GECKO

GOVERNANCE FOR NEW MOBILITY SOLUTIONS

Final Update of New Mobility Services and Business Models

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Abstract	This deliverable reviewed and analysed recent disruptive mobility services and technologies. Each disruptive innovation was critically evaluated by key factor analysis, market analysis and Osterwalder business model canvas, with different case studies. This deliverable is based on findings of D1.1 and D1.2 and has been made in close cooperation with D2.5. Multiple sources of data was collected, including desk research, interviews and focus groups on the stakeholder workshops. Findings of this deliverable show that different innovations are influenced by various factors, which is also directly related to current market status. The business model canvases of new mobility services and technologies also indicate that the value creation, delivery, and capture mechanisms of these cases. This deliverable also looked into the impacts of COVID-19 on these innovations due to the fact that the pandemic has significant influences on the sustainable urban mobility and might potentially facilitate / deter some disruptive innovations. Finally, a sustainability-oriented future scenario was chosen to explore how business models and regulatory policies might be changed in the future.
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LIST OF ACRONYMS

AI – Artificial Intelligence
API - Application programming interfaces
APL - Automated Parcel Lockers
AV - Automated Vehicles
B2B – Business-to-business
B2C – Business-to-customer
B2G – Business-to-government
CAA –Civil Aviation Authorities
CAGR - Compound annual growth rate
CAV – Connected and Automated Vehicles
CCAM – Cooperative, connected, and automated mobility
D – Deliverable
EASA – European Aviation Safety Agency
EU – European Union
EV – Electric Vehicles
E-VToL – Electric Vertical Takeoff and Landing
FAA - Federal Aviation Administration
GDPR – General Data Protection Privacy
GHG – Greenhouse Gas
GPS - Global Positioning System
HTT -Hyperloop Transportation Technologies
ICE - Internal Combustion Engine
ICT – Information and Communication Technologies
IoT – Internet of Things
ITS – Intelligence Transport System
KPI – Key Performance Indicator
MaaS – Mobility as a Service
MSP – Mobility Service Provider
OECD – Organisation for Economic Co-operation and Development
OEM – Original Equipment Manufacturer
ORION - On-road Integrated Optimization and Navigation
PT - Public Transport
TM - Traffic Management
TM2.0 – Traffic Management 2.0
TMC – Traffic Management Centres
UAM – Urban Air Mobility
UAS - Unmanned-aerial Systems
UN – United Nations
UTM - Unmanned Traffic Management
V2C – Vehicle-to-cloud

V2I – Vehicle-to-infrastructure
V2V – Vehicle-to-vehicle
VToL – Vertical Take-off and Land

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1. EXECUTIVE SUMMARY

D1.4 reviews and analyses recent disruptive mobility services and technologies, which are divided into four innovation categories: 1) connected, cooperative and automated mobility, 2) infrastructure, network and traffic management, 3) MaaS and MaaS platform, and 4) shared on-demand mobility. Each disruptive innovation is critically evaluated by key factor analysis, market analysis and Osterwalder business model canvas, with different case studies. This deliverable is based on findings of D1.1 and D1.2 and has been made in close cooperation with D2.5.

To complete this deliverable, the GECKO research team collected multiple sources of data. At the first stage, we conducted secondary research on new mobility services and technologies from academic literature, industry report and news articles. Key technological, social, operational and business factors of 13 innovations were summarized to help us capture the overall picture of the development of each innovation. At the second stage, semi-structured interviews with key stakeholders (i.e., industry practitioners and public authorities) were conducted to investigate the market readiness, positioning and maturity of these innovations. Business model cases were also developed during this stage. At the third stage, the research team used stakeholder workshops to further verify the findings and explore how the future scenario will influence business models to provide suggestions for regulatory policies.

