GECKO

GOVERNANCE FOR NEW MOBILITY SOLUTIONS

Regulatory schemes and governance models for disruptive innovation

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RUPPRECHT CONSULT-FORSCHUNG & BERATUNG GMBH	DE	RC
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1.0	26/03/2020	UITP	Final review and submission	

LIST OF ACRONYMS

2RL – Regulation Readiness Level
AV – Automated Vehicles
BoB - Biljett- och betalstandard
CAV – Connected, Automated Vehicles
GDPR – General Data Protection Regulation
IoT – Internet of Things
JARUS - Joint Authorities for Rulemaking on Unmanned Systems
JTC - Joint Technical Committee
KPI – Key Performance Indicator
MaaS – Mobility as a Service
MOU – Memorandum of Understanding
SESAR - Single European Sky ATM Research
SUMP – Sustainable Urban Mobility Plan
UAS – Unmanned Aircraft Services
UAS - unmanned aircraft systems
VTOL - vertical take-off and landing
WP – Work Packages

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EXECUTIVE SUMMARY

This deliverable aims at evidencing new regulatory schemes and governance models for disruptive mobility innovations, that can foster innovation while protecting users' safety and security and achieving sustainable mobility goals.

First, we analysed the various approaches to regulate disruptive innovations, with a definition of policy instruments (e.g. laws, directives, taxes, calls for bids, etc.) and governance models that are implemented. We also studied five flexible governance models that could be more compliant with fast evolving technologies and services than binding rules and market-based approaches that are more used today:

- Adaptive regulation: step-by-step process with a policy reviewed following impact assessment;
- Regulatory sandboxes: experimentation of a solution within restricted conditions;
- Outcome-based regulation: the policy goals are achieved by stakeholders without constraints on the process to fulfil them, with a monitoring performed through the measurement of performance indicators;
- Risk-based regulation: adaptation of the policy according to the level of risk;
- Collaborative regulation: involvement of all the stakeholders to define the policy.

We also considered an integrated approach to regulate all the disruptive mobility solutions, relying on the SUMP example.

Then, we analysed the regulatory challenges linked to disruptive mobility innovations in mobility (e.g. interoperability, cooperation models), the barriers for their deployment (e.g. existing laws), or the risks brought by the solution (e.g. transport unaffordability for MaaS could generate social issues). This analysis was performed for the four categories of disruptive mobility innovations we defined in WP1:

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

This work led to the design of the Regulatory Matrix, which is a regulatory supportive tool that aims at providing regulatory responses and recommendations to public authorities, which will be able to address challenges and barriers related to the deployment of disruptive innovations in mobility, while guaranteeing expected benefits and avoiding threatening risks.

This Regulatory Matrix was set-up through the construction of the regulatory database which gathers regulations of these mobility solutions at the worldwide level, thanks to desktop research, surveys and interviews carried out with stakeholders. We figured out for each regulation

the challenges and barriers addressed by this regulation and the risks to prevent from unexpected bad impacts.

We analysed further these regulations to define the 2RL parameter which allows the tool to propose the regulatory approach most in line with the existing regulatory environment of the authority. We considered the Regulation Readiness Level in terms of a time scale for applying the regulation on an innovative mobility solution, depending on the deployment of the solution in the market:

We thus continued the construction of the Regulatory Matrix with an assessment of the 2RL parameter for each regulation and came up to the following table which sets up global 2RL assessment for all the case studies:

Disruptive mobility category	Case study	2RL assessment
Cooperative, connected and automated vehicles	Connected and automated vehicles	**1:** Related to a disruptive technology/service for which norms and standards have to be defined
	Passenger urban air mobility	**2:** Related to the experimentation of a new technology/service
	Drone last mile delivery	**1:** Related to a disruptive technology/service for which norms and standards have to be defined
Shared/On-demand mobility	Car-sharing/Car-pooling	**3:** Related to the regulation of a new technology/service already deployed
	Bike-sharing	
	Ride-hailing/TNC	
	On-demand ridesharing	
	Crowdshipping	**1:** Related to a disruptive technology/service for which norms and standards have to be defined
MaaS and MaaS platform		**2:** Related to the experimentation of a new technology/service
Infrastructure, network and traffic management	Big data for transport	**1:** Related to a disruptive technology/service for which norms and standards have to be defined
	Cooperative traffic management	**2:** Related to the experimentation of a new technology/service
	Hyperloop	**1:** Related to a disruptive technology/service for which norms and standards have to be defined

This Regulatory Matrix was developed closely with the Regulatory Frameworks Dashboard, which provides impact assessment of these regulations through the assignment of Key Performance Indicators (safety, security, environmental, etc.).

INTRODUCTION

Disruptive mobility services that come into the market revolutionize the mobility concept, leading to the transition to "Smart mobility" which aims at integrating alternative modes of transportation in order to address issues that the cities are currently facing, such as poor air quality, traffic congestion, etc.

These innovations are currently leading to more sustainable modes of transport. In addition, the high connectivity of vehicles and infrastructures allows innovative business models for integrated journey services (planning, combination of modes of transport, e.g. MaaS), or shared/on-demand mobility. All these disruptive services have a significant impact for passengers and freight transportation.

However, local authorities are facing regulatory challenges. They have to foster the innovations, while achieving policy goals, creating a sustainable ecosystem and protecting citizens. As a way of example, the data exchanged with the consumers, at the core part of many disruptive mobility services, can be a critical issue for users' privacy and safety. Also, insurance and more in general contractual issues are strictly related to services, such as MaaS, combining different modes of transportation. Similarly, issues related to fair competition, e.g. between taxis and private hire vehicles (an issue implying the exercise of either legislative or administrative power), public and private services, or equity between cities and peri-urban or rural areas, etc…

GECKO (Governance principles and mEthods enabling deCision maKers to manage and regulate the changing mObility systems) aims at supporting authorities with tools and recommendations in order to create a new regulatory framework, suitable for the transition to a new mobility era.

The activities that are carried out within the Work Package 2 are focused on Regulatory and governance frameworks, providing:

- An analysis of regulatory responses and governance models (see D2.1),
- An investigation of main economic, political and social variables (see D2.2),
- An analysis of cooperation models among public and private parties (see D2.3)
- Regulatory approaches and governance models for disruptive innovations, **which is the scope of this deliverable** (**D2.4**).

1 METHODOLOGY

The deliverable D2.4 relies on the results coming from the WP1 and WP2 of the GECKO project:

- Description of disruptive mobility solutions and business models (WP1)
- Analysis of regulatory responses and governance models (WP2, D2.1)
- Identification of economic, political, social variables influencing the regulatory responses (WP2, D2.2)
- Analysis of cooperation models among public and private parties (WP2, D2.3)

This study shapes the critical features of new regulatory schemes (e.g. policy instruments, pros and cons, challenges addressed) and associated governance models that can foster innovation without compromising the adequate level of protection with regards to security, safety, social protection, fair competition, etc. In addition, this new regulatory framework must address environmental issues and contributes to sustainable mobility.

In order to achieve these objectives, several steps punctuate the study:

- The analysis of regulatory challenges related to disruptive innovations, describing positive and negative impacts for each mobility solution that will be studied in the following four categories:
  - Cooperative, connected and automated transport technologies;
  - Shared/on-demand mobility;
  - MaaS and platforms;
  - Infrastructure, Network and Traffic Management Systems.
- The analysis of different regulatory approaches: the current regulatory processes and policy instruments but also the regulatory trends, highlighting the network approach which is at the opposite of the fragmented current regulatory systems. In fact, nowadays, mobility solutions are regulated on a mode-by-mode basis, independently from each other, without having a global regulatory approach for all mobility solutions.

These analyses are used to provide a Regulatory Matrix that will evidence different approaches. This leads to regulatory responses through the completion of a regulatory database that gathers regulations that exist/are upcoming at the European scale. These regulations were collected thanks to desktop research, interviews and surveys sent to stakeholders involved in this project (mobility solution providers, industries, consulting companies, public authorities, international organizations, see deliverable D5.1)[1]. They will evidence some criteria, “patterns”, which can influence the regulatory approach that is chosen by policy makers for each mobility service considered in the framework of this study. This leads to the “Regulation Readiness Level” (2RL) assessment, providing recommendations regarding the regulatory approach to adopt for

[1] “Deliverable D5.1: Stakeholder engagement plan”, B. Fenton & al.

disruptive mobility solutions according to criteria such as the need of standard definition or experimentations, availability of the service in the territory.

The Regulatory Matrix is strongly correlated to the Regulatory Dashboard that is delivered in the Deliverable D3.1, which provides KPIs to assess the impacts provided by new regulatory schemes through **an interactive table that links the regulatory database with these KPIs**.

2 VARIOUS APPROACHES LEADING TO POLICY OUTCOMES

For the GECKO project, regulations are defined according to OECD (Organisation for Economic Co-operation and Development):

> *"A regulation may be defined as any instrument by which governments, their subsidiary bodies, and supranational bodies (such as the EU or the WTO) set requirements on citizens and businesses that have legal force. The term may thus encompass a wide range of instruments: from primary laws and secondary regulations to implement primary laws, subordinate rules, administrative formalities and decisions that give effect to higher-level regulations (for example, the allocation of permits) and standards. Regulations may emanate from non-governmental or self-regulatory bodies to which governments have delegated regulatory powers. Regulations do not only address the activities of the private sector. They include the rules and procedures that frame the internal operation of public authorities, including ministries and government agencies. So-called "soft law" is increasingly important. This means that, for example, administrative guidance and circulars which are not intended to have legal force, may acquire legal force in practice. Most countries have a well-established hierarchy of regulations, starting with their Constitution. They usually require that lower-level regulations must not conflict with higher-level regulations, and that the former must derive their legitimacy from the latter."*

In the framework of the study of different approaches for transport regulations, a deep analysis will be performed regarding the policy instruments for mobility services.

2.1 Glossary

This glossary aims at defining key words for this deliverable:

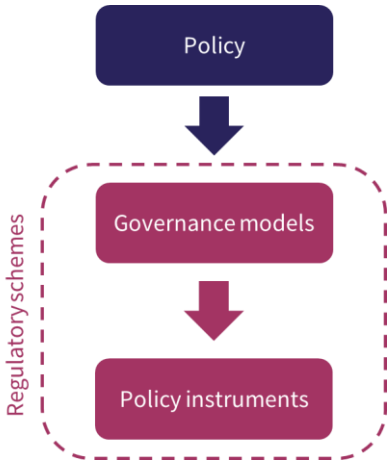


Figure 1: Relationships between the different glossary terms

Regulatory scheme: This is the plan implemented to regulate a product or a service, with a set of regulatory measures, using different policy instruments in the framework of given governance models, in order to achieve policy goals.

Governance models: In the framework of this project, they can be defined as the approach adopted to regulate disruptive mobility innovations, the methodology employed: how and "how much" do we regulate? As an example, do we define standards by involving all the relevant stakeholders in the process, such as industries, or do we adopt an approach that involves only experts?

Policy instruments: They refer to the means of implementation of a policy or a governance model: laws, call for bids, etc.

The relationships between the different terms are represented on the Figure 1.

In the scope of this research, we will focus on the policy instruments and regulation processes, that will shape the critical features of regulatory schemes. The description of policy makers' organizations and authorities (from local to international levels) in charge of regulating transport are detailed in the deliverable D2.1 of the GECKO project: "Analysis of regulatory responses and Governance models" (A. Reynaud & al.).

2.2 Governance models

Modes of governance can be classified among three categories: hierarchical, network, market, according to [2].

- **Hierarchical** governance: this top-down approach has been "traditionally" used on a national level, relying on binding rules or procurements (legal form, boards, votes, IP mechanisms [3]).
- **Market** governance: policy instruments can be used to influence on economic variables (competition, pricing, taxes, subsidies) to achieve policy goals. For example, these instruments are employed for environmental policies in order to incentivize the use of alternative fuels for vehicles, through gas taxation.

[2] "Urban planning and transport policy integration: the role of governance hierarchies and networks in London and Berlin", Philipp Rode, *Journal of Urban affairs*, 2019.

[3] https://hal-mines-paristech.archives-ouvertes.fr/hal-01488631v2/document

- **Network** governance: this relatively new mode of governance relies on collaboration between different relevant stakeholders for the decision-making process, whether public or private parties, non-profit organizations.

The report published by I.M. Bouwma & al. [4] focused on two governance models that can be particularly relevant regarding environmental policy. These modes can be part of network governance, as they are involving several actors, and form more inclusive approach:

- **Self-governance**: business or industry actors impose themselves rules in order to achieve policy objectives (e.g. the definition of standards regarding the Hyperloop with the consortium of industries that develop this technology).
- **Knowledge** governance: Knowledge production and dissemination can be key influencers regarding the decisions that have to be done regarding policies.

Table 2-1: Advantages/Drawbacks of Governance Modes

Governance mode	Advantages	Drawbacks
Hierarchical	• Efficient way to reach policy goals • Clear chain of command • Efficiency regarding long-term actions • Uniform solutions: norms and standards	• Poor flexibility • Exclusive approach (few stakeholders): hard adhesion • Risks of lack of social acceptancy
Market	• Innovation enhancement • Efficient way to achieve policy goals	• Risk of market failure, disequilibrium of the ecosystem if there is not independent supervision
Network, Self-governance, Knowledge	• Innovation capacity • Flexibility • Awareness raising • Initiatives incentives • Inclusive rulemaking: great adhesion for the achievement of public policy goals	• Possible barriers through protection of mutual interests, lack of trust within stakeholders • Difficult to get outcomes [5]

[4] "Policy instruments and modes of governance in environmental policies for the European Union", I.M. Bouwma & al.

[5] https://epubs.scu.edu.au/cgi/viewcontent.cgi?article=1767&context=bus_pubs

2.2.1 *Policy instruments*

The regulation of urban transport is mostly defined at the national or local level, as it is outside the competence of the EU. However, the EU can use its legal abilities to impact urban transport (basically related to single market and environment competences). The European GECKO project aims at providing a new regulatory framework for disruptive mobility solutions that can generate great outcomes, relying on policy instruments applicable all over Europe.
For these reasons, the policy instruments presented hereafter are at the EU levels, knowing that most of them can also be carried forward national or local level.

2.2.1.1 Hierarchical governance: binding rules

As mentioned before, binding rules and procurements fall into hierarchical governance models. Regarding European binding legal instruments, the three main legal instruments at the European levels are the following [6]:

Table 2-2: Binding rules – European level

Policy instrument	Area of application [7]	Example related to mobility services
Regulation	"A "regulation" is a binding legislative act. It must be applied in its entirety across the EU.	Flight Compensation Regulation 261/2004 set up common rules regarding air passengers' rights, when a flight is delayed, cancelled, or overbooking happens. [8]
Directive	A "directive" is a legislative act that sets out a goal that all EU countries must achieve. However, it is up to the individual countries to decide their own laws on how to reach these goals.	Directive 2010/40/EU related to the deployment of Intelligent Transport Systems [9].
Decision	A "decision" is binding on those to whom it is addressed (e.g. an EU country or an individual company) and is directly applicable."	Commission Implementing Decision 2016/209 on a standardisation request to the European standardisation organisations as regards Intelligent Transport Systems in urban areas. [10]

[6] https://www.eumonitor.eu/9353000/1/j9vvik7m1c3gyxp/vh75mdhkg4s0
[7] https://europa.eu/european-union/eu-law/legal-acts_en
[8] https://eur-lex.europa.eu/legal-content/EN/TXT/HTML/?uri=CELEX:32004R2006&qid=1555678165234&from=EN
[9] https://eur-lex.europa.eu/legal-content/EN/TXT/HTML/?uri=CELEX:32010L0040&qid=1555677931095&from=EN
[10] https://eur-lex.europa.eu/legal-content/EN/TXT/HTML/?uri=CELEX:32016D0209&qid=1555678022045&from=EN

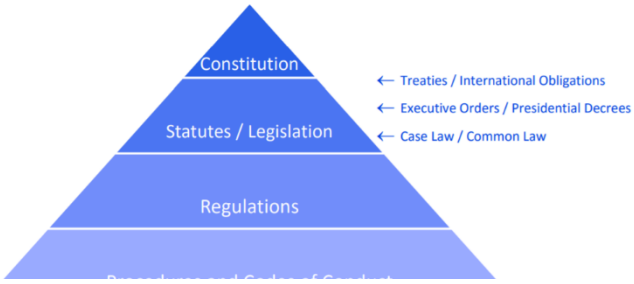


Figure 2: Hierarchy of law, extracted from "The hierarchy of laws: understanding and implementing the legal frameworks that govern elections", IFES

N.B.: Several legal instruments at the national level implement policies, with a given hierarchy. On the following figure is represented this hierarchy, which is common for European Member States.

2.2.1.2 Non-binding rules

Regarding European non-binding rules, the policy instruments at the European levels are the following [6]:

Table 2-3: Non-binding rules – European level

Policy instrument	Area of application [11]	Example related to mobility services
Recommendation	European Union recommendations incentivise individuals, companies, Member States to set up measures to achieve policy goals.	Commission recommendation (EU) 2019/534: Cybersecurity of 5G Networks [12].
Opinion	This policy instrument is in order to allow to make a statement regarding specific policy.	The "Clean Air Policy Package" carried out by the European Committee of Regions [13]
Guideline	This non-binding rule aims at defining a future action plan to achieve policy goals.	"Guidelines on the exemption procedure for the EU approval of automated vehicles" [14]
Communication	This policy instrument aims at communicating about current or future policies (evaluations, outlines…)	COM(2018)293: *Europe on the move, Sustainable mobility for Europe: safe, connected and clean* [15]

[11] https://www.eumonitor.eu/9353000/1/j9vvik7m1c3gyxp/vh75mdhkg4s0
[12] https://eur-lex.europa.eu/legal-content/EN/TXT/?qid=1556008335312&uri=CELEX:32019H0534
[13] https://cor.europa.eu/en/our-work/Pages/OpinionTimeline.aspx?opId=CDR-1217-2014
[14] https://ec.europa.eu/growth/content/guidelines-exemption-procedure-eu-approval-automated-vehicles_en
[15] https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:52018DC0293

Policy instrument	Area of application	Example related to mobility services
Declaration	This instrument is used to make a statement on a specific topic, rarely used.	Graz Declaration "Starting a new era: clean, safe and affordable mobility in Europe"[16]
Green paper	The Green Paper is employed in order to initiate debates within European Union regarding a specific topic.	"Towards a new culture for urban mobility" [17]
Working paper / Report	The reports evaluate current policies for further improvements.	"Study on passenger transport by taxi, hire car with driver and ridesharing in the EU" [18]

These policy instruments are thus part of knowledge governance models, as they produce knowledge, insights that can have a key influence on regulatory measures.

Some policy initiatives are also set up [19], related to **self- and network governance models**:

- **Self-regulation:** Industries/Businesses can set up code of conducts in order to achieve policy goals in a more flexible and efficient way, but also in order to earn reputation and influence the competition [20]. ISO 14001 (eco-management requirements) is a standard that has been developed through this mode of regulation [21].
- **Co-regulation (network):** The regulation process can involve several stakeholders (not only the legislators), from private sector, non-governmental associations, associations, etc.

