DIRIZON

Final proposal for business models options for data-exchange in context of CAD

Deliverable 6.1

October, 2020

Project Nr. 867492

Project acronym: DIRIZON

Project title:

Advanced options for authorities in light of automation and DIgitilisation horizon 2040

Deliverable 6.1 – Final proposal for business models options for data-exchange in context of CAD

Due date of deliverable: 01.06.2020

Actual submission date: 28.10.2020

Start date of project: 01.09.2018 End date of project: 31.11.2020

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Version: final

1 Executive summary

This document reports the activities of WP6 Exploration of Business Models of the DIRIZON project. This work is aimed at providing "business model options" for an NRA driven data-exchange platform in the context of future CAD deployment in Europe. In order to create these options, the work must deal with the current heterogeneous landscape on the one hand and a desirable future landscape. We have observed the current European position in the data and platforms landscape and devised a future scenario. This scenario is termed 'CAD-fleet-as-a-service' and reflects a situation in which CAD-fleets and corresponding public and private data services are flourishing.

In order to understand, from a business modelling perspective, how to reach such a scenario, we combined the concepts of a platform business model, governance (e.g. of alliances and collaborations), good governance of commons and collaborative networks. Next, we detailed three study scenarios, based on real life examples interpreted in the context of CAD and scaled to full European scale. We evaluated these scenarios within the consortium on six pre-set criteria, in order to find elements that support or hinder a move towards the desirable scenario.

Table 1: Summary of evaluation of the three studied scenarios

	NRA-Dominant (NDS) Based on C-Roads	**Market-Dominant (MDS)** Based on Your-Now	**Hybrid (HS)** Based on MobiDS
Traffic	Traffic Knowledge Authority	City-level servicing collaboration	Local to global by interoperability
Convergence	"Agree first"	"Big Markets First"	By design Enabling
Governance	NRA-centric	CEOs at Joint Ventures Local coordination	Local public private collaboration
Business	Passive: agreed standards	OEM driven Big Tech driven	Local to global by interoperability
European Values	Not in contradiction Limited mandate at NRAs	If market demands	By design Enabling
Innovation	Pilot to standard Pre-competitive & R&D heavy	Customer centric Unknown traffic effect	Decentralized, yet replicable

We found for the scenarios:

- The NDS is an NRA driven governance structure that systematically coordinates pilots and the process to derive standards from that. As such, it interfaces with the automotive industry, mainly on standardization.
- The MDS tends to drive business "where the money is", which is more applicable to urban areas. In cities, public organization are both served and collaborated with.
- The HS is a decentralized approach to public and private collaboration. Based on principles, such as data sovereignty, both public and private parties, as well as citizens build trust in this way of working. However, the base example (MobiDS) is still at its early stages, so expanding it to a full scale bears uncertainties.

Based on these and more detailed insights, we proposed a strategy in which the strong elements are combined. In summary, this strategy promotes the readily established European governance structure, and suggests it be expanded by both sub-national authorities as well as market party participation. Furthermore, the recommendations are to also "IDS-ify" both pilots and city-based data-sharing implementations. The result would be a decentralised, yet connected organization that implements and governs data-sharing following European values.

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Abbreviations

Abbreviation	Full Title
AD	**A**utomated **D**riving
API	**A**pplication **P**rogramming **I**nterface
B2B	**B**usiness to **B**usiness
B2C	**B**usiness to **C**onsumer
BMC	**B**usiness **M**odel **C**anvas
CAD	**C**onnected and **A**utomated **D**riving
CAV	**C**onnected and Cooperative **A**utomated **V**ehicle
CCAM	**C**onnected and **C**ooperative **A**utomated **M**obility
CEDR	**C**onference of **E**uropean **D**irectors of **R**oads
C-ITS	**C**ooperative **I**ntelligent **T**ransport **S**ystems
C-Roads	**C**ooperative **R**oads
CPR	**C**ommon **P**ool **R**esource

DAB	**D**igital **A**udio **B**roadcasting
DX.X	**D**eliverable X.X
GDPR	**G**eneral **D**ata **P**rotection **R**egulation
HD	**H**igh-**D**efinition
ICT	**I**nformation and **C**ommunications **T**echnology
IDS	**I**nternational **D**ata **S**paces
ISAD	**I**nfrastructure **S**upport for **A**utomated **D**riving
ITS	**I**ntelligent **T**ransportation **S**ystem
MaaS	**M**obility **A**s **a** **S**ervice
NAP	**N**ational **A**ccess **P**oint
NRA	**N**ational **R**oad **A**uthority
ODD	**O**perational **D**esign **D**omain
OEMs	**O**riginal **E**quipment **M**anufacturers
PEB	**P**rogramme **E**xecutive **B**oard
RDS	**R**adio **D**ata **S**ystem
RO	**R**oad **O**perator
SAE	**S**ociety of **A**utomotive **E**ngineers
SDK	**S**oftware **D**evelopment **K**it
SRTI	**S**afety-**R**elated **T**raffic **I**nformation
TERAP	**T**rusted **E**lectronic **R**egulation **A**ccess **P**oint
TMC	**T**raffic **M**anagement **C**enter
VMS	**V**ariable **M**essage **S**igns
V2I	**V**ehicle **to** **I**nfrastructure
V2V	**V**ehicle **to** **V**ehicle
WP	**W**ork **P**ackage

Definitions

Term	Definition
ACTOR	An entity (human or company) that interacts with the system for the purpose of completing an event.
AUTOMATED DRIVING	A traffic system in which vehicles are capable of sensing its environment and operating and manoeuvring in traffic to achieve a goal, with little or no human input. It is supported by connectivity consisting of Vehicle-to-Infrastructure (V2I) communication, Vehicle-to-vehicle (V2V) communication, Vehicle to Everything (V2X) communication, Infrastructure to everything communication (I2X).
DEVICES	The components of an Information Technology (IT) network that permit the communications needed required for data applications and services (such as servers, routers, detection systems etc.).
DIGITALISATION	The implementation of digital technologies, which when combined with Information and Communication Technology (ICT) tools, assist in making transport modes more interoperable and smarter
DIGITISATION	The process of converting physical information into a digital format.

OPERATIONAL DESIGN DOMAIN (ODD)	A description of the specific operating conditions in which the automated driving system is designed to properly operate. It includes but is not limited to roadway types, speed range, environmental conditions (weather, day/ night time, etc.), prevailing traffic law and regulations, and other domain constraints (SAE J3016 June 2018).
USE CASE	A function of the system, the desired behaviour (of the system and actors), specification of system boundaries and definition of one or more usage scenarios. It combines all possible scenarios that can occur when an actor tries to achieve a certain technical objective (business goal) with the help of the system under consideration.

2 Introduction

The CEDR Transnational Research Programme was launched by the Conference of European Directors of Roads (CEDR). CEDR is the Road Directors' platform for cooperation and promotion of improvements to the road system and its infrastructure, as an integral part of a sustainable transport system in Europe. Its members represent their respective National Road Authorities (NRA) or equivalents and provide support and advice on decisions concerning the road transport system that are taken at national or international level.

The participating NRAs in the **CEDR Call 2017: Automation** are **Austria, Finland, Germany, Ireland, Netherlands, Norway, Slovenia, Sweden** and **the United Kingdom**. As in previous collaborative research programmes, the participating members have established a Programme Executive Board (PEB) made up of experts in the topics to be covered. The research budget is jointly provided by the NRAs as listed above.

Modalities and infrastructure in mobility are becoming more and more digital, connected and automated. This creates huge potential for digital, automated and dynamic control. Simply think how individual drivers, traffic, safety and infrastructure was addressed four decades ago, two decades ago and today. Add to that a fleet of connected automated vehicles to conventional cars and trucks, using numerous sensors and artificial intelligence and updated software modules to route and respond, ubiquitous connectivity in different technologies, to intelligent infrastructures. Then think about the technological interdependencies and the number of components and the number and sort of parties involved in creating this interoperable system. It is completely overwhelming and hard to imagine this can actually work reliably.

There are good reasons to think it can. In any future CCAM scenario digital services will be created and delivered by an ecosystem of international and national, governmental and commercial, small and large service providers using in-car, mobile or aftermarket devices. NRAs have always played, and will also always play a crucial role in this scenario. But the paradigm shift from four decades ago to that future is in ecosystem thinking and strategy. Ecosystem thinking is not just about understanding who's active in the sector and who relates to whom, ecosystem strategy is the art of balancing control of your assets and influencing the use of assets of another.

In other domains we observe that some parties master this skill really well and are taking advantage of the hyperconnectivity. Think about companies such as Uber, Google, AirBnB, Amazon, SalesForce, Alibaba and Tencent. These platform strategies are affecting Europe's sectors as well, including mobility, by disrupting existing business models, by focusing on providing user value whilst harvesting huge amounts of data. Europe is currently prioritizing development of a proper alternative to this dominance, by approaches such as the International Data Space (data autonomy) and Gaia-X (data storage).

It is in this overarching trend and context that we are seeking an answer to how NRAs could organize and utilize data-exchange, between peers and other organizations in the mobility domain in this future where a substantial CAD-fleet is moving on a digitally connected infrastructure.

The objective of this work package is to explore networked business and governance models for a decentralized data exchange facility between public and private actors in context of a future CAD scenario.

The development of a data exchange facility leads NRAs to ask about what the possible and preferred NRA role(s) could be and how to get there. In the development of a data exchange facility, it is important to understand what can and should be offered by the NRA, under what conditions, what the NRA's obligations are, while at the same time not competing with commercial interests, and not creating favourable conditions for one party over another. And also deal with national differences in policies and technological deployments. Furthermore, the other (non-NRA) parties need to participate in the data exchange platform, they also need to

have incentives to participate. This is the context for the exploration of the platform business models but also how the different NRAs relate to one another and to the members in the ecosystem: in other words the governance.

2.1 Project background

The digitalisation of road networks and the rapid developments in automated driving will affect the core activities that (national) road authorities carry out and provide them with new and more efficient ways to achieve their goals for road safety, traffic efficiency, the environment and customer service. In this context, digitalised data plays a key role and enables the connectivity needed to improve efficiencies in managing, maintaining and operating the road network. Equally, digitalisation, along with connectivity, are crucial prerequisites to enable automated driving. Digitalisation of road assets can provide a number of benefits to road authorities including new (business) opportunities resulting from data sharing, the improvement of enhanced traffic management with Intelligent Transport System (ITS) equipment, improved asset management thus allowing for more reliable performance monitoring of assets and more efficient maintenance processes. Road Operator (RO) business practices will need to adapt to exploit these opportunities

To support road authorities in their digital transition and in their interaction with other actors in cooperative automated driving, the Conference of European Directors of Roads (CEDR) commissioned and funded the “advanced options for authorities in light of automation and DIgitalisation hoRIZON 2040”, (DIRIZON) project in the Transnational Research Programme Call 2017 on “Automation”. The DIRIZON project’s goal is to assist the aforementioned road authorities and Road Operators in identifying how these developments will affect their operations and their interaction with others. In this respect, DIRIZON will determine the implications of digitalisation and automated driving on specific core topics and their consequences on data needs and requirements for data-exchange.

2.1.1 WP6 in DIRIZON, including scoping

The objective of this work package is to explore networked business and governance models for a decentralized data exchange facility between public and private actors in context of a future CAD scenario.

In this work package we adopted after some initial exploration the following theses

- Digital services in any future CCAM scenario will be created and delivered by an ecosystem of international and national, governmental and commercial, small and large service providers using in-car, mobile or aftermarket devices.
- The data-exchange concepts and their governance must ensure that these service providers (*including* NRAs) are optimally facilitated in the creation and proper functioning of these services is, e.g. by providing added value elements, e.g. by enriching services, toolkits, good governance and consistent access in all countries
- From the perspective of the service providers, whose use determines the value of the data-exchange, a seamless and uniformly available platform facility for building their services on top of would be ideal. But how to realise that in a decentral way, with which governance and conditions?

The methodology devised in this report revolves around the creation and evaluation of three reality inspired scenarios for data sharing in context of CAD. The three scenarios are: NRA-dominant (the NRA controls many of the functions from sensing to data storage to delivery of the data driven services), Market Dominant (the NRA plays a minimal role and leaves most activities to ‘the market’) and Hybrid (a mix of these scenarios). The purpose of evaluating these scenarios is to learn which aspects are valuable and which are limiting. These aspects

are identified and formulated as recommendations for consideration in WP7 – the roadmap.