Findings of this deliverable show that different innovations are influenced by various factors, which is also directly related to current market status. The business model canvases of new mobility services and technologies also indicate that the value creation (i.e., what value propositions are proposed in order to create value in the market), delivery (i.e., how the value is delivered to the new mobility services or technologies receivers), and capture mechanisms (i.e., how the value is captured by the new mobility services or technologies providers) of these cases. Further data analysis suggests that each innovation category has its own distinctive value proposition, which keeps evolving because of the uncertainties of rapidly changing market status and regulations. Different value capture mechanisms are identified by the analyses.

D1.4 also looked into the impacts of COVID-19 on these innovations due to the fact that the pandemic has significant influences on the sustainable urban mobility and might potentially facilitate / deter some disruptive innovations. Finally, a sustainability-oriented future scenario was chosen to explore how business models and regulatory policies might be changed in the future. The findings provide guidance for public authorities to design and implement more appropriate policies to prosper the development of the transport industry.

2. INTRODUCTION

2.1. Deliverable Motivation and Scope

Many disruptively new mobility services and technologies have been developed over the last decade. These innovations have redefined the transport industry and changed users' behaviour in both positive and negative ways, given high uncertainties of disruptive innovations. It is therefore important to understand the key factors (i.e., technological, social/behavioural, operational and business factors) [1], market development (i.e., market readiness, market positioning and market maturity) and business models of these innovations. A state-of-the-art knowledge on these areas would enable the authorities to design an adaptive and appropriate regulatory framework, which fosters the development and implementation of disruptive new mobility services and technologies. However, there is currently a fragmented understanding of these innovations, which restricts the development of suitable regulatory frameworks.

Against this background, this deliverable reviews and analyses key factors, market development and business models of disruptive innovations for passengers and goods transport. The business model case selection is based on GECKO stakeholder database and professional contact of consortium partners. Moreover, D1.4 has investigated the impacts of COVID-19 on these innovations due to the fact that the pandemic has significant influences on the sustainable urban mobility and might potentially facilitate / deter some disruptive innovations. In addition, a sustainability-oriented future scenario was selected to explore how business models and regulatory policies might be changed in the future. The findings provide guidance for public authorities to design and implement more appropriate policies to prosper the development of the transport industry.

Following the innovation categories identified in D1.1 and D1.2, the analysis of D1.4 focuses on 4 innovation categories: 1) connected, cooperative and automated mobility, 2) infrastructure, network and traffic management, 3) MaaS and MaaS platforms, and 4) shared on-demand mobility. Each innovation category has various disruptive innovations. Therefore, different cases are introduced and discussed to capture the whole picture of disruptive changes in the transport sector. Most cases in this deliverable are new start-ups, which to some extent reflects the nature of disruptive innovations in the transport industry.

2.2. Deliverable Structure

- Chapter 1 presents an executive summary for D1.4.
- Chapter 2 defines the motivation, scope and structure of this deliverable.

[1] This deliverable does not include factors of security and cybersecurity, safety, data and social protection, ethics because these factors are covered in D1.1 and have not been changed significantly over the past year. Instead of repeating similar contents, D1.4 added sections of COVID-19 as it is more relevant and timely to this deliverable.

- Chapter 3 introduces 4 innovation categories and the key concepts of market analysis and business model.
- Chapter 4-7 discuss key factors, market development and business models of new mobility services and technologies according to four innovation categories, including connected, cooperative and automated mobility, infrastructure, network and traffic management, MaaS and MaaS platform, and shared on-demand mobility. The discussion of how COVID-19 influences these innovations are also included here.
- Chapter 8 introduces a sustainability-oriented future scenario to investigate how business models and regulatory policies might need to be changed in the future.

3. NEW MOBILITY SERVICES AND TECHNOLOGIES: DEFINITION AND KEY CONCEPTS

3.1. Four Categories of Mobility Innovations

The following subsections are succinct descriptions of four innovation categories. For more details, please refer to GECKO D1.1.