[16] https://www.eu2018.at/latest-news/news/10-30-Graz-Declaration.html
[17] https://eur-lex.europa.eu/legal-content/EN/ALL/?uri=CELEX:52007DC0551
[18] https://ec.europa.eu/transport/sites/transport/files/2016-09-26-pax-transport-taxi-hirecar-w-driver-ridesharing-final-report.pdf
[19] https://ec.europa.eu/info/sites/info/files/file_import/better-regulation-toolbox-18_en_0.pdf
[20] OECD (2015-03-01), "Industry self-regulation: Role and use in supporting consumer interests", *OECD Digital Economy Papers*, No 247, OECD Publishing, Paris
[21] Environmental self-regulation and sustainable economic growth: the seamless web framework", W. J. Altham, T. F. Guerin, *Eco-Management and Auditing* 6:61-75, 1999

2.2.1.3 Market-based instruments

These instruments include [19]:

Policy instrument	Example related to mobility services/transport
Taxes **Charges** **Fees** **Fines** **Penalties**	Carbon taxes
	In London, the Ultra-Low Emission Zone is a traffic pollution charge scheme that was put in place in April, 2019 in order to improve air quality. Vehicles whose emission standards are not compliant with the ULEZ standards pay the charge.
	Dynamic fees regarding parking, like in San Francisco [22]
	Drivers can pay fines if they have not the right environmental sticker ("Crit'air" in France, "Feinstaub-Plakette" in Germany, etc.)
Liability and compensation schemes	Regulation 261/2004 is a European law regarding compensation and assistance to passengers in case of denied boarding or flight cancellation [23].
Subsidies and incentives	The "Clean Mobility Package" leads to the "CEF Transport call", financing innovative technologies for sustainable transport [24], the European Startup Prize for mobility [25]
Deposit-refund systems (fee discount if the person brings back a component for recycling purpose)	Motor oil in Canada, lead-acid batteries in USA [26].
Labelling schemes	The Nordic Swan label for liquid and gaseous fuels [27], the Moma.biz project.
Tradable permit schemes	European Union Emission Trading Scheme [28]
Call for bids	EU Commission call for tender for a "Study on an "Economic modelling exercise in support of the multi-modal transport market studies for nine core network corridors""[29]

[22] http://www.eltis.org/sites/default/files/report_summary_reviews_of_measures.pdf
[23] https://eur-lex.europa.eu/legal-content/FR/TXT/HTML/?uri=CELEX:32004R0261&from=EN
[24] https://ec.europa.eu/transport/themes/sustainable/news/2017-11-21-eu-funding-alternative-fuel-deployment_en
[25] https://startupprize.eu/
[26] Deposit-refund systems in Practice and Theory, M. Walls, *Discussion paper*, 2011
[27] https://www.nordic-ecolabel.org/product-groups/group/?productGroupCode=099
[28] https://ec.europa.eu/clima/policies/ets_en
[29] https://ec.europa.eu/transport/content/study-economic-modelling-exercise-support-multi-modal-transport-market-studies-nine-core_en

2.2.1.4 Education and information

Education and information are at the core of knowledge governance model. This way of implementing policies can include [4]:

- Publicity information campaigns;
- Targeted educational programs;
- Interactive workshops;
- Invitation of sharing opinions and points of views.
- All these tools are part of awareness raising campaigns. We could mention as an example the MIMOSA project, one of the CIVITAS initiatives, which set up School Mobility Manager Campaign, Pedestrian Circulation Campaign (interactive initiative), Public transport Campaigns and Eco driving campaigns (interactive workshops).

2.2.2 *Focus on local governance regarding mobility*

Cities are major players regarding mobility, as 55% of the population is currently living in cities (68% in 2050) according to UN. Local authorities are responsible of organizing urban transport at 3 levels[30], in agreement with regulations that were voted at higher political level:

- **Strategy:** definition of the objectives that must be fulfilled to address city challenges, such as the improvement of road security, decreasing congestion, the improvement of public transport, the incentivization towards the use of eco-friendly services and intramodality, parking regulation, etc. As an example, we could mention the Sustainable Urban Mobility Plans (SUMPs) adopted at EU level, setting urban mobility policies, which aims at improving residents' quality of life by addressing issues as congestion, air/noise pollution, climate change, road accidents, unsightly on-street parking and the integration of new mobility services.
- **Tactic:** definition of the technical specifications and the means that will be required to achieve these objectives.
- **Operation:** implementation of the tactic through:
- **The regulation of private operators** (call for tenders, public contracting);
- **The subsidies** to support shared mobility services deployment, public transport or infrastructure improvement, or other financing means that could incentivize the use of these services.
- **The taxation of polluting vehicles/fuels**, the access restriction to some areas (e.g. Low Emission Zones), the traffic blocks in the case of smog level alerts;
- The awareness rising campaign to incentivize citizens to use sustainable transport means.
-

[30] "Régulation et concurrence dans le transport collectif urbain », Aurélie Coppe and Axel Gautier, https://www.cairn.info/revue-reflets-et-perspectives-de-la-vieeconomique-2004-4-page-65.htm

2.2.3 *Stakeholders' insights: pros and cons for each policy instrument*

During the first stakeholders' workshop (London - October 2019), we asked to the stakeholders their vision about some policy instruments (pros and cons, in which context this instrument is more appropriate), relying on their expertise about disruptive mobility solutions.

Table 2-4: Policy instruments: stakeholders' insights

Policy instruments	Pros	Cons	Where it could work the best?
EU directives	• Harmonization • Clarity and stability • International jurisdiction • Specific cases: jurisdiction involving a country border	• Slow process • Differences of implementation • Restrictiveness • Complicated language • Hard to change • Not focused on rural zones • Can't be too early	Addressing long term issues: environmental (climate targets), security, safety Product/service approval Definition of standards (interoperability, technical, etc.) Regulation of business processes Cybersecurity and environmental data Transnational mobility
National Regional Local laws	• Suitable for local markets • Suitable for local context conditions • Relying on local expertise	• Political influence that obliges companies to adapt to multiple criteria; • Institutions not in decision taking process (local) • Require enforcements • Not focused on rural zones • Difficult to change	For the mobility solution operation
Self/co-Regulations	• Ease of implementation No enforcement required • Common business approach	Companies don't follow City/citizens' interests not always considered Flexibility	• Regulation through pilot projects • Impact assessment

Policy instruments	Pros	Cons	Where it could work the best?
Collaborative Approach	• Unification of different perspectives • Synergies • Greater understanding between stakeholders • Should be inclusive	• Can be slow	• Regulation of new/less known markets • Regulation of pilot projects • Impact assessment, externalities
Taxes Charges	• Ensures control for the city • Revenues for the city	• Set barriers • Business model made infeasible • Less popular measure	To regulate negative externalities, behaviours (bonus/malus)
Subsidies and incentives	• Short-term business model made feasible • Increase of positive externalities • Internalizing external costs, be part of investment • Higher rewards	• Market distortion • Prevent innovation • Long time to create right subsidy plans • Long term uncertainty • Potential for exclusion	• Enable business models/products encouraged • Positive behaviours • Directly back to users, not to companies

2.3 Towards flexible approaches of governance models

In order to overcome barriers and avoid the potential risks related to the implementation of disruptive innovations, new regulatory schemes must be implemented, compliant with the fast pace of change in the urban mobility systems. Actually, the European regulation process, as well as Member states', is currently slow and hardly flexible:

- A preliminary study is performed in order to assess the necessity to implement a regulation or not, by carrying out an impact analysis and consulting the relevant stakeholders. The study tries to anticipate the future possible situations, but it becomes harder since the technologies evolve faster.
- A proposal is submitted and revised until the last version that will be voted and adopted.
- The amendments are adopted through a revision procedure (long-time period).

Nowadays, public authorities are advised not to regulate too quickly but rather to wait until the impacts of new systems are understood.

These new approaches have to be carried out without compromising on the adequate level of performance of transport services nor negatively affecting some stakeholders in the transport ecosystem, while contributing to a sustainable model (e.g. incentivizing the use of public transport instead of private vehicles, etc.).

In addition, mobility services are increasingly provided through mobile applications and other digital interfaces, sometimes at an international level (e.g. rail, carsharing, etc.). In this vein, new regulatory approaches as the network approach appears to be the most suitable regulatory approach. The same approach could be suitable for those new services relying on applications which provide users with intermodal combination of transport services. For these (MaaS-kind) services, the network approach, indeed, could overcome the current and unsuitable regulation model focused on a mode-by-mode basis.

According to Deloitte study[31] (few references exist on this topic), 5 new approaches can be adopted to address these challenges: adaptive regulation, regulatory sandboxes, outcome-based regulation, risk-based regulation and collaborative regulation. In this section, we will define these approaches and illustrate them with examples applied to mobility.

[31] "The future of regulation: Principles for regulating emerging technologies", Deloitte Insights

2.3.1 *Adaptive regulation*

➲ **Definition:** Adaptive regulation could be defined as the regulation that could be changed in order to be more compliant with a new framework, addressing new challenges that are brought by unexpected innovations, events.

"A structured regulatory process that enables learning and modification of policy over time via adjustments informed by data collection and analysis." [32]

➲ **The advantages and drawbacks of this regulatory process** are presented on the table below:

Table 2-5: Adaptive regulation - Advantages/Drawbacks [32]

ADVANTAGES	DRAWBACKS
• High Flexibility • Compliant with fast evolving and not anticipated technology framework	• Public expenditure regarding data collection • Policy instability

➲ **Policy instruments:**

Soft laws such as self/co-regulations are adaptive regulations. Impact analysis, indicators monitoring, and periodic review will allow the policy makers to know if the regulations achieve the policy goals or require adjustments.

Adaptive licensing could be also a policy instruments that could be used to get an iterative approach regarding the implementation of a disruptive mobility service.

Two ways of implementation are possible regarding adaptive regulations: automated and discretionary[32]. Either the rule is changed under conditions that have be defined initially, either the rule is reviewed step by step by the regulator on a schedule that he considers relevant.

➲ **Application example: the SUMPs process (more information on section 3.3)**

As we mentioned before, SUMP aims at implementing a strategy to develop modern and sustainable urban mobility, which has to foster the use of public transport and other eco-friendly modes (cycling, intermodal solutions, shared mobility services, micromobility, etc.).

[32] "Adaptive Regulation: Instrument Choice for Policy Learning over Time", Lori S. Bennear and Jonathan B. Wiener, Draft paper, Feb. 2019

2.3.2 *Regulatory Sandboxes*

➲ **Definition:** The concept of regulatory sandboxes relies on the deployment of the innovation on restricted and controlled conditions, to evaluate the expected benefits of the disruptive service/technology, to perform an impact analysis and assess the regulation requirements. This experimentation process allows the innovations to be implemented, while ensuring policy makers that their goals are achieved. This measure accelerates the development of the innovations and thus leads to the reduction of time-to market. The Financial Conduct Authority (UK) was a pioneer among regulating organizations for that specific regulatory process (see footnote 31).

➲ **The advantages and drawbacks of this regulatory process** are presented on the table below:

Table 2-6: Regulatory Sandboxes - Advantages/Drawbacks

ADVANTAGES	DRAWBACKS
• Innovation and competition fostering • Reduced time-to-market • Customers' protection improved. • Ensuring market integrity • Development of rules that are compliant with the disruptive service, technology or business model • Applicable at all levels	• High costs • Advantages for selected startups for startups compared to the other ones. • Risks for consumers who are testing the service/product due to lack of regulation

➲ **Policy instruments:**

Subsidies are a policy instrument that is suitable for this regulation process. It is also required to process through "traditional" regulation process to be allowed to perform experimentation of novel technologies.

➲ **Application example: Automated vehicles experimentations/pilot zones:**

At the European scale, legislative initiatives were setup in order to accelerate the development of AV through the authorization of pilot zones that check vehicles safety. At the European scale, amendments were adopted at the Vienna convention, the Declaration of Amsterdam also setup the speed limit for AV. But national rules were also adopted.

Examples of experimentation projects:

- In France, in April 2019, 16 supplementary experimentation projects were subsidized for 2 consortia through the "PACTE law", in order to drive 11 million kilometres by 2022 with autonomous vehicles [33]. The experiments will include public transport (autonomous

[33] https://www.ecologique-solidaire.gouv.fr/vehicules-autonomes#e1

shuttles), personal vehicles (driving on four-lane divided road), freight and logistics droids (Twinswheel in Montpellier), and will be carried out in city centre as well as less dense areas (see the map below): the objective is to demonstrate vehicle safety This action is part of the global French strategy regarding the acceleration of the development of autonomous vehicles that started in 2014, following decrees and ordinances that have been setup to authorized experiments.

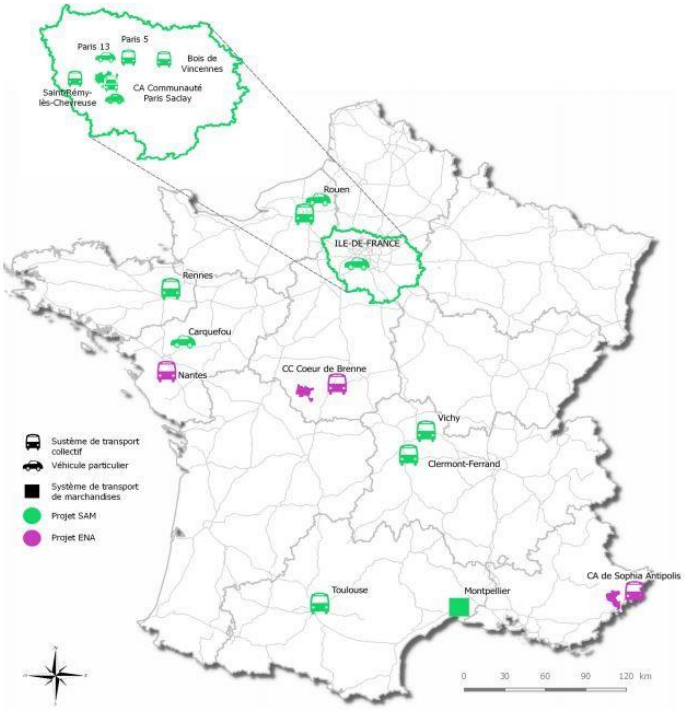


Figure 3: French autonomous vehicles experimentations

• UK setup in 2015 the "Centre for Connected and Autonomous Vehicles" that work on AV legislations [34], providing new policies, subsidies to accelerate the development of UK's AV ecosystem. The objective to achieve is getting AV on the roads by 2021. The government already announced that it will bring some the deployment of autonomous shuttles in London and Edinburgh[35].

Figure 4: Autonomous shuttle in London © Business Insider

• The Netherlands was classified as a leader, with the highest *AV readiness index* defined by the KPMG study [36], through the establishment of policies suitable for the AV development: early testing

[34] https://www.gov.uk/government/organisations/centre-for-connected-and-autonomous-vehicles/about
[35] https://www.gov.uk/government/news/from-science-fiction-to-reality-people-in-london-and-edinburgh-set-to-be-the-first-to-trial-self-driving-vehicle-services
[36] "Autonomous Vehicles Readiness Index »,KPMG, 2018

approval (2015), development of new driving licenses, but also large subsidies for infrastructure improvement and AV pilots.

- European subsidies also allow the development of pilot zones, e.g. the Avenue Project[37] (Geneva, Lyon, Copenhagen, Luxembourg), Auto C-ITS [38](Madrid, Paris and Lisbon).

2.3.3 *Outcome-based regulation*

- **Definition:** This regulatory process details the policy objective to achieve, without detailing the specification of the process that should be used to fulfil them. Results are monitored according performance indicators.
- **The advantages and drawbacks of this regulatory process** are presented on the table below:

Table 2-7: Outcome-based regulation - Advantages/Drawbacks

ADVANTAGES	DRAWBACKS
• Innovation enhancement (either technological or methodological) • More flexibility • More adoption by the regulated party that develops its own solutions to be compliant • Applicable at all levels	• Not efficient if the expected outcomes are not well defined • Lack of guidance could be disturbing • Higher cost for the definition of specification and measurement of performance indicators

- **Policy instruments:**

Soft laws such as self/co-regulations are compliant with that process too. Impact analysis, indicators monitoring will allow the policy makers to know if the regulations achieve the policy goals and expected outcomes.

- **Application examples:**

This regulatory process could be employed for security purpose: this is a considered solution for regulating aviation security in Canada[39], as well as in maritime industries[40] that have both to be eco-friendlier.

This process is also suitable for privacy purpose. GDPR set up a list of objectives to relevant stakeholders: for example, the right to erasure (Art. 17).

[37] https://h2020-avenue.eu/content/avenue-demonstrator-sites
[38] https://www.autocits.eu/
[39] "Towards outcome-based regulatory compliance in aviation security", R. Tawhid & al., Conference paper (20th IEEE International Requirements Engineering Conference (RE), September 2012, DOI: 10.1109/RE.2012.6345813
[40] "Goal/Risk based design- Benefits and Challenges", Vince Jenkins, Interferry, Dubai, October 2012

2.3.4 *Risk-based regulation*

- **Definition:** This regulatory approach aims is defining as following:

> "The application of a systematic framework that prioritises regulatory activities and deployment of regulators' resources on an evidence-based assessment of risk", Baldwin & Black, 2007

This means that this regulatory process allocates resources proportionally with risk priority, which is given regarding impact and likelihood. Mitigation measures are thus carried out considering first the higher risks that have been assessed, and then going down into the priority list in order to address all the risks.

- **The advantages and drawbacks of this regulatory process** are presented on the table below:

Table 2-8: Risk-based regulation - Advantages/Drawbacks

ADVANTAGES	DRAWBACKS
• Risk assessment could support better decision-making. • Greater outcomes • Cost-effective	• Higher cost to perform risk assessment and performance and risks monitoring; • Risk assessment unreliability could prevent from adopting the right measures

- **Policy instruments:** This regulatory approach encompasses all policy instruments, from traditional ones to new ones in order to achieve policy goals.

- **Application example:**

Risk-based regulation is used to fulfil environmental objectives, as well as ensuring food safety, securing financial markets and occupational health and safety, improving legal services[41].

For instance, Australia, through the Office of the National Rail Safety Regulator, employs this process in order to improve rail safety[42].

[41] Black, Julia and Baldwin, Robert (2012) "When risk-based regulation aims low: a strategic framework. Regulation and Governance", 6 (2). pp. 131-148. ISSN 1748-5983 DOI: 10.1111/j.1748-5991.2012.01127.x

[42] https://www.onrsr.com.au/__data/assets/pdf_file/0003/13278/Presentation-Risk-Based-Regulation-Central-BOF-9-December-2015.pdf

2.3.5 *Collaborative regulation*

- **Definition:** Collaborative governance could be defined as follows:

"A governing arrangement where one or more public agencies directly engage non-state stakeholders in a collective decision-making process that is formal, consensus-oriented, and deliberative and that aims to make or implement public policy or manage public programs or assets."[43]

This regulatory process requires shared understanding, trust within parties involved.

- **The advantages and drawbacks of this regulatory process** are presented on the table below:

Table 2-9: Collaborative regulation - Advantages/Drawbacks

ADVANTAGES	DRAWBACKS
• Better adoption of the regulatory measures by non-state stakeholders through an agreement. • Regulations are more compliant with the stakeholders' framework. • More democratic management • Share of knowledge and resources	• It could be time consuming to build a consensus and get trust from each other. • Complex structure with no clear leadership.

- **Policy instruments:** Co-regulation is suitable for that purpose.

- **Application example: Industry guidelines for the security of the transport of dangerous goods by road**

In 2005, to address the issues related to the diversity of standards regarding the road transport of dangerous goods, a co-regulation initiative was set up to submit guidelines at the European level. The gathered stakeholders were European Councils and associations:

- AISE (International Association for Soaps, Detergents and Maintenance Products)
- CEFIC (European Chemical Industry Council)
- CEPE (European Council of the Paint, Printing Ink and Artists' Colours Industry)
- CLECAT (European Association for Forwarding, Transport, Logistics and Customs
- Services)
- ECTA (European Chemical Transport Association)
- EFMA (European Fertilizer Manufacturers Association)
- FECC (European Association of Chemical Distributors)
- FIATA (International Federation of Freight Forwarders' Associations)
- IRU (International Road Transport Union)

[43] "Collaborative Governance in Theory and Practice", C. Ansell & A. Gash, JPART 18:543-571, doi:10.1093/jopart/mum032

2.4 Summary

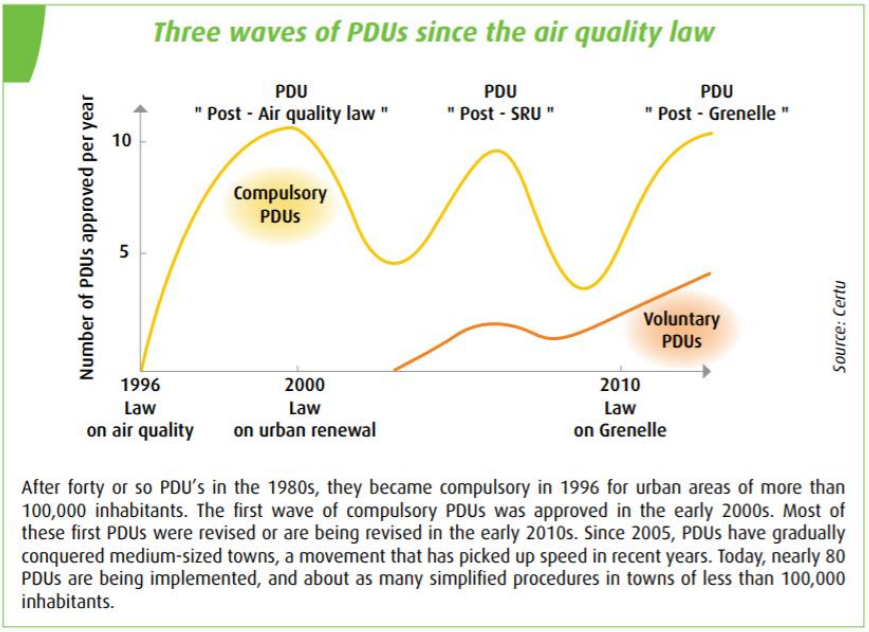
Table 2-10: Summary table of governance models and policy instruments

Governance model	Definition	Example of policy instruments	Where it could work the best ?
Binding rules	Legislative acts, 'traditional' laws or directives	• EU directives • National/regional/ local laws	• Definition of standards • Long-term policy objectives • Cybersecurity, environmental data • Transnational mobility • Solution operation
Market	Influence on economic variables to achieve policy goals	• Taxes/charges • Call for bids	• Negative externalities • Behaviours
Adaptive regulation	Policy that can be adjusted over time, relying on data collection and analysis	• Self/co-regulations • Adaptive licensing	• Impact assessment
Regulatory sandboxes	Deployment on the innovation on restricted and controlled conditions for impact analysis	Subsidies and incentives	• Pilot projects • Innovation enhancement • Impact assessment
Outcome-based	Stakeholders impacted by the regulations achieve policy goals without constraints on the process	Self/co-regulations	• Impact assessment
Risk-based	Regulatory activities and resources allocated on evidence-based assessment risks	All policy instruments	• Regulation of pilot projects • Impact assessment
Collaborative regulation	All stakeholders involved in the	Co-regulation	• Definition of standards

	definition of the regulation/policy		• Regulation of new markets

2.5 Towards an integrated approach, coping with the current fragmented regulatory schemes

Urban transportation planning has been existing for several decades in order to propose tools for the development of active modes and public transport. For example, in France, the urban mobility plans "Plans de déplacement urbains" were started, following the French domestic transport law[44] in 1982, with a progressive adoption by local authorities, as we can see on the figure below.