The work is organised alongside five tasks:

1. Draft Ecosystem models for the scenarios Use Cases. The outputs of this work have been reported in D3.1 Digitalisation and Automation: Implications for use cases, Identification of Stakeholders and Data Needs and Requirements.
2. Selecting and detailing the examples and developing full scale European scenarios.
3. Development of a scenario assessment framework
4. Assessment of the scenarios using the framework
5. Synthesize

The use cases identified in "WP2: NRAs and Digitalisation" and analysed in depth with NRAs (WP3: Digitalisation and Automation) and external stakeholders (WP4: Other Stakeholders' views on Digitalisation and Automation) formed the basis for further elaboration in different scenarios. The collaboration between Networked business and governance models (WP6: Exploration and Business Models) and the digital platform (WP5: Towards a Digital Platform) ensured that the architectural approach and the organizational considerations are aligned. "WP7: Step by step transition toward full digitalisation of the road network" consolidates the findings of the other WPs into an encompassing roadmap.

Following consultation with the PEB during a meeting in Brussels on November 26th' 2019 it was agreed that the approach to Work Package 5 and Work Package 6 would be rethought. With regard to Work Package 5; instead of one largely harmonized model for an exchange platform, a range of possible technical data exchange options are now emerging due to international system heterogeneity, which must be examined. In order to illustrate and prove the variants, it is planned to show and evaluate current example projects. This task is more complex than planned and expected.

With regard to WP6, the conclusions in the workshop summary, e.g. "The NRAs currently do not see the necessity to present themselves as a single seamless platform."; "NRAs will participate in international governance bodies and pro-actively set these up, if needed.", have introduced a stronger focus on governance as being part of a collaborative network business model. The changes can be seen in Table 2.

Table 2: Changes within the tasks of WP6

6.1 Draft Ecosystem models for the scenarios Use Cases	Not affected. This is covered in D3.1 and D4.1
Task 6.2 Selecting and detailing the business model scenarios	The notion of business model scenario was expanded to 'collaborative network' and includes both platform business model and governance aspects. The scenarios were developed as 'NRA-Dominant', 'Market Dominant' and 'Hybrid'. These were based on real-life examples, but interpreted a) in context of Use Case 3 and 'inflated' to full European scale.
Task 6.3 NRA Data sharing platform Business Model Scenario Assessment framework	The aspects in the evaluation framework were expanded to include governance, convergence and 'European Values'
Task 6.4 Assess the use case business models from different perspectives	See 6.3
Task 6.5 Synthesize	

2.2 The European approach on industrial platforms

A pan-European NRA-driven data-exchange facility that interacts with members of the future digital CAD ecosystem can be seen as a public-private platform. The public and economic

relevance of such a digital asset cannot be underestimated. Consequently, the challenge being addressed in this report must be considered from that perspective. Recently the European Commission (Lemke, 2018) and TNO (Stolwijk et al., 2019) released an analysis and policy approach to the wider industrial platform landscape. These are quoted in the below.

"The European, as well as the global, Business to Business (B2B) platform landscape is characterised by a high proliferation and fragmentation of diverse solutions with few signs of consolidation. Success in the B2B platform battle requires commercial platforms to be collaborative, simple, scalable, secure, and trusted.

Data is becoming critical in integrating production (within companies - e.g. digital factories) and between companies, linking organisations along the value chain, thus for the business growth strategy of companies and it will become more important in future. Europe is committed to developing a European approach on data and to putting in place the most suitable collaboration strategies to embrace European values on data sovereignty and openness. That is why the EU has adopted the General Data Protection Regulation (GDPR) and promotes data usage and sharing, open APIs, and interoperability.

Key issues that play in the landscape of industrial platforms:

- Digitalisation of factories and value chains are key developments underlying concepts such as Industry 4.0. Digital platforms play a crucial role in the future of European industry.
- There are changes in international trade regimes and more broadly geopolitical developments. Protectionist tendencies are becoming stronger (e.g. the America First policy of the U.S.).
- The current U.S. dominance in Business to Consumer (B2C) platforms and strong position of Chinese platforms may be extended to Industrial B2B platforms – which would have major implications for European industries.

Delaying or failing to respond to the challenges will have a profound impact on the future of European industry. Industrial data platforms and data sovereignty will condition the competitive advantages that our industry may draw from the next generation AI solutions and other digital opportunities. The decisions we make today should ensure that European technological excellence also translates in a privileged positioning of European companies in the global markets."

2.3 An "ideal future" scenario called "CAD-fleet-as-a-Service"

Following up on the observations of the November 26th, 2019 Workshop, which revealed heterogeneity in technical deployments, policies and NRA preferences, the project needed to think of a new approach to generate requirements for both the architectural approach as well as for the networked business and governance model. Also, influenced by Europe's strategic digital autonomy analysis and forthcoming strategy on implementing data sovereignty and openness as European values to maintain autonomy and competitiveness, we drafted a brief scenario. This scenario serves as an ideal scenario, in the sense that it would realize the abovementioned sovereignty and openness, leave room for national heterogeneity, yet allow for the desired traffic, infrastructure and safety control and be attractive for industries – at full European scale. The idea being, that moving towards such scenario would be desirable, yet different pathways (scenarios) are expected to emphasize different values and incur different trade-offs. One can think of an NRA-dominant pathway, or a market dominant pathway. In Figure 1 below, we sketched several pathways from the current situation towards a future scenario. The current situation we summarized as 'heterogeneity' to reflect that, with respect to mobility data sharing, nations and regions have different technologies deployed, different policies and preferences.

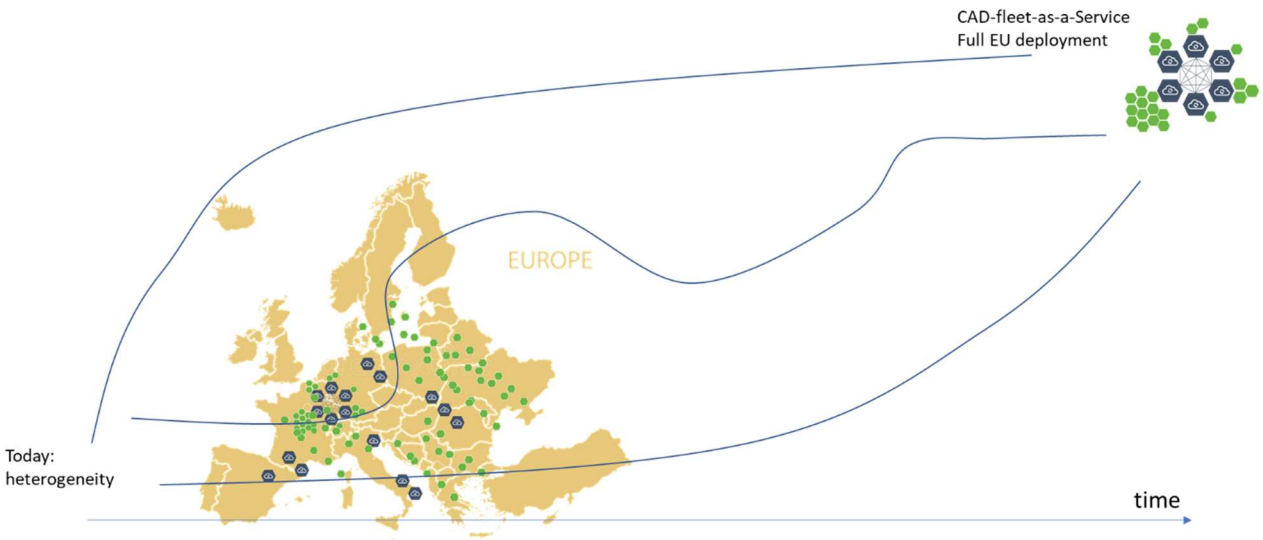

Figure 1: Different pathways to reach full European deployment

We termed the future scenario "CAD-fleet-as-a-Service", as the purpose in this scenario would be to support the data-exchange to be able to jointly serve a very large fleet of CAD vehicles, much like an integrated service. This, in a way that it is attractive for CAD manufacturers to deliver to Europe, as well as for service providers to develop digital services that benefit the users of the CADs, as well as road authorities and traffic managers for effective and efficient road and traffic management.

We listed the scenario to bear the following characteristics:

- An environment in which the data required to operate, **a heterogeneous and massive CAD fleet** flows unhindered**.**
    - This includes safety & traffic flow related messages, new services innovation.
- It would implement the European Values, e.g. Sovereignty, Openness – without affecting performance and functionality.
- It would be attractive to OEMs and service providers, as this environment would be reliable and cost-effective.
- It would be efficient and effective for NRAs, in the sense that NRAs could indeed manage their polices on ensuring safety, traffic flow and regulation to set standards and that investments in infrastructure and digital assets would be minimal, because of sharing (public-private)
- "**CAD-fleet-as-a-service**" as an analogy to connected factories (manufacturing-as-a-service)
- The scenario would allow different nations and companies to participate in this scenario in their own pace, i.e. no "big bang" radical change would be needed.

Indeed, this appears to be a somewhat 'utopian' scenario, desirable for all stakeholders. We used this scenario to derive the evaluation criteria in section 6.1. The different pathways indicate that there are different ways to achieve such a future scenario, e.g. by allowing market forces to get there, or by strong central governmental coordination.

2.4 Reading guide

Section 3 Methodology describes the process in which we gathered and analysed information to draw conclusions and propose recommendations. Section 4 introduces the theoretical background to our approach consisting of business models, governance and collaborative networks. Section 5 detail the three different scenarios and the framework used to describe them. Section 6 details the evaluation framework and analysis of the scenarios and concludes with a number of recommendations. The report concludes with Section 7 Conclusion.

3 Methodology

This section describes how we approached the challenge at hand. It is split in two main phases: a preparatory phase and an analytical phase. In the first phase the role models and Use Case flows were defined and the many platform considerations were explored. This phase was concluded by a stakeholder workshop. The analytical phase revolves around the creation and evaluation of three reality-inspired full scale European scenarios for data sharing in context of CAD. The focus lies on Use Case 3, as it is the most complex one, building on, and thereby partly incorporating, Use Case 1 and 2.

3.1 Preparatory phase

In order to prepare for the business modelling analysis, WP6 contributed to WP3 in setting up the method and supporting canvas for defining, discussing and validating the Use Case diagrams. These are reported in "D3.1 Digitalisation and Automation: Implications for use cases, Identification of Stakeholders and Data Needs and Requirements". Based on this work, the different roles, data supply and data use approach in the stakeholders surveys and reported in D4.1 was based.

The challenge to design the architecture for the envisaged platform and corresponding business model options, triggered a fruitful exploration between WP5 and WP6. At this point the high-level requirement was that the platform should support the data-exchange required for the three use cases. That principle triggered many subordinate discussions, based on the concepts and theories introduced in the next section. To illustrate the scope of these discussions, we will pose here a number of questions, such as;

Is the platform for internal or external use to NRAs? If it is external, who can use it (openness)? Is it a standard, or a piece of software, or is it a system? Is it centralized or decentralized? Do we expect it to be the same in each country, or can differences exist? Is the service provision seamless over countries? Can cars and service providers discover services? To what extent is it relevant for the business model what types of data are available, and what the qualities are? Are services facing and interaction with CADs integrated, consistent and available through one point? Who would do that? How will this be governed, and by whom? Whom do we expect to take the lead and set control? What should be done in order to leverage an ecosystem of digital service developers?

These discussions led to the conclusion that the scope was too broad to address by the original approach. To narrow the scope, the main stakeholders needed to be consulted. This was done in the CEDR CAD group workshop, held November 25, 2019 in Brussels. The outline and results of that workshop are captured in the Appendix. As indicated in section 2.2 the conclusion of that workshop shifted the focus for WP6 from platform business model to collaborative network and governance.

3.2 Analysis phase

Figure 2 below depicts the different steps we took to meet the challenges as described in Section 2. In summary, the methodology revolves around the creation and evaluation of three reality-inspired scenarios for data sharing in context of CAD. The three scenarios are: NRA-dominant, Market Dominant and Hybrid. The purpose of evaluating these scenarios is to learn which aspects are valuable and which are limiting. The purpose is not to select the optimal

scenario, but rather to be able to compose an optimal mix.

