to accommodate the changing and growing ride-hailing market, ensure safety of the new services and clarify the rules that apply to ride-hailing and more classical taxi business. Countries followed different paths in responding to this disruptive innovation.

In **Spain**, on demand transport services companies can only work with drivers who carry a valid professional VTC (Vehicle with a driver) license, as required for all professional drivers. In 2015, the country passed a law fixing the number of private hire drivers to one for every 30 taxi drivers. Since already at that point there were much more private hire drivers in the country, they allowed to confirm applications for those drivers who had submitted their applications before the new rule was introduced. This regulation was highly questioned due to its effect on competition and dissatisfied both taxi drivers and private hire drivers because of the need to obtain new licences since their existing licences would become obsolete. In 2018, licensing was devolved to the regional units of Spanish governance which caused major regulatory fragmentation across Spain[227].

In **Germany**, local laws require taxi drivers to hold commercial licenses in order to pick up passengers and adhere to a set fare structure. There is no separate regulation, so on demand transport services need to comply with existing taxi laws.

French authorities earlier imposed the rule forcing car services to wait for 15 minutes between reservation and pick up. Later, the government has merged "Collective Transport Permit" with "Chauffeurs License" to make it difficult to obtain license and thereby restrict the expanding of ride-hailing in France. In a case that ended up with the French Court of Cassation it was ruled in March 2020 that a former Uber driver should have been considered an employee instead of

[226] https://www.forbes.com/sites/samshead/2019/05/10/ubers-rocky-road-to-growth-in-europe-regulators-rivals-and-riots/?sh=5a1c231b5c67

[227] https://www.inlinepolicy.com/blog/when-regulation-goes-wrong-ride-hailing-in-spain

a self-employed partner, which is an important precedent in the governance of employment status of the drivers[228].

Denmark has introduced new taxi laws in February 2017 that includes requirements such as mandatory fare meters, video-surveillance and seat occupancy detectors to activate the airbags. These rules were applicable to ride-hailing as well, which made Uber withdraw their operations from the country.

Local Governance

It is left to the cities to decide on how the service can operate and set the conditions to gain access to the public infrastructure. As a result, there are substantial differences on how these services are regulated on national, regional and city level. For example, in **Amsterdam** the holders of the premium taxi licence are allowed to use tram and bus lanes, **Brussels** is running a training program for new drivers, in **Warsaw** occasional transport do not need to comply with the maximum allowed prices. In **Stockholm,** the taxi service has been deregulated, as well as in **Helsinki**. In some cities, on-demand transport services are banned, and in some cities, these are allowed as they also complement the existing public transport offer.

After long history of taxi drivers' strikes and litigations between the taxi companies and Uber, and the devolvement of licencing private hire operators to regional authorities, the city of **Barcelona** in January 2019 adopted new rules on how ride hailing services can operate. The new rules require a vehicle to be booked at least 15 minutes in advance, and this pushed Uber and Cabify, another ride-hailing app, to cease their operations in Barcelona[229], as the booking requests are almost always made instantly. Other regions, including **Andalusia**, banned VTC vehicles from certain areas of cities, or from picking -up or dropping-off passengers close to public transport hubs.

In **Brussels,** Uber was banned in April 2014[230]. In October 2015, Uber suspended its UberPOP service and continued to operate its UberX service, which uses licensed drivers. The service is still available in the city today, although the commercial court of Brussels banned its activities in January 2019. The ban became only valid for the 19 communes of **Brussels**, and does not apply to customers who use Uber to travel to the airports that are located outside the communes' territory. The ruling was published in Dutch, creating substantial confusion on interpretation, and the French ruling that followed established that UberX service can legally operate in the region of **Brussels**[231].

In **Rome**, private hire drivers are required to obtain licences. A taxi license in **Rome** is worth 150,000 EUR but the NCC (cars rented with a driver) license is worth just one tenth of this sum,

[228] https://techcrunch.com/2020/03/04/uber-driver-reclassified-as-employee-in-france/
[229] Uber, Cabify announce they are pulling their services out of Barcelona
[230] Uber to continue in Brussels despite ban by court
[231] Uber peut bel et bien CONTINUER d'opérer à Bruxelles

which has created tensions between taxi and private hire drivers. Similarly, in **Madrid**, regular taxi licences cost between 135.000 – 160.000 EUR, whereas private hire vehicle license costs much less and the drivers enjoy softer rules.