3.1.1. Connected, cooperative, and automated mobility

A connected vehicle is defined as a motor vehicle "that connects to other vehicles and/or devices, networks and services outside the car including the internet, other cars, home, office or infrastructure" [2]. In the future, connected vehicles might directly interact with each other and with the road infrastructure. This interaction is the domain of cooperative mobility, which is enabled by digital connectivity between vehicles and between vehicles and transport infrastructure[3]. An automated vehicle is defined as "a motor vehicle which has technology available to assist the driver so that elements of the driving task can be transferred to a computer system" [4]. In contrast, an autonomous vehicle is defined as "a fully automated vehicle equipped with the technologies capable to perform all driving functions without any human intervention" [5]. Example of disruptive innovations in this category includes connected and automated vehicles, passenger urban air mobility, and drone last mile delivery.

3.1.2. Infrastructure, network, and traffic management

Infrastructure can be defined as innovations in infrastructure management, pricing, taxation and finance, digitalization and integration[6]. Network and traffic management "provides guidance to the European traveller and haulier on the condition of the road network. It detects incidents and emergencies, implements response strategies to ensure safe and efficient use of the road network and optimises the existing infrastructure, including across borders. Incidents can be unforeseeable or planned: accidents, road works, adverse weather conditions, strikes, demonstrations, major public events, holiday traffic peaks or other capacity overload" [7]. Example of disruptive innovations in this category includes big data for fleet management and logistics, cooperative road traffic management, and Hyperloop.

[2] Gowling WLG, Are you data Driven?
[3] Intelligent transport systems
[4] European Parliament, Briefing January 2016, Automated Vehicles in the EU.
[5] European Parliament, Briefing January 2016, Automated Vehicles in the EU.
[6] Transport Infrastructure Expert Group.
[7] Intelligent Transport Systems, Traffic Management

3.1.3. MaaS and platforms

"Mobility-as-a-Service (MaaS) is a user-centric, intelligent mobility management and distribution system, in which an integrator brings together offerings of multiple mobility service providers, and provides end-users access to them through a digital interface, allowing them to seamlessly plan and pay for mobility" [8]. The MaaS Platform is the IT structure that is used by the MaaS Operator to provide the final service of mobility to the end-users. Example of disruptive innovations in this category includes MaaS and MaaS platforms.

3.1.4. Shared on demand mobility

Shared mobility and on-demand mobility are two trends emerged as a response to the change in traveller need for cheaper transport (e.g. sharing the cost of travel) and the need for easy access to a transport (service) at a given moment. Shared mobility and on-demand mobility can also reduce congestion and space by private vehicles in cities. Shared mobility can be defined as usage of shared resources, in this case vehicles, which are made available to registered users at various locations in the city. On-demand mobility, on the other hand, is service provided 'on-demand', when requested by the customer, and not based on a fixed schedule. Example of disruptive innovations in this category includes on-demand ride sharing, bike sharing, e-scooter sharing/micromobility, ride hailing and crowd shipping.

3.2. Market Analysis

Three different market analysis tools were used to investigate the market development of disruptive innovations: market readiness, market positioning and market maturity. Market readiness levels feature four business process-oriented phases, from ideation to scaling business to a sustainable, resilient and commercial operation[9]. Table 1 is the market readiness scale.

Table 3-1: Market Readiness Scale

0	Perception of a need	IDEATION	
1	Basic research		Need is described, no evidence
2	Needs formulation		Articulation of needs based on customer/users stories
3	Needs validation		Initial stakeholder interest on the product
4	Small scale stakeholder campaign	TESTING	Campaign with stakeholders (friendly, usual customers, business partners, etc.)

[8] The MaaS Dictionary
[9] CloudWATCH2 - H2020

5	Large scale early adopter campaign		Campaign with early adopters (target groups, intended customers)
6	Proof of traction	TRACTION	Paying customers
7	Proof of satisfaction		Positive feedbacks from paying customers
8	Proof of scalability	SCALING	Stable pipeline and strong understanding of the market, solid revenue projections
9	Proof of stability		KPIs matched and predictable growth
Source: adapted from CloudWATCH2 - H2020			

Market positioning is critical to the operation of new mobility services and technologies. According to Epiphany, Steven G. Blank[10], there are four different types of market, including existing market, new market, re-segmentation of an existing market as a low-cost player and re-segmentation of existing market by employing a niche strategy.