Nevertheless, these transportation plans were focused on traffic reduction with a focus on one mode and a limited impact assessment.

At the European scale, the White Transport Paper started to foster the development of a network approach for the regulation of all urban mobility services, either for people or goods.

Paragraph 49: "In the urban context, a mixed strategy involving land-use planning, pricing schemes, efficient public transport services and infrastructure for non-motorised modes and charging/refuelling of clean vehicles is needed to reduce congestion and emissions. Cities above a certain size should be encouraged to develop Urban Mobility Plans, bringing all those elements

[44] https://www.cerema.fr/system/files/documents/2017/11/1304_Fiche30ansPDU_EN_cle6c8317.pdf

together. Urban Mobility Plans should be fully aligned with Integrated Urban Development Plans. An EU-wide framework will be needed in order to make interurban and urban road user charging schemes interoperable."[45]

Following this initiative, the European Commission published in 2013 the "Urban Mobility Package", through the communication COM(2013) 913 to develop the Sustainable Urban Mobility Plans (SUMPs) to adopt this network approach all over EU.

"New approaches to urban mobility planning are emerging as local authorities seek to break out of past silo approaches and develop strategies that can stimulate a shift towards cleaner and more sustainable transport modes, such as walking, cycling, public transport, and new patterns for car use and ownership. […] Sustainable Urban Mobility Plans are about fostering a balanced development and a better integration of the different urban mobility modes."[46]

These SUMPs are also an innovative approach through the eight principles that drive this concept[47]:

- Plan for sustainable mobility in the "functional urban area", by considering people and goods flows for the urban core **and** commutes to work;
- Establishment of **cooperation models** between other planning (land-use, spatial planning, etc.), different levels of government (local, regional, national, etc.), and between public and private parties;
- **Participatory approach**, involving citizens and all the stakeholders (before, only experts were included in the process);
- **Performance assessment**, with an impact monitoring in terms of quality, security, safety, etc.;
- **Long-term vision,** with a detail implementation plan;
- **An integrated approach**, which encompasses all transport modes, either public or private, people or goods, as well as infrastructures and services.

These targeted objectives are achieved through 12 steps process (see the following figure) which are part of four phases: preparation and analysis, strategy development, measure planning, implementation and monitoring.

[45] https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:52011DC0144&from=EN
[46] https://ec.europa.eu/transport/sites/transport/files/themes/urban/doc/ump/com%282013%29913_en.pdf
[47] "Guidelines for developing and implementing a Sustainable Urban Mobility Plan" – 2nd Edition

Figure 5 SUMP process, extracted from the 2nd edition of the SUMP Guidelines – The symbol ✓represents political involvement steps.

According to the article published by E. Pisoni & al.[48], the SUMPs have already been setup in 642 cities, with a reduction of the emission pollutants already observed: up to 2% for PM2.5 particles and close to 4% for NO2 particles.

The regulatory supportive tools developed within the GECKO project could be added in the definition of the strategy through the SUMP process. In fact, the first steps of this process enable a precise overview of the current situation on the territory that allow the 2RL assessment (see section 4.3), which is the main parameter to provide custom-made recommendations on the regulatory process that can be used to foster the integration of all the transport modes while achieving policy objectives. As these tools encompass all disruptive mobility solutions, they are compliant with the integrated approach adopted for SUMP.

[48] "Evaluating the impact of "Sustainable Urban Mobility Plans" on urban background air quality", E. Pisoni & al., Journal of Environmental Management 231 (2019) 249-255

3 REGULATORY CHALLENGES, BARRIERS, RISKS

3.1 Global challenges, expected benefits, barriers and risks related to disruptive mobility solutions

All disruptive mobility solutions aim at improving our way of life by offering services or technologies that will reduce our environmental footprint or improve mobility services offer. But what are the challenges and barriers to achieve this objective? What are the risks and negative impacts that we have to avoid through regulations?

3.1.1 *Global expected benefits*

- Expected benefits for mobility services

All these high connected mobility innovations can provide real-time journey information and guidance for mobility service users who can improve their travel time. They can have also additional options, such as on-demand travel or other solutions to address first mile/last mile issues.

Disruptive mobility solutions thus improve the global service offer which is more attractive and incentivizes the migration from private car ownership to more sustainable modes.

- Socio-economical expected benefits

In addition, mobility is key for the assessment of the global city attractiveness and quality of life. Currently, traffic jams can hinder the economic development of cities.
Disruptive mobility solutions can be a key building block for the sustainable development of cities, a driving force for their economic growth, as it extends the urban area by facilitating the access by suburbs areas. In addition, they create an ecosystem around this field of expertise that fosters innovation and creates business opportunities.

- Environmental expected benefits

As mentioned before, these disruptive innovations can reduce our global environmental footprint if they are used in the most appropriate regulatory framework. Improving traffic management through the connectivity of the infrastructures can have a huge impact on traffic jams and on the incentivization towards the use of shared electric mobility and multimodal transport.
These new mobility solutions can thus induce people to migrate from private car ownership to more sustainable modes and by consequence improve air quality and the global environmental footprint.

3.1.2 *Common challenges*

But there are some challenges to address to get these positive outcomes, relying on the influencing factors that were detailed in deliverable 2.2 (see the extracted figure below):

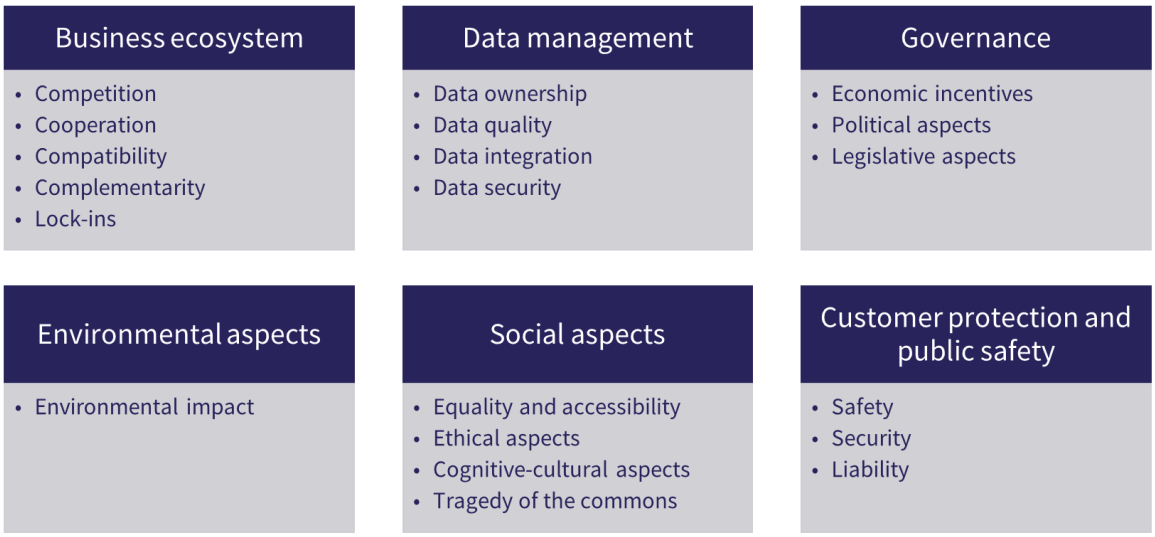


Figure 6: Influencing factors - Extracted from the Deliverable 2.2: "Investigation of main economic, political and social variables" A. Tsvetkova & al.

- Data-related challenges

Disruptive mobility solutions are offering a new paradigm regarding transport which becomes more and more connected (autonomous vehicles, services proposed through APIs, etc.).

- The massive data exchanges (traffic data collection, e-ticketing, etc.) are very challenging in terms of **privacy and security**, which are key criteria in order to get massive adoption of the technologies.
- In addition, **data ownership** has to be defined in the framework of cooperation models (see GECKO Deliverable 2.3 Analysis of cooperation models among public and private parties).
- On a technical point of view, **heterogeneous data have to be integrated** and processed in a way that guarantees **information quality**. Data **interoperability** is thus an objective to achieve.
- Also, as some data on transport are supranational, and their use could bring further improvement for traffic management, the EU has set the first legislative block to build a unique and interoperable database[49].

- Cooperation and governance challenges

Cooperative Intelligent Transport Systems (C-ITS) will manage the interactions with all connected devices (infrastructure, vehicles, smartphones), revolutionizing transportation planning and

[49] *COMMISSION DELEGATED REGULATION (EU) 2017/1926 of 31 May 2017*, supplementing Directive 2010/40/EU of the European Parliament and of the Council with regard to the provision of EU-wide multimodal travel information services.

traffic management. The challenge here is to define a **cooperation model** to get the **right balance between public and private interests**:

- Achievement of policy goals;
- Customer protection;
- Social acceptancy, through fair access of transport services.
- Best market environment.

This cooperation models are part of the **new governance models** that will define **new political and legal framework** compliant with these disruptive mobility solutions.

- Regulatory challenges

The **design of the new regulatory framework is also challenging**, as it has to be compliant with the fast evolution of technologies and services, using new governance models that are more flexible. In addition, to foster the transition towards a new mobility era, a new regulatory approach has to be adopted, encompassing all interconnected mobility solutions.

- Energy transition challenge

All disruptive mobility solutions (current or future) help to prepare the energy transition, by offering fewer polluting vehicles, solutions for traffic improvement, shared services instead of private vehicle ownership. Public authorities have thus to address the challenge to **foster the innovation while ensuring themselves that the disruptive innovations are compliant with policy goals** and avoiding possible risks that can prevent from achieving them (see paragraphs "Risks").

3.1.3 *Global potential barriers and risks*

Several barriers can prevent from deploying disruptive innovations in transport:

- **Legal**: the lack of standards, the unspecified ownership of data or other public procurement principles.
- **Technological**: the lack of interoperability, the bad dimensioning of mobile network, the lack of integration between transport modes, the infrastructure which is not compliant;
- **Social**: The lack of public acceptance of the technologies or lack of measures such as subsidies to foster their acceptance; marginalization or discrimination of some sections of the society (e.g. disabled persons), who cannot access new mobility solutions.
- **Ethical**: Loss of privacy due to mobility solutions that rely on information such as location data to improve services.

In addition, unexpected and unwanted impacts can potentially be brought by innovative mobility solutions. They have to be considered in order to set up the right regulatory framework that will avoid them:

- **Security and safety:** the lack of cybersecurity and personal data protection (external access to people geolocation, social and cultural information, IDs, bank codes, lack of data interoperability, etc.), unreliable mobility solution providers;

- **Economics:** disequilibrium of the ecosystem of the mobility solution providers (e.g. unfair competition, market failure), unprofitable business models;
- **Social:** public transport less affordable, and by consequence less inclusive, due to the use of private services instead of public one (disequilibrium of the ecosystem).

3.2 Challenges, expected benefits, barriers, potential risks for each category of disruptive mobility services, case studies

NB: The definitions of disruptive mobility services were reported in the previous deliverable D1.1[50].

3.2.1 *Cooperative, connected and automated transport technologies*

AV pilot projects are being monitored in many countries at the worldwide scale (USA, Singapore, European cities, etc.). Key issues to be addressed include the performance of automated transport technologies, a regulatory framework which supports the fast introduction of these technologies, acceptable levels of cybersecurity, as well as new business models. The Strategic Transport Research and Innovation Agenda (STRIA) Roadmap for Cooperative, Connected and Automated Transport aims to develop a customer-centric, intermodal integrated transport system to ensure greater efficiency, safety and wellbeing and lower environmental impacts.

3.2.1.1 Expected benefits

The expected benefits of autonomous and connected vehicles are:

- More safety and comfort:
  - Improvement of road safety: reduction of the number and severity of accidents
  - Reduction of stress and fatigue during driving
  - Saving time for other tasks
  - Reduction of fuel consumption
  - Decrease in the number of fines
- Smart mobility
  - Optimization of journey time
  - Better use of road infrastructure and greater traffic fluidity
  - Responding to new mobility needs: increasing the efficiency of the transportation of goods and fostering the emergence of multi-modal transport solutions

[50] Deliverable D1.1: "Review of new mobility services and technologies", V. Lubello & al.

3.2.1.2 Challenges

To be deployed on a large scale, autonomous vehicles will have to:

- Achieve a level of technological maturity that meets safety requirements;
- Ensure interoperability of the various systems, through cooperative infrastructures, standards and norms, certification procedures, maintenance networks, etc.;
- Provide new mobility services;
- Ensure their economic viability;

Other important considerations concern the deployment of the underlying infrastructures necessary for the wide-scale operation of CAVs: firstly, a telecommunications network that allows to satisfy – in terms of bandwidth and latency – the huge need for data transfers, but also, depending on the operating models that will emerge, the installation of signage or dedicated traffic lanes.

It can be noted that the use of CAVs could develop at different paces in urban and rural areas: better network coverage and more infrastructure will allow better functionality in cities, at least as a first step.

On the regulatory point of view, the definition of a new legal framework is challenging, existing legal barriers have to be lowered down (e.g. Vienna convention forbids driverless vehicles), while ethical issues related to artificial intelligence algorithms employed have to be addressed. In addition, this regulatory framework has to be defined at national and international levels in order to ensure interoperability (infrastructure, data) over several countries (at the EU level at least).

3.2.1.3 Potential Risks and Barriers

Table 3-1: Potential risks and barriers regarding cooperative, connected and automated technologies

Risk / Barrier	Description	Category
Barrier: Lack of layout of the territory	Lack of equipment of infrastructures preventing vehicles from communicating with their environment	Technical
Barrier: Responsibility	Who is responsible in case of incident?	Legal
Barrier: Ethical issue	What are the ethical rules to be applied as a priority in the case of a choice between two incidents?	Legal
Risk: Security of other users	One of the greatest complexities to be expected for the onboard computer will certainly be to take into account the reactions of humans who will still command their movements.	Security

Risk / Barrier	Description	Category
Barrier: Public acceptation	The willingness of the public to transfer responsibility to the vehicle is not acquired. Fear of lack of security and regulations is also a barrier.	Social
Barrier: Simulation	Although a number of pilot demonstrations of CAVs technologies are taking place in Europe, there is still a need to test the technological readiness, reliability and safety of automated transport functions in complex traffic situations at large scale.	Technical
Risk: Cybersecurity	Protection of personal data. Hacking the system and taking control of the vehicle for criminal purposes.	Security
Barriers: Political barriers and lack of communication	Conflicting goals, lack of recommendations and information, non-inclusion of manufacturers in the regulation, rules varying from one city to another.	Social, Economical
Risk: Creating congestion and pollution	Replace journeys that would have been made in soft mobility (or public transport) by car journeys.	Environmental
Risk: Ride empty	Vehicles confined to a geographical area (obliged to return to their empty area), obliged to ride empty to find a passenger.	Environmental
Risk: No accountability in relation to the material	Shared material and infrastructure degradation because "it belongs to everyone".	Economical

3.2.2 *Shared/on-demand mobility*

A comprehensive set of mobility services can be defined as shared/on-demand mobility: electro-micro-mobility (e-scooters), bike-sharing, car-sharing, ride-hailing.

These services imply different regulatory challenges. As an example, dockless bike-sharing and e-scooter sharing requires proper legislative measures on drivers' conduits and on public space management.

But when we deal with regulatory challenges linked to shared/on-demand mobility services, one of the first examples that comes to mind is Uber, as it regards a public (and political) decision on the way the market is managed. Local authorities are dealing with the implementation of this famous ride-hailing service. For example, in London, its licence to operate was not renewed by Transport for London in 2017 because of "lack of corporate responsibility in relation to a number

of issues which have potential public safety and security implications"[51], but ended up getting a 15 month permit in 2018[52]. Other countries have partially banned this service (France, Italy, Finland, Germany, Netherlands), or have even fully banned it (Denmark, Northern Territory of Australia, Hungary, Bulgaria, China)[53], as the Uber business model is not compliant with their local regulations, and sometimes is considered as an unfair competitor with taxi drivers. We could also mention the free-floating electric scooters that were removed three days after deployment in Toulouse (France)[54], or the dockless bike-sharing that was banned in Amsterdam[55], etc. These examples reflect the current issues that the local authorities are facing with regard to this category of mobility service.

3.2.2.1 Expected benefits

The benefits of performing services of shared and on-demand mobility are numerous, we have listed below the **main benefits that justify big investments in these new modes**:

- Reducing congestion
- Lower costs for households by cost sharing, smoother traffic, reducing vehicle ownership and access to soft transport (cheaper); lower cost also for the public authorities by reducing the wear and tear and maintenance of infrastructures, increasing the use of public transport, increasing public spaces by reducing parking, etc.
- Opening up rural and peri-urban areas

Other more general benefits arise from these key features:

- Social cohesion
- Attractiveness of cities: increased economic activity through a full range of transport for city centres
- Improving air quality and therefore quality of life and health

To achieve these results, challenges need to be met. Regulations should maximize the achievement of these objectives.

[51] https://www.independent.co.uk/travel/news-and-advice/uber-ban-countries-where-world-taxi-app-europe-taxi-us-states-china-asia-legal-a7707436.html
[52] https://www.theguardian.com/technology/2019/feb/26/uber-survives-legal-challenge-london-black-cab-drivers
[53] https://www.oyster.com/articles/64335-where-is-uber-banned-around-the-world/
[54] https://www.ladepeche.fr/article/2018/10/23/2893850-trottinettes-libre-service-sont-volatilisees-mardi-matin-toulouse.html
[55] https://www.bikebiz.com/amsterdam-bans-dockless-bikes/

3.2.2.2 Challenges

The main challenge of shared mobility is **offering citizens a service with the same advantages as the individual car** (door-to-door) **while sharing the journey** (at the same time) **or the vehicle** (over a longer period) with other users**.**

To obtain an almost door-to-door journey, a critical mass of users must be attained. This critical mass can only be achieved if the different modes of mobility are required to associate with each other. **An offer of intermodal mobility with a thorough orchestration is necessary.** The Maas addresses this problem.

Other challenges are then inserted into this global challenge:

- Address short distance journeys (problems of the first and last km)
- Address home-work paths: increase the number of occupants of the personal car for those who have no choice.
- Address last minute journeys (real-time mobility)

All these challenges, to be met, face barriers or have risks. The regulations to be put in place must at all costs allow to circumvent these barriers and limit these risks, with the design of a framework that allows a win-win partnership between private and public parties.

3.2.2.3 Potential Risks and Barriers

Any innovation comes with economic, political, social and environmental risks but it is possible to frame each new mode of mobility to limit these issues, for instance the regulation that came into effect for the electric scooters in Paris in April 2019[56], then generalized and came into effect in the whole of France in May 2019[57].