By the end of 2020, Uber was able to resume operations in **London** after being banned. A year earlier Transport for London (TfL) rejected an application for a license and the opportunity to work in this city. The reason for the refusal to register Uber was the concern about passenger safety due to current identification system[232]. The new license period is 18 months and allows TfL to closely monitor compliance with regulations regarding passenger safety. However, Uber is still awaiting a separate UK court decision regarding the drivers' employment status. Uber insists that drivers are self-employed, while drivers demand minimum wages, weekend compensation, and paid breaks. Another interesting development is that as of January 2019, Uber is adding a 15 pence per mile 'clean air fee' in **London** with the objective to help drivers purchase more environmentally friendly vehicles, to operate a fully EV fleet by 2025[233].

[232] https://www.cnbc.com/2019/11/25/uber-stripped-of-its-london-license-in-huge-blow-dealt-by-tfl.html
[233] London Uber fares go up after electric car charge

5. IMPACT OF COVID-19 ON THE GOVERNANCE OF DISRUPTIVE MOBILITY INNOVATIONS

The World Health Organization announced the COVID-19 pandemic in March 2020. The pandemic has impacted most existing industries, including transportation and travel. National governments have imposed restrictions on unnecessary mobility, as well as adapted regulations for the safety of certain groups associated with an increased risk of disease spread. National governments have proposed various restrictions related to the pandemic. For example, the most common options included the transfer of employees to remote work and the closure of offices and businesses, schools, restaurants, and restrictions on the use of public transport. All of these actions directly contributed to financial instability and recession in most countries[234]. Mobility restrictions have affected 90 percent of the world's population[235].

All the measures taken have an impact on mobility and form new trends that may play a role in the future even after the restrictions are lifted. Moreover, the global crisis is associated not only with “lockdowns” in many countries, but also with the high probability of a subsequent global economic recession. The current situation is rather uncertain and changeable. Most of the introduced measures can be considered bold and not based on previous experience. Below we describe how the governance of mobility has been affected by the COVID-19 pandemic and outline implications for the governance of disruptive mobility innovations in the long and short term.

5.1. Governance responses to the COVID-19 pandemic in the mobility sector

Safety restrictions on urban transport

Urban public transport, especially in the beginning of the Covid-19 pandemic, has been considered to pose an increased risk of spreading the disease. In this regard, national authorities imposed restrictions on the use of urban public transport and promoted instead the use of cars, bicycles or walking, despite the lack of scientific evidence. Drivers and support personnel received new instructions, training, and protective equipment to perform their duties. The restrictions

[234] Eichenbaum, M. S., Rebelo, S., & Trabandt, M. (2020). *The macroeconomics of epidemics* (No. w26882). National Bureau of Economic Research. https://www.nber.org/system/files/working_papers/w26882/w26882.pdf

[235] Gössling, S., Scott, D., & Hall, C. M. (2020). Pandemics, tourism and global change: a rapid assessment of COVID-19. *Journal of Sustainable Tourism*, 1-20. https://doi.org/10.1080/09669582.2020.1758708

were associated with a decrease in the number of contacts between the driver and passengers. Cash payments for travel were stopped, drivers were isolated or access was restricted, new electronic tickets were introduced. The restrictions also meant to diminish the health risks for passengers. For example, some restrictions relate to the occupancy of the bus, the observance of a safe distance inside the vehicles, etc. For example, **Milan** imposed a 25% occupancy limit[236], **Portugal** recommended to use 2/3 of the transport capacity[237]. However, it is now confirmed that the use of public transport, when following the recommended measures, is one of the least risky places to acquire COVID-19[238].

The general mobility market has also felt the impact of the pandemic. Passengers refused to share trips with other passengers. Uber and Lyft have imposed partial restrictions on ridesharing in a number of countries[239]. Micro mobility operators have been forced to significantly reduce or stop their activities in some markets outside Europe due to the users' fears of contracting COVID-19 through shared equipment. However, in Europe, shared bikes and e-scooters were instead increasingly used[240].

Concerns regarding the safety of travelling have led to the increasing use of individualized modes of transport, which includes private cars, as well as bikes, e-scooters and other active modes (both private and shared). Such a modal shift has led to various governance responses aiming to facilitate safe and sustainable transportation such as the support for cleaner vehicles, extending infrastructure for micromobility and promoting sustainable transport in general, which are discussed further.

Shift to active modes and micromobility

Despite the decline in personal mobility, for example due to job losses or working from home, cycling infrastructure has been in increased demand due to assumed safety and an increasing demand for fast order delivery (UberEats, etc.).