Table 3-2: Market Positioning

MP	Market Positioning	
A	Existing market	
B	New market	
C	Re-segmentation of an existing market as a low-cost player	
D	Re-segmentation of existing market by employing a niche strategy	

Whilst market readiness research analyses the level of readiness for a product/service to be introduced in the marketplace, the market maturity analysis, describes the different stages of life of a marketplace. As written in the Harvard Business Review (1965) article by Theodore Levitt11, the product life cycle has 4 clearly defined stages (i.e., introduction/development, growth, maturity and decline), each with its own characteristics that mean different things for business that are trying to manage the life cycle of their particular products.

Table 3-3: Market Maturity

MM	Market Maturity	

[10] Blank, S.G. (2005). The Four Steps to the Epiphany. Self-published: Cafepress.com

[11] Harvard Business Review, Theodore Levitt, 1965

I	Introduction/ Development	
II	Growth	
III	Maturity	
IV	Decline	

For complete discussion on tools of market readiness, market positioning and market maturity, please see D1.1.

3.3. Business Model and Business Model Canvas

Transport organizations need to develop a sustainable business model in order to survive in todays' competitive environment. "A business model articulates the logic, the data, and other evidence that support a value proposition for the customer, and a viable structure of revenues and costs for the enterprise delivering that value. [...] It's about the benefit the enterprise will deliver to customers, how it will organize to do so, and how it will capture a portion of the value that it delivers" (p.179).[12] With a well-defined business model, organizations are able to specify what customers need, and how organizations can best meet those needs and get paid for doing so.[13]

The business model canvas was selected as the main tool because it is a well-established way to investigate the multitude of business model elements, which offer a comprehensive view of how a firm creates, delivers, and captures value. A business model can also be described through multiple elements that show the logic of how an organization intends to make money, which is known as business model canvas.[14] Business model canvas is a strategic management tool for developing new or verifying existing business models. It can be explained by nine building blocks, including customer segments, value propositions, channels, customer relationships, revenue streams, key resources, key activities, key partnerships, and cost structure.[15] For more details on business model canvas, please refer to D1.2.

[12] Teece (2010), Business models, business strategy and innovation.
[13] Ovans (2015), What is a business model?
[14] Osterwalder and Pigneur (2010), Business model generation: A handbook for visionaries, game changers and challengers.
[15] Hossain (2014) Business development model of canvas: The 9 building block approach

4. CONNECTED, COOPERATIVE AND AUTOMATED MOBILITY

Connected, cooperative, and automated mobility (CCAM) is expected to reshape the way we travel and move in the European transport industry. With the integration of CCAM into existing mobility and transport ecosystems, the transportation systems will be safer, more efficient and more comfortable.[16]

CCAM delivers profound changes in transportation systems and offers many opportunities to improve the quality of public transport. It can be used for shared mobility services that enable the integration with public transport and MaaS platforms.[17] In turn, the CCAM will benefit people who are not able to drive independently (e.g., incapacitated, or disabled people, and those without a driving license). The shared CCAM will bring many benefits, including more flexible, customisable, and accessible mobility services, improved use of urban space, enhanced and integrated travel experience and reduced air pollution. The benefits in these areas will further increase the efficiency of whole transportation and mobility systems.

Although CCAM has potential to create a user-centred and all-inclusive mobility and contribute to decarbonisation, it might bring negative influences to the sustainability. For example, if the car ownership increases with the development of CCAM, the metropolitan areas might encounter more congestion challenges, which threaten the transport system and distort the objective of sustainable mobility. Therefore, it is critical to evaluate the advantages and disadvantages of CCAM and provide a representation of what the future with autonomous vehicles would look like.[18]

Example of disruptive innovations in this category includes connected and automated vehicles, passenger urban air mobility, and drone last mile delivery. In this chapter, we discuss the key factors that are relevant to these new mobility technologies and services, the market analysis and business models. In the end of this chapter, the influences of COVID-19 on the development of CCAM will be discussed.