[56] https://www.ouest-france.fr/ile-de-france/paris-75000/trottinettes-electriques-paris-adopte-l-interdiction-de-circuler-sur-le-trottoir-6293281

[57] https://www.lemonde.fr/economie/article/2019/05/04/la-circulation-des-trottinettes-electriques-sera-interdite-sur-les-trottoirs_5458278_3234.html

Table 3-2: Potential risks/barriers for Shared and On-Demand Mobility

Risk / Barrier	Description	Mobility Service	Category
Lack of layout of the territory	Lack of areas equipped at intermodal nodes, poor signage. Lack of stations or empty stations.	Carpooling / Carsharing	Technical
Security and quality of life of pedestrians	The new individual free-floating modes of transport are currently causing accidents (increasingly frequent) and congestion on the sidewalks. The absence of noise from electric vehicles is also a danger.	Individual modes	Security
Citizen involvement	A lack of willingness on the part of the citizens who do not opt for carpooling and car-sharing applications would prevent the critical mass necessary for their efficiency. Society needs to think about its future using soft mobility and public transport.	Carpooling / Carsharing / Soft mobility / Public transport	Societal
Psychological costs	Confidence in the individual, fear of lack of security, obligation to talk, lack of regulations. Insurance.	All	Societal
Mentality change with regard to mobility	Reliability: assurance of making the journey from A to B, then from B to A especially for those which are not predictable. Autonomy of electric vehicles. Avoid a trip reservation that is too long or complicated, especially for short journeys.	Carpooling / Carsharing / Individual…	Societal
Cybersecurity	Protection of personal data.	All	Security
Political barriers and lack of communication	Conflicting goals, lack of recommendations and information, non-inclusion of manufacturers in the regulation, rules varying from one city to another, protection of public transport companies.	All	Social
Creating congestion and pollution	Replace journeys that would have been made using soft mobility (or public transport) by car journeys.	On demand services / Carsharing / Carpooling	Environmental
Empty Ride	Vehicles confined to a geographical area (having to return to their area which is vacant), obliged to ride to find a passenger (cannot park).	Taxis & VTC / Autonomous Taxi	Environmental
No accountability in relation to the material	Shared material and infrastructure degradation because "it belongs to everyone".	Individual soft mobility / Car sharing / Public transport	Economical

Risk / Barrier	Description	Mobility Service	Category
Economic viability	The authorities must have a viable economic model because they do not have infinite financial resources.	All	Economical
Logistic viability	Manage material logistics: having bikes, cars, scooters and others in the right strategic location. Manage the logistics of the charging them electrically.	Car sharing / Individual soft mobility	Economical
Complex ticketing	Lack of integration of the city's overall offer.	All	Technical
Integrating mobility for all	Users without smartphones. People with reduced mobility.	All	Social

3.2.3 *MaaS and platforms*

MaaS: Mobility as a Service. This is one of the most disruptive innovations, in a way that it will change significantly the worldwide conception of mobility, merging all mobility services in order to provide a unique offer, making easier the journey planning and booking, thus leading to the reduction of car ownership. With a growth of 150% per cent per year, MaaS is expected to generate $11bn of revenues by 2023[58], through initiatives such as Whim or Moovel. Europe is very competitive, with four European cities ranked among the most prepared city for large-scale MaaS deployment, at the worldwide scale: Helsinki, Stockholm, Vienna, Amsterdam[59].

But MaaS market will be driven also by the regulations. Merging all transport services will be challenging, as private and public stakeholders are involved, with different interests and objectives. MaaS is one of the most relevant examples illustrating the necessity to move from the current mode-by-mode transport regulation basis to a network approach.

3.2.3.1 Expected benefits

MaaS aims at gathering all mobility services, thus targeting the common benefits mentioned in section 3.1, and the benefits from all the mobility services that are mentioned in the case studies. Moreover, as MaaS provides intermodal mobility services, specific benefits can be point out, such as:

- Addressing first mile/last mile problem;
- Improving travel time;
- Reducing car ownership;

[58] https://www.smartcitiesworld.net/news/news/regulation-will-drive-mobility-as-a-service-3440
[59] https://www.smartcitiesworld.net/news/news/helsinki-leads-in-mobility-as-a-service-3308

- Enhancing the use of all transport resources;
- Developing country-wide ticketing system, thus making journey planning and booking easier.

3.2.3.2 Challenges

Key features must be considered when we deal with MaaS deployment, as this service brings numerous players, divided in three categories:

- Competition perspective;
- Customer protection (e.g. insurance);
- Cooperation between public and private companies (are public transport companies willing to allow private one to sell their tickets ?)
- Platforms interoperability
- Data security, both related to the protection of central cloud and to the heterogeneous data integration.

This is a global regulatory challenge, as it is directly related to the design of a new integrated approach for the regulation of disruptive mobility solutions.

Table 3-3: MaaS Key Features, listed regarding three points of view: competition perspective, customer protection, data security.

Competition perspective	Customer protection	Data security
The choice of the right balance between public and private interests (adequation with policy goals, and business profitability), in order to create the best market environment: user-centric, customer-centric, market-centric.	The right regulatory framework regarding information quality and liability.	The protection of the personal data that are use within all stakeholders, for traffic management (location), but also for the data used for booking and payment.
The establishment of a cooperation framework (open data, new business models with the use of an intermediary platform, etc.) and the reliability assessment of transport service providers.	The right regulatory framework regarding the journey management: alternative route guidance, insurances, etc.	The heterogeneous data integration, and the data uniformization within all stakeholders (journey planning, pricing, etc.).
The market transparency		The cybersecurity regarding the e-payment for the customers.

3.2.3.3 Potential Risks and Barriers

MaaS can offer significant improvements regarding mobility with a right regulatory framework that can prevent from the risks and barriers related to the downward slide of the implementation of this service. On the table below are listed specific environmental, social, economical, political, technical and security barriers/risks specific to MaaS functionalities.

Table 3-4: Potential Barriers/Risks for MaaS

Barriers/Risks	Description	Category
Risk: Lack of cooperation between the stakeholders:	No agreement can be found preserving mutual interests (market disequilibrium, inability for authorities to address market failures), transport operators refuse to adjust their business models to integrate the platform (no commercial agreements to sell transport services to a third party).	Economical
Barrier: Lack of infrastructure	Lack of investment regarding infrastructure (all transport modes must be connected to be integrated in the service)	Economical
Risk: Market failure	Too much MaaS operators available on a given territory can lead to local market failure and prevent from the deployment of MaaS.	Economical
Barrier: Lack of data interoperability	Heterogeneous data required for MaaS development can't be processed to ensure intermodality.	Security
Risk: Transport less affordable	Public transport less affordable for customers through the integration in the platform, pressure on public transport operators for the prices.	Social
Barrier: Low public acceptation	Lack of public acceptation regarding dropping car ownership, the use of a platform sharing personal data within different stakeholders.	Political
Risk: Lack of consumer protection	No guarantee in case of cancellation, unavailability of one or several transport modes	Security
Risk: Lack of cybersecurity	Lack of protection regarding e-payments and personal data.	Security
Barrier: Lack of transport services (e.g. rural areas)	In rural areas, new transport modes need to be available in order to deploy MaaS.	Economical
Barrier: Unavailability of intramodality	Difficulties to integrate multimodal transport nodes in metropolitan and urban areas	Technical
Risk: Dis-incentivising sustainable trips, congestion increased	Depending on the modes of transport that are used (e.g. TNC chosen massively instead of public transport or active modes)	Environmental

Risk: Liability problems in case of wrong data provision	Liability issues related to wrong data provision	Legal
Risk: Lack of control on mobility solution provider	Lack of control on transport service providers integrating MaaS platform can lead to safety and security issues.	Security

3.2.4 *Infrastructure, network and traffic management systems*

Traffic management plans are currently established with information provided by traditional sensing and surveillance technologies located on the road, without considering information coming from the drivers themselves through the connected vehicles or the apps they use (Waze, Google Maps, etc.). The advent of these IoT allows advanced monitoring technologies, and information improvement regarding traffic conditions. Cooperation between all the stakeholders could thus improve road traffic management, leading to a congestion decreased and air quality improvement.

3.2.4.1 Expected benefits

As described in deliverable D2.1[60], high-performant traffic management system contributes to sustainable mobility thanks to a better understanding of current traffic conditions, leading to road safety improvement and congestion decrease. This could lease also to new traffic models and control strategies that can improve performance of current traffic management plans. Moreover, building Cooperative Traffic Management System could also bring social and economic benefits by creating a cooperative framework between private and public stakeholders.

Infrastructure is key regarding smart mobility, as monitoring technologies and devices are at the core of the services/functionalities proposed by each innovative solution. Efforts and investment are currently being made in order to get a connected infrastructure that addresses these disruptive technologies requirements. In addition, innovative infrastructure is also being developed to provide new sustainable transport.

3.2.4.2 Challenges

- Infrastructure:

Besides the common challenges of smart mobility solutions, a relevant example to explain specific challenges that can be/will be brought by disruptive infrastructure is the development of

[60] Analysis of regulatory responses and Governance models, A. Reynaud, G. Marinic, C. Busquet, Y.Bousse, V. Lubello

hyperloops. As it was explained for Deliverable D2.1(see footnote 60), hyperloops implementation is hard on a regulatory point of view, as this mode of transport has not been yet categorized and standardised: difficulties are met to get authorizations for the deployment of this transport. This case study illustrates quite well the necessity to provide a new regulatory framework that will be able to anticipate the advent of future disruptive solutions.

- Traffic Management:

Cooperative traffic management system is very challenging regarding heterogeneous data integration coming from the stakeholders (traffic managers, drivers, etc.), information liability, security and processing (traffic condition representation and hazards identifications). In addition, a cooperation framework has to be setup with public and private stakeholders in the way that mutual interests are preserved. Also, a common database will be a necessary infrastructure for the development of this service. Accordingly, it will be also necessary to establish common standards for data interoperability, which could be reached through a network approach.

3.2.4.3 Potential Risks and Barriers

Table 3-5: Potential Barriers and risks regarding infrastructure and traffic management technologies

Barriers/Risks	Description	Category
Risk: Lack of cooperation between the stakeholders:	No agreement was found preserving mutual interests (market disequilibrium, inability for authorities to address market failures), transport operators refuse to adjust their business models to integrate the C-ITS traffic management system (no commercial agreements to sell transport services to a third party).	Economical
Barrier: Lack of data interoperability	Standards have to be defined for the heterogeneous data that have to be processed.	Technical, legal
Barrier: Lack of correct mobile network dimensioning	Global traffic management can be slowed down/blocked due to bad connectivity	Technical
Risk: Liability problems in case of wrong data provision.	Lack of control on data providers regarding data quality.	Legal, Security
Barrier: Unspecified ownership of data	Cooperation issues due to the unclear ownership of data	Economical

Barriers/Risks	Description	Category
Risk: Lack of public acceptation	Lack of willingness, trust regarding data sharing (especially geolocation).	Social
Barrier: Lack of Investment	Investment has to be done to update existing infrastructure or to build new ones.	Economical
Risk: Lack of maintenance subsidies	Infrastructure are not sustainable and unreliable in case of lack of maintenance.	Economical

4 REGULATORY MATRIX

4.1 Methodology

The Regulatory Matrix is a regulatory supportive tool that aims at providing regulatory responses and recommendations to public authorities, which will be able to address challenges and barriers related to the deployment of disruptive innovations in mobility, while guaranteeing expected benefits and avoiding threatening risks.

In order to provide relevant recommendations, we must have a good knowledge of the regulations related to disruptive innovations that exist over the world. In the framework of this deliverable, we set-up a **Regulatory Database** that collects all relevant data regarding these regulations:

- Description of the mobility solution regulated
- Category of mobility solution regulated: MaaS/platforms, connected and automated vehicles, shared/on-demand mobility, infrastructure/network and traffic management (see section 3 of this deliverable);
- Description of the regulation
- Physical jurisdiction: country(ies), region, city.
- Policy instrument
- Regulatory approach: binding rules, adaptive, etc.
- Outcomes (impacts) brought by the regulations:
- Barriers for implementation addressed,
- Expected benefits,
- Negative impacts to look for.

Then, we analyze for each disruptive mobility solution several regulatory approaches that were employed. **What are the key criteria that modify the approach taken to regulate a solution from one city to another?** This will help to understand better local authority's framework and categorize different types of regulatory responses through **the 2RL (Regulatory Readiness Level) parameter**. After this analysis, we will be able **to complete the Regulatory Database with this 2RL assessment**.

This Regulatory Database was completed by KPIs which assess more precisely the impact of regulations with metrics in the framework of the development of the Regulatory Frameworks Dashboard (Deliverable 3.1). This database will be included in an interactive tool that will be delivered to policy makers by M24 (November 2020).

4.2 The Regulation Database

At the core of the tool, this Regulation Database is a table (typically an Excel file) that collects all relevant data regarding case studies of regulations of disruptive mobility solutions. This interactive matrix was delivered as the same time as the Deliverable 3.1, as it includes a complementary analysis of the regulations in the database with KPIs.[61]

4.2.1 *Data collection*

4.2.1.1 Surveys

Two surveys were made to collect data for this database.

The first one is long, answering questions to gather all information we want to collect. This survey was dedicated to GECKO partners who contributes to this tool. This could be used also as a track for experts' interviews.
A second survey was set up in order to be sent to stakeholders. This survey was shorter in order to ensure a massive participation. The idea was to collect case studies at the European scale and to complete missing information afterwards with desktop research.
Some screenshots of the form are in annexes, see section 6.1.

4.2.1.2 Interviews

Three interviews have been performed in order to collect more data (reports available in section 6.2):

- Breogan Sanchez, at Fundación CIRCE: regulation of e-scooters at Zaragoza (Spain).
- Mateo Gudic, Teserakt: regulation that should be implemented for the bicycle infrastructure (Croatia)
- Colin Koh, Asian Detours: regulatory framework for e-scooters in Singapore, governance models regarding disruptive innovations.
- A transport technology provider: regulatory framework of tachographs.

[61] "Deliverable 3.1: The Regulatory Frameworks Dashboard", C.Busquet & al.

4.2.2 *Results*

The figures below present the distribution of the 136 regulations according to the case studies and the governance model employed, to have an overview of the current contents in the Database:

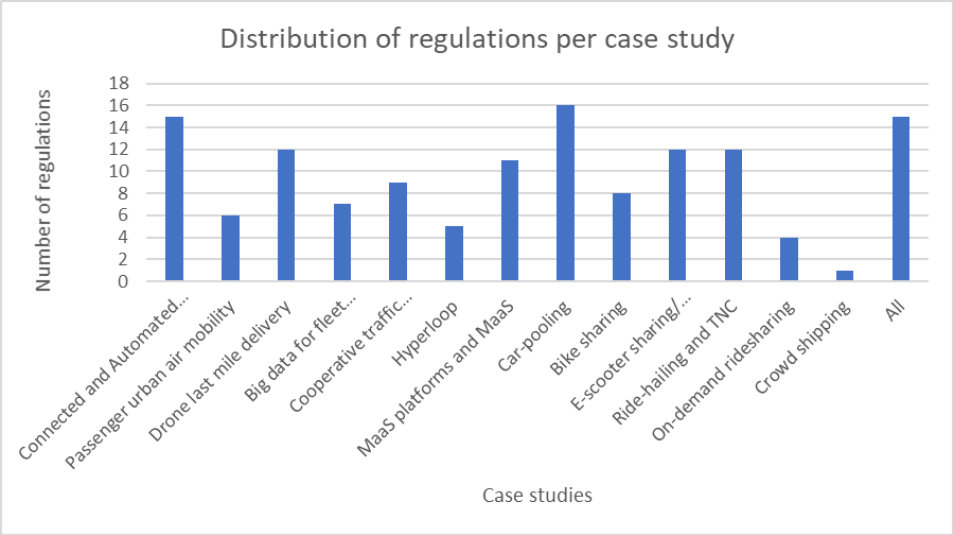


Figure 7: Distribution of regulations per case study

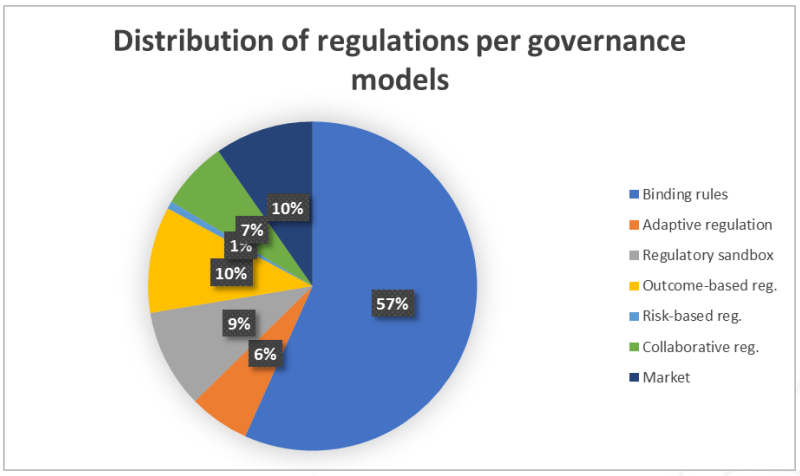


Figure 8: Distribution of regulations per governance models

From figures 7 and 8 we can conclude that few regulations exist for the most disruptive innovations, such as passenger urban air mobility or hyperloop that have a lower Technology Readiness Level or Market Readiness Level, as defined in Deliverable 1.1.

The main governance models used to regulate disruptive innovations are binding rules or market approach, flexible approaches are more adopted when there are more experimentations carried out. However, we can see that collaborative regulation is progressively used with some examples regarding hyperloop (consortium of industries to define technical standards) or e-scooters (Lisbon).

In addition, we have drawn a map to display the distribution of the collected regulations per country, at a worldwide level, then with a zoom into European countries:

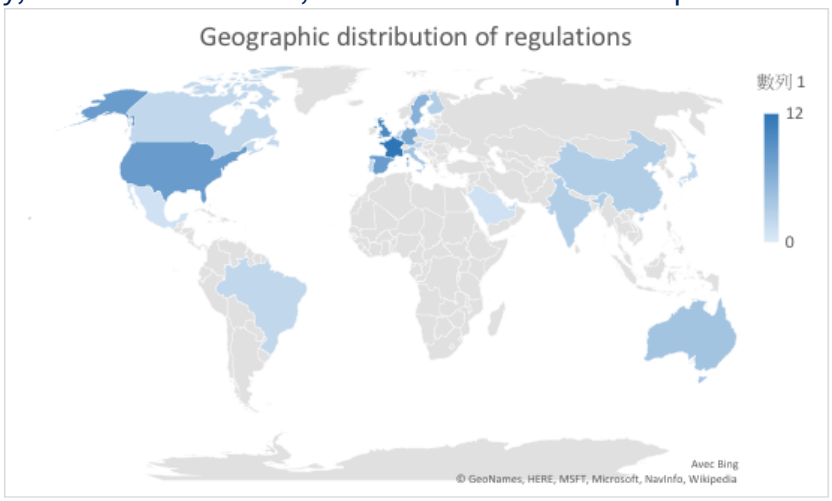
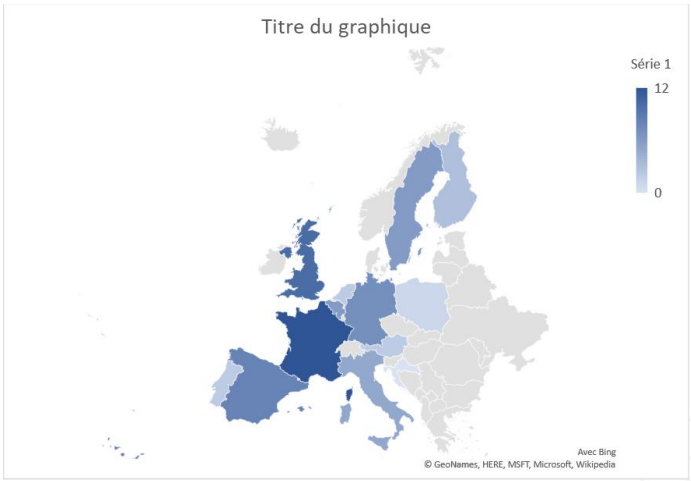


Figure 9: Geographic distribution of regulations (Zoom into Europe below)



4.3 The Regulation Readiness Level (2RL) assessment

The 2RL parameter allows the tool to propose the regulatory approach most in line with the existing regulatory environment of the authority, by assessing policy makers' readiness level to integrate the solution into the existing mobility offer available in their territories.

To define this parameter, an analysis of the regulations in the database was performed to define the influencing factors for the definition of the 2RL parameter. It is important to point out key criteria that can make a city adopt a different regulatory approach, for example:

- **Ecosystem & Innovation:** presence of companies/operators deploying the solution, research teams working on related topics, innovation strategy, market status…

- **Infrastructure:** presence of traffic management centre, data management of the network, information technology infrastructure…
- **Policy objectives:** roadmap, existing and future laws, subsidized R&D topics, presence of existing private-public cooperation framework, sustainable initiatives.