The introduction of new temporary lanes for cyclists in **Berlin** and **Brussels** was a response to the increased use of bicycles[241]. The speed of adoption and implementation of strategies for the transition to sustainable transport has increased significantly in **Bologna**. In other cities, we have seen continued and accelerated transition of the central parts of cities to pedestrian zones and the reduction of the speed of cars to 20 km/h, for example in **Vienna** and **Edinburgh**. In response to the lockdown, city authorities quickly introduced new rules based on traffic monitoring and

[236] https://www.reuters.com/article/uk-health-coronavirus-italy-transport/public-transport-seen-as-major-culprit-for-italy-coronavirus-surge-idUKKBN27D218
[237] https://www.visitportugal.com/en/content/covid-19-measures-implemented-portugal
[238] https://www.uitp.org/publications/public-transport-is-covid-safe/
[239] https://www.uber.com/us/en/coronavirus/
[240] https://www.uitp.org/publications/public-transport-is-covid-safe/
[241] https://storymaps.arcgis.com/stories/9f47ef654c7841e1a8d35034088d75b7

collected data[242]. For example, **Paris** has made improvements in the use of cycle paths and traffic management in general. Some major roads are now primarily focused on soft mobility (e.g. 1/3 of a road can be dedicated to buses and 2/3 to bikes and e-scooters), and the pandemic has accelerated the city's mobility agenda efforts to deprioritize cars[243].

Sustainable transport development is consonant with the plans of states to overcome the consequences of the pandemic. During the lockdowns, the number of private car trips decreased. However, at the same time, the load on the transport infrastructure associated with home delivery of goods has increased. As an example, it is worth noting the use of bike paths by couriers. Bicycles and scooters are used by couriers to deliver goods and quickly move between sites in busy city centers. Some cities, such as Chicago, are adopting new mobility management programs. They are usually tested in certain areas, and, if successful, transferred to the entire territory.

The need to maintain physical distance between residents encourages authorities to provide more space for pedestrians and cyclists. One example is **Bogotá**, which has provided 76 kilometers of new cycle paths. Other examples include **New York City**, which completely closed off several streets to make them pedestrianized, and **Oakland**, California, which closed about 10 percent of its streets to traffic. A "step forward in cycling culture" was made in **France** which involved an investment of 20 million euros in the development of cycling infrastructure[244]. Pilot projects to widen cycle paths with motorways to maintain the required distance between participants were first applied in **Berlin** and then extended to more than one hundred cities in **Germany**[245]. In case of success of these initiatives and support from residents, there is reason to assume that some of these measures will remain in demand after the end of the COVID-19 pandemic. City residents and tourists can get a more livable city with fewer traffic accidents and air pollution, and the development of the infrastructure for different active and shared micromobility solutions will continue to be prioritized.

Shift to private car use

The need to maintain physical distance can shape long-term trends in transport use. Some people could resume using personal cars and refuse to use public or shared-mobility. The experience of **China** shows that the use of personal cars, bicycles and walking is increasing, while the use of public transport is decreasing. The use of private cars during a lockdown in **Paris** fell by 30%;

[242] https://ec.europa.eu/transport/road_safety/road-safety-measures-covid-transitional-era-common-high-level-group-principles-we-exit-crisis_en

[243] https://techcrunch.com/2020/11/20/how-four-european-cities-are-embracing-micromobility-to-drive-out-cars/

[244] https://www.lemonde.fr/planete/article/2020/04/30/un-plan-gouvernemental-de-20-millions-d-euros-pour-encourager-la-pratique-du-velo-au-deconfinement_6038198_3244.html

[245] https://storymaps.arcgis.com/stories/9f47ef654c7841e1a8d35034088d75b7

however, this parameter quickly returned to almost pre-pandemic level after the quarantine was lifted[246].

At the start of the pandemic, there were no strict guidelines for the use of private cars. The authorities' recommendations were often strictly opposite from country to country. For example, in the UK, it was recommended that the use of public transport be avoided in favour of private cars. At the same time, parking fees in some municipalities were reduced or cancelled entirely[247].

While these were temporary measures to curb the spread of the virus, currently city governments are making efforts to expedite the introduction of restrictions on the use of private vehicles in the city centres or to expand walking areas (**Stockholm** and **Delft**)[248]. Priority is given to public transport, electric transport, and delivery services.

Assuming that the citizens' habit of travelling individually persists, there is an increasing urge to support cleaner vehicle and fuel technologies as well as facilitate the transition to sustainable mobility. This has led many countries to include strategies for achieving sustainable mobility in their post pandemic recovery plans, which is discussed further.