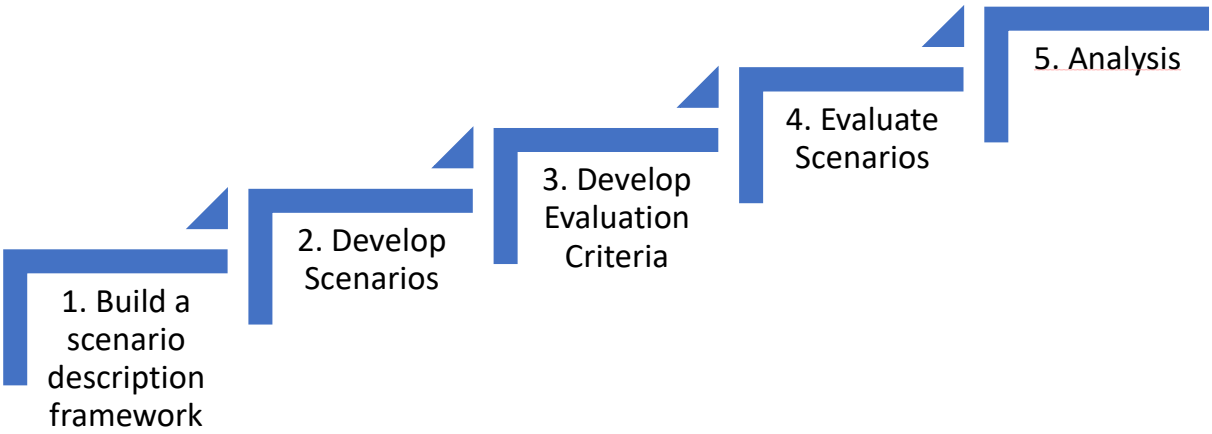

Figure 2: Graphical representation of the WP6 methodology

1. **Build a scenario description framework**

The first step is to build a framework to describe scenarios. This is done by reviewing relevant works on collaborative networks, platform business models and governance. This theoretical background is described in Chapter 4. Based on these theories, we identified and defined five key dimensions that describe collaborative networks. The dimensions are: Ecosystem, Support and services, Geography, Governance and Application and these are defined in Section 5.3.

2. **Develop Scenarios**

The purpose of the second step is to compose scenarios for the business model and governance of data-sharing in context of CAD, in order to be able to learn from these scenarios, which elements, from a business and organizational governance perspective, work or do not work on a full European scale. In order to do that we were looking to develop the following scenarios:

1. NRA-Dominant: The community of NRAs is setting up and coordinating the data-sharing in context of CAD, at full European scale.
2. Market Dominant: Market parties (e.g. OEMs or BigTech) are setting up and coordinating the data-sharing in context of CAD, at full European scale.
3. Hybrid: NRAs and market parties are collaborating to set up and coordinate the data-sharing in context of CAD, at full European scale.

Each of these scenarios is expected to reveal a different logic in how data exchange between ecosystem actors is coordinated. This will affect what the full European landscape of data-sharing in context of CAD and its pathway will look like. The way such landscape is arranged will affect its 'performance'. (The performance criteria to which the scenario is evaluated is presented in Chapter 6). It is important to understand these differences in performance, in order to be able to understand which properties to achieve and which properties to avoid.

In order to create these scenarios we executed the following steps:

1. We searched for relevant related current examples for each of the scenarios. For the NRA-Dominant example, we chose C-Roads as a relevant and known example. For the Market Dominant example, we chose Your-Now. And as the Hybrid example, we chose Mobility Data Space. These are detailed in Section 5.4
2. We described these following the description framework built in the previous step.

3. Next, we considered how the real life examples would implement the Use Case 3. See Section 5.2 for a full description of Use Case 3.
4. Next, we interpreted what the translated example would look like if implemented on full European Scale.

The results of step 2-4 are described in Section 5.4. The activities were executed by the full DIRIZON consortium.

3. Develop Evaluation Criteria

In order to be able to learn from the scenarios, we set up a set of six different criteria that can serve as a lens to look at the scenarios and see differences, pros and cons. The set of criteria should reflect the perspectives of different public and private stakeholders and different nations. The criteria that were used are: Traffic, Convergence, Governance, Business, European Values, Innovation. These are described in Section 6.1.

4. Evaluate Scenarios

After the construction of the scenarios and development of the evaluation criteria, the scenarios were evaluated in an online workshop. The consortium participants were asked to study the three scenarios and evaluate the three scenarios, criterion by criterion.

Statements were formulated as follows (example for the Traffic criterion): "*In the full European scenario digital control of safety and flow of traffic can be realized. Managing safety and flow of traffic of the road infrastructure are among the key objectives of the NRAs' mandates.*". Responses were requested on a 5-point Likert-scale, ranging from 'Strongly disagree' (point 1) to 'Strongly agree' (point 5).

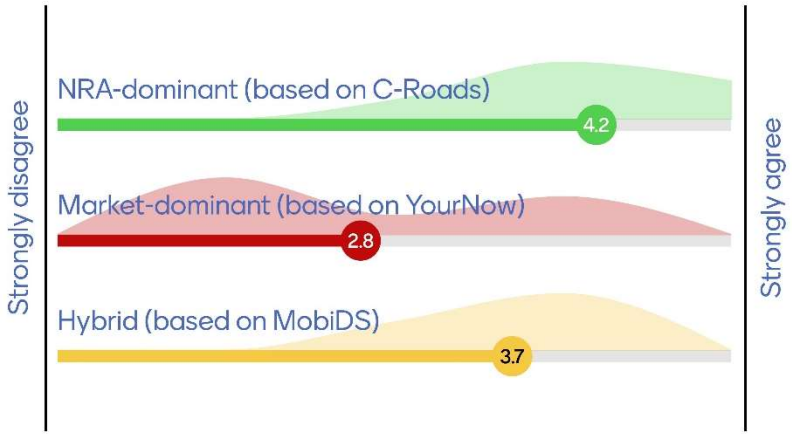

Figure 3: Example evaluation result for 1 criterium

After the quantitative evaluation, the motivations were thoroughly discussed. In this way all criteria were processed. Note that the purpose of these exercises is about eliciting the motivations, rather than the numerical evaluation. The results are summarized and discussed in Section 6.2.

5. Analysis

Following the evaluation process, the results were gathered and discussions summarized and presented in an overview. For each of the criteria it was considered which elements from each of the scenarios would be interesting for establishing or avoiding in a future scenario. These elements were discussed internally and also discussed with the CEDR CAD group.

4 From platform business models to collaborative networks

The purpose of this chapter is to introduce the key foundations for business modelling in the data-sharing context. As stated in the introduction, the scope shift from business models for a platform towards a collaborative network has been taken into account here.

In the first section we discuss business models and platform business model constructs. In the second section we introduce a few notions about governance, before we enter into the concept of Collaborative Networks. This section is concluded by an example from manufacturing industry, the Smart Connected Supplier Network.

4.1 Business models

The following section is quoted from a recent TNO report (TNO, 2020) on collaborative business modelling and introduces the background of business modelling.

"The term 'business model' has been used more and more often over the past two decades. In essence, a business model describes how an organisation creates value. It shows how an organisation is structured and shows what value is realised (described in the value proposition) and how this is achieved. In conventional theory, business models are in principle organisation-centric. Central is a single organisation and how this organisation creates value. Environmental and institutional factors influence how the specific business model can be structured. Also, the definition of value often involves a fairly narrow interpretation, namely financial value. Sustainability is not usually included in the traditional business model.

Analysis of the use of the term 'business model' reveals three different forms (Massa, Tucci and Afuah, 2017). The first is the business model as a descriptive archetype of how businesses operate in practice. Examples are 'razor & blade' (cheap core product, more expensive additional products), 'freemium' (product or service is offered free of charge, advanced functionalities are priced) or 'pay-per-use' (a fee per moment of use). The second form of use involves understanding the images of business logic that managers hold, as opposed to describing reality. The third form of use, which could be positioned between the two preceding ones, is that of a formal model that consists of elements and relationships. A well-known model is the Business Model Canvas, which was developed specifically from an organisation-centric perspective, but there are many other forms and examples.

In practice, the business model is used for various purposes (Al-Debei, Mutaz & Avison, 2010). The first is that of a means to create a shared perception between multiple people (or companies). For example: what activities are needed to deliver a service to a specific target group? The second purpose is that of operationalising a strategy. By specifying the elements of a business model, a clear picture is created of how the company intends to realise the strategy. The third purpose is to capture and use knowledge on business models. This enables users to compare business models and observe performance.

These forms find their origin in strategy, management and information systems. In this sense, it is not surprising that in these business models a central place is created for the financial-economic revenue capacity of a single organisation. In the light of sustainability and climate objectives, various elaborations and counter-movements have emerged in response to this purely financial economic perspective (Bocken et al., 2014; Geissdoerfer, Vladimirova & Evans, 2018). The aim here is to integrally incorporate sustainability objectives into the business model by applying a broader concept of value. The 'triple bottom line' (people, planet, profit) and 'multiple value creation' are well-known, but hard to operationalise concepts. This school of thought is also known as 'Sustainable Business Models' (SBM). In this movement, the concept of servitisation (Product-Service System, PSS) is prominent (Tukker & Tischner, 2006)."

A business model is thus about value creation and value capturing. An often practiced misconception is that business models would not apply to governmental organizations, based on their not-for-profit status. We see the business model as a concept to understand and design value creation and capturing, also in context of public-private value creation. In this case, we are looking to create an organizational construct to support data-exchange in a European level in context of CAD.

Below, a 'conventional' business model canvas (BMC) is depicted. It shows from left to right, how value is transformed from inputs from key partners, by performing activities and utilizing key resources to what is referred to as the value proposition. This value created is then delivered to various customer segments. With the transformation several costs are associated, whereas the revenue block represents the associated incoming value captured.

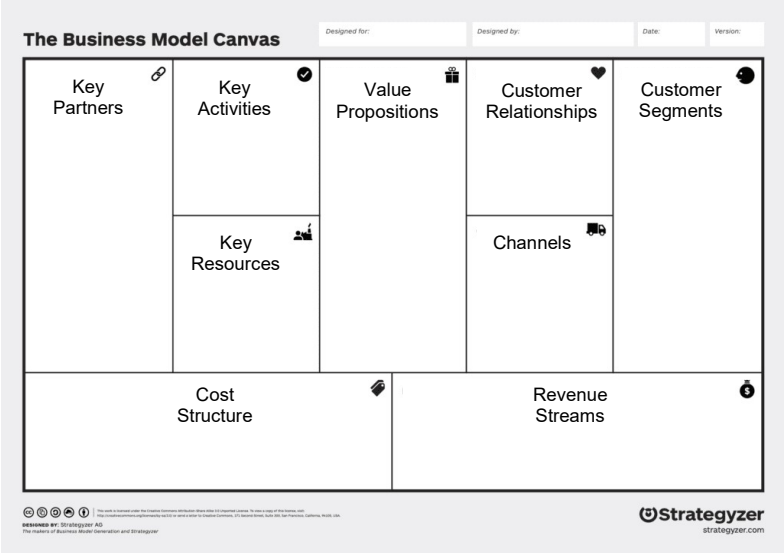

Figure 4: Business Model Canvas

Although the BMC is a very easy to understand tool, for our challenge it would be inadequate. The reason for this being that the value creation that we are considering here is an interplay between multiple NRAs and multiple data providers (e.g. CADs) and multiple data users (e.g. service providers, OEMs, other NRAs and governmental authorities). A specific business model archetype that is more relevant in this situation is the so called 'platform business model'.

4.1.1 Platform business models

Platform business models are special business models because the value they create is the facilitation of transactions between different types of users of the platform. There are many well-known examples, such as AirBnB or the Apple App-store. Also data-exchange facilities adhere to this principle because they link 'supply' of data to 'demand' of data. Such business models are also referred to as 'multi-sided business models', referring to the 'supply' and 'demand'-sides of the platform.

There is one essential characteristic of such business model to mention here, and that is that successful platform business models need to achieve a critical mass in both 'supply'-side and 'demand'-side rather quickly in order to establish network effects. This can be interpreted as follows: the platform needs a certain collection of data-sources in order to be useful for service providers , and on the other hand, a platform needs a certain demand established for data source owners to be willing to share data via the platform. This principle is depicted in figure 5.

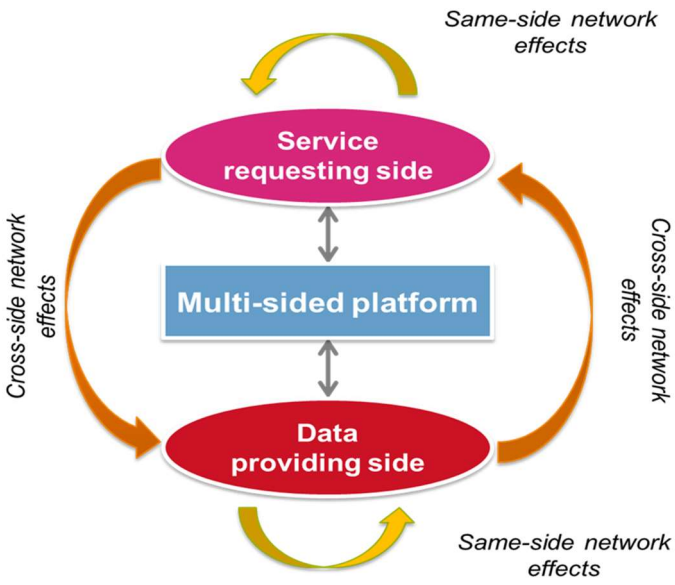

Figure 5: The working of platform business models

In the figure above we see the platform in the centre and the 'supply'-side in the bottom. The 'demand'-side is on top. It should be noted, that the organization that exploits the platform can also be a data-provider, and also a data-user (i.e. service provider).