These examples of parameters are showed in the table hereafter:

Table 4-1: 2RL Parameters

Ecosystem	Deployment of the disruptive mobility solution in the territory
	Deployment of the disruptive mobility solution in another territory
	Number of companies offering the disruptive mobility solution in the territory
	Number of laboratories working on a topic related to the disruptive mobility solution
	Number of ITS accelerators in the territory
	What is the consumers' acceptance regarding the mobility solution?
Infrastructure	Presence of traffic management centre
	IT infrastructure: presence of open data for mobility solutions
	Facilities allowing the deployment of the mobility solutions: dedicated lanes, parking, etc.
	Planned facilities/infrastructures allowing the deployment of the mobility solutions
	Presence of technical services in charge of maintenance
	Payment IT infrastructure available
	Air space control infrastructure
Policy objectives	Is the deployment of the solution planned in the policy roadmap? Which year?
	Passed pilot program related to the mobility solution
	Future/Planned pilot program related to the mobility solution
	Number of regulatory bodies
	Existing regulations regarding this disruptive solution
	% of subsidies dedicated to transport and mobility solutions
	Presence of private-public cooperation for the deployment of this mobility solution

At the beginning of this research, it was believed that the 2RL parameter could be defined to categorize different regulatory approaches into three profiles, depending on the parameters we listed above:

- **"Flagship"**: advanced and visionary regulatory responses to integrate and comply with mobility offer;
- **"Adapters":** flexible approach, adopted by policy makers open to learn and follow evolutions of other countries, adapting themselves to better framework conditions;
- **"Conservative":** policy makers tend to protect existing legal approach and service providers work under very stringent conditions.

However, if we complete the previous table for two different mobility solutions (namely Hyperloop and E-scooters), we realize that the application of a regulatory approach depends on

the market and technology readiness levels of the mobility solutions. It is difficult to categorize a regulatory approach (binding rules, market approach, regulatory sandboxes, etc.) into the above described three profiles. For example, the deployment of hyperloops requires the definition of norms and standards regarding the vehicle itself or the related infrastructure, whereas the regulation of e-scooters sharing is more related to the limitation of operators because it is already deployed at the EU level.

Table 4-2: 2RL assessment: comparison between two case studies

Example of case studies		Hyperloop	E-scooters
Ecosystem	Deployment of the disruptive mobility solution	No	Yes
	Number of companies offering the disruptive mobility solution	Very few	Many (some cities list 15 operators)
Infrastructure	Planned facilities/infrastructures allowing the deployment of the mobility solutions	No	Yes (cycle lanes)
	Payment IT infrastructure available	No	Yes
Policy objectives	Is the deployment of the solution planned in the policy roadmap? Which year?	Yes	No (already deployed)
	Passed pilot program related to the mobility solution	No	Ongoing
	Future/Planned pilot program related to the mobility solution	Yes	Yes
	Number of regulatory bodies	Very few	Local authorities
	Existing regulations regarding this disruptive solution	Very few	Market approaches, binding rules for traffic code
	% of subsidies dedicated to transport and mobility solutions	Many (prototypes)	Few (already deployed)
	Presence of private-public cooperation for the deployment of this mobility solution	Yes	Yes

In view of this, it is better to consider the Regulation Readiness Level in terms of a time scale for applying the regulation on an innovative mobility solution, depending on the deployment of the solution in the market. This can be used as a basis for the definition of a 2RL parameter. Nevertheless, at each step of the regulatory process, policy makers can decide to include the following recommended flexible approaches that will be able to comply with innovative mobility offer without neglecting users' security and safety:

Table 4-3: Definition of 2RL parameter

2RL	Description	Regulatory approach - ***Recommendations***
1	Related to a disruptive technology/service for which norms and standards have to be defined	**Collaborative approach** to define norms and standards to ensure long-term security and safety at the EU level ➲ This approach allows fast adoption by manufacturers/service providers, as they are involved in the process and bring their expertise.
2	Related to the experimentation of a new technology/service	**Binding rules** to allow the deployment of the mobility solution (amendment of the national traffic code, etc.) for the experimentation of the solution. ➲ These rules can be mandatory to lower down legal barriers that prevent from the deployment of the solution or to set up a framework for experimentation and pilot programs. **Regulatory sandboxes** to test the solution on a restricted area and provide impact assessment. ➲ This approach allows the design of an appropriate regulatory framework thanks to the experience gained through pilot programs. **Market approach** to select operators to carry out the experimentation (subsidies, tradeable permit, etc.) ➲ This approach can be part of the regulatory framework set up to test a disruptive mobility solution.
3	Related to the regulation of a new technology/service already deployed:	**Binding rules** to define the conditions of use of the mobility solution (traffic code, insurance, etc.) ➲ Idem as level 2 **Collaborative approach**, local private-public cooperation to deploy the solution (e.g. Memorandum of Understanding) ➲ This approach allows the stakeholders to face challenges related to the fast emergence of disruptive innovations, with an adoption of a common agreement that fosters service providers' mobility solution while ensuring the achievement of policy objectives. **Market approach** to limit the number of operators or set up a cap on a fleet (licensing). This ensures that mobility solution providers will respect policy objectives (security, sustainability, etc.) through the fulfillment of specifications defined within a tradeable permit. Labelling schemes,

		financial instruments or education can also be used to incentivize the use of a mobility solution. For this approach, ➲ Either policy makers have to deal with the consequences of the mobility innovations 'pushed to the market' by solution providers ➲ Either policy makers want to promote more the solution in the city (e.g. car-sharing)

4.4 The Regulatory Matrix: case studies

4.4.1 *Cooperative, connected and autonomous mobility*

4.4.1.1 Connected and automated vehicles

Table 4-4: Connected and automated vehicles - Approach 1: Collaborative regulation

Declaration of Amsterdam (14th of April, 2016)
• Public-private cooperation framework to set-up 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[62].
Status of the regulation
• Has been implemented
Jurisdiction level
• Supranational: EU
Type of regulations
• Open method of coordination
Existing governance model/new approach
• New approach: Collaborative regulation

[62] https://www.regjeringen.no/contentassets/ba7ab6e2a0e14e39baa77f5b76f59d14/2016-04-08-declaration-of-amsterdam---final1400661.pdf

Outcomes
• Legal challenges are addressed through the deployment of a new regulatory framework co-designed by public and private stakeholders, ensuring safety and security for road users while incentivizing innovation.
2RL assessment
• **1:** Related to a disruptive technology/service for which norms and standards have to be defined

Table 4-5: Connected and automated vehicles - Approach 2: Binding rules

Traffic code amendments (Straßenverkehrsgesetz)
• Amendments allowing autonomous driving, subject to being able to regain control at any time.[63]
Status of the regulation
• Has been implemented
Jurisdiction level
• National
Type of regulations
• National/Regional/local law
Existing governance model/new approach
• Existing: binding rules (directive, laws, etc.)
Outcomes
• This binding rules rises an existing legal barrier that prevents from the use of autonomous vehicles (Vienna Convention). Safety and security are risks that have to be monitored.
2RL assessment
• **2:** Related to the experimentation of a new technology/service

Table 4-6: Connected and automated vehicles - Approach 3: Market

Smart Road Decree (Italy)

[63] https://www.gesetze-im-internet.de/stvg/__1a.html and https://www.gesetze-im-internet.de/stvg/__1b.html

• Permission for testing autonomous vehicles on Italian road[64]: this decree sets up technical requirements for AVs to be allowed to ride on Italian roads and the procedure for the application in order to get authorization from the Ministry of Transport.
Status of the regulation
• Has been implemented
Jurisdiction level
• National
Type of regulations
• Tradeable permit
Existing governance model/new approach
• Existing: Binding rules
Outcomes
• This binding rule addresses political challenges for the deployment of the autonomous vehicles and ensures safety. Security is a risk that can be monitored.
2RL assessment
• **2:** Related to the experimentation of a new technology/service

Table 4-7: Connected and automated vehicles - Approach 4: Regulatory sandbox

Catalonia Living Lab
• Catalonia Living Lab is a public-private framework for development and testing CAV technologies. Its primary goal is to cover international needs related to CAV development and testing through the comprehensive aggregation of Catalan public and industry infrastructures and services.[65]
Status of the regulation
• Has been implemented
Jurisdiction level
• Regional
Type of regulations
• Subsidies and incentives
Existing governance model/new approach
• New approach: Regulatory Sandbox

[64] https://www.lexology.com/library/detail.aspx?g=92459224-5666-4c35-9ed0-6780cf380129

[65] http://catalonialivinglab.com/

Outcomes
• This living lab can have an economic impact for the development of autonomous automotive industry in Catalonia. Through experimentations, safety challenges are addressed.
2RL assessment
• **2:** Related to the experimentation of a new technology/service

Conclusions

Regarding the connected and autonomous vehicles, the market readiness is at a level 4-5[66], meaning that testing is currently happening at a worldwide level.
Several approaches are adopted through a top-down and step-by-step processes, as this technology is new and involves many changes in terms of infrastructure and regulatory framework.

- At the EU level, **collaborative approach** was adopted in order to coordinate efforts and co-design the most appropriate regulatory framework (Declaration of Amsterdam).
- At the national level, **binding rules** set amendments to rise legal barriers (traffic code amendments) and define conditions of use and tests (Smart Road Decree in Italy, Road Traffic Act in Singapore, Ordinance 2016-1057 in France, etc.) that regulate the **market** through the delivery of authorizations.
- At the regional/local level, experimentation is performed through public/private cooperation in the framework of **regulatory sandboxes**, which allows the development of infrastructure and the AVs (e.g. Catalonia Living Lab) through subsidies and incentives.

2RL assessment for this case study

CCAM

At the EU level, experimentations are being carried out to provide impact assessments to define the most appropriate regulatory framework. We can position this solution on the second step of the regulatory time scale (experimentation of the technology/service).

4.4.1.2 Passenger urban air mobility

Table 4-8: Passenger urban air mobility - Approach 1: Collaborative regulation

Urban Air Mobility initiative[67]

[66] https://www.cloudwatchhub.eu/exploitation/readiness-market-more-completing-software-development#MRL
[67] https://eu-smartcities.eu/initiatives/840/description

• This initiative aims at accelerating the development and deployment of Urban air mobility at the EU level by bringing all relevant stakeholders to define strategic roadmaps and carry out demonstrator projects.
Status of the regulation
• Has been implemented
Jurisdiction level
• Supranational
Type of regulations
• Open method of coordination
Existing governance model/new approach
• New approach: collaborative regulation
Outcomes
• This initiative will allow the stakeholders to deploy pilot programs that enables the design of the most compliant regulatory framework to foster innovation into the market while ensuring the achievement of policy objectives (safety, security).
2RL assessment
• **1:** Related to a disruptive technology/service for which norms and standards have to be defined • **2:** Related to the experimentation of a new technology/service

Table 4-9: Passenger urban air mobility - Approach 2: Binding rules

Special condition for small-category VTOL aircraft[68]
• The European Union Aviation Safety Agency defined technical specifications for vertical take-off and landing (VTOL) aircraft, as there are not certification specifications yet (2019 regulation).
Status of the regulation
• Was implemented
Jurisdiction level
• Supranational
Type of regulations
• Technical standard
Existing governance model/new approach

[68]

• Existing: binding rules (directive, laws, etc.)
Outcomes
• This certification will allow the deployment of the VTOL aircraft, lowering down pre-existing legal barriers.
2RL assessment
• **1:** Related to a disruptive technology/service for which norms and standards have to be defined

Conclusions

Passenger Urban Air Mobility deployment is at its early stage. Certifications and standards are progressively coming up. In Europe, they are defined through the impulsion from the European Aviation Safety Agency as well as collaborative initiative such as the European SESAR Joint Undertaking that will accelerate the development of a regulatory framework and the market maturity[69]. At the worldwide scale, there is also another initiative that exists to design rules for unmanned systems: JARUS[70].

2RL assessment for the case study

Passenger UAM

For the reasons mentioned before, this case study is positioned at the first level of the 2RL scale.

4.4.1.3 Drone last mile delivery

Table 4-10: Drone last mile delivery - Approach 1: Binding rules

Commission Implementing Regulation (EU) 2019/945 of 12 March 2019 on unmanned aircraft systems and on third-country operators of unmanned aircraft systems [71]
This regulation defines technical requirements for the design and manufacture of unmanned aircraft systems ('UAS') intended to be operated under the rules and conditions defined in Implementing Regulation (EU) 2019/947 and of remote identification add-ons. It also defines the type of UAS whose design, production and maintenance shall be subject to certification.
Status of the regulation
• Has been implemented

[69] https://www.sesarju.eu/
[70] http://jarus-rpas.org/
[71] https://eur-lex.europa.eu/legal-content/EN/TXT/?qid=1581420670694&uri=CELEX:32019R0945

Jurisdiction level
• Supranational: EU
Type of regulations
• EU directive
Existing governance model/new approach
• Existing: binding rules (directive, laws, etc.)
Outcomes
• This regulation defines technical requirements and procedures to ensure security and safety during Unmanned Aircraft Systems flight. It will also harmonize national rules and the market at the EU level.
2RL assessment
• **1:** Related to a disruptive technology/service for which norms and standards have to be defined

Table 4-11: Drone last mile delivery - Approach 2: Risk-based regulation

Commission Implementing Regulation (EU) 2019/947 of 24 May 2019 on the rules and procedures for the operation of unmanned aircraft
This regulation defines procedures for operations of unmanned aircraft systems as well as for personnel, including remote pilots and organisations involved in those operations. Three categories of operations (open, specific and certified) according to the level of risks involved were introduced in order to define different regulatory approach for each category.

Category of operations	Open *low risk*	Specific *medium risk*	Certified *high risk*
Authorisation needed	None	Authorisation from NAA based on operational risk assessment or specific scenario	Authorisation from NAA/EASA
UAS	Compliant with Commission Delegated Regulation on UAS	Compliant with requirements included in the authorisation	Certified UAS
Operations allowed	Restricted to: ▪ VLOS ▪ Altitude < 120 m ▪ Other limitations defined by: - Commission Regulation on UAS operations - National airspace zones	Restricted to: ▪ Operations specified in the authorisation ▪ Limitations defined by national airspace zones	Controlled airspace U-Space
Regulations	Commission Regulation on UAS operations in open and specific		Revision of existing aviation regulation
	Commission Delegated Regulation on UAS	No regulatory requirement (UAS requirements included in the authorisation)	

Figure 10: Table of the different regulatory approaches adopted according to the level of risk. Source: Dronerules.eu

Status of the regulation
• Has been implemented (operational in June 2020)
Jurisdiction level
• Supranational
Type of regulations
• EU directive
Existing governance model/new approach
• Risk-based regulation
Outcomes
• This regulation aims at addressing all drone operations and harmonizing European market.
2RL assessment
• **1:** Related to a disruptive technology/service for which norms and standards have to be defined

Table 4-12: Drone last mile delivery - Approach 3: Adaptive regulation

Drone deliveries in North Canberra and Logan[72]
• Australian civil aviation safety authority approved Wing company (licensed and certified operator) to deliver food and drinks, medications or other small items within a 10km radius from a base station (North Canberra in Australian Capital Territory and Logan in Queensland). Suburbs will be progressively integrated into this regulation.
Status of the regulation
• Has been implemented
Jurisdiction level
• Local
Type of regulations
• Tradeable permit
Existing governance model/new approach
• New approach: adaptive regulation
Outcomes
• This regulation defines operational conditions (coverage radius, operating times) for drone delivery. Economic risks should be monitored because drone delivery is allowed with an exclusive operator, Wing.
2RL assessment
• **2:** Related to the experimentation of a new technology/service

Table 4-13: Drone last mile delivery - Approach 4: Regulatory sandbox

Drone City - Pélican project in Nouvelle-Aquitaine (France)
• Nouvelle-Aquitaine region published "Drone City" call for proposals in order to carry out drone delivery experimentations in 2016. The project Pélican (Projet d'Etude de Livraison de Colis Aérien en Nouvelle Aquitaine) was selected in 2017, with a consortium composed by e-commerce leader (C-discount), major industry player (Thales) and local drone ecosystems (SMEs, laboratories).
Status of the regulation

[72] https://www.casa.gov.au/drones/industry-initiatives/drone-delivery-systems

• Has been implemented
Jurisdiction level
• Local
Type of regulations
• Subsidies and incentives
Existing governance model/new approach
• New approach: regulatory sandbox
Outcomes
• This regulation aims at testing drone delivery in urban areas. This project will address technical, safety and security challenges and will help at defining the most appropriate regulatory framework for drone delivery while incentivizing innovations and contributing to local drone economy.
2RL assessment
• **2:** Related to the experimentation of a new technology/service

Conclusions

Three types of rules apply to commercial drone operations[73]:

- Safety and Operations: depending on the flight characteristics, licenses/ certificates or training will be requested by aviation authorities. These characteristics will also define requirements for flying conditions, such as maximum altitude and restricted zones.

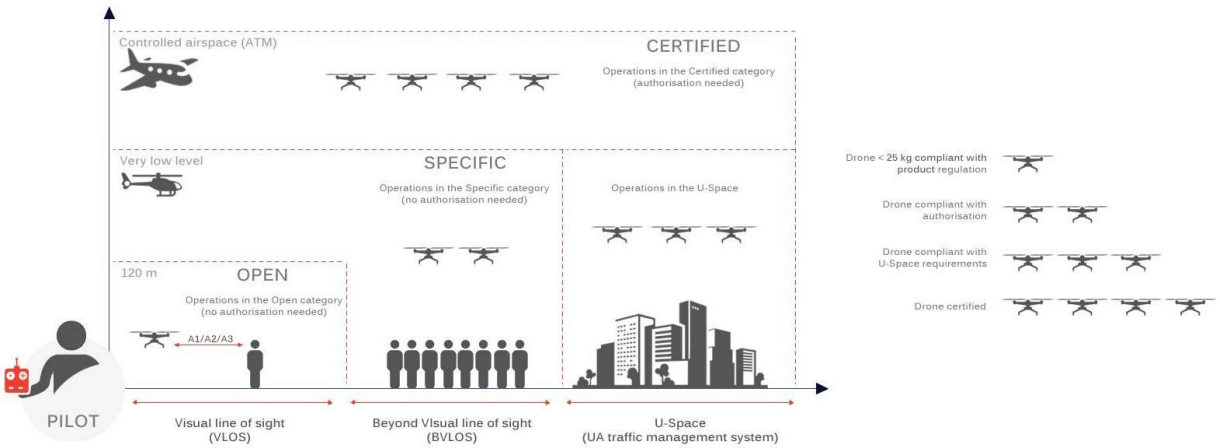


Figure 11: Drone flight characteristics. Source: Droneroles.eu

- Insurance and liability

[73] http://dronerules.eu

- Privacy and Data protection

At the EU level, the European project Drone Rules set up an interactive regulatory map to present regulations per country for three types of drone use (recreational, model aircraft or professional drone): https://dronerules.eu/en/professional/regulations.

In 2019, two regulations harmonized national rules for EU (see Table 4-10 and Table 4-11) regarding all existing and future operations, that will be effective converted at the national level by July, 2021:

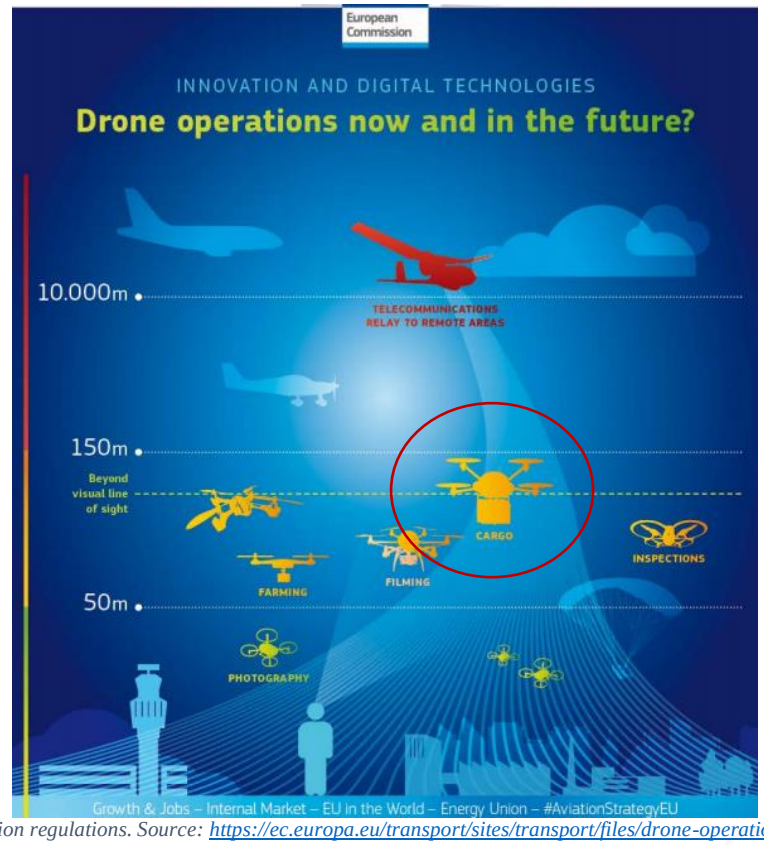


Figure 12: EU Drone operation regulations. Source: https://ec.europa.eu/transport/sites/transport/files/drone-operations-now-and-in-the-future.pdf

Partnership with companies (through licensing or subsidies) allows to start experimentations of this service around the world, after the definition of technical and operational requirements.