The promotion of sustainable mobility

The transition to sustainable mobility has been coupled with the recovery from COVID-19 pandemic. A number of initiatives have been taken to accelerate this process, such as interim legislation on climate and EV incentives in **Spain**[249]. These plans are in tune with the countries' economic stimulus packages (reducing emissions, changing energy sources and cars to more environmentally friendly ones). At the same time, the EU has developed a set of actions aimed at achieving countries' carbon neutrality. Priority actions for achieving sustainable mobility are associated with replacing carbon fuels, stimulating the use of new types of mobility, including micromobility, automation and digitalization of transport, construction and use of appropriate infrastructure. The latest communication from the European Commission on Sustainable and Smart Mobility Strategy as well as the Green Deal emphasize the need for green solutions to fundamentally transform the transport industry.

Another example is the Department for Transport in the **UK**, which has developed a sustainable transport program and a range of transport innovations to facilitate the transition to a new mode of transport and transport systems[250]. These decisions are consonant with the methods of overcoming the COVID-19 pandemic, aimed at a systemic transition from vehicle ownership to their use, accelerating electrification (development of technologies for electric transport, promoting micromobility, etc.).

[246] https://meetingoftheminds.org/urban-logistics-lessons-from-the-lockdown-in-paris-33769?mc_cid=f13d690a13&mc_eid=ca5f9d1c2c
[247] https://www.londoncouncils.gov.uk/services/parking-services/operational-advice-during-covid-19
[248] Urban Mobility Strategy https://international.stockholm.se/globalassets/ovriga-bilder-och-filer/urban-mobility-strategy.pdf
[249] https://www.wsp.com/en-GL/insights/sustainable-mobility-post-covid-19
[250] https://www.londoncouncils.gov.uk/services/parking-services/operational-advice-during-covid-19

Thus, measures to combat the COVID-19 pandemic have become in agreement with previous plans to combat climate change and environmental goals. Recently, some countries have reduced funding for climate programs, however, COVID-19 recalled the need for change and the importance of the climate agenda for the future of humanity. Figure 4 provides an overview of some of the country-level initiatives to achieve transport sustainability.

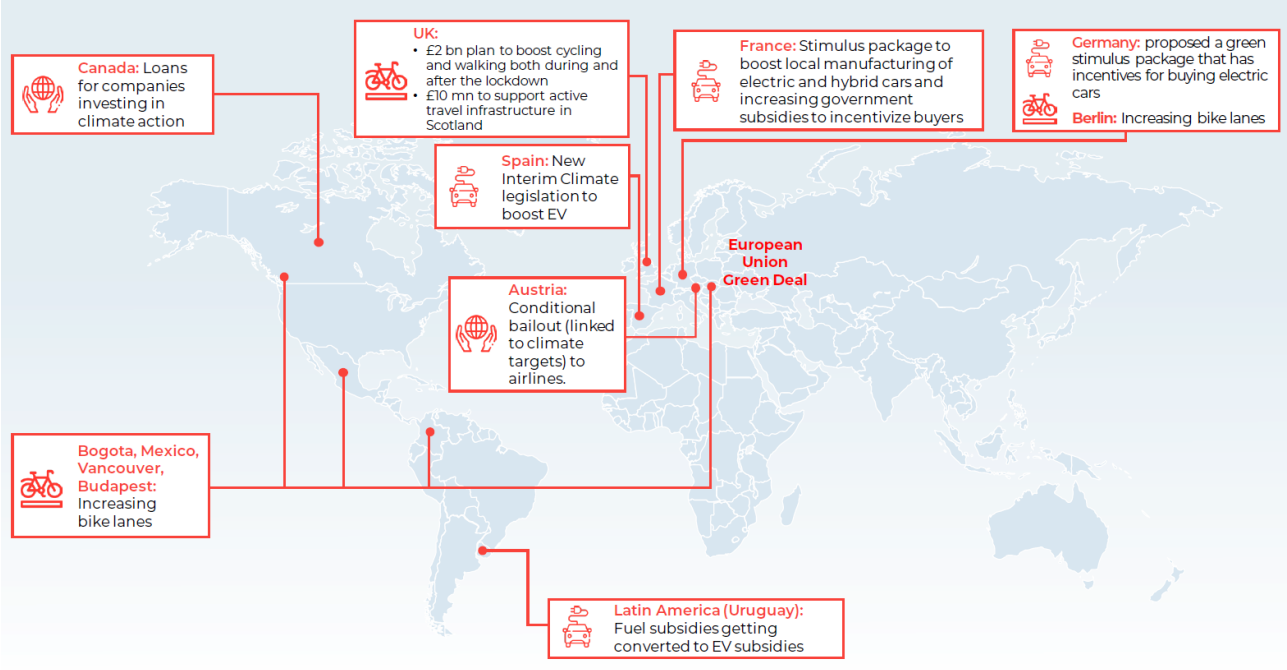

Figure 4 Mapping of certain policy incentives towards sustainable mobility[251]