4.1. Connected and automated vehicle

4.1.1. Technological, social, operational and business factors

Technological

[16] Hopkins, D., & Schwanen, T. (2018). Automated mobility transitions: governing processes in the UK. Sustainability, 10(4), 956.

[17] Lazarus, J., Shaheen, S., Young, S. E., Fagnant, D., Voege, T., Baumgardner, W., ... & Lott, J. S. (2018). Shared automated mobility and public transport. In Road Vehicle Automation 4 (pp. 141-161). Springer, Cham.

[18] Botte, M., Pariota, L., D'Acierno, L., & Bifulco, G. N. (2019). An overview of cooperative driving in the european union: policies and practices. Electronics, 8(6), 616.

Connected and automated vehicles (CAV) refer to autonomous/connected vehicles or self-driving cars (vehicles that can guide themselves without human intervention).[19] Connected vehicles are vehicles that use any of a number of different communication technologies to communicate with the driver, other cars on the road (vehicle-to-vehicle [V2V]), roadside infrastructure (vehicle-to-infrastructure [V2I]), and the "Cloud" [V2C]. Autonomous vehicles (AVs) are referred to self-driving, driverless or robotic. Many disruptive technologies, for example, 5G and ultra-reliable low-latency communications, advanced sensors, distributed control algorithms, and machine learning, have been used in the development of CAV to improve vehicle safety, efficiency and commute times.[20] Given that driver error is considered a major culprit in over 90% of all road crashes and it has recently been estimated that 94% of public roadway crashes happen due to human errors,[21] one of the benefits of CAVs include crash elimination, as a vehicle can monitor the environment continuously and compensate for lapses in driver attention. Reduced traffic congestion is another potential benefit of CAV. Experiments show that with as few as 5% of vehicles being automated and carefully controlled, it is possible to eliminate stop-and-go waves caused by human driving behaviour. The researchers found that by controlling the pace of the autonomous car in the study, they were able to smooth out the traffic flow for all the cars. The reduction in congestion and electrification of CAVs will most likely result in a reduction of CO2 emissions as well. A recent report estimates that connected autonomous electric vehicle will play a vital role in emerging revolution in sustainable low-carbon mobility and will be at the forefront of rapid transformation in transportation, due to their potential to operate with higher vehicle efficiency.[22] In addition, by accelerating and decelerating more smoothly than a human driver, CAV technology can reduce fuel consumption and result in further improvements from reducing distance between vehicles and increasing roadway capacity and reduced travel times. Other potential cost-saving domains include reduced manpower, i.e., drivers and law enforcers. With the recent pandemic, the application of CAV technologies might also have benefits to alleviate the spread of virus as it reduces the chance of contacts and supports the new way of shared mobility in the future. However, the systems underlying AVs (sensors, radar, and communication devices) are expensive compared to older vehicles which leads to the questions about the affordability of the CAV technology.[23] Other barriers include liability, licensing, security, and privacy concerns.
Social and behavioural
The cost of advanced technologies, safety, social and ethics issues are key barriers for CAV adoption because it relates to public acceptance of CAV. Currently, this innovation is still in early stage of the market, with relatively high price, compared with other cars. It might be compensated by driver cost if we talk about shared transport, whether it is public (bus) or private (taxi). The safety and ethics of CAV also influences the individual's willingness to adopt