2RL assessment for the case study

Drone delivery

The regulatory framework of drone last mile delivery was recently shaped up regarding technical and operational requirements, they are progressively implemented. Several experimentations are being carried out on different local areas around the round. For these reasons, this case study is positioned between 1 and 2 on 2RL scale.

4.4.2 *Shared/ On-demand mobility*

4.4.2.1 Car-sharing/car-pooling

Table 4-14: Car-sharing/Car-pooling - Approach 1: Outcome-based regulation

Label « Autopartage – Métropole de Lyon »
• Carsharing label according to L1231-14 national law with the definition of technical specifications of the cars and parking requirements
Status of the regulation
• Has been implemented
Jurisdiction level
• Local
Type of regulations
• Labelling schemes
Existing governance model/new approach
• Outcome-based regulation
Outcomes
• This law incentivizes the use of carsharing to limit private car ownership and solve environmental issues. • The law related to this labelling scheme defines technical specification to get this label and parking requirements to address organisational challenges.
2RL assessment
• **3:** Related to the regulation of a new technology/service already deployed

Table 4-15: Car-sharing/Car-pooling - Approach 2: Adaptive regulation

Recognition conditions and procedure for car sharing organisations in Ghent
• This regulation defines specifications and conditions of car sharing deployment in Ghent (Flanders, Belgium). An annual evaluation assesses the environmental impact of carsharing with the eco-score of each vehicle, the number of users per vehicle, etc.
Status of the regulation
• Has been implemented
Jurisdiction level
• Local

Type of regulations
• Tradeable permit
Existing governance model/new approach
• Adaptive regulation
Outcomes
• This law incentivizes the use of carsharing to limit private car ownership and solve environmental issues, with the annual eco-score.
2RL assessment
• **3:** Related to the regulation of a new technology/service already deployed

Table 4-16: Car-sharing/car-pooling - Approach 3:Binding rules

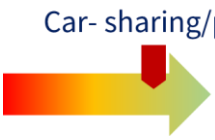
Certification of enrolment: engrossed substitute house bill 2384 Personal Vehicle Sharing Programs[74]
• This law defines requirements for insurance policies of car-sharing related to personal vehicles in the state of Washington.
Status of the regulation
• Has been implemented
Jurisdiction level
• Regional
Type of regulations
• National/Regional/local law
Existing governance model/new approach
• Existing: binding rules (directive, laws, etc.)
Outcomes
• This law addresses legal challenges because it defines drivers' liability in the framework of car-sharing programs with personal vehicles.
2RL assessment
• **3:** Related to the regulation of a new technology/service already deployed

[74] https://apps.leg.wa.gov/documents/billdocs/2011-12/Pdf/Bills/Session%20Laws/House/2384-S.SL.pdf

Conclusions

Regulations mainly occur at the local level to incentivize the use of this mobility solution that limits private car ownership and prevents from car emission increase: labelling schemes, definition of technical specifications and environmental criteria to ensure environmental outcomes, organization of public space (parking availabilities, etc.).

2RL assessment for the case study



The regulations are categorized into the 3rd level of the 2RL, as this service is largely deployed over the world.

4.4.2.2 Bike-sharing

Table 4-17: Bike-sharing - Approach 1: Market

Licensing shared e-vehicles[75]
• This regulation limits the number of operators and the maximum capacity of e-vehicles per operator in Barcelona, Spain. It will allow more e-vehicles than bikes and will enforce a tax on all shared vehicle. The tax is the same for a bike, an e-bike or a moped, thus encouraging the providers to operate mainly mopeds and e-bikes.
Status of the regulation
• Has been implemented
Jurisdiction level
• Local
Type of regulations
• Call for tender (bids)
Existing governance model/new approach
• Existing: market approach
Outcomes
• This market approach ensures that sustainability objectives regarding micromobility (e-bikes and moped) are achieved.

[75] https://www.barcelona.cat/infobarcelona/es/movilidad-y-transportes/las-motos-y-bicis-compartidas-pagaran-una-tasa-para-aparcarlas-en-la-calle-2_834511.html

2RL assessment
• **3:** Related to the regulation of a new technology/service already deployed

Table 4-18: Bike-sharing - Approach 2: Adaptive regulation

Chengdu municipal regulations concerning shared bicycle operation management and service specification (trial)[76]
• This regulation specifies requirements for bicycle sharing operators to operate in Chengdu (China), such as maintenance, parking, insurance, data sharing for a 2-year trial. The evaluation of this service is ensured by an assessment committee defined as: http://gk.chengdu.gov.cn/govInfoPub/detail.action?id=98003&tn=6
Status of the regulation
• Has been implemented
Jurisdiction level
• Local
Type of regulations
• National/Regional/local law
Existing governance model/new approach
• New approach: adaptive regulation
Outcomes
• This regulation allows the experimentation of bike-sharing service during 2 years. This experimentation will provide impact assessment for the definition of an appropriate regulatory framework to prevent organisational issues while incentivising this sustainable mode of transport.
2RL assessment
• **2:** Related to the experimentation of a new technology/service

[76] http://gk.chengdu.gov.cn/govInfoPub/detail.action?id=98002&tn=6

Table 4-19: Bike-sharing - Approach 3: Binding rules

Code of practice for dockless cycle hire[77]
• This code outlines requirements and recommendations that operators are expected to follow as part of delivering safe and effective schemes in London.
Status of the regulation
• Has been implemented
Jurisdiction level
• Local
Type of regulations
• Recommendations
Existing governance model/new approach
• Existing: binding rules (directive, laws, etc.)
Outcomes
• This code of practice ensures the sustainability of dockless cycle hiring by setting an appropriate framework to prevent from nuisance or obstruction on public roads that can be encountered when this service is deployed over a city.
2RL assessment
• **3:** Related to the regulation of a new technology/service already deployed

Conclusions

Bike-sharing regulations aim at preventing from bad impacts that can be observed, such as obstruction of public space, while fostering active modes of transport and related services which are sustainable and contribute to the decrease of private car ownership.
Market approach is widely used to face bad consequences by limiting the number of operators or the fleet, with specific requirements in terms of maintenance, parking, etc.
Adaptive regulation was adopted in order to provide impact assessment through pilot programs that set up an appropriate framework for the deployment of this service.

2RL assessment for the case study

This case study is positioned at the third level of the 2RL scale, as most of regulations apply to service already deployed.

[77] http://content.tfl.gov.uk/dockless-bike-share-code-of-practice.pdf

4.4.2.3 E-scooter sharing

Three approaches of e-scooter regulations are presented below.

Table 4-20: E-scooter: Approach 1: Market

E-scooter service exploitation within the city borders
• The regulation is about the e-scooter service exploitation within the city of Zaragoza borders being effective last April 2019[78]
Status of the regulation
• Has been implemented
Jurisdiction level
• Local
Type of regulations
• Call for tender (bids)
Existing governance model/new approach
• Market approach (existing)
Outcomes
• Social challenge addressed and political barriers risen: there is a better public acceptation for this mobility solution. • Security has to be monitored.
2RL assessment
• **3:** Related to the regulation of a new technology/service already deployed

Table 4-21: E-scooter - Approach 2: Memorandum of Understanding

Memorandum of Understanding in Stockholm
• The Traffic Mayor has signed an MOU with operators of e-scooters etc which governs some practices (e.g. parking, speed etc)[79]
Status of the regulation
• Has been implemented
Jurisdiction level
• Local
Type of regulations

[78] https://www.zaragoza.es/ciudad/gestionmunicipal/contratos/ver_Fehaciente?id=71902
[79] http://meltwater.pressify.io/publication/5cf5276c43a56200043a9691/5cc2e92ebc666f1000014954

• Open method of coordination
Existing governance model/new approach
• New approach: collaborative regulation
Outcomes
• Political challenge is addressed through the deployment of this mobility solution through a collaborative approach.
2RL assessment
• **3:** Related to the regulation of a new technology/service already deployed

Table 4-22: E-scooter - Approach 3: Regulatory sandbox

Pilot programme in Amsterdam
• Amsterdam wants to learn what the latest generation of partial mobility vehicles can contribute to its objectives. The city started controlled experiments for the 2019-2021 period.
Status of the regulation
• Has been implemented
Jurisdiction level
• Local
Type of regulations
• Tradeable permit
Existing governance model/new approach
• New approach: regulatory sandbox
Outcomes
• Organisation challenge is addressed by this regulation. The pilot programme aims at deploying the solution in a proper way.
2RL assessment
• **2:** Related to the experimentation of a new technology/service

Conclusions

Driving codes are regulated at the national level. At the local level, the regulation is more related to the number of operators or vehicles allowed, with specific operational requirements.

Regarding e-scooter sharing operation, **market approach** is widely adopted among big cities (Paris, Barcelona, Boston, Brussels) as well as smaller towns (Zaragoza), to prevent bad impacts that were observed at the beginning of the deployment of the mobility solution: safety and

parking issues. If we take the example of Paris, the deployment of the mobility solution happened early and this service has been exploding then, due to the high density of the city, saturated public transport, local policy involving the high development of cycling lanes and short distances to be ridden[80].

Nevertheless, other approaches have also been chosen to avoid also bad impacts and ensure the achievement of policy objectives:

- **Memorandum of understanding** (Lisbon, Stockholm). If we take the example of Lisbon, this city has adopted proactive line and policy in terms of enhancing innovations regarding new mobility solutions, notably shared mobility services since 2008[81]. The MoU gathers all stakeholders regarding shared mobility services to ensure policy objectives (safety, security), while developing infrastructure for these new mobility solutions.
- **Regulatory sandboxes** (Portland, Amsterdam). In Amsterdam, the 2-year program aims at assessing more precisely the benefits brought by e-scooter, knowing if the deployment of this mobility solution is compliant with policy objectives (currently, there is bad public acceptation due to high public space constraints caused by free-floating services).

Readiness Level assessment

E-scooter

If we refer to the previous table describing example of parameters regarding 2RL assessment, we can conclude that most of the cities have already an ecosystem for this new developing market (with a readiness level at 6-7[82]), with several e-scooter sharing operators (national and international), leading to a high 2RL assessment.

4.4.2.4 Ride-hailing and TNC

Table 4-23: Ride-hailing/TNC - Approach 1: Binding rules

Assembly Bill No 5, Chapter 296[83]
• The bill changed the status of ride hailing drivers in the whole Californian state. Drivers were before independent contractors and should now be employees of a ride hailing app. As an employee, drivers will benefit from the social advantages any other worker benefit from.
Status of the regulation
• Has been implemented

[80] https://www.lesechos.fr/idees-debats/editos-analyses/comment-paris-est-devenue-la-capitale-mondiale-de-la-trottinette-electrique-373145

[81] Deliverable D2.3 : « Analysis of cooperation models among public and private parties", Y. Bousse & al.

[82] Deliverable D1.1, "Review of new mobility services and technologies and set-up of knowledge bank", V. Lubello & al.

[83] https://leginfo.legislature.ca.gov/faces/billTextClient.xhtml?bill_id=201920200AB5

Jurisdiction level
• Regional: California
Type of regulations
• National/Regional/local law
Existing governance model/new approach
• Existing: binding rules (directive, laws, etc.)
Outcomes
• This regulation addresses social issues risen from the deployment of this service in California.
2RL assessment
• **3:** Related to the regulation of a new technology/service already deployed

Table 4-24: Ride-hailing/TNC - Approach 2: Market

Point-to-point passenger transport industry bill[84]
• This law sets up new separate licenses between street and ride-hailing services in Singapore
Status of the regulation
• Has been implemented
Jurisdiction level
• National
Type of regulations
• National/Regional/local law
Existing governance model/new approach
• Market approach: licensing.
Outcomes
• This law addresses unfair competition between taxis and ride-hailing services.
2RL assessment
• **3:** Related to the regulation of a new technology/service already deployed

[84] parliament.gov.sg/docs/default-source/default-document-library/point-to-point-passenger-transport-industry-bill-14-2019.pdf

Conclusions

Regulations are set-up to address social and economic issues related to the deployment of this service, such as unfair competition with taxis and the lack of social coverage for drivers: establishment of insurance policy, social advantages and licensing process. Binding rules and market approach are the governance models employed for the regulations recorded into the database.

2RL assessment for the case study

Ride-hailing/TNC  The regulations are categorized into the 3rd level of the 2RL, as this service is largely deployed over the world.

4.4.2.5 On-demand ridesharing

Table 4-25: On-demand ridesharing - Approach 1: Regulatory Sandbox

Mobility on-demand (MOD) sandbox program[85]
• The Sandbox Demonstration Program provides a venue through which integrated MOD concepts and solutions – supported through local partnerships – are demonstrated in real-world settings in Los Angeles.
Status of the regulation
• Has been implemented
Jurisdiction level
• Local
Type of regulations
• Subsidies and incentives
Existing governance model/new approach
• Regulatory sandbox
Outcomes
• This project aims at improving transportation efficiency by promoting agile, traveller-centric multimodal service.
2RL assessment
• **2:** Related to the experimentation of a new technology/service

[85] https://www.transit.dot.gov/research-innovation/mobility-demand-mod-sandbox-program

Table 4-26: On-demand ridesharing - Approach 2: Binding rules

Registration of flexible route local bus service[86]
• The document gives guidance on the requirements for the operators to set up a flexible bus route in United Kingdom.
Status of the regulation
• Has been implemented
Jurisdiction level
• National
Type of regulations
• National/Regional/local law
Existing governance model/new approach
• Existing: binding rules (directive, laws, etc.)
Outcomes
• This document will address organisational challenges related to the deployment of flexible local bus service.
2RL assessment
• **3:** Related to the regulation of a new technology/service already deployed

Table 4-27: On-demand ridesharing - Approach 3: Market

Contract carriage permit (8343-369/AT-2/DST, India)[87]
• Among on demand services, motor bike taxis and busses operate on Contract Carriage permits.
Status of the regulation
• Has been implemented
Jurisdiction level
• Regional
Type of regulations
• Tradeable permit
Existing governance model/new approach
• Existing: market

[86] https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/555828/registration-flexibly-routed-local-bus-services-guide-for-operators.pdf

[87] https://wricitieshub.org/newmobility/sites/default/files/khemka%20memo%20(3).pdf

Outcomes
• This permit defines operator licensing requirements to deploy on-demand services.
2RL assessment
• **3:** Related to the regulation of a new technology/service already deployed

Conclusions

Regulations regarding on-demand ridesharing are often common with ride-hailing/TNC legislations. Market approach/Binding rules are thus often used regarding the regulation of this mobility solution. However, we can see that some research and experimentation for flexible services are carried out in USA.

2RL assessment for the case study

On-demand ridesharing

As ride-hailing/TNC case studies, on-demand ridesharing falls into the 3rd category of Regulatory Readiness Level, as regulations mainly apply to a service already deployed.

4.4.2.6 Crowdshipping

Table 4-28: Crowdshipping - Approach 1: Binding rules

Article 44 Loi Orientation Mobilités[88]
• This article defines new rights for shippers (this also works for TNC riders) and sets up a new working framework in France.
Status of the regulation
• Has been implemented
Jurisdiction level
• National
Type of regulations
• National/Regional/local law
Existing governance model/new approach
• Existing: binding rules (directive, laws, etc.)

[88] https://www.legifrance.gouv.fr/affichTexte.do?cidTexte=JORFTEXT000039666574&dateTexte=&categorieLien=id

Outcomes
• This regulation tackles social issues related to the development of crowdshipping in France.
2RL assessment
• **1:** Related to a disruptive technology/service for which norms and standards have to be defined

Conclusions

Very few regulations exist regarding crowdshipping, even if many companies have been created for these past few years and this market is growing. Most of regulations apply to shared economy markets, broadly speaking.
Regulatory framework could be appropriate to address social issues related to this service and define insurance policy.

2RL assessment for the case study

As very few regulations have been listed in the Regulatory Database for crowdshipping, this case study is positioned at the 1st level of the 2RL scale.

4.4.3 *MaaS and MaaS platforms*

Table 4-29: MaaS and MaaS platforms: Approach 1: Outcome-based regulation

Ticket and payment standards in Sweden - Biljett- och betalstandard (BoB)[89]
• The National Ticket Standard (BoB) is owned by the public transport sector in Sweden. The development of this standard is a common effort performed in a cooperation called BoB-Tech. The BoB-Tech forum is open for anyone that wants to contribute. This standard will create interoperability between ticketing systems offered by several operators.
Status of the regulation
• Has been implemented
Jurisdiction level
• National

[89] https://samtrafiken.atlassian.net/wiki/spaces/BOB/pages/116124852/BoB+Manual

Type of regulations
• Technical standard
Existing governance model/new approach
• New approach: outcome-based regulation
Outcomes
• This regulation will remove an organizational barrier that prevent from the deployment of MaaS in Sweden, which is also a challenge regarding MaaS: interoperability. Security should be monitored afterwards.
2RL assessment
• **1:** Related to a disruptive technology/service for which norms and standards have to be defined

Table 4-30: MaaS and MaaS platform - Approach 2: Adaptive regulation

MaaS services and business opportunities[90]
• This report evaluates the emerging traffic service markets and analyses the impacts and business opportunities of the Mobility as a Service, which is a paradigm change for Finland.
Status of the regulation
• Has been implemented
Jurisdiction level
• National
Type of regulations
• Recommendations
Existing governance model/new approach
• New approach: adaptive regulation
Outcomes
• This report aims at giving recommendations to address organizational challenges and incentivize the deployment of this service through subsidies and economic incentives for the mobility market.
2RL assessment
• **2:** Related to the experimentation of a new technology/service

[90] https://julkaisut.vayla.fi/pdf8/lts_2015-56_maas_services_web.pdf

Table 4-31: MaaS and MaaS platform - Approach 3: Regulatory sandbox

Umbrella framework agreement[91]
• 20 Million euros of subsidies in 2/3 years will subsidize the implementation of MaaS in 7 pilot cities in an agreement between 24 private parties and the Dutch Ministry of Infrastructure and Water management.
Status of the regulation
• Has been implemented
Jurisdiction level
• National
Type of regulations
• Subsidies and incentives
Existing governance model/new approach
• New approach: regulatory sandbox
Outcomes
• This regulation will incentivize MaaS deployment by addressing economic issues through project financing.
2RL assessment
• **2:** Related to the experimentation of a new technology/service

Table 4-32: MaaS platforms - Approach 4: Binding rules

Act on Transport Services in Finland[92]
• The Finnish Act on Transport Services streamlined market legislation both for goods and people transport lessened admin burden in many ways and introduced new rules on the opening of transport related data and API's.
Status of the regulation
• Has been implemented
Jurisdiction level
• National
Type of regulations
• National/Regional/local law

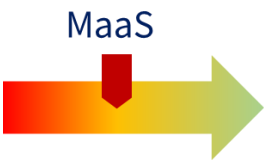
[91] https://julkaisut.vayla.fi/pdf8/lts_2015-56_maas_services_web.pdf
[92] https://www.finlex.fi/fi/laki/kaannokset/2017/en20170320_20180731.pdf

Existing governance model/new approach
• Existing: binding rules (directive, laws, etc.)
Outcomes
• This act lowers down existing legal barriers that prevent from the full deployment of MaaS, such as the obligation for transport operators to have open APIs and provide open data. This will lead to decrease the use of private cars and thus address environmental issues.
2RL assessment
• **3:** Related to the regulation of a new technology/service already deployed

Conclusions

Regarding MaaS, regulating open data and data sharing is key. Under the impetus of European directives that recommend open data and regulate online intermediation services[93], European countries progressively define a regulatory framework for the definition of technical standard for data sharing (see Table 4-29) and the authorization to sell online transport tickets by a third-party. In addition, when it comes to consumer protection, hard law can establish an insurance framework guaranteeing consumers against the cancellation of one of the combined modes of transport.
Subsidies and incentives allow the experimentation of this disruptive service through several cities in different countries.
Finland, one of the pioneer countries on this topic, adopted the paradigm change to Mobility as a Service through the adoption of a new transportation act.