Digital solutions and traffic monitoring

Data-driven innovations have played an important role in managing the COVID-19 pandemic. In particular, certain business reported data on passenger flow to local governments in order to support their decision-making[252]. Examples include data sharing between **UK**'s department of transport and ITS UK[253]. Another example concerns the use of mobile apps that generate real-time information on the public transport occupancy level and allow adapting the offer of the transport services accordingly. Such apps have been used in **Hamburg** [254], **Catalonia**[255] and **Versailles**[256].

[251] Source: "Sustainable mobility Post Covid 19", WSP Global Inc.
[252] https://www.itf-oecd.org/covid-19/policy-responses
[253] https://shotl.com/news/how-overcoming-covid-19-can-kick-start-the-maas-revolution
[254] Lozzi, G., Marcucci, E., Gatta, V., Pacelli, V., Rodrigues, M., & Teoh, T. (2020). COVID-19 and urban mobility: Impacts and perspectives. https://www.europarl.europa.eu/RegData/etudes/IDAN/2020/652213/IPOL_IDA(2020)652213_EN.pdf.
[255] https://www.tmb.cat/en/barcelona/applications-downloads/tmb-app
[256] Corby. (2020). Versailles Grand Parc welcomes Wever, the platform that informs you of live traffic. https://www.leparisien.fr/info-paris-ile-de-france-oise/transports/versailles-grand-parc-accueille-wever-la-plate-forme-qui-vous-informe-du-trafic-en-direct-04-06-2020-8330001.php.

Beijing has also introduced a digital booking system for tracking movements [257] that allowed passengers can book a 10-minute reservation slot on their smartphones to enter stations via a fast track using a QR code generated on their phones. Those who do not make a reservation must wait in line before entering.

One of the ways to incorporate drones more into everyday life and increase trust has been by using them during lockdowns. For example, **Italy** and **France** used drones with installed thermal imaging cameras to track the spread of the disease[258]. Such actions contributed to at least temporary removal of some of the restrictions related to autonomous air mobility in these countries.

It is also worth emphasizing the positive impact on the development of new types of mobility and the infrastructure associated with this during the pandemic. First, private and public stakeholders have become more aware of the importance of sharing the information they collect, which is beneficial to the implementation of MaaS and ITS solutions. Second, as discussed earlier, air mobility has also benefited through temporary removal of restrictions, which can accelerate the implementation of such innovations. Third, the accentuated need for more informed, data-driven transport management can facilitate creating a favourable environment for ITS and on-demand mobility solutions.

Slower deployment of mobility innovations

Among the negative consequences of the pandemic, lockdowns and the transition of employees to remote work on an ongoing basis have reduced the demand for mobility, which affects most transportation modes. Further, the slowdown in economies has led to a decrease in interest and investment in the implementation of innovative solutions in the field of mobility[259]. As a result of the lockdowns, tests of autonomous vehicles as well as pilot ITS projects, for example, SOCRATES2.0[260], were postponed or put on hold. On the one hand, the need for autonomous vehicles could increase if physical limitations persist. On the other hand, the decline in investment in autonomous transport due to the shift in current priorities can delay the implementation of the solution.

5.2. Impacts of the COVID-19 pandemic in the short and long term

In the course of our analysis, we identified both negative and positive impacts of COVID-19 pandemic on the governance of disruptive mobility innovations in the long run. On the one hand, some of the innovations received financial support from the state, changes were made to the

[257] https://www.chinadaily.com.cn/a/202003/05/WS5e60ba72a31012821727ca7b.html
[258] https://www.itf-oecd.org/sites/default/files/drones-covid-19.pdf
[259] https://news.itu.int/covid-19-where-are-the-self-driving-cars-and-trucks/
[260] https://socrates2.org/news-agenda/news/socrates20-and-corona-virus

transport infrastructure, and restrictions on implementing some solutions were reduced. On the other hand, the restrictive measures associated with the pandemic have slowed down the adoption of other technologies. Nevertheless, some of the immediate responses to the pandemic may persist (for example, transport infrastructure dedicated to micromobility and active modes) or completely disappear (state financial support).