[19] Connected and automated mobility
[20] Connected and automated vehicles
[21] Li, T. & K. M. Kockelman, Valuing the safety benefits of connected and automated vehicle technologies
[22] Vaidya, B. & H. T. Mouftah, 2019. Connected autonomous electric vehicles as enablers for low-carbon future
[23] The cost of self-driving cars will be the biggest barrier to their adoption

this new technology. For example, when an Uber self-driving car fatally struck a pedestrian in Arizona in 2018, this attracted a wide media attention and raised questions related to the safety performance and acceptance of autonomous vehicles.[24] The results of one study on the perceptions and expectations of AVs provide some evidence that interactions with AVs of vulnerable road users increase perceptions of safety and approval of this technology, and suggest that increased opportunities to interact with AVs would lead to improved public attitudes toward the technology. On the other hand, a study conducted by MIT in 2017 has found that nearly half of 3,000 respondents said they would be less likely to purchase or use a car that completely drives itself. The respondents said that they feel uncomfortable with the loss of control and that they do not feel self-driving cars are safe.

Although CAVs have potential benefits to a user-centred and all-inclusive mobility, it might bring some society and sustainability challenges as well. CAV might cause employment issues around the fact that taxi drivers might have less competitive advantages and lose their jobs. In addition, with the potential increase of car ownership enabled by CAV, the metropolitan areas might encounter more congestion challenges, which in turn threaten the transport system and distort the objective of sustainable mobility.

Operational
CAV is expected to bring operational efficiency to logistics hubs, integrating road transport with other logistics operations. For example, if truck arrivals at a terminal are known beforehand, yard planning can be made more efficient by avoiding congestion in particular areas. In addition, autonomous systems could foster last mile operations between logistics centres and port terminals, thus reducing barriers for intermodal transport. However, as mentioned above, high operational costs of CAVs compared to traditional cars are often considered as one of the major barriers to their adoption. Previous research assumed that the necessary AV technology would increase vehicle price by an average of 20%, leading to higher acquisition costs. However, due to more balanced driving of AVs, it is further assumed that automation and electrification might lower fuel costs by 10%. In addition, it is expected that CAVs will need less components maintenance due to more considerate automatic driving. Based on earlier research it was assumed that safer driving resulting from AVs would lower insurance rates by 50%, but more recent research regards this as conservative, as today's Tesla Autopilot is reported to have already decreased accident rates by 40%. However, this estimate is highly uncertain.[25]
Business
There is high possibility that AVs will initially be offered for sale not to private owners but to robo-taxi-fleet operators. Robo-taxis refers to driverless ride-sharing services which are being tested in the United States. This is due to two reasons. The first one is a very high price of the sensors. For robo-taxis that will be a lesser problem because vehicles will be operating and thus generating revenue throughout the day, while private cars are in use only about 5% of the time. Second, safe functioning of AVs will be much easier in limited geographical ranges that have been mapped in fine detail, such as city centres.[26] However, it is important to consider the

[24] Perceptions and expectations of autonomous vehicles – A snapshot of vulnerable road user opinion
[25] Cost-based analysis of autonomous mobility services
[26] Self-driving cars will require new business models

regulations which might influence the possibility of the evolution on dedicated areas. For high speed and private CAV to evolve on open roads, many tests and simulations are needed in order to evaluate safety issues and ensure a low failure rate. These are multi-stages of tests which would be needed. An option is to simulate and to experiment on the field and to see how to improve regulations progressively. If robo-taxis are made possible for real transport operations, it is likely that their speed limit will be constrained to a low speed.
When it comes to the use of AVs in freight transport, investors have been supporting start-ups that developing the technology for self-driving trucks as these could lower the cost of shipping goods by eliminating drivers (Amazon is an example of a company that is already using autonomous trucks to move cargo in the United States). The CAV industry relies on collaboration and sharing of data among companies, therefore, it is expected that there will be more mergers and acquisitions as well as partnerships between auto manufacturers and technology companies in the future.[27]