2RL assessment for the case study



MaaS is very disruptive in terms of business model and is a real paradigm change in transportation. Many local transport operators in the world have started to develop this service through city planners. Few of them experience the full concept, with the integration of public and private services, but technical standards regarding data have already been defined at the EU/national scale. For these reasons, MaaS is positioned as the 2nd level in the 2RL scale.

[93] https://eur-lex.europa.eu/eli/dir/2019/1024/oj

4.4.4 *Infrastructure, network and traffic management*

4.4.4.1 Big data for transport

Table 4-33: Big data for transport - Approach 1: Binding rules

Directive (EU) 2019/1024[94]
• The Directive on open data and the re-use of public sector information provides a common legal framework for a European market for government-held data (public sector information).
Status of the regulation
• Has been implemented
Jurisdiction level
• Supranational: EU
Type of regulations
• EU directive
Existing governance model/new approach
• Existing: binding rules (directive, laws, etc.)
Outcomes
• This regulation harmonizes current Member states' regulation to ensure the digitalisation of public sector services to incentivize digital innovation and technologies.
2RL assessment
• **1:** Related to a disruptive technology/service for which norms and standards have to be defined

Table 4-34: Big data for transport - Approach 2: Outcome-based regulation

Proposal for a regulation of the European parliament and of the council on electronic freight transport information COM/2018/279[95]
• This proposal aims at tackling legal barriers for the digitalisation of transport information, due to fragmented legal framework and IT environment with non-interoperable systems or solutions.

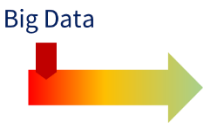
[94] https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A32019L1024
[95] https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A52018PC0279

Status of the regulation
• Has been implemented
Jurisdiction level
• Supranational: EU
Type of regulations
• Recommendations
Existing governance model/new approach
• New approach: outcome-based regulation
Outcomes
• The uniform regulatory framework (same acceptance from authorities for electronic documents, common requirements for service providers and platforms) coming from this recommendation will have environmental and organisational impacts and will lower down legal barriers
2RL assessment
• **1:** Related to a disruptive technology/service for which norms and standards have to be defined

Conclusions

Over the past few years, recent regulations regarding Big Data have been adopted to get the regulatory framework required for the deployment of new disruptive mobility services at the national or supranational level: personal data protection (GDPR), data-sharing for public services, standards for data. There is still a lack of harmonized regulatory framework at the EU level to incentivize the use of electronic documentation for freight, this is highlighted by the proposal for a regulation mentioned in this section.

2RL assessment for the case study



This case study is positioned as the 1st level of the 2RL scale, as it was the first step for the deployment of ITS through the definition of standards that ensure interoperability, security and safety.

4.4.4.2 Cooperative traffic management

Table 4-35: Cooperative traffic management - Approach 1: Binding rules

COMMISSION DELEGATED REGULATION (EU) 2015/962[96]
• This regulation defines specifications in order to provide EU-wide real-time traffic information services.
Status of the regulation
• Has been implemented
Jurisdiction level
• Supranational: EU
Type of regulations
• EU directive
Existing governance model/new approach
• Existing: binding rules (directive, laws, etc.)
Outcomes
• This regulation ensures exchange and re-use of data between road traffic management stakeholders (road authorities, road operators and service providers) at the EU scale.
2RL assessment
• **1:** Related to a disruptive technology/service for which norms and standards have to be defined

Table 4-36: Cooperative traffic management - Approach 2: Regulatory sandbox

SOCRATES 2.0[97]
• SOCRATES2.0 stands for 'System of Coordinated Roadside and Automotive Services for Traffic Efficiency and Safety'. It is a European project based on a cooperation of road authorities, service providers and car manufacturers. The objective is to implement cooperation models developed through TM2.0 programme into 4 pilot cities (Antwerp, Amsterdam, Copenhagen and Munich) with the development of a protocol for traffic management.
Status of the regulation
• Has been implemented

[96] https://eur-lex.europa.eu/legal-content/EN/TXT/?qid=1576576360282&uri=CELEX:32015R0962

[97] https://socrates20.org

Jurisdiction level
• Local
Type of regulations
• Subsidies and incentives
Existing governance model/new approach
• New approach: regulatory sandbox
Outcomes
• This project incentivizes C-ITS within a private-public partnership that addresses organizational challenges.
2RL assessment
• **2:** Related to the experimentation of a new technology/service

Conclusions

Standards were recently defined regarding C-ITS. Some cities started to set-up experimentations regarding public-private partnership regarding road traffic management, but this process is at the early stage.

2RL assessment for the case study

C-ITS

According to the conclusions, this case study is positioned at the 2nd level of 2RL scale.

4.4.4.3 Hyperloop

Table 4-37:Hyperloop - Approach 1: Collaborative regulation

Creation of a Joint Technical Committee - JTC 20[98]
• The creation of a Joint Technical Committee, part of the European Committee for standardization and the European Committee for Electrotechnical Standardization sets up a cooperation between industrial leaders - Transpod (Canada, Italy, France), Hardt Hyperloop (Netherlands), Zeleros Hyperloop (Spain) and Hyper Poland (Poland) – and will lead to a new regulatory framework regarding Hyperloop, in particular the development of high safety standards and interoperability criteria and sub-assemblies.

[98] https://zeleros.com/2020/02/11/european-countries-agree-to-establish-common-standards-for-hyperloop-systems/

Status of the regulation
• Has been implemented
Jurisdiction level
• Supranational
Type of regulations
• Technical standard
Existing governance model/new approach
• New approach: collaborative regulation
Outcomes
• This collaborative approach will lower down legal barriers that prevent from the deployment of this disruptive mode of transport, as there is no legal status yet (neither a train nor a plane)
2RL assessment
• **1:** Related to a disruptive technology/service for which norms and standards have to be defined

Table 4-38: Hyperloop - Approach 2: Regulatory Sandbox

Authorization and support to Zeleros from Generalitat Valencia (regional Spanish authority) and Sagunt city hall to test hyperloop on a 2km track in Parc Sagunt [99]
• Authorization and subsidies to Zeleros, Valencian Hyperloop company, in collaboration with universities and laboratories (Universitat Politècnica de València, Institut Technlògic de l'Energia and Centre d'Investigacions Energètiques, Mediambantals i Technològiques) to test the Hyperloop on a 2 km track in Parc Sangunt.
Status of the regulation
• Has been implemented
Jurisdiction level
• Local
Type of regulations
• Subsidies and incentives
Existing governance model/new approach
• New approach: outcome-based regulation
Outcomes

[99] http://www.presidencia.gva.es/va/inicio/area_de_prensa/not_detalle_area_prensa?id=779124 and http://www.aytosagunto.es/es-es/actualidad/Paginas/zeleros-parc-sagunt-hyperloop.aspx

• The deployment of a hyperloop on a test track will give the opportunity to validate the technologies in real conditions, leading to an increase of regional attractiveness and an economic impact on the region. This will also help to define a new regulatory framework through this experimentation.
2RL assessment
• **2:** Related to the experimentation of a new technology/service

Conclusions

Hyperloop, as the most disruptive mode of transport, is at the early beginning of the regulatory process. Standards, certifications and interoperability criteria for the infrastructure and the sub-assemblies need to be defined at the supranational level. The recent (11th February 2020) creation of the Joint Technical Committee will lead to these definitions at the EU level.

Nevertheless, some experimentations started in some regions around the world in order to validate the technology, with the support and authorization from regional/local authorities: Nevada (USA), Valencia (Spain), Nouvelle-Aquitaine/Occitanie (France), India, etc.

2RL assessment for the case study

Hyperloop

If we refer to the table presenting the different of the 2RL scale (see Table 4-3), we can position the hyperloop transportation technologies at the first level.

4.4.5 *2RL assessment: summary of case studies*

Disruptive mobility category	Case study	2RL assessment
Cooperative, connected and automated vehicles	Connected and automated vehicles	**1:** Related to a disruptive technology/service for which norms and standards have to be defined
	Passenger urban air mobility	**2:** Related to the experimentation of a new technology/service
	Drone last mile delivery	**1:** Related to a disruptive technology/service for which norms and standards have to be defined
Shared/On-demand mobility	Car-sharing/Car-pooling	**3:** Related to the regulation of a new technology/service already deployed
	Bike-sharing	
	Ride-hailing/TNC	
	On-demand ridesharing	
	Crowdshipping	**1:** Related to a disruptive technology/service for which norms and standards have to be defined
MaaS and MaaS platform		**2:** Related to the experimentation of a new technology/service
Infrastructure, network and traffic management	Big data for transport	**1:** Related to a disruptive technology/service for which norms and standards have to be defined
	Cooperative traffic management	**2:** Related to the experimentation of a new technology/service
	Hyperloop	**1:** Related to a disruptive technology/service for which norms and standards have to be defined

5 GENERAL CONCLUSION

In the framework of this deliverable, we studied different regulatory approaches to regulate disruptive mobility innovations, in particular the new flexible approaches that can be able to accommodate with the fast emergence of disruptive solutions (adaptive regulation, regulatory sandbox, outcome-based/risk-based regulation, collaborative regulation).

Then, we listed challenges, barriers and risks related to disruptive mobility innovations that need to be addressed with a new regulatory framework, either environmental, economic, social, organizational, etc.

These studies lead to the development of the Regulatory Matrix, which provides regulatory responses compliant policy makers' framework *via* the assessment of the 2RL parameter and research in the database with the application of some filters (governance model, case study, jurisdiction). This tool is delivered with the Regulatory Frameworks Dashboard (Deliverable 3.1), as both regulatory supportive tools were merged.

Therefore, this Regulatory Matrix could lead towards an integrated approach to regulate disruptive mobility innovations, coping with the current fragmented regulatory framework. This tool can be integrated with other supportive tools for the integration of a new mobility offer in cities, such as the Sustainable Urban Mobility Plans.

6 ANNEXES

6.1 Screenshots of surveys for the completion of the Regulatory Database

6.1.1 *Long survey*

GECKO Project - Regulatory Database

Description du formulaire

Is it a regulation that *

- has already been implemented
- will be implemented soon
- should be implemented
- Autre...

Please explain the regulation you want to describe in very few words *

Réponse longue

How would you describe the physical jurisdiction level? *

- Supranational
- National
- Regional
- Local
- Autre...

Where does/should the regulation apply?

Here we want to characterise the physical jurisdiction where the regulation you describe applies

If you know, what is the precise name of the area where the regulation takes place (neighborhood, city, country, EU)?

Réponse courte

Choose the country-ies where the regulation applies *

- all over EU
- Austria
- Belgium
- Bulgaria
- Cyprus
- Croatia

What kind of regulation is it? *

- EU Directives
- National/regional/local law
- Technical standard
- Self/co-regulation
- Recommendations
- Open method of coordination
- Education and information
- Taxes/Charges/Fees/Fines
- Penalties
- Liability and compensation schemes
- Subsidies and incentives

Choose the category concerned by the regulation

Cases à cocher

- [ ] Cooperative, connected and automated transport technologies
- [ ] Alternative fuels and electric mobility
- [ ] Shared/On-demand mobility (car-sharing, P2P sharing, ride-sharing, ride-hailing, bike-sharing, etc.)
- [ ] MaaS and platforms: MaaS ecosystems, journey planners, ICT platforms
- [ ] Infrastructure, Network and traffic management systems

The regulation refers to the transport of: *

- ( ) Goods
- ( ) Persons
- ( ) Both

Choose the mobility service(s) concerned by the regulation?

Cases à cocher

- [ ] All
- [ ] Services with stations (car, bike, moped, etc.)
- [ ] Services without stations (car, bike, moped, scooter, etc.)
- [ ] New individual electric vehicles (hoverboard, segway, skate, etc.)
- [ ] Private Hire Vehicles
- [ ] Taxi
- [ ] On demand bus
- [ ] Autonomous taxi
- [ ] Autonomous shuttle
- [ ] Public transport by boat

Please tick what are the main impacts for the mobility service related to the implementation of that regulation: expected benefits, removed current barriers that prevent from deploying the service, and possible risks overcome ? *

	Expected benefits	Barriers to implement	Risks related to the implem...
Social	[ ]	[ ]	[ ]
Economical	[ ]	[ ]	[ ]
Environmental	[ ]	[ ]	[ ]
Political	[ ]	[ ]	[ ]
Legal	[ ]	[ ]	[ ]
Organisational	[ ]	[ ]	[ ]
Security	[ ]	[ ]	[ ]
Safety	[ ]	[ ]	[ ]

Who is in charge of the decision to implement the regulation?

Réponse courte

Regulation approach *

- ( ) Traditional regulatory model: rules setup relying on a review of current innovations and market (laws, treaties, statut...
- ( ) Adaptive regulation: responsive and iterative approach
- ( ) Regulatory sandboxes: prototype and test new approaches
- ( ) Outcome-based regulation: businesses and individuals achieve in their own way the regulatory objectives
- ( ) Risk-weighted regulation: shift from one-size-fits-all regulation to a data-driven, segmented approach
- ( ) Collaborative regulation: involving a broader set of players across the ecosystem
- ( ) I don't know
- ( ) Autre...

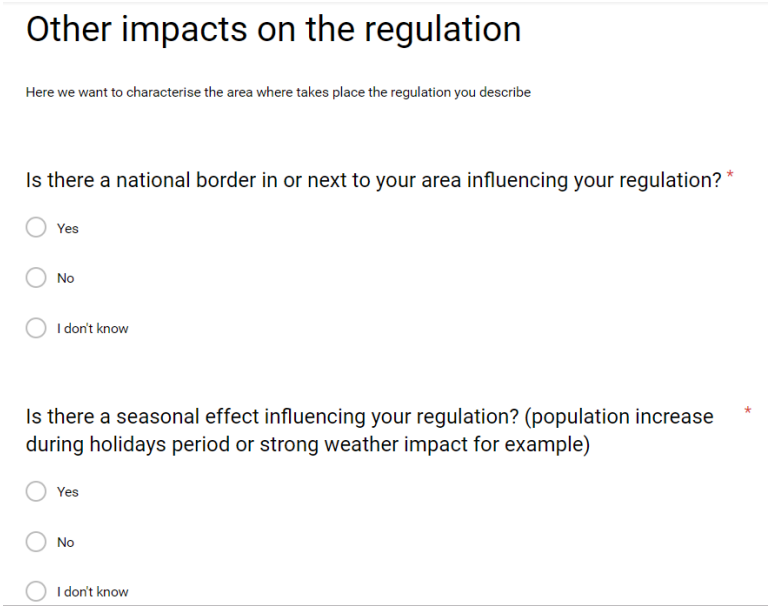
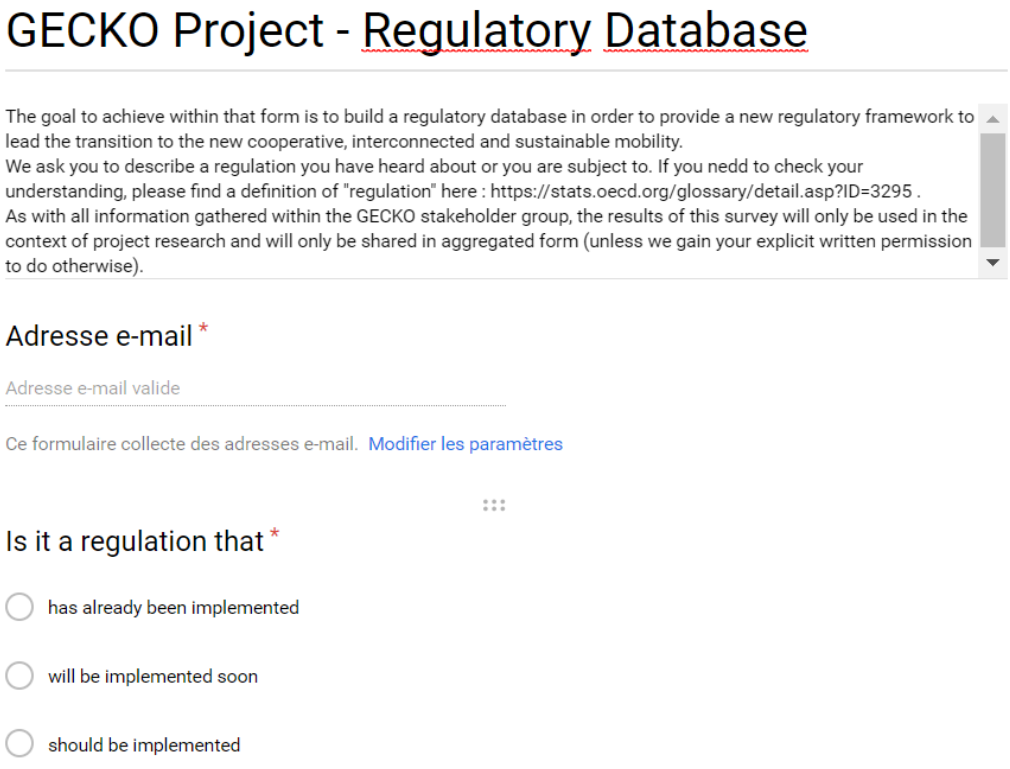
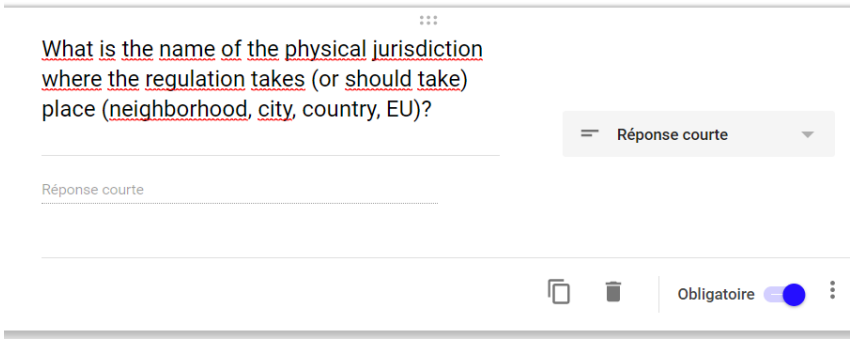


Figure 13: Long survey screenshots

6.1.2 *Short survey*





Short description of the regulation : *

Réponse longue

Choose the category-ies concerned by the regulation *

- [ ] All
- [ ] Cooperative, connected and automated transport technologies
- [ ] Alternative fuels and electric mobility
- [ ] Shared/On-demand mobility (car-sharing, P2P sharing, ride-sharing, ride-hailing, bike-sharing, etc.)
- [ ] MaaS and platforms: MaaS ecosystems, journey planners, ICT platforms
- [ ] Infrastructure, Network and traffic management systems

The regulation refers to the transport of: *

- ( ) Goods
- ( ) Persons
- ( ) Both

Choose the mobility service(s) concerned by the regulation? *

- [ ] All
- [ ] Services with stations (car, bike, moped, etc.)
- [ ] Free floating services (car, bike, moped, scooter, etc.)
- [ ] New individual electric vehicles (hoverboard, segway, skate, etc.)
- [ ] Carpooling
- [ ] Carsharing
- [ ] Crowdshipping
- [ ] Private Hire Vehicles
- [ ] Taxi
- [ ] On demand bus
- [ ] Autonomous shuttle

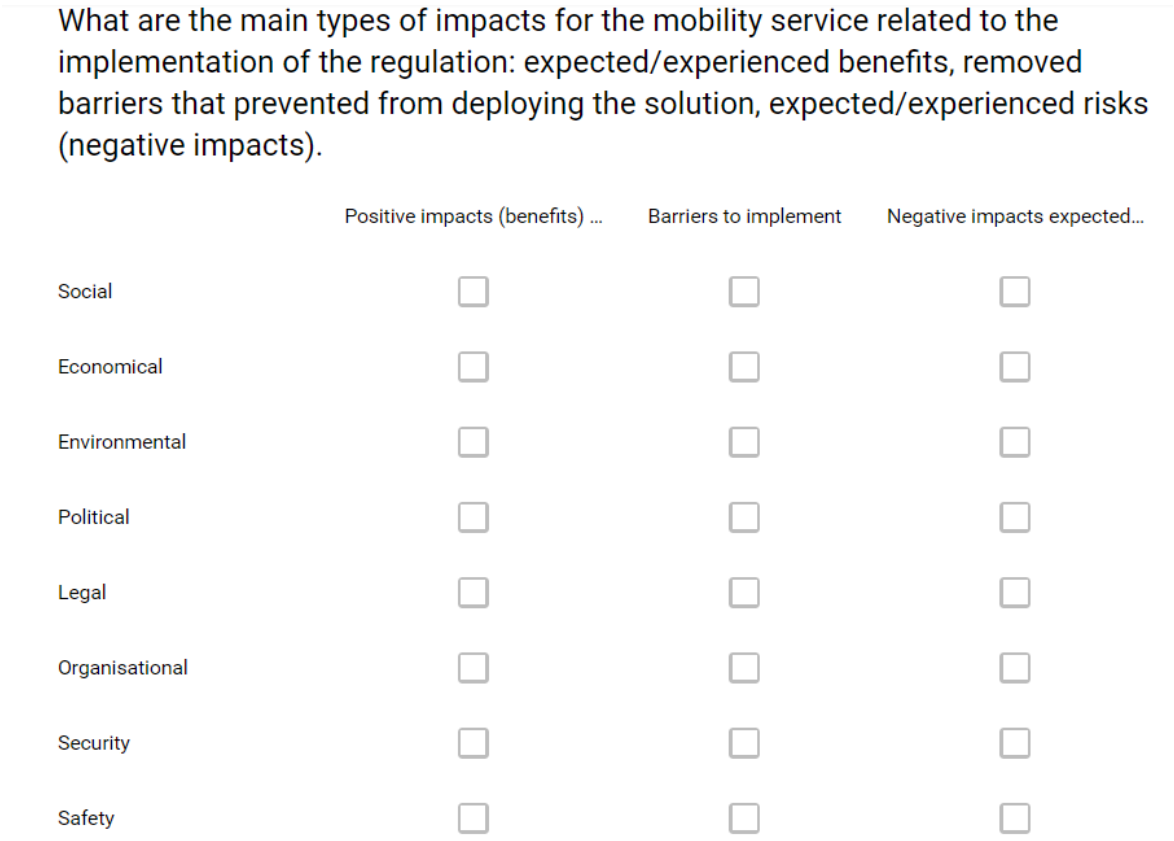


Figure 14: Short survey screenshots

6.2 Reports of interviews

6.2.1 *Breogan Sanchez, Fundacion CIRCE*

- Presentation of the interviewed person

Breogan, project officer at Fundación CIRCE, registered on the Stakeholders group.
Fundación CIRCE is a research and technology transfer center in the energy field, working on several topics such as sustainable mobility, Industry 4.0, etc.