Digital platforms are built to scale. This is why there are so many different examples that follow strategies in which in the first years strong investments are made in achieving a large user base, often at a loss. These strategies are banking on the network effect.

This can only be achieved if user needs from *both* sides are being fulfilled, almost to the extreme. Only when the value experienced is high, the user will not engage in direct, but in 'platform-mediated' transactions. The value for the demand side (north) depends on the total available set of data, whereas the incentive to provide data (south) is present if there are many users and uses of the data. If the platform is the dominant go-to system, then it will thus also attract more users and more data sharers. This effect of attraction is a critical success factor of growth and value of a platform business model. Figure 6 presents useful stages to achieve that.

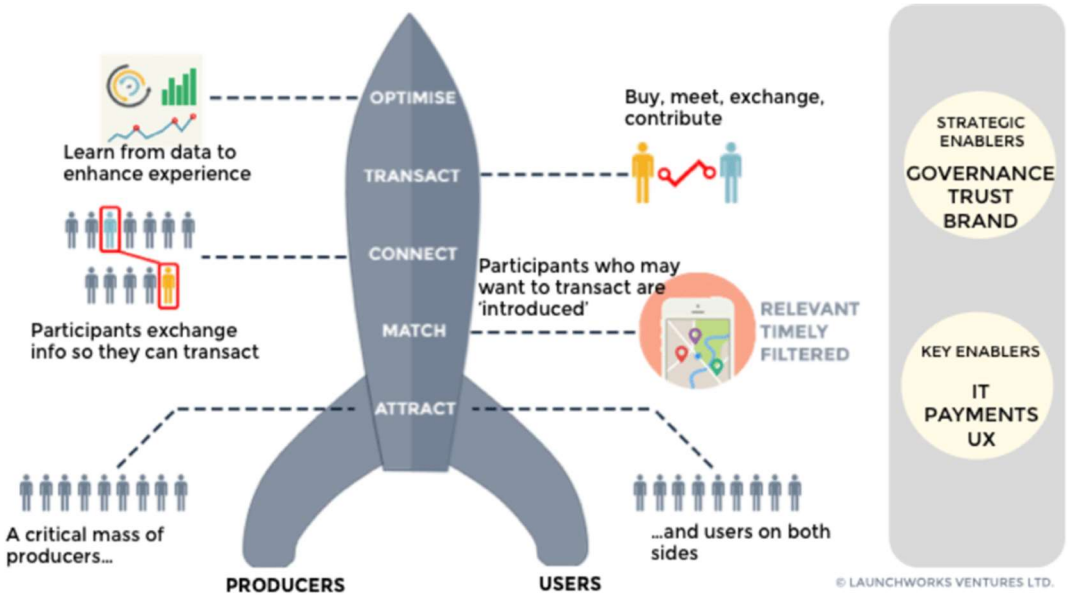

Figure 6: The rocket model for platform strategies

Figure 6 depicts the 'rocket model' for platform business strategies. We will briefly summarize the stages:

- Attract: the platform and its role must reach awareness and interest from the users. Often this requires substantial campaigning.
- Match: once on the platform, it must be easy to search and find the supply needed
- Connect: before the actual transaction can take place, details and credentials must be in place
- Transact: this is the core function of the platform. In this case, it is about the actual use of a certain data source.
- Optimize: only when the whole process from attraction to transaction is monitored, it is possible to improve the user journey.

Note that typically in a data-sharing landscape the connect-phase can be quite intense in terms of setting credentials, and configuring APIs etc. Once that is in place, data sources can be read multiple times in a longer period of time (of course, credentials are checked each time).

Considering the above, some of the key questions to be asked when designing a platform business model for data-exchange are:

- Who is the owner/exploiter of the platform?
- Who are the supplying and demanding users, and what data sources would they need?
- How can I optimize the user journey from the attract to the optimize phase?
- In which process do they need the data?
- What complementary services do the users need? Should I make these available on the platform?
- What qualifications, if any, must be met, in order to supply or use data from the platform?
- How can I achieve critical masses on both sides of the platform? How can I spur the creation of new services that utilize the available data? How can I easily onboard suppliers and users of data?
- What alternatives to the users have, i.e. is there any competition?

Note that this discussion above is not technological in nature, i.e. the technology is expected to fulfil as much as possible the requirements implied by the above. In other words, technically being able to support data-exchange in the given Use Cases is an insufficient condition for adoption of the platform. Despite the appealing success stories, many platforms fail for business strategy related reasons: (1) mispricing on one side of the market, (2) failure to develop trust with users and partners, (3) prematurely dismissing the competition, and (4) entering too late (Cusumano et al., 2019).

Designing a platform thus requires a very good understanding of the ecosystems in which they are introduced. In the context of data-sharing for CAD, the ecosystems are relatively complex. Each country is organized in a different way and each OEMs organizes in a different way.

4.2 Governance

Governance defines how and organization is steered, it includes setting, implementing and monitoring of policies and it includes also how and by whom what type of decisions are made. Typically, it includes mechanisms to balance powers and requires levels of accountability. A governing body consists of members, and their primary duty is to enhance the functioning and progress towards the objectives of an organization.

In this case we are interested in how the data-sharing is governed. We can define several levels of governance:

1. Governments govern markets and sectors with regulations. This includes the data-sharing.

2. The organisations involved, formally or informally, can set up a governance structure, to steer associated organizations and their collaboration towards a set of objectives (e.g. CAD-fleet-as-a-service)
3. The data-sharing collaboration, by means of its governance, decisions and performance, influences and therefore contributes to the governance of the ecosystems it participates in. Much like a powerful platform affects business.

In this section we are focusing on the second level of governance.

In order to operationalize this type of governance, we briefly introduce the building blocks of the alliance governance framework:

- Goal: What are the objectives of the alliance?
- Risks: What are the main barriers to achieving the objectives and what are the main risks for the involved organisations, pursuing the objectives via this alliance?
- Decision Making: Who gets to make what decisions and which procedures should be followed?
- Culture (Ethics): Are there any expected differences in culture and ethics in the participating organisations?
- Scope and Exclusivity: What is the scope of the collaboration and are partners free to join this alliance, and are partners free to join other alliances?
- Trust and Commitment: Do partners trust each other and are partners willing to contribute to the objectives of the alliance, or to what extent are contractual commitments needed to support behaviour?
- Governance Bodies: What is the organisational structure of the collaboration, e.g. working groups, steering groups etc.?
- Communication Structure: What are formal and informal means of communication?
- Legal Form: Should the alliance take on a specific legal form? If so, which?
- Financial Agreements: What are the financial commitments and agreed money flows between participants? Also including risk sharing, in case of losses etc.

In light of the discussion on platform business models, above, it should be noted that the two concepts are interrelated, specifically if the platform is “exploited” by an alliance or collaboration. More specifically, the strategic orientation and preferences of the members will determine the scope and exclusivity and goals. The scope and exclusivity, as well as the goals, will to a large extent define the value proposition and key questions related to the platform business model.

With respect to the third level of governance (data sharing collaboration), and related to the second (governance structure), data is often referred to as the ‘new oil’. Specifically, in the light of the ‘CAD-fleet-as-a-service’-scenario, the data-exchange platform can be seen a facility and organization that optimizes the European landscape for sharing data in context of a widely deployed CAD-fleet. In other words, the ambition and conditions set in the governance and platform business model parameters affect the common interest, i.e. the European landscape. A too narrow approach could leave the landscape subject to commercial play and worse, potential loss of data-sovereignty, as mentioned in the ‘race Europe cannot afford to lose’. A too broad approach may leave the endeavour unmanageable and ineffective.

This leads to the point that (CAD-related) data could be seen as a form of ‘commons’. Elinor Ostrom (1990) defines the Common Pool Resource (CPR) as “a type of good consisting of a natural or human-made resource system (e.g. an irrigation system or fishing grounds), whose size or characteristics makes it costly, but not impossible, to exclude potential beneficiaries from obtaining benefits from its use. Unlike pure public goods, common pool resources face problems of congestion or overuse, because they are subtractable. A common-pool resource typically consists of a core resource (e.g. water or fish), which defines the stock variable, while providing a limited quantity of extractable fringe units, which defines the flow variable. While

the core resource is to be protected or nurtured in order to allow for its continuous exploitation, the fringe units can be harvested or consumed."

We argue that these characteristics to a large extent also apply to the availability and access to CAD-related data: access to data can be limited (specifically those under current control of commercial parties) and that will affect the creation of public (traffic flow, safety) and private value. Therefore, it is of importance to design a platform and governance that nurtures the availability and use of those data.

Elinor Ostrom has developed a number of 'Principles for good governance of commons'. Below, we discuss a more practical interpretation of these principles. In the below, both the platform (as a system) as well as the associated datasets could be seen as 'resource'.

- Define boundaries: There are clearly defined boundaries around the common resources of a system from the larger environment. This can refer to the types and sources of data.
- Define legitimate users: There is a clearly defined community of legitimate users of those resources. This can refer to both the providers and users of the platform.
- Adapt locally: Rules for use of resources are adapted to local needs and conditions. This can refer to country, or city specific needs and availabilities. In other words, acknowledge heterogeneity in uses and regions.
- Decide inclusively: Those using resources are included in decision making. This refers to both the users of the platform as a facility, as well as the data sources. In the end the CAD users are also indirect users of the data shared through the platform.
- Monitor effectively: There exists effective monitoring of the system by accountable monitors. This can apply to availability and use of the data, but also to service levels of the platform system.
- Share knowledge: All parties share knowledge of local conditions of the system.
- Hold accountable: Have graduated sanctions for those who violate community rules.
- Offer mediation: Offer cheap and easy access to conflict resolution.
- Govern locally: Community self-determination is recognized by higher-level authorities.
- Don't externalize costs: Resource systems embedded in other resource systems are organized in and accountable to multiple layers of nested communities.

In summary, these criteria lead to a framework directed at the "internal organization" of the platform and a framework directed at establishing a flourishing ecosystem in which data is shared and the platform is widely available.

4.3 Collaborative Networks

A set of NRAs or other parties, sharing data via a digital platform, can be seen as a 'collaborative network'. It is defined as *"an alliance of entities (e.g. organizations and people) that are autonomous, geographically distributed, and heterogeneous in terms of their operating environment, culture, social capital and goals, but that collaborate to better achieve common or compatible goals, and whose interactions are supported by computer network.*" Consequently, a collaborative networked organization is defined as *"a collaborative network subject to some kind of organization over the activities of its constituents, identifying roles for the participants, and having some governance rules.".*

Dutton & William (2008) describe three different types of collaborative network organizations based on how they support collaboration;

- *Sharing*: The ability to create linked documents and objects within a distributed network, thereby reconfiguring how and what information is shared with whom. This is exemplified by Tim Berners-Lee's inventing the Web to share documents at CERN (European Organization for Nuclear Research). This has been moved forward by his later articulation of the idea of a 'semantic Web' to support more intelligent search, linkage and retrieval of information.
- *Contributing*: The ability to employ social networking applications of the Web to facilitate group communication, thereby reshaping who contributes information to the collective group.
- *Co-creating*: The ability to collaborate through networks that facilitate cooperative work toward shared goals (e.g. joint writing and editing of Wikipedia), thereby reconfiguring the sequencing, composition, and role of contributors.

Camarinha-Matos and Afsarmanesh (2006) describe four different levels of collaboration based on integration level and the maturity level of the collaboration. Figure 7 depicts the needed building blocks for complex collaborations.