4.1.2. Market analysis

Market readiness
When it comes to CAVs, solutions exist at the "ideation" and to some extent at the "testing" market readiness level (4-5). Many governments (e.g. USA, UK, China, Germany and Australia) have been developing plans and guidelines for the introduction of CAVs. In terms of the readiness of the road network, developers like Google and Tesla are focusing on develop self-driving vehicles that can run effectively on the existing infrastructure and use existing static communications. Therefore, there will be no significant amount of infrastructure change. In the meanwhile, other stakeholders have been more cautious by warning that self-driving vehicles could cause different operational problems and arguing for better vehicle connectivity. It is argued that infrastructure change will need a 30-year planning. Therefore, CAVs are less likely to develop to their fullest potential without planning by transport policymakers, planners and engineers to ensure that infrastructure changes are sufficient.[28]
Market positioning
There are several major players in the rapidly growing CAV industry such as Tesla, Uber and Alphabet. However, a number of auto brands, start-ups in auto tech market, large corporations, big technology brands, telecommunications companies and other investors are also investing in autonomous R&D. In 2019, Amazon announced their investment in Rivian, a competitor to Tesla, and in Aurora, an independent automotive start-up.[29] Since 2018, Apple has been building out the beginnings of its self-driving car fleet, with 66 vehicles officially on the road as of July 2018. It was also reported that Apple was working to provide autonomous cars for employee transit between corporate facilities.

[27] Self-driving cars face two important challenges, says World Economic Forum executive
[28] Johnson, C. 2017. Readiness of the road network for connected and autonomous vehicles
[29] Competition in the autonomous vehicle industry is heating up

Audi has revealed different AV prototypes derived from its A7 and RS 7 models, including consumer-oriented test vehicles. Together with Daimler and BMW, Audi is part of the German consortium that bought Nokia's HERE precision mapping assets, which has designed an open specification for vehicle sensor data collected and transmitted to the cloud by connected vehicles. In July 2017, Audi unveiled its new flagship A8, which at the time was the first vehicle in production that could allow its users to "drive" hands-free. Mercedes has also been taking other steps toward self-driving cars by deploying semi-automated advanced driver assistance systems to many of its newer models. Bosch, one of the world's largest automotive suppliers, has dedicated more than 2,000 engineers to driver-assistance systems. It has also partnered with GPS maker TomTom for the mapping data necessary for this endeavour. Samsung has been testing self-driving cars on South Korea's public roads. Their self-driving cars are based on Hyundai vehicles equipped with cameras and sensors. [30]
Market maturity
The AV market is driven by several factors such as increasing efforts from governments as well as consumers to ensure road safety and to develop CAV infrastructures, which boost the demand for a reliable transportation system. In addition, increased government focus boosts market growth. Moreover, factors such as increasing focus on vehicle platooning, a transition from car ownership to MaaS, and revenue generation opportunity for different layers of the automotive ecosystem is expected to create opportunities for the market growth. However, factors such as reliability issue with the AVs, inadequate infrastructure, cybersecurity threats due to increasing data, etc. limit the market growth.[31]

4.2. Passenger urban air mobility

4.2.1. Technological, social, operational and business factors

Technological
Urban air mobility (UAM) refers to the use of aerial AV or vertical take-off and land (VToL) vehicles to transport people living in populated urban areas. Three technologies are in particular relevant to the implementation of UAM. First, advanced automated systems are an essential part of urban air mobility because it can detect the external environment and automatically calculate the best and safest route for passengers. Second, a dedicated 5G network is crucial for future air traffic control.[32] Third, a well-developed UAM infrastructure is needed as taking urban transportation to the sky requires robust and integrated city infrastructure, such as weather and GPS satellite, uninterrupted power supply, fast charging stations and vertiport.[33]
Social and behavioural

[30] 40+ Corporations working on autonomous vehicles
[31] Global Autonomous Vehicle Market to 2028
[32] Urban Air Mobility Will Not Succeed Without a Dedicated 5G Network
[33] Infrastructure barriers to the elevated future of mobility