- Short Form answers

He answered the form related to regulations for disruptive mobility solutions:

1) Is it a regulation that:
   - Has already been implemented.
2) What is the name of the physical jurisdiction where the regulation takes (or should take) place (neighborhood, city, country, EU)?
   - Local
3) Short description of the regulation :

- The regulation is about the e-scooter service exploitation within the city borders, being effective last April 2019.

4) Choose the categories concerned by the regulation:
   - Alternative fuels and e-mobility
   - Shared/On-demand mobility
5) The regulation refers to the transport of:
   - Persons.
6) Choose the mobility service(s) concerned by the regulation?
   - Station services (car, bike, moped, **scooter**, etc.).
7) What are the main types of impacts for the mobility service related to the implementation of the regulation: expected/experienced benefits, removed barriers that prevented from deploying the solution, expected/experienced risks (negative impacts).
   - Benefits expected: Social, Political, Legal, Security, Safety.
   - Barriers to implement: Social, Legal, Organisational, Safety
   - Risks: Social, Security, Safety
8) Please describe the most significant expected impact:
   - The regulation ensures a better cooperation between private operators and the city legislation. Up to 2 companies can exploit the e-scooter service, fulfilling some requirements which have been criteria to be chosen during the call for bids including: a) spatial distribution, b) zero emission pick-up system, c) security system, and d) funds for safety and good practices promotion. The council itself provided a wide range of bike + e-scooter parking slots (taken off from car slots). Besides, an urban special regulation has been also applied.

- **Interview:** Long survey completed

- Two projects interesting for GECKO:
- SIMPLA: RIA: This project aims at harmonizing mobility and energy plans with guidelines to ensure that synergies could be figured out for theses plans and complementary measures will be developed.
- LOCATIONS: Interreg: Bad impacts are due to the arrival of cruise of tourists, leading to bad perception of this touristic activities by the inhabitants of the concerned cities which see their population increasing 10-fold. This project aims at promoting sustainable mobility solutions such as pedestrian trails or micromobility modes instead of taxis or car rental. Infrastructures were developed within the project for that purpose (port of Lisbon, Malaga, Trieste).

- Zaragoza use case:

This is the 5th city in Spain. In early 6 months, 5 companies arrived to deploy e-scooters in this very dense city, provoking a chock among their inhabitants, particularly the conservative and elder companies, opposed to the other ones who were supporting the deployment of that mobility systems which are more sustainable than private cars.

The city council decided to integrate e-scooter as a public service. A call for bids selected two companies among several criteria, including:

- Employment quality: good contracts, equity women/men…
- Fuel: electric vs diesel
- Etc.

This ensures that the cities control these services and their functionalities, satisfying the more unwilling persons.

In addition, the city deployed infrastructure (parking slots removed and replaced by e-scooter and bikes parks) and bought a fleet (850 vehicles per company).
This incentivized the citizens to use these sustainable modes.
The city has already a large network of buses, intercity train, public bikes. Taxis are well operating at a low cost, Uber is not available (maybe because it is not cost-efficient due to low-cost competition). An airport ensures mainly air cargo, positioned at a strategic position between Spanish important city such as Bilbao, Madrid, Barcelona, Valencia.
The MaaS is currently under development, the city was waiting for the integration of escooters in the public service. But preliminary agreements were signed to share data.

- At the country scale

A new chapter of the general circulation code was published at the end of May, precising e-scooter driving rules: mandatory helmets, speed limited up to 25 km/h. But the Zaragoza initiative was not replicated to other cities in other cities in Spain regarding e-scooters.
In Barcelona, following taxi drivers' protestation, a local regulation prevented Uber-like services to allow a booking in less than 15 minutes, whereas in Madrid there is no special regulation.

6.2.2 *Mateo Gudic, Teserakt*

- Presentation of the interviewed person

Mateo, Consultant at SYSTRA Ltd., registered on the Stakeholders group as a member of a NGO called Teserakt - association for interdisciplinary research.

- Short form answers

He answered the form related to regulations for disruptive mobility solutions:

1) Is it a regulation that:
    - Should be implemented.
2) What is the name of the physical jurisdiction where the regulation takes (or should take) place (neighborhood, city, country, EU)?
    - Country
3) Short description of the regulation :
    - Regulation on bicycle on infrastructure (OG 28/2016)
4) Choose the categories concerned by the regulation:

- Infrastructure, Network and traffic management systems.

5) The regulation refers to the transport of:
   - Persons.
6) Choose the mobility service(s) concerned by the regulation?
   - Free floating services (car, bike, moped, scooter, etc.).
7) What are the main types of impacts for the mobility service related to the implementation of the regulation: expected/experienced benefits, removed barriers that prevented from deploying the solution, expected/experienced risks (negative impacts).
   - Benefits expected: Social, Economical, Environmental, Legal, Security, Safety.
   - Barriers to implement: Political, Organizational
8) Please describe the most significant expected impact:
   - By applying this Regulation we will finally have standardized cyclist infrastructure which will improve safety and bring new users towards bicycles and away from cars.
9) Comments:
   - Croatia still doesn't have any Regulations or Laws regarding e-mobility or even MaaS systems, and some cities do not even try to improve existing cycling infrastructure by complying with existing Regulation.

- Interview: Long survey completed

Split is a UNESCO World Heritage site, facing severe issues related to traffic congestion and lack of infrastructure. Actually, cycling is not safe because there are no dedicated bike lanes and vehicular traffic is prioritized. This situation is shared among lots of cities in Eastern Europe.
This is currently being improved but it is a slow process. The main barrier for the development of sustainable modes of mobility is a lack of political willingness.
However, City of Split bought public bicycles (standard and electrical) and built up 8 stations so far. Car sharing is more common in Zagreb (smartphone app to pick up the car). Regarding other disruptive mobility services, private hire services are very popular and allowed by new law only if each driver is registered as a taxi business. However, the Law liberalized their numbers so now they are significantly adding up to congestion.
Public transport within the city mainly comprises of public bus service. Modernization is still required in order to set up a ticketing system, but there was a significant investment in new bus fleet with around 100 new vehicles. Railway transport is heavily underutilized with low numbers of passengers, but there are some plans to extend the existing suburban train to connect the city centre and the growing airport with a fast train service.

Teserakt is promoting sustainable modes of transport, especially emphasizing pedestrian safety and incentivizing the completion of large pedestrian street network within the infamous “Split 3” area[100].

[100] https://slobodnadalmacija.hr/split/strucnjaci-predlazu-kako-poboljsati-zivot-na-splitu-3-treba-rijesiti-cak-devet-lokacija-534560

6.2.3 *Colin Koh, Asian Detours*

- Presentation of the interviewed person

Colin, managing director at Asian Detours, registered on the Stakeholders group.
Asian Detours is a company that designs and implements engagement programs.

- Form

He answered the form related to regulations for disruptive mobility solutions:

1) Is it a regulation that:
    - Has already been implemented.
2) What is the name of the physical jurisdiction where the regulation takes (or should take) place (neighborhood, city, country, EU)?
    - Country
3) Short description of the regulation :
    - Active Mobility Act - Regulating the use of all kinds of personal mobility devices, incl. bicycles, e-scooters, mobility aids, etc. Works in conjunction with: 1) Other legislature such as Road Traffic Act Bicycles Rules; 2) Guidelines, and 3) Engagement programs such as the Safe Riding Program.
4) Choose the categories concerned by the regulation:
    - Shared/On-demand mobility (car-sharing, P2P sharing, ride-sharing, ride-hailing, bike-sharing, etc.),
    - Infrastructure, Network and traffic management systems.
5) The regulation refers to the transport of:
    - Persons.
6) Choose the mobility service(s) concerned by the regulation?
    - New individual electric vehicles
7) What are the main types of impacts for the mobility service related to the implementation of the regulation: expected/experienced benefits, removed barriers that prevented from deploying the solution, expected/experienced risks (negative impacts).
    - Benefits expected: Economic, environmental.
    - Barriers to implement: Social
    - Risks: Social, Security
8) Please describe the most significant expected impact:
    - Use of e-scooters elicits huge negative response largely based on emotion.

- Interview

Colin has strong expertise regarding micromobility solutions. He sets up programs to engage the public with regards to new transports, explaining how these solutions can change the mobility habits with the view of reducing misunderstanding.
Emotional, psychological factors should be at the core of new regulatory approaches. Training, cognition-based approach could be much more efficient that setting up more traditional rules, with more buy-in and perception from citizens.

⇨ **Advice for the tool:** include inputs that help choice with a good understanding of human nature, with factors that could lead to bad perception and acceptance of the regulation.

It is important to point out that e-scooters could be important on a social point of view. E-scooters, as it is a low-cost solution, provide an affordable way to offer food delivery.
On the general regulations regarding e-scooters, driving code (off-road infrastructure has to be used), dimension and charging systems definitions were set up.
E-scooters are licensed.

6.2.4 *Transport technology provider*

- Context & Introduction
- The aim of the GECKO project is to develop regulatory decision support tools for policy makers (Matrix + Dashboard). For this a database needs to be set-up, in order to have exhaustive knowledge about existing regulations at the European scale. This will allow the regulatory approaches suggested by the project to be compliant with current regulatory frameworks.
- Tachograph is a ubiquitous tool that has been used in international commercial road transport since the 1970s for the purposes of recording driving times and enforcing EU regulations. With technological advancements, the tachograph has undergone a lot of changes, it was initially changed from analogue to digital and then became “smart” since past few years.
- The evolution of Tachograph due to technological advancements can have several implications, not only for commercial road transport, but also for social aspects such as “posting of workers” and “fair working conditions”. If deployed well, it has the potential of becoming a disruptive technology.
- In view of this, the regulatory approaches adopted by the EU for grappling with the technological advancements in Tachograph present an interesting case study for the GECKO project. Below is the discussion held with a transport technology provider on an EU regulation relating to tachographs.

- Short Form (already filled in)

He answered the form related to regulations for disruptive mobility solutions:

1) Is it a regulation that:
   - Has already been implemented.
2) What is the name of the physical jurisdiction where the regulation takes (or should take) place (neighborhood, city, country, EU)?
   - EU
3) Short description of the regulation:

- "COMMISSION IMPLEMENTING REGULATION (EU) 2016/799 of 18 March 2016 implementing Regulation (EU) No 165/2014 of the European Parliament and of the Council laying down the requirements for the construction, testing, installation, operation and repair of tachographs and their components".

4) Choose the categories concerned by the regulation:
   - Cooperative, connected and automated transport technologies
5) The regulation refers to the transport of:
   - Both Goods and Persons
6) Choose the mobility service(s) concerned by the regulation?
   - Bus, Multimodal freight service
7) What are the main types of impacts for the mobility service related to the implementation of the regulation: expected/experienced benefits, removed barriers that prevented from deploying the solution, expected/experienced risks (negative impacts).
   - **Positive:** Social, Legal, Security, Safety.
   - **Barriers to implement:** Economical, Organisational
   - **Risks:** Limiting the use of the device, Dependency on external software, Dependency only on a few manufacturers.
8) Please describe the most significant expected impact:
   - Increased security, introduction of mandatory GNSS data in haulage industry

- Long Form Survey Questions, contains questions from the short form survey plus some additional questions (filled in based on the interview)

1. Is it a regulation that:
   - has already been implemented
   - will be implemented soon
   - should be implemented
2. Please explain the regulation you want to describe in very few words
   - "COMMISSION IMPLEMENTING REGULATION (EU) 2016/799 of 18 March 2016 implementing Regulation (EU) No 165/2014 of the European Parliament and of the Council laying down the requirements for the construction, testing, installation, operation and repair of tachographs and their components"
3. If you know, what is the precise name of the area where the regulation takes place (neighborhood, city, country, EU)?
   - EU
4. Choose the country(ies) where the regulation applies
   - All EU
5. How would you describe the physical jurisdiction level?
   - Supranational
   - National
   - Regional
   - Local

- Other

6. What kind of regulation is it?

- It is an EU implementing regulation
- It lays down the provisions necessary for the uniform application of the following aspects regarding tachographs:
  - recording of driving and resting times and driver's activities;
  - recording of the position of the vehicle at certain points during the daily working period of the driver;
  - remote early detection of possible manipulation or misuse of smart tachographs;
  - interface with intelligent transport systems;

7. Choose the category concerned by the regulation:
   - Cooperative, connected and automated transport technologies
   - Alternative fuels and electric mobility
   - Shared/On-demand mobility (car-sharing, P2P sharing, ride-sharing, ride-hailing, bike-sharing, etc.)
   - MaaS and platforms: MaaS ecosystems, journey planners, ICT platforms
   - Infrastructure, Network and traffic management systems
8. The regulation refers to the transport of:
   - Goods
   - Persons
   - Both
9. Choose the mobility service(s) concerned by the regulation?
   - Bus, Multimodal freight service

10. What are the main types of impacts for the mobility service related to the implementation of the regulation: expected/experienced benefits, removed barriers that prevented from deploying the solution, expected/experienced risks (negative impacts)?
    - **Positive**: Social, Legal, Security, Safety.
    - **Barriers to implement**: Economical, Organisational
    - **Risks**: Limiting the use of the device, Dependency on external software, Dependency only on a few manufacturers.

11. Please describe this benefit in few words
    - The use of tachograph presents a good EU model for implementing different road transport regulations in commercial transport. It is a model that can serve as an example for other countries outside of the EU as well. The model has been adopted at UN level by 57 Contracting Parties and has therefore become international.
    - The regulation fosters close collaboration between different entities from both the public and private sectors.

- This collaboration allows access to data between different entities.
- It is a closed tool and the regulation under discussion makes tachograph even more secure.

12. Please describe this barrier in few words

- The costs for implementing the requirements in the regulation can be quite high, as tachographs equipped in all the commercial vehicles in Europe would need to adapt to the regulatory requirements.
- Implementing the requirements stipulated in the regulation can be challenging at organizational level, since all the different organizations and stakeholders would need to coordinate and collaborate for the effective implementation of the regulation. Even if one stakeholder is excluded from the process, the system may not work.
- GDPR also influence the implementation of these regulations, which can impact the collection and storage of data.

13. Please describe this risk in few words

- While the regulation being discussed ensures that tachograph remains closed and secured, this can prevent the device to communicate with other devices and sensor networks in and around the vehicle, thus impacting the intelligence of tachograph and limiting the purposes for which it can be used.
- The regulation also does not address the fact that the tachograph collects and provides raw data, thus creating a dependency on external software for data analysis and extrapolating meaning.
- The specificity of tachograph in terms of its function and manufacturing is such that it can create a dependency on a restricted number of actors.
- Overregulation of a technology as well as the use of too technical and heavy language in the regulation can also impose a burden on small/new actors, thus reinforcing dependencies on a restricted number of actors.
- Regulations can sometimes require introduction of specifications, which may not turn out to have any practical use. This can create complications during the development phase and increase financial costs.
- Policy makers/Regulators should also be aware that any assumptions made about a specific technology can turn out to be false during actual implementation phase of the same and can pose a risk for its successful adoption.
- Regulating a technology should take into account the uncertainties imposed by technological advancements, as by the time a solution is implemented, the technological environment in which it would operate may advance to the next level.
- Interoperability requirements in a regulation can also pose a risk to successful implementation and adoption of a technology. Interoperability in this context can

mean compatibility of hardware and/or software with different devices and platforms, as well as operability across different countries.

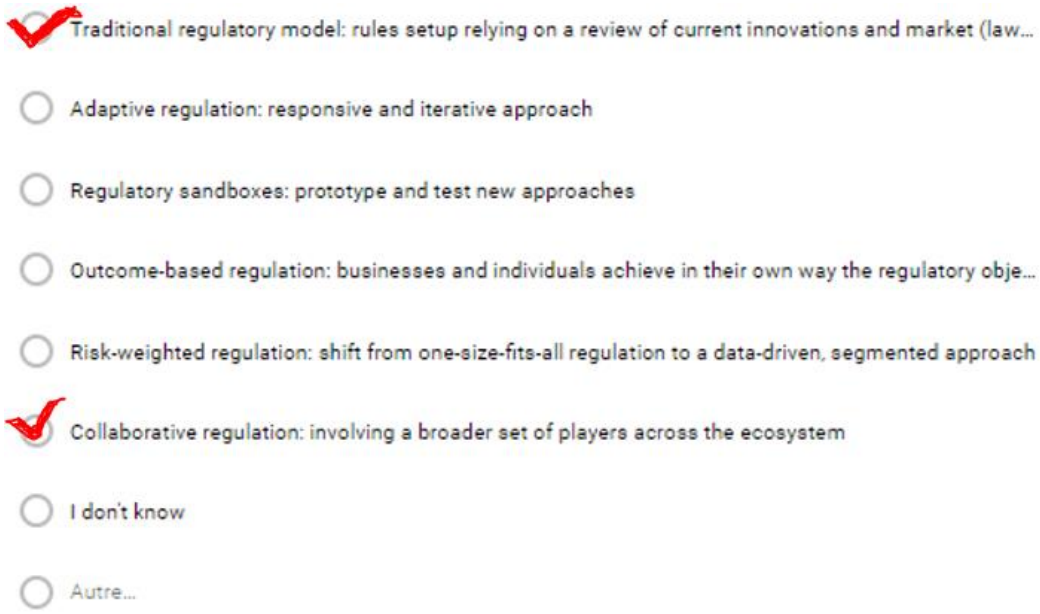
14. Who is impacted by the regulation?

- All stakeholders in the commercial road transport sector including – drivers, vehicle manufacturers, manufacturers of tachograph, enforcement organizations, road transport service providers.

15. Who is in charge of the decision to implement the regulation?

- All stakeholders in the commercial road transport sector including –vehicle manufacturers, manufacturers of tachograph, enforcement organizations, road transport service providers. Members States are in charge of setting up the security system behind the tachograph, in collaboration with the EU Commission Joint Research Centre.

16. Regulation approach



GECKO CONSORTIUM

The consortium of GECKO consists of 10 partners with multidisciplinary and complementary competencies. This includes leading universities, networks and industry sector specialists.

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