We consider it important to understand how this crisis affects the mobility industry and will further influence governance models for innovations in mobility sector. The established practice of exchanging data between public and private companies during the pandemic may become regular as part of the formation of a sustainable and resilient transport industry. It is also worth noting the practice of repurposing transport infrastructure during the pandemic, which will partly be retracted in the future. However, it may affect the planning and development of cities in the long term.

The long-term effects of the socio-economic crisis caused by the pandemic could change the priorities of public policy to focus on immediate actions to recover from the economic crisis, while toning down sustainability priorities. Also, distancing recommendations run counter to plans to reduce the number of private cars and increase the use of public transportation, which can also irrevocably change citizens' priorities. To summarize, there are a number of impacts of the COVID-19 pandemic on the governance of disruptive mobility innovations in the long term:

- Accelerated promotion of shared micromobility and mobility solutions that rely on digital platforms (MaaS, e-scooter sharing and bike sharing, etc.)
- Changes in urban infrastructure planning will have a long-term impact on the development of micromobility services and shared mobility
- Using a personal car as a protected space will postpone or hinder the promotion of new type of shared mobility solutions
- CCAM and clean vehicles will be promoted as a means to reduce the impact of increasing use of private cars
- Improving collaboration and data exchange between public and private companies which will increase the acceptance and help develop adequate governance frameworks for data-driven mobility innovations
- Air micromobility has shown the benefits of being used during stressful situations and might be fast-tracked
- Higher time-to-market will be seen for solutions like ITS and CCAM which require significant investments

6. CONCLUSIONS

New mobility trends and associated disruptive innovations, if governed correctly, can lead the way towards smart and sustainable mobility which implies a pivot away from ownership of a means of transportation towards increased usership and value of individual journeys. These innovations can provide solutions to issues such as the last mile, congestion on busy roads or peak hours. However, there are several existing barriers, such as the lack of integration with established transport modes, the lack of suitable regulation and governance frameworks for the new aspects brought into light by these innovations, and potential negative externalities created by the mobility solutions. As we can see from the analysis presented in this report, different innovations require different governance interventions and have been addressed with different governance models in isolation from one another. A detailed summary of which governance instruments and models have been applied for governing various aspects related to the disruptive mobility innovations is presented in the Appendix. The presented information is not exhaustive, but provides an understanding of which aspects or mobility innovations have more solid governance frameworks, which of them are governed mostly through 'hard' or 'soft' governance, and which governance models would be required in addition to existing governance. In this report, we do not explicitly assess the success of the instruments used for governing disruptive mobility innovations. Rather, the impact assessment of governance responses is the next task in GECKO project.

Several regulatory initiatives are emerging within different countries in Europe at national level, but also at city level where soft law tools are increasingly used. These include various memorandums of understanding, codes of conduct and guidelines which can quickly address the changing landscape of mobility innovation. This transitional period characterised by the strong use of soft law tools highlights the need for a European framework on regulation of these disruptive innovations related to mobility. The role of such European framework would be to set the principles that support and guide national governments and local authorities in the development of their respective regulatory frameworks. This need is clearly illustrated with the example of pilot projects for autonomous vehicles in Luxembourg and Finland that make the public to accept autonomous shuttles and as a means to help solve the issue of the last mile. Now, the governments are waiting for an adequate regulatory framework at European level to start the development and implementation of autonomous bus shuttles.

The need for harmonization at a European level is especially apparent regarding the testing of automation, but also infrastructure linked to automation or e-mobility. The question of safety is an issue that needs a European response and, as highlighted in this research, the question of safety is inherent to several categories of innovation from automation to MaaS and e-scooters. Another element that requires harmonization relates to the question of access. First, access to cities has often been addressed with the development of UVAR in almost all the European capital cities. This question of access also needs harmonization specifically regarding the use of bus stops and bus lines by autonomous bus or innovative taxi business models. Second, the question

of access is also important when it comes to access to a profession with the question of the licensing of drivers, as recently seen with Uber.

Another key point is the responsibility of platforms for the services they intermediate. Requirements regarding intermediaries vary significantly across the EU. Many European cities are all working on that issue and would need guidelines to harmonize it and ensure fair competition between the different players.

Yet another element that requires harmonisation at the European level is the governance of data in various respects. For example, this is relevant in respect of liability when it comes to automation, but also for driving and rest times for drivers or for e-scooters to understand the needs of the city in terms of mobility. The governance of data is of key importance, and it is rather urgent to implement concrete strategies in order to avoid self-governance. Moreover, data sharing and access to data are critical questions, treated differently across EU Member States. These raise significant sensitivities amongst transport operators, both in terms of impact on their business of opening such data and in terms of costs associated with the data gathering and compatible data formats.