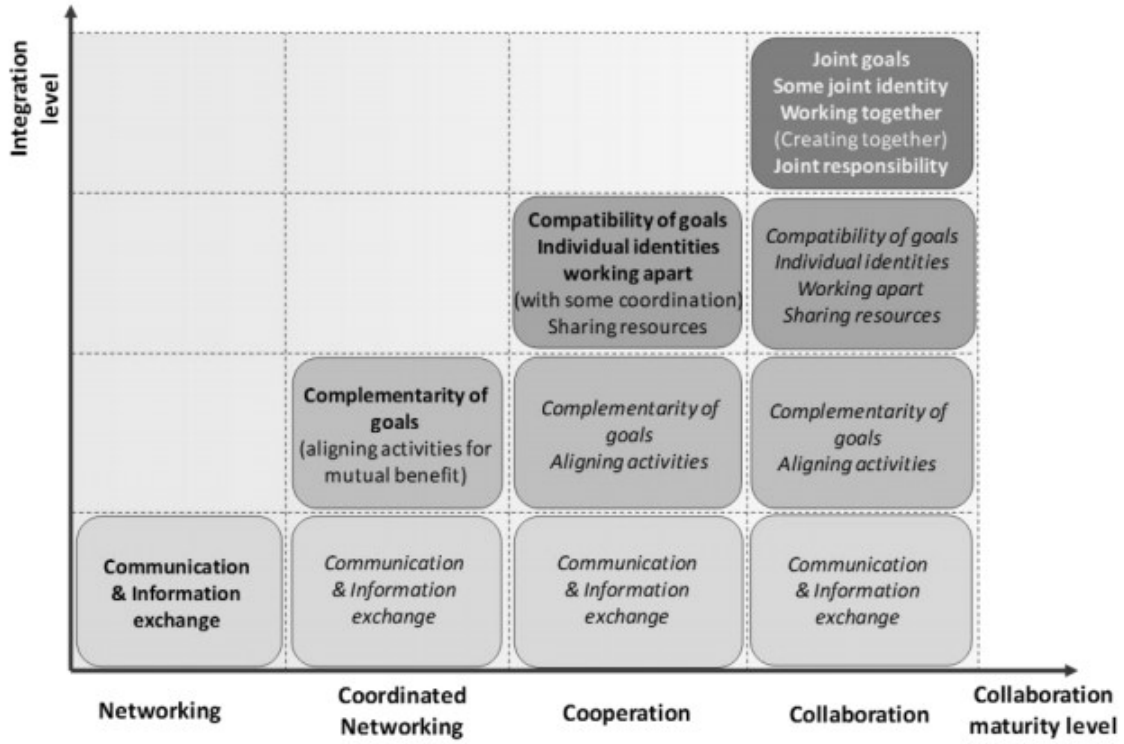

Figure 7: The building blocks of collaborations (Camarinha-Matos & Afsarmanesh, 2006)

If a collaborative network has (also) an externally facing proposition, then the concepts of platform business model, alliance governance, governance of the commons and collaborative network are strongly intertwined. In Figure 8, the relationship between the elements constituting a collaborative network are depicted. In the middle layer, there are the NRAs (potentially also other type of organizations) in rectangles, that are interconnected. Each NRA serves its own set of users (i.e. organizations sharing and using CAD, traffic and road-network related data). By means of the interconnection of the NRAs, all users get to share and use data with all other users.

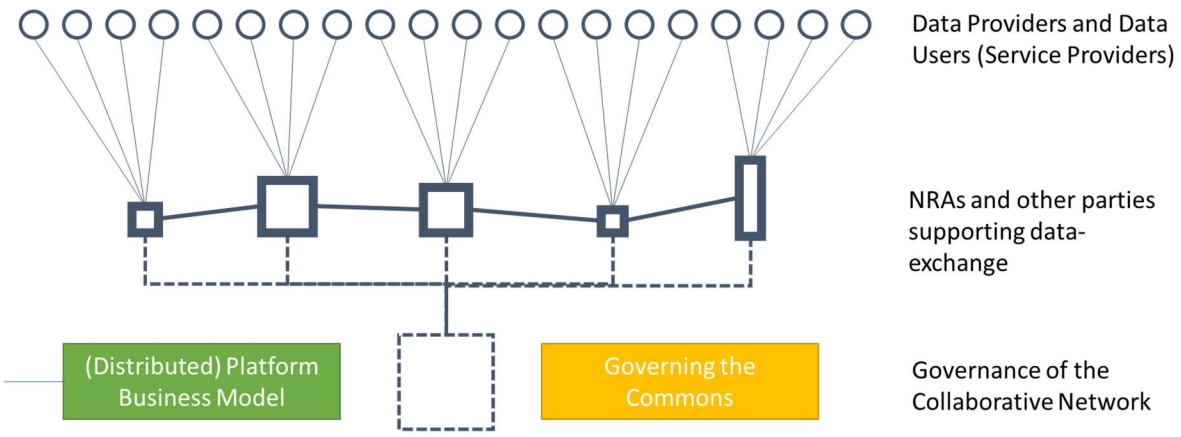

Figure 8: The elements of a collaborative network

The individual rectangles (NRAs and other parties) as well as the set of rectangles *jointly* represent services to the ecosystem. This is the access to mobility data, which is the value proposition of the platform business model. The individual and uniform availability of data to a large extent affects the flourishing of that ecosystem (commons). For users (i.e. data driven service providers that support CAD), the platform is less valuable if certain data is only geographically partially available. The set of rectangles represents a computer system (collaborative network), i.e. as it is a set of servers and connections that together make the data accessible. In the bottom layer, the dotted rectangle, represents the (alliance) governance needed to achieve, maintain and upgrade the interoperability between the NRAs.

4.4 An example of a collaborative network: The Smart Connected Supplier Network (SCSN)

This section introduces a collaborative network of manufacturing companies and data-sharing platforms that jointly developed an interoperability standard, based on the International Data Spaces Association. It serves as an example of how NRAs might collaborate to achieve the desired landscape.

Digital collaboration in the supply chain is one of the goals to increase efficiency and reduce costs. However, various supply chain partners do not collaborate in a digital way yet, since they use different unconnected ICT systems. In order to solve this challenge the partners of field labs Smart Connected Supplier Network (SCSN) developed a standard for information sharing based on semantic technology, thereby ensuring optimal interoperability between the supply chain partners for the most prominent information streams.

Interoperability is aimed at the so-called intermediaries, referred to as Service Providers, in a manufacturing network. Intermediaries allow manufacturing parties with different ERP (Enterprise Resource Planning) systems to exchange data. Typically, these intermediaries use different data models and protocols to interconnect ERP systems. This lock-in leads to 'islands' of manufacturing companies that can exchange data. This limits the accuracy and agility of supply chains.

The SCSN standard builds on the International Data Spaces (IDS) standard. This is a European standard for data sharing that enables data sovereignty developed by the partners of the International Data Spaces Association. SCSN and IDS bring a "connect-once -reach the entire supply chain scenario" to manufacturing companies. This is a different approach as the bilateral EDI (Electronic Data Interchange) connections or the use of decentralized platforms. This makes the supply chain collaboration easier to implement and scale, enables manufacturing companies to reduce the administrative burden and the prevention of errors. It also enables agility of the entire supply chain and a more successful risk management. Which

in turn reduces the time-to-market for manufacturing companies and suppliers.

Figure 9: Graphical representation of Service Providers and manufacturing companies in the SCSN example

The main benefit is for the manufacturing companies (green hexagons). They have to 'connect once only' with a Service Provider (blue hexagons). Because the Service Providers are interoperable, the manufacturing companies can connect to other manufacturing companies, served by another Service Provider. This connects the 'islands'. The implication for Service Providers is that they have to collaborate with their peer and competing Service Providers. This is feasible, since all connected manufacturing companies, their customers, benefit from this approach. In order to manage this tension and promote the overarching benefits of the sector ("commons") the Service Providers unite in the SCSN foundation. However, the Service Providers still maintain their own unique profile and services portfolio to serve their own customers.

The adoption of the SCSN standard and the introduction of the SCSN foundation has changed the value proposition of the Service Providers to its customer manufacturing companies. The SCSN foundation has a value proposition toward the Service Providers: ensuring interoperability by maintaining the SCSN standard. The SCSN foundation also has a value proposition to the manufacturing companies. This is, among other things, the maintenance of an 'address book'. This allows manufacturing companies that are not yet connected to find each other and realize the benefits of digital communication (TNO, 2020).

Relevance for DIRIZON

The relevance of this example for the future data-exchange business model of NRAs is that in the European landscape, the role of the NRAs can be compared to the role of the Service Providers. On the one hand, each NRA serves its own ecosystem consisting of providers and users of traffic and road-network related data, e.g. via National Access Points, in its own way. On the other hand, the NRAs, forming a group of peers, are the common element present in each nation, potentially providing the interoperability that the national ecosystems need to realize the services related to CCAD.

5 European Scenarios for study

This section introduces the scenarios for evaluation. In Section 3.2 step 2. it was described how we built these scenarios from real-life examples to full scale European scenarios. Section 5.1 summarize the examples that we used. Section 5.2 presents the DIRIZON Use Case 3 (see D3.1 and D4.1) scenario , which is used as the basis for evaluation of the scenarios. Section 5.3 describes the framework of aspects that used to describe the examples and the three full scale European scenarios. In Chapter 6 the evaluation will be presented.

5.1 Overview of the three examples

C-Roads

The C-Roads platform is a joint initiative of European Member States and road operators for testing and implementing C-ITS services to ensure harmonisation and interoperability in the deployment of C-ITS across Europe. C-Roads consists of 23 members with the ultimate objective to deploy enhanced interoperable cross-border C-ITS services for road customers. The initiative is currently on-going, and it is a cooperation between the NRAs and road operators. A detailed overview of the C-Roads pilot tests can be found in D2.1 – NRAs and Digitalisation, Table 4.2.

YourNow

YourNow is a commercial initiative built on a joint venture between the BMW Group and Daimler AG. It is designed to combine and integrate mobility services from five different areas, namely on-demand mobility, carsharing, ride hailing, parking, and smart charging. The aim is to create a seamlessly connected urban mobility experience for users by combining new and existing relevant initiatives. They already have 60 million customers globally, as the joint venture incorporates many working initiatives.

Mobility Data Space (MobiDS)

The “Mobility Data Space” project has started to initiate the development of a national mobility data ecosystem in Germany. Within the project, the existing Mobility Data Marketplace (MDM) of the Federal Highway Authority (BASt) and other municipal traffic data platforms will be linked to form a decentralized data space, thereby forming a federal mobility data ecosystem. This platform will make it possible to utilize regional data at the national level, and supports data-based services. For this purpose, it will be expanded to include a secure and protected execution environment for services and data apps, in which mobility data can be provided and refined while guaranteeing data sovereignty. In this way, even more sensitive mobility data such as floating car data (FCD) can be used.

5.2 Use Case 3: Infrastructure Support for Automated Driving (ISAD) for CAD

Infrastructure Support for Automated Driving (ISAD) for CAD is digitized information, on top of the HD map and the digitized traffic regulations, to support CAV functioning. The use of a HD map is assumed. Thus, this use case covers vehicles in a mixed environment, supporting connected and automated vehicles (CAVs) by extending their Operational Design Domain (ODD) and improving safety, traffic flow and environmental impacts. The focus within this use case is the infrastructure support services provided by the road operator. The type of data that CAVs need to extend their ODD are related to the local traffic situation, by definition beyond its sensor system scope. They need for example data based on measurements of other vehicles’ real-time speeds and travel times, traffic volumes, and detection of incidents and accidents, on the road segment level and, if possible, at the lane level.

Some of these data can already be supplied by other sources: real-time speeds and travel

times on road segments or trajectories by Road Operators (ROs) and third party service providers. In the future, the infrastructure-based detection and measurement systems can be complemented by other sources of data, such as probe vehicle data (locations, travel times, speeds, braking actions, weather conditions, road slipperiness, temperature etc.). Additionally, the standardization of road signs to enable the signs to be read by cameras in CAV is required, but is not further discussed within DIRIZON.

Figure 10 shows the process flow diagram for the infrastructure support for automated driving within this use case. Data on traffic, incidents and accidents and environmental data generated by various sources (loops, cameras, etc.) are collected and made available, either via the National Access Point and/or the Traffic Management Centre.