Pending harmonization regarding issues outlined above, it seems necessary to work towards clarifications in national regulation to ensure a level playing field between traditional actors and new players who are competing in the same market thus guaranteeing fair competition.

In light of the recent and still ongoing COVID-19 pandemic, we see that current regulatory frameworks and processes require deep changes in order to adapt not only to the fast-changing mobility landscape, but also to unexpected events that can disrupt mobility on a global scale. The adoption of more flexible and adaptive governance models can help address the challenges related to this paradigm shift. Moreover, real-time data acquisition and analysis through different data-driven innovations in mobility would allow for proactive rather than reactive governance. In this respect, the governance of disruptive mobility innovations puts similar pressure on the existing governance frameworks as the pandemic crisis we have been experiencing.

Proactive and adaptive governance would allow to direct mobility innovations in the desired direction so that they create value for transportation systems and solve challenges related to them rather than create new challenges. For that, mobility innovation developers can be involved in a dialogue with local transportation authorities thus engaging in collaborative regulation. This way, the focus shifts from reactively addressing new challenges brought by mobility innovations to a more focused search for those that can actually create benefits for the local society rather than only for direct users. This way, no innovation is preferred or obstructed in its implementation, but it can be seamlessly integrated with the future sustainable mobility systems.

APPENDIX. Governance of various aspects related to disruptive mobility innovations

Policy and regulatory aspects	Relevance of policy and regulatory aspects to specific mobility innovations											Governance models used per policy and regulatory aspect	Proposed governance models
	CCAM			Infrastructure, network and traffic management		MaaS and platforms	Shared and on-demand mobility						
	Connected and automated vehicles	Passenger urban air mobility	Drone last mile delivery	Infrastructure	Network and traffic management		Car sharing	Car-pooling	Bike sharing	E-scooter sharing	Ride-hailing		
Competition						Regulation (EU)	Regulation (EU)	Permits (L) Regulation (EU)	Call for bids (L) Licensing (L) Tradeable permits (L)	Call for bids (L) Licensing (L) Tradeable permits (L) Regulation (N, L) Taxation (L)	Licensing (N, L) Regulation (N, L)	Market approach Binding rules	Market approach – Adaptive regulation
Cooperation	Research funding (EU) Policy (EU) Forum (I)			Forum (I) Directive (EU)	Forum (I) Regulation (EU) Piloting (I, EU, L)	Directive (EU) Piloting (N, L)		Piloting (N)	MOU (L) Policy (EU, N)	MOU (L) Regulation (N)	MOU (L)	Collaborative reg. Market approach Regulatory sandbox	Collaborative reg. Regulatory sandbox
Compatibility	Research funding (EU) Guidelines (EU) Regulation (EU) Policy (EU)		Regulation (EU)	Policy (EU) Directive (EU) Guidelines (EU) Piloting (N)	Forum (I) Roadmap (I) Regulation (EU)	Regulation (EU) Directive (EU) Local laws (L)	Regulation (EU)		Regulation (EU)	Regulation (EU)	Access to infrastructure (L)	Binding rules	Adaptive reg. Collaborative reg.
Complementa-rity	Declaration (EU) Action plan (EU)			Policy (EU) Directive (EU) Guidelines (EU)	Forum (I) Roadmap (I)	Piloting (N,L)	Regulation (N)	Subsidy (N)	Guidelines (EU) Piloting (EU, L) Policy (N)	Guidelines (EU) Piloting (L)	Directive (EU) Regulation (L)	Regulatory sandbox	Adaptive reg. Outcome-based Regulatory sandbox
Data ownership and use	Directive (EU)				Directive (EU)	Regulation (EU, L)	Regulation (L, EU)	Regulation (N, EU)	Regulation (EU)	Regulation (EU)	Regulation (EU)	Binding rules Outcome-based	Binding rules Collaborative reg. Outcome-based
Data quality	Research funding (EU) Action plan (EU)			Directive (EU)	Directive (EU) Regulation (EU)	Regulation (EU, N) Directive (EU)	Directive (EU)	Directive (EU)	Directive (EU)	Directive (EU)	Regulation (EU)	Binding rules	Binding rules
Data integration	Research funding (EU) Regulation (EU)			Directive (EU)	Roadmap (I) Directive (EU) Regulation (EU) Funding (EU)	Regulation (EU, N) Directive (EU)	Directive (EU)	Directive (EU)	Directive (EU) Regulation (EU)	Directive (EU) Regulation (EU)	Regulation (EU) Directive (EU)	Binding rules Regulatory sandbox	Collaborative reg.
Data security and privacy	Directive (EU) Regulation (EU)				Roadmap (I)	Regulation (EU), Directive (EU)	Directive (EU)	Directive (EU)	Directive (EU)	Directive (EU)	Directive (EU)	Binding rules	Binding rules
Promotion of innovations	Forum (I) Resolution (I) Declaration (EU) Research funding (EU) Policy (EU, N) Piloting (N, L) Funding (N)			Funding (EU, N)	Communication (EU) Policy (EU) Funding (EU) Subsidy (N) Piloting (L)	Piloting (N, L) Policy (N, L)	Funding (N, L) Policy (N, L) Taxation (N) Access to infrastructure (N, L)	Policy (N, L) Taxation (N) Access to infrastructure (N)	Declaration (EU) Policy (EU) Funding (EU, N, L)			Regulatory sandbox Market approach	Collaborative reg. (definition of standards) Regulatory sandbox
Employment								Taxation (N)			Directive (EU) Regulation (L) Legal precedent (EU)	Market	Adaptive reg. Market
Environmental impact	Policy (EU)			Policy (EU)	Policy (EU)	Policy (EU)	Funding (N) Regulation (N, L) Labelling (N) Access to infrastructure	Funding (N) Regulation (N, L)	Directive (EU) Funding (L)	Directive (EU) Policy (EU) Piloting (N)		Binding rules Regulatory sandbox	Adaptive reg. Binding rules Outcome-based