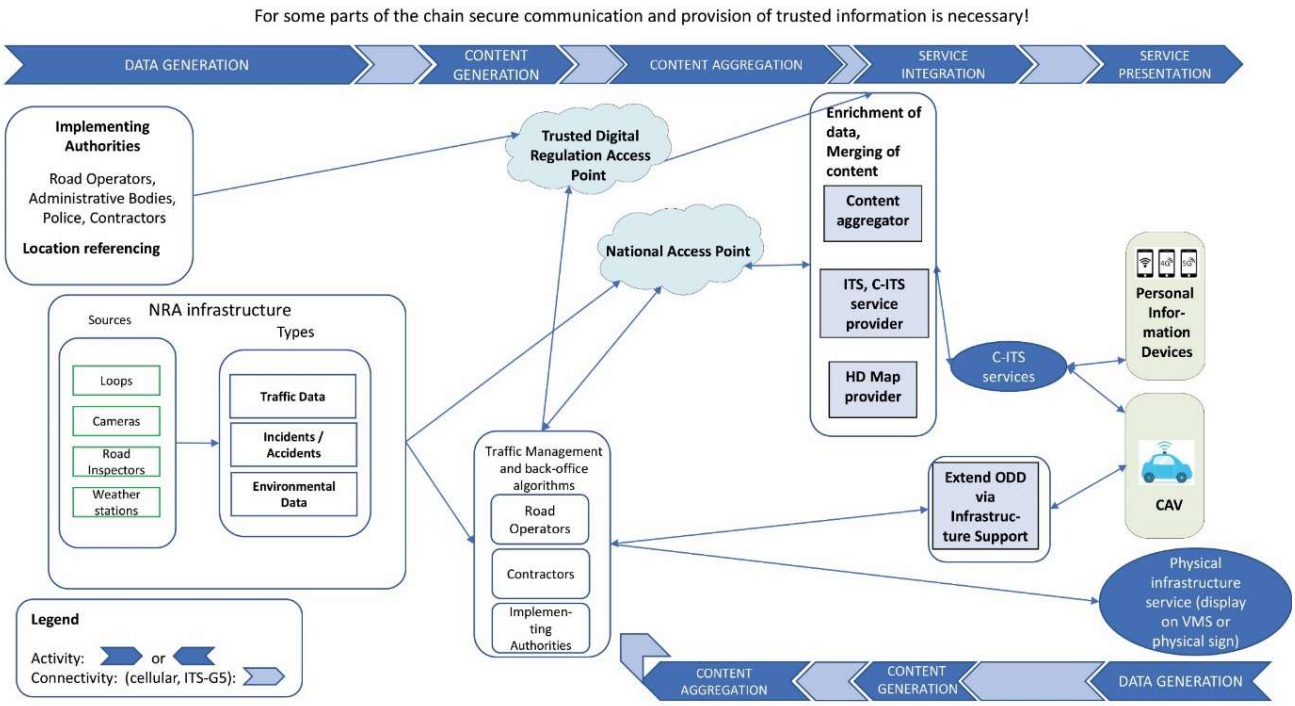

Figure 10: Use Case 3 diagram. Use Case 3 is seen as an overarching Use Case (i.e. it implies Use Case 1 and 2 as well)

The Traffic Management Center makes use of the data on traffic, incidents and accidents and environmental data to carry out its traffic management functions. The binding traffic management measures are provided to the Trusted Electronic Regulations Access Point. Traffic management data, advice, information and warnings (non-binding) are provided to the NAP. The Traffic Management Center also provides advice to individual CAVs in order to extend their ODDs, using all available sources of data including vehicle sensor data. The Traffic Management Center provides its traffic management services in the traditional manner on VMSs or signs.

Content aggregators, (C-)ITS service providers and HD map providers enrich their own services using data from the National Access Point, providing these services to vehicles and (portable) electronic devices. This information is “visualized” for the user. The user can be a driver or an automated vehicle. The final decision on how to use the advice or warning lies with the driver or vehicle. Regulations have to be followed.

(Portable) electronic devices and CAVs provide vehicle sensor data (e.g. speed, type of vehicle). These data are collected via roadside stations and via C-ITS Service Providers.

The use case considers the dynamic development of both vehicles’ ODD and infrastructure services over the short, medium and long term; during this transition period, automated, connected and conventional vehicles coexist at different levels of (automation) technology.

Infrastructure support services and vehicle equipment can be used to collect dynamic or real-time data to extend the ODD of cooperative automated vehicles.

Figure 11 lists the most important actors in each of the four phases in the process of infrastructure support for Automated Driving. Road operators are expected to play a very important role in the different phases of use case 3 implementation.

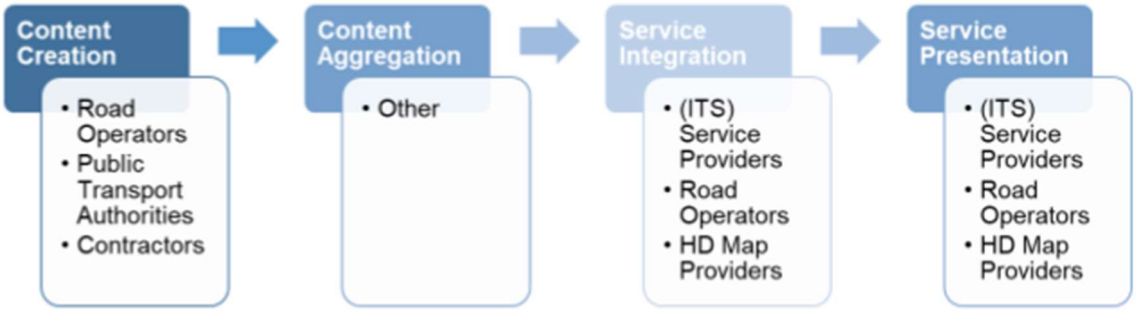

Figure 11: Overview of most important actors within use case 3 (based on D4.1 output)

5.3 A framework to describe Collaborative Networks

In table 3 a number of aspects and the corresponding questions to detail collaborative networks as a basis for scenarios are listed. These are meant to help describing exemplary, archetypical collaborations presented in section 5.4. The purpose of the archetypical collaborations is that European scenarios will probably emerge from different collaborations and consequently take on the characteristics of such collaboration. The characteristics of the collaboration affect the creation of value (impact) as well as the costs of keeping it up.

Table 3: The aspects and corresponding questions used to describe Collaborative Networks

	Aspect	Question
1	**Ecosystem**	*Which organization types are in scope of the Collaboration?* The ecosystem is determined by the organizations that take part in the data sharing (sharing and using). These might be different type of parties, or only NRAs (and it may differ per country). In general, the more types of organizations are in scope of the data-sharing, the richer the collection of available data is, the higher the adoption rate will be and consequently the impact in society for data-sharing. As a trade-off, the more types of parties, the more complex the governance of the data-sharing will be, as all of these parties have different stakes. • What type of organization are in scope? NRAs, OEMs, Telecom providers, data service providers • Is the initiative open? Can other type of organizations enter? Openness • Who is leading the initiative? Does this leadership imply control over the initiative? Leaders can be for example a few NRAs, All NRAs, the European Commission, Industry. In general leaders are more in control, i.e. are in a position to set their stakes as the basis of the initiative. • Is a formal regulatory authority, e.g. TERAP, included? This is relevant for the position of the initiative. Not included implies a dependency to the initiative as well as for users having to depend on multiple organization (not a one-stop-shop).

2	**Support and services**	*What is the scope of supporting services (value proposition) of the Collaboration?* The support and services scope refers to the level of support that users of the data-sharing initiative (both those sharing and using data) get in order to participate in the data-sharing initiative. This can take on many forms from passive to very active. This continuum can start from simply informing the participants on how data can be obtained, to setting standards on the type of data and terms of agreement, …, to actively supporting organizations in implementing the standard, …, to setting service levels on quality and availability of data, …, to establishing interoperability between data-sharing (e.g. deliver Polish data through services available in Spain), …, to organizing hackathons and financing for development of new data driven services (e.g. start-ups), …. • Is the initiative focused on the back-end of NRAs (interoperability), or the front-end? Is it including support for new data driven services? • Is there some kind of vision or roadmap in which a short term priority focus, e.g. services, software, regional, NRA focus, is linked to a longer term desired position?
3	**Geography**	*What is the geographical scope of the Collaboration?* The geographical scope relates to countries in which the initiative applies. The chosen geographical scope is often determined by organizational pragmatism (less organizations is easier) and/or regulatory scopes (regulation or pilot approvals are typically obtained within one country). The nature of the collaboration is not always logically limited to the initial geographical scope (e.g. services for warning of road works have value cross-country), nevertheless measures for scaling up may not have been taken into scope of the initiative. • Is the current geographical scope within one country, national, between certain countries, across Europe, or global. • Does the initiative take any measures to scale up geographically?
4	**Governance**	*How is the Collaboration governed?* Governance refers to the way that the initiative is organized and specifically how decisions about the initiative are taken. The governance determines the distribution of power and the speed with which the initiative can respond to changes. It also affects the support base for the offer of the initiative as influence on the initiative will lead to taking into account requirements and wishes of the stakeholder. Governance may change over time. Typically, market driven initiatives do not prioritize full penetration, whereas regulatory driven initiatives must be inclusive. • How can the governance of the initiative be characterized? No or minimal governance, decentral (each participant has one vote), National representation (one nation one vote), Central (a decision maker is appointed),…
5	**Application**	*What is the scope of the application, data or technology?* Collaborations typically scope themselves, for pragmatic or regulatory reasons, in terms of technology, data or applications. Application scopes can for example be safety & traffic related, CAD

		exclusive, infotainment. This affects the type of data in scope and it also affects the type of organizations and their role in the collaboration, i.e. there is a regulatory basis for NRAs related to safety and traffic related. However, this also affects the 'willingness to pay', as travellers currently seem to be more willing to pay for individual value, e.g. my routing advice. A typical consideration is however that the technical and digital infrastructure for sharing and using data is generic to some level, i.e. it can be used for data driven services outside the scope. • What is the scope of applications and data, e.g. safety & traffic related, CAD, infotainment? • Is there a regulatory basis or mandate underpinning that scope? *Note that data and technology are covered in WP5.*

5.4 Description of Examples and European Scenarios

By translating the mechanics and characteristics of the three example cases - which have been described in 5.1 - to UC3, and putting them in a full European scale context, an NRA-dominant, a Market-dominant and a Hybrid-scenario have been created. The details of these scenarios are described below.

5.4.1 NRA-Dominant Full European Scenario

This chapter outlines how DIRIZON UC3 would work on full European scale if it would have the same characteristics as the C-Roads initiative.

5.4.1.1 Ecosystem

In case of an NRA-dominant scenario on full European scale, there would be a platform, led by NRAs and road operators, connecting numerous parties to enable data sharing and deploying services for road customers.

The ecosystem comprises the following actors:

- European and non-European NRAs
- Road operators
- Ministries/ Department of Transport
- (Highway) research institutes
- C-ITS service providers
- OEMs
- Public contractors

The platform grew by scaling several successful pilot tests that were conducted at an early stage to investigate the harmonization of C-ITS deployment throughout Europe, and now includes actors from nearly all member states. It is open to other member states either as a member or associated member, but participation is dependent on agreeing to adhere to principles regarding deployment via the platform agreement, and members must be actively willing to participate in initiatives. The platform is taking a more open approach to sharing between members, and is led by NRAs.

5.4.1.2 Service/support

The services covered on the platform are road works warning, weather conditions, emergency vehicle approaching, in-vehicle signage, in-vehicle speed limits, signal violation and green light optimal speed advisory etc. The communication technology used is ITS-G5, cellular

communication, DAB, RDS, Wi-fi/Bluetooth.

The above data and services were assessed and selected based on pilot tests. The establishment of an interoperable data-sharing platform across borders was achieved by choosing the data collection promoting standards which seemed of highest quality during different communication technology tests.

In essence objectives are long term, focused on large scale deployment of CAD services.

5.4.1.3 Geography

Starting from pilot tests on national level throughout Europe, the platform got deployed in nearly every member state. Cross-border collaboration is taking place within Europe, with the scope to include safety, traffic management and digital traffic regulation. The members are working together to expand the platform in countries that are not yet participating to enable the envisioned full European scale. The geographical scope is undifferentiated, meaning that the aim is to include every area and location.

5.4.1.4 Governance

The driving body of the platform is the Steering Committee that comprises representatives from all its member states and the infrastructure operators. The Steering Committee is responsible for ensuring interaction with external stakeholders.

Several Working Groups have been established within the platform to assist the Steering Committee in taking proper decisions that ensure the interoperability and the correct operation of the platform.

Core members are allowed to vote on required specifications and then follow these specifications during deployment. Associated members have access to the information but they are not allowed to vote.

5.4.1.5 Application

The core members of the collaboration established new standards that facilitate the harmonization of C-ITS and CAD services internationally, throughout Europe. The focus lays on effectively enhancing the quality of data, the services and the technologies used. The platform started with several pilot tests including cross border testing and validation to assess e.g. technical and security aspects, service harmonisation, infrastructure communication etc. and create standards based on that.

5.4.2 Market-Dominant Full European Scenario

This chapter outlines how DIRIZON UC3 would work on full European scale if it would have the same characteristics as the YourNow initiative.

5.4.2.1 Ecosystem

The ecosystem is competitive, driven and organized by private companies but is in collaboration with and open to other (public) parties to join. .

Actors in the ecosystem are:

- OEMs (original equipment manufacturers, e.g. Daimler, BMW Group)
- BigTech companies
- Service provider companies (responsible for service integration, could be an OEM)
- NRAs (provide data)
- Traffic Management Centers (TMC) (provide data)
- End users

Throughout whole Europe multiple platforms are deployed, each serving different cities and

countries. This makes the ecosystem versatile and makes it look like a large system consisting of many smaller ecosystems, each with a geographical focus. Occasionally some overlaps and changes happen within the whole European ecosystem, due to withdrawal following competition and other market dynamics.