Equity and accessibility							Regulation (L)	Tradeable permit (L)			Tradeable permit (L)	Binding rules Market	Binding rules Market
Ethical aspects	Report (EU)											Binding rules Collaborative reg.	Collaborative reg.
Cognitive-cultural aspects	Communication (EU)	Communication (EU)	Communication (EU)		Communication (EU)							Regulatory sandbox	Collaborative reg Adaptive reg
Tragedy of the commons									Tradeable permit (L)			Binding rules Market approach	Adaptive reg.
Public health												Binding rules Market approach	Binding rules Market approach
Safety	Convention (I) Resolution (I) Directive (EU) Regulation (EU) Piloting (N, L) Regulation (N)	Certification (EU)	Regulation (EU)	Regulation (EU) Directive (EU) Policy (EU) Piloting (N)	Forum (I) Convention (I)		Labelling (L) Licensing (L)		Guidelines (L) Licensing (L) Call for bids (L)	Regulation (N, L)	Regulation (N) Licensing (N, L) Ban (N) Access to infrastructure (L)	Risk-based (for UAS) Binding rules	Risk-based
Security (cybersecurity)	Policy (EU) Directive (EU) Regulation (EU)				Directive (EU) Regulation (EU)	Regulation (EU)	Directive (EU)	Directive (EU)	Directive (EU)	Directive (EU)	Directive (EU)	Binding rules	Collaborative reg.
Liability	Directive (EU) Report (EU)				Roadmap (I)		Regulation (N)				Legal precedent (EU)	Binding rules	Collaborative reg.
Cross-cutting issues	Forum (I) Policy (EU, N) Regulation (EU, N) Research funding (I, EU)	Forum (EU)	Model regulation (I) Regulation (EU)	Agreement (I, EU) Policy (EU) Piloting (N)	Forum (I) Roadmap (I) Policy (EU) Funding (EU) Piloting (L)	Policy (EU) Piloting (N)						Binding rules Outcome-based Regulatory sandbox	Outcome-based
Governance models used per innovation	Binding rules (establishment of standards) Collaborative reg. (definition of standards) Regulatory sandboxes	Binding rules Risk based-reg. Regulatory sandbox	Binding rules Risk-based reg. Regulatory sandbox	Binding rules Regulatory sandboxes Collaborative reg.	Binding rules Regulatory sandboxes Collaborative reg.	Binding rules Regulatory Sandboxes Outcome-based	Binding rules (operation requirements) Adaptive reg. Regulatory sandboxes Market	Binding rules Market Outcome-based	Binding rules Market Adaptive reg. Outcome-based	Binding rules Market Adaptive reg. Regulatory sandboxes Collaborative reg.	Binding rules Market		
2RL assessment	1 or 2	1	1 or 2	1	2	2	3	3	3	3	3		

Governance levels:

I – International level

N – National level

EU – EU level

L – Local level

For 2RL assessment, please see Figure 1

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