The platforms originate from OEMs and BigTech companies (e.g. Google, Uber).

5.4.2.2 Service/support

Each platform provides kits and online trainings, APIs to make connecting to the platform (by cities and authorities) as easy as possible. The platforms originating from Bigtech companies have set up an open ecosystem in which 3rd party developers participate to create applications.

BigTech companies also market 'after-market' AD kits that turn legacy cars into AD cars. There are also service packages for non-AD cars that get many of the non-AD functions. For the OEM variants, this would be in-house.

Support provided by the service providing companies is of high level, focused both on front-end and back-end. Their support is provided to 3 different actors:

- Support for NRAs, TMCs: Provide tooling for them with which they can get the information the service providing companies collected.
- Support for other OEMs that want to join platform (two potential options):
    - White label solution (i.e. create copy): Provide the code and algorithms the company is built on "as a service", other OEMs can then build their own version based on this.
    - Collaboration in existing system (i.e. join): A continuum of shared services can be identified and implemented in collaboration with the new party.
- Support for end users (car buyers/users): Full support with usage and problems.

5.4.2.3 Geography

Each of the platforms has a global ambition, but focuses on 'big markets' where revenue can be expected. This means that deployment mainly follows AD car sales. Other market indicators (e.g. level of competition) influence the location of operation as well. Platform operators looked for fit markets, chose cities to serve that fit the criteria set by themselves and chose to not serve other areas. Some territories may be abandoned due to competition.

The platforms started in 'home regions', based on earlier trials. The focus clearly lays on large cities and urban areas, therefore, city road authorities and municipalities are more interesting to partner with than NRAs at first stage.

The total served area throughout Europe is scattered and continues to grow over time.

5.4.2.4 Governance

Governance lays with the EOMs and BigTech companies and is central within each platform. Each company is governed by the company board and the shareholders. In deployments there is close collaboration with local authorities, but collaboration between different platforms is also possible. City level governance may arise within the platforms due to practicalities and as it could help in meeting specific local needs.

5.4.2.5 Application

The focus is on the services that bring user value and revenue, including infotainment. The scope of the services focuses on the support of the AD vehicle and sources in regulatory data where available. However, other relevant connections and related services can also be incorporated in the platforms as long as they bring user value. BigTech companies tend to focus on broad data gathering for their advertising business models.

5.4.3 Hybrid Full European Scenario

This chapter outlines how DIRIZON UC3 would work on full European scale if it would have the same characteristics as the MobiDS initiative.

5.4.3.1 Ecosystem

The ecosystem is aimed at exchanging traffic data and traffic rules and consists of numerous public and private parties. There is close collaboration between the parties and the platform works as an open initiative. The initiative is led by NRAs on the national scale, together with OEMs on the international scale, but every actor is in control of their own data.

The main actors in the ecosystem are:

- NRAs: Providing the data exchange platform or NAP, and provide data
- Regional Authorities/Road Operators: Providing data
- OEMs: Providing data (hereby creating a feedback loop), and providing a service for their own fleet and users. OEMs are also the international component in the ecosystem.
- Data service providers: Data aggregation/enrichment
- Telecom providers: Ensuring connectivity

As the actors using the platform are diverse, the definition of appropriate IDS rules is necessary. An ecosystem on European scale is possible either with or without national access points (NAPs).

5.4.3.2 Service/support

Support with implementation and participation is provided for participants within the ecosystem. The overall aim is to create high quality, good service and data provision for all members, making it possible to create a national service (e.g. national route planning) instead of scattered local solutions. The use of IDS connectors and apps from an appstore (e.g. TERAP App) is part of the service.

5.4.3.3 Geography

This initiative started from a national level, but was easily scalable to a full European level, as it is easy to take local differences into account and scalability is one of the core requirements of the IDS concept.

5.4.3.4 Governance

This initiative has both strong organizational and technical governance (e.g reference model, certification process etc.). Local collaboration between business actors and governments forms the base of governance, which makes it scalable. NRA and OEMs cooperate and drive governance together on a large (i.e. European) scale. The IDS concept itself is driven by the International Data Spaces Association (IDSA).

5.4.3.5 Application

The platform is an open mobility data ecosystem in which the data providers can determine and control the conditions under which their data may be used and exploited by other players.

The starting point of this platform was general safety-relevant traffic information (SRTI), which was chosen because of the related obligations and its high potential. Once on European scale, the scope broadened to include safety and traffic related data, digital regulations and provision of CAD services.

Car sensors are used and shared to generate the SRTI while the OEMs are using their fleet. This data then gets aggregated and interpreted by NRAs, also creating a feedback loop. The NRAs get access to this vehicle data by paying for it on the platform.

6 European Scenarios Evaluation

This chapter describes the evaluation results for the three European scenarios. The scenarios are presented in the previous chapter and the approach for building and evaluating is presented in Chapter 3 on methodology. In the next section the criteria are described. In section 6.2 the evaluation itself is described and in section 6.3 the evaluation is discussed. Recommendations based on this analysis are formulated in 6.4

6.1 Evaluation criteria for European Scenarios

The following criteria are introduced to evaluate scenarios composed of the archetypical examples as described in 4.2. The criteria will be evaluated by a 5-point Likert scale as a response to a statement and explanation.

Table 4: Description of the evaluation criteria for European Scenarios

	Criteria	Description
1	Traffic	*In the scenario digital control of safety and flow of traffic can be realized.* Managing safety and flow of traffic of the road infrastructure are among the key objectives of the NRAs' mandates. The initiative to share data should contribute to achieving this.
2	Convergence	*The scenario provides clear opportunities for different countries and regions to develop in their own pace without forming "islands" (i.e. parts of Europe that become difficult and costly to become interoperable).* Currently countries have different deployments and preferences. Yet for seamless and reliable operation of the CAD it can be useful that initiatives stay or can become interoperable.
3	Governance	*The governance presented in the scenario is likely to be effective (in establishing public and private values) and efficient (value for money).* Collaborations imply different stakeholders with different stakes and consequently governance.
4	Business	*The presented scenario is expected to generate participation of industry (OEMs, digital service providers,..).* The participation of businesses is necessary to acquire data as well as to implement data flows in context of CAD. Furthermore, infrastructure can be shared with industry.
5	European Values	*The scenario is expected to establish with safety, security, privacy and sovereignty of data guaranteed. There is no winner-takes-all scenario, yet services are on-par with global alternatives. And Europe is nevertheless attractive for industry.* Currently the digitalization of industries is heavily influenced by American and Chinese powers. Europe strives for a strong strategic position, whilst guaranteeing the 'European Values'.
6	Innovation	*The scenario provides a fertile ground for experimentation, improvements and creation of new developments to advance the digital services.*

		As many different and parallel developments are ongoing and are expected to continue to do so, the capability to generate and adopt innovation to deal with future challenges is of key importance.

6.2 Evaluation

Table 5 summarizes the qualitative evaluation, as performed by the consortium. The color-coding is the result of the numerical evaluation (numbers are omitted), from green to orange to red where green implies that, according to the responses, this scenario is the most preferred scenario for a particular criterion, while red is the least preferred.

Table 5: Qualitative evaluation of three full scale European Scenarios

	NRA-Dominant	**Market-Dominant**	**Hybrid**
	Based on C-Roads	Based on YourNow	Based on MobiDS
Traffic			
	The collaboration is based on NRAs. This means that knowledge and authority to guide and control traffic flow and security is at the core. Actual control to ensure and guarantee delivery and affect behaviour in-car is a new dependency on wireless connectivity and on-board equipment.	The market-dominant scenario will focus on car and fleet-centric services and optimization. Overview and influence on the system (mixed fleet, mixed modalities) is considered to be challenging as a business goal, as it includes modalities and payment flows concerning competitors. However, mobility service platform providers are offering integrated control room / dashboards solutions, often offering also payment services. These parties have a multi-city market in mind and thus an incentive to provide the knowledge, intelligence and support to deliver tooling, e.g. including (urban) traffic management. However, facing different implementations by different vendors everywhere.	The "overlay" of mobility data space abstracts from implementation specific standards and protocols, which creates a broader incentive for multi-city offerings. This means that local working configurations can continue to work. This is "backwards compatible".
	Traffic flow and safety is a very broad topic with many subtopics. Specifically safety messages, requiring reliability and short time lags in communication, continues to be a challenge.		
Convergence			
	Convergence in this scenario is based on standards developed and set by the central governance body and its participants. The flow is basically pilot, set standard, implement and scale. This 'agree first' principle may hamper speed of roll-out, as decisions will be	"Big markets first" logic, may lead to "islands" where services are available. Also continuity of offered services may be a challenge, witnessed by withdrawal of businesses from certain markets. In general the "sell first" approach will drive speed, but may suffer from lack of network effects, as different	Convergence is a design-principle in this scenario, without too narrow prescriptions to local existing situations. The MobiDS "overlays" local working configurations, potentially based on different standards. This "backward" compatibility allows new solutions to be built on top, and it allows to

	based on multiple differing deployments, backgrounds and perspectives.	cities may be locked by different competing vendors that may not see the benefit of interoperability.	gradually replace existing solutions to the new standard. This is a theoretical feature and will have to be proven in practice.
Governance			
	This scenario represents a strong NRA-driven governance-based approach. This suggests a high efficiency on topics in scope (of NRAs) and authority (on decisions and investments related to the road network). The governance structure is however government dominant, which implies that themes like market disruption and illegal state aid are relevant.	Within company governance is typically given by hierarchical order and mandates. Within companies incentives to reuse systems, e.g. by deploying them in different cities, are generally high. At regional and local levels governance structures between platform providers and public authorities must nevertheless be developed. This is labour intensive and time-consuming. For smaller cities and municipalities there may be concerns that service contracts may result in strong dependencies. In this oligopolistic scenario, where just a few strong platform providers serve the market, cities may become independent 'islands'.	Governance is focused on local collaboration between governments and business. Such limited scope may spur efficacy, without the specific need to align with a much wider community (i.e. as standards based). Good practices can be copied elsewhere, however this is not guaranteed and may thus be subject to local negotiations.
	In general a distinction is made between efficiency and effectivity of governance. Efficiency refers to the speed of decision making, whereas the effectivity/efficacy refers to the speed of achieving objectives, resulting from good governance. The latter is deemed the most relevant interpretation here.		
Business			
	Development of new business is mainly enabled, but not incentivized per se, by the standards that are agreed with the automotive ecosystem, as that creates a uniform approach. Furthermore in the various pilots, collaboration is sought with industry (and vice versa). Due to the data intense, more real-time and feedback loops, AD support will however require a substantial change in the operation of road operators. Forthcoming legislation may force market participants to use certain data sources	The automotive ecosystems will continue to try to turn the opportunities, driven by the availability of data and connectivity into new business models. This will happen on the one hand within the closed and OEM controlled ecosystems, aiming to ensure safety and security, but also lock-in customers for revenue streams (subscription). On the other hand, tech-giant controlled ecosystems will be more open to app-developers and will focus on the customer's willingness to pay, or willingness to share data (e.g. in advertisement based business models). There even may be collaborations between the two. However, market forces are not likely to establish interoperability,	Collaboration is focused on balancing interoperability and independence. This allows businesses to develop services relatively independent from the standards to which local/regional NRAs and other data source providers comply, without compromising scalability. This allows businesses and NRAs to prove the effects of their efforts in traffic flow and safety, with reasonable chances of being able to be implemented elsewhere. However, this may not prove as uniform as in the NRA- and market-dominant settings, as by design local adaptations are allowed and assumed

	and reach service levels.	so it is expected that multiple independent ecosystems form. As control of the user interface is generally crucial, public partners are typically addressed as data sources.	
European Values			
	In principle, NRAs will not implement anything in contradiction with the European Values, given their governmental status, NRAs are primarily focused on and legitimized for national traffic system operation. Scope and ambition limitations may hamper realization. In other words: are data autonomy of European citizens and organzations and a strong Europe in a global competitive landscape in scope of NRAs?	Generally market parties are not expected to fully implement the European Values, given their profit orientation and shareholder optimization. However, more and more companies are also including societal values and touting such as USP. Furthermore, if "market demands", it may be necessary to comply to reach scale. "Room" for implementation depends on the fierceness of Google and Tencent (type of) competition.	The IDSA is designed to support collaborations that allow for data sovereignty etc., but does not in itself enforce or scale the implementation. It is an important enabler and philosophy, which is guided by the IDSA. But it has to be adopted, and adapted, to specific situations. So it ultimately depends on local governance choices.
	This criterium contains many different subcriteria, that may pan out differently, if considered in isolation. E.g. a strong European competitive landscape could be assessed independent from the European values.		
Innovation			
	C-Roads is in fact an organizational infrastructure to execute and evaluate pilots and consequently promoting outcomes to standards and guidelines for European or global implementation. Currently it is more focused on pre-competitive research and funding, but has potential to govern implementation in a similar manner	Innovation is focused on short- mid-term earnings from creating customer value. The externalities (e.g. systemic risks/effects) of new commercial services are not in focus, unless required by regulation. The focus on shorter term positive business case implies risk aversion and may warrant broader collaboration, due to the coordination costs, specifically among competitors. IP is dominantly seen as a competitive advantage, which typically leads to exclusion of competitors. In a platform landscape this leads to "islands".	The decentralized, yet interoperable approach, allows for a mix of top-down and bottom-up innovation. Bottom-up innovations can take place in context of concrete practical (and operational) situations, and then via the governance structure (peer-to-peer) made available elsewhere. This governance structure should also encourage and ensure this reuse and organize for incentives and (IP) protection. However, as local implementations may differ, transportability (i.e. easy application in different contexts) of innovations may be limited.

6.3 Analysis

Table 6 below captures the evaluation in keywords and provides a summary of the qualitative evaluation of the three scenarios.

Table 6: Summary of evaluation of the three studied scenarios

	NRA-Dominant (NDS) Based on C-Roads	**Market-Dominant (MDS)** Based on Your-Now	**Hybrid (HS)** Based on MobiDS
Traffic	Traffic Knowledge Authority	City-level servicing collaboration	Local to global by interoperability
Convergence	"Agree first"	"Big Markets First"	By design Enabling
Governance	NRA-centric	CEOs at Joint Ventures Local coordination	Local public private collaboration
Business	Passive: agreed standards	OEM driven Big Tech driven	Local to global by interoperability
European Values	Not in contradiction Limited mandate at NRAs	If market demands	By design Enabling
Innovation	Pilot to standard Pre-competitive & R&D heavy	Customer centric Unknown traffic effect	Decentralized, yet replicable

Based on this analysis, we can summarize the basic contribution of each of the scenarios briefly:

The NDS is NRA driven governance structure that systematically coordinates pilots and specifically the process to derive standards from that. As such, it interfaces with the automotive industry. However, standardization is the main dialogue subject there.

The MDS is by nature commercially driven from either automotive or BigTech. This seems to drive business "where the money is", and that appears to be in urban areas, as witnessed by the services that currently being deployed over cities. In cities, public organization are both served and collaborated with.

The HS is a decentralized approach to public and private collaboration. Based on principles, such as data sovereignty, both public and private parties, as well as citizens build trust in this way of working. However, in contrast with the previous two scenarios, the base example (MobiDS) is still at its early stages, so inflating it to a full scale bears uncertainties.

Clearly, each scenario has a different profile.

Earlier, we stated that the current landscape is heterogeneous in technology and preferences. And that we are aiming to move towards the 'CAD-fleet-as-a-service' scenario (see section 2.3). The underlying question thus how these scenarios can help us achieve that. What could a strategy look like? The second observation is that for the full EU-scale UC3 implementation (CAD fleet as a service) close collaboration with OEMs is needed for car data-and-control. Mutual interest between NRAs and OEMs must be achieved in the collaboration.

1. The NDS provides a EU-wide pilot-to-standard structure. It has established practices that coordinate national and inter-national pilots and has processes to take these learnings to a European or international standard. This approach is an effective means in scaling innovation from pilot to large scale.

2. NDS provides an EU-wide NRA centric governance structure interfacing automotive industry. This scenario is established by a body of collaborating NRAs. It has established processes to decide on standards and has working groups that work on developing knowledge on identified topics. This governance body has, due to its broad representation, acquired power and can be considered a meaningful partner for automotive.

3. NDS is authoritative on traffic and safety management. Due to its members, the NDS governing body has both the authority as well as the (access to the) knowledge relevant to manage traffic flow and safety (on the related networks).

4. In the MDS we observe services, platforms and public-private collaboration at city-level. The digital platforms and services (e.g. park, share, public transport, car sharing,…) are typically available at city level. Often, this includes data management and provision of analytical and management tools for city authorities and public transport management. At this point, integration of AD is foreseen in Mobility-as-a-Service platforms. This is an important observation, as it illustrates that public and private parties collaborate beyond agreeing to standards, but in actual data sharing and service provision. Clearly, here is a commercial incentive. And thus also competition. The consequence of that is the collaboration stops at city limits and may be non-interoperable beyond.

5. HS provides a scalable / replicable concept (IDS). The IDS based implementations strike a balance between replicability and specific local configurations. The purpose of the IDS "layer" is indeed to allow existing implementations to continue, while the layer ensures interoperability and control of data. This means that services that build on top of this layer, can be marketed elsewhere. However, it may be unclear beforehand what exact specifications a local implementation must meet in order to become interoperable.

6. NDS seems limitedly legitimized for advancing "European Values", e.g. data sovereignty. As NRAs have mandates focused on traffic and safety management and infrastructure, their mandates may fall short in governing the digital and data-landscape as sketched in the CAD-as-a-fleet scenario. That would indeed include ensuring that Europe becomes an attractive landscape for CAD-fleets and service providing ecosystems, all compatible with the European values. However, it seems also unlikely that any other body would be in a position to govern that.

6.4 Recommendations

In this section we turn the analysis into recommendations.

1. Further "institutionalize" the governance structure from NDS. As C-Roads was taken as a basis example for the NDS, it makes sense to build forward on this establishment. CEDR can help achieving this, as it has a long standing organization. Yet it would be necessary to adopt a mission statement along the lines of the CAD-fleet-as-a-Service scenario. It is important to understand that such an objective has overarching implications, and goes well beyond harmonisation. This means that such a governance body, from the perspective of the NRAs would deal with infrastructure, regulation, traffic and safety and digitization from an integral and strategic perspective. Therefore it must have support from the highest levels of the NRAs.

2. Ensure pilots are "IDS-*ified*", for replicability and sovereignty. Currently the pilots and implementations are, given its novelty, not compliant with IDS. And, assuming IDS can be made applicable to deployments such as Use Case 3, new pilots should be implemented following this paradigm, to ensure replicability and engrained data sovereignty. This will help to gradually build the landscape.

3. Include sub-national authorities in the governance structure. The MDS reveals that automotive and BigTech are interested in servicing and collaborating in the urban domain. In order to leverage that interest and relevance for the data-exchange, the sub-national authorities should be included in the governance structure. This can help them to participate in the same "wave". Furthermore, as there seems not to be a unifying

coordination at sub-national level, this may also represent a benefit for automotive and collaborate also at the aggregated national level beyond standardization.

4. Ensure commercial implementations in public-private collaborations (e.g. cities) are "IDS-*ified*". For the same arguments as 2. It is important that also local deployments become aligned in this principle. It should be investigated to what extent this can be posed as a requirement, even in existing situations and licenses.

5. Expand legitimacy of governance structure to include advancing "European Values", e.g. data sovereignty. In order for a union of NRAs to form the nucleus in a CAD-fleet-as-a-service scenario, they must have mandates to go well beyond the traffic, infrastructure and safety. This could imply that national ministries have to be involved.

6. Extend governance structure to include automotive and small tech. As the CAD-fleet-as-a-service scenario is by no means a public-only endeavour, participation from automotive industry and digital parties in the governing body is necessary. The exact level of involvement is however yet to be determined.

7. Actively profile and monitor regional and national infrastructures and actively broker upscaling / replication of IDS-ified pilots and (commercial) best-practices. In order to spur the transition, and because the advised scope of governance is very large, it is advised to set up a monitoring facility to observe the progress in becoming "CAD-fleet-ready". Furthermore, such monitoring facility and organization, should also aid in pro-actively identifying brokering opportunities. E.g. services developed in one area, to be applied elsewhere. This is known to increase the learning effect and speed up the transition.

7 Conclusion

This document reports the activities of WP6: Exploration of Business Models of the DIRIZON project. This work is aimed at providing “business model options” for an NRA driven data-exchange platform in context of future CAD deployment in Europe. In order to create these options, the work must deal with the current heterogeneous landscape on the one hand and a desirable future landscape. We have observed the current attention to a European position in the data and platforms landscape and devised a future scenario. This scenario is termed ‘CAD-fleet-as-a-service’ and is meant to reflect a situation in which CAD-fleets and corresponding public and private data services are flourishing.

In order to understand, from a business modelling perspective, how to reach such a scenario, we combined the concepts of platform business model, alliance governance, good governance of commons and collaborative networks.

We detailed three study scenarios, based on real-life examples, interpreted in context of CAD and scaled to full European scale. These scenarios are: 1) NRA-Dominant (NDS), based on the C-Roads example, 2) Market Dominant (MDS), based on the Your-Now example and 3) Hybrid (HS) (Public-Private), based on the Mobility Data Spaces (MobiDS, an IDS implementation).

We evaluated these scenarios within the consortium on 6 pre-set criteria, in order to find elements that support of barrier a move towards the desirable scenario. We found for the scenarios:

- The NDS is NRA driven governance structure that systematically coordinates pilots and specifically the process to derive standards from that. As such, it interfaces with the automotive industry, mainly on standardization.
- The MDS seems to drive business “where the money is”, which appears to be in urban areas. In cities, public organization are both served and collaborated with.
- The HS is a decentralized approach to public and private collaboration. Based on principles, such as data sovereignty, both public and private parties, as well as citizens build trust in this way of working. However, the base example (MobiDS) is still at its early stages, so inflating it to a full scale bears uncertainties.

Based on these and more detailed insights, we proposed a strategy in which the strong elements are combined. In summary, this strategy promotes the readily established European governance structure, and suggests it be expanded by both sub-national authorities as well as market party participation. Furthermore, the recommendations are to also “IDS-ify” both pilots and city-based data-sharing implementations. The result would be a decentral, yet connected organization that implements and governs data-sharing following European values.

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9 Appendix 1: CEDR CAD group Workshop

November 25, 2019 a workshop with the CEDR CAD group was organized by WP5 and WP6 of DIRIZON. It revolved around 4 statements and a number of questions to identify the preferences of the group. This workshop and the subsequential discussions have led to a brief scope change.

Statement 1: Digital services in any future CCAM scenario will be created and delivered by a collaboration of small and large service providers, governmental and commercial, using in-car, mobile or aftermarket devices.

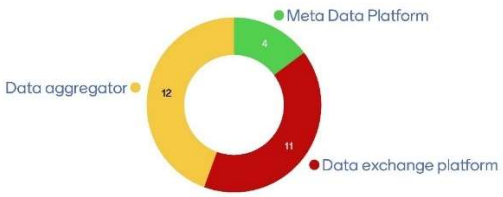
Do you think that the NRAs should take a leading role in the ecosystem to establish trust and quality?

Do you think the NRA should fullfill also the role of "content aggregator"?

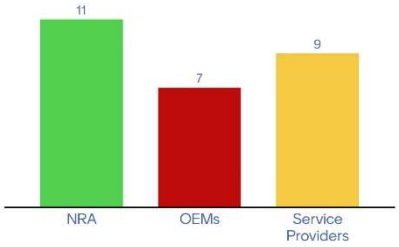
What prerequisites must be fulfilled for OEMs and service providers not to operate their own proprietary ecosystems?

Statement 2: Service providers using data typically have a trans or multinational exploitation scope. Even for non-cross-border services. Uniform access and service discovery, or 'roaming' empower development and operation of services.

Which role should the NAPs play in a trans-national data-exchange platform scenario?



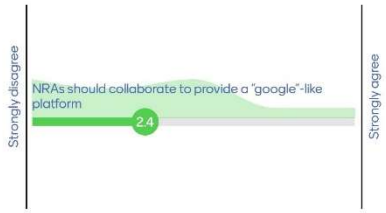
What are the constant elements (the same in each country) in a future decentralized exchange platform?



How would you implement a Trusted Electronic Regulation Access Point?

What level of governance do you think is needed to operate a trans-national data exchange platform?

Do you think that the NRAs should collaborate to provide the service providers a "google"-like platform for building their services on top



Statement 3: Appropriate services would pave the way for providing data services directly into vehicles, mobile devices or aftermarket devices used inside vehicles and, vice versa, providing sensor-data back to the connected backends. On-board technologies and forthcoming data may change, as well as the data required for in-car services.

Do you think that the data fields currently in focus will be stable and sufficient for the time being, or is substantial alignment required?

Statement 4: (In-car) services are the most important use of our data. The data-exchange platform and its governance must ensure that these service providers are optimally facilitated in the creation and proper functioning of these services is, e.g. by providing added value, e.g. by enriching services, toolkits, SDKs, hackathons, sandboxes, testbeds and protocols to stimulate value creation (service innovation) with our data. The creation of new services may stand to benefit collective benefits in traffic flow.

Do you think that NRAs should support service innovation to realise the best use of data?