UAM might contribute to the sensitive population groups. For example, E-VToL could be used for transferring elderly or disabled people to the doctors and hospitals. The national government might also use it to connect rural and suburban areas to urban areas. Since urban traffic congestion significantly influences people's daily life. urban air mobility is also a solution for future transport. It might address the emerging social needs of residents and travellers in urban areas. Moreover, the arrival of urban air mobility might bring substantial behavioural change to business and tourism travellers. These travellers care more about the time and convenience rather than the cost of service.
Operational
Many European countries (e.g., Germany and France) have invested heavily in the development and procurement of advanced eVTOL systems for commercial operations. With the advancement of automation and globalization, there are needs for increased operational efficiency, reduction in human intervention for intercity and intracity transportation using eVTOLs. According to the call from European Commission, "new concepts of operations allowing UAM traffic to be interwoven with the multi-modal urban transportation or emergency systems (e.g. ground/air ambulances), with due account of the safe and secure utilisation of the air space."[34] Therefore, there will be many operational opportunities in European countries and the global.
Business
The European UAM market is projected to grow at the highest rate of any global region until 2030 according to research from Markets and Markets. Overall, the global UAM market is projected to grow from USD 5.3 billion in 2018 to USD 15.2 billion by 2030, at a CAGR of 11.33% from 2018 to 2030.[35]

4.2.2. Market analysis

Market readiness
The market for UAM service is expected to grow in a quick pace. According to our interview, the current market readiness level of UAM is between the level 5 and 6 (i.e., between large scale early adopter campaign and proof of traction). UAM has been testing with key stakeholders (i.e., target groups and intended customers) across Europe. Many companies have also started their pre-commercialisation activities, such as Lilium (Germany), Volocopter (Germany), Airbus (Netherlands), Wingcopter (Germany), Heart Aerospace (Sweden).[36] There are some enablers that will enhance the market readiness of UAM. For example, the advanced automated technologies and integrated city infrastructure will support the development UAM service at commercialization stage. On the other hand, there are some barriers for UAM service to be commercialized in different cities. For instance, safety, privacy,

[34] Towards sustainable urban air mobility
[35] Research suggests Europe to lead world for UAM to 2030
[36] The future of urban air mobility in Europe

environment, and noise and visual disruption will be main concerns for public acceptance of urban air mobility.[37]
Market positioning
UAM is a new market. Form a B2B perspective, there are more than 70 manufacturers worldwide, including Boeing, Airbus, Bell Helicopters, Uber, Lilium. These manufacturers not only sell their products to the service providers but also develop brand new services in different cities.[38] From a B2C perspective, there will be more and more service providers to offer customised services for different purposes (e.g., health care, tourism, and business) in the future. To maintain the competitive advantages in this market, firms need to develop a robust UAM ecosystem and well-designed business model. They need to start with clear market positioning and use niche market strategy to acquire early adopters and build strong brand reputation.
Market maturity
Since most of UAM are in the testing stage, the market is very new, with few existing competitors. The existing market size is small but growing steadily with the UAM business ecosystem. Therefore, the market maturity is at the introduction/ development stage.

4.3. Drone last mile delivery

4.3.1. Technological, social, operational and business factors

Technological
Drones currently rely on several sophisticated technologies. However, many of these still need to be improved before drone delivery becomes a common practice. 1. **Autonomous flight**. Although some drones are already able to fly without the support of a human who controls its route, this technology is not yet consolidated. Currently the most mature unmanned-aerial systems (UAS) applications involve short-range surveillance and associated photographs or videos. All drones that travel further than the operator visual line of sight require unmanned traffic management (UTM)[39]. Recently the US Federal Aviation Administration (FAA) and UAS stakeholders created the Low Altitude Authorization and Notification Capability program, which provides UAS with access to controlled airspace near airports by processing airspace authorizations at low altitudes in near real time[40]. The COVID-19 pandemic also encourages the development of

[37] NASA: URBAN AIR MOBILITY (UAM) MARKET STUDY
[38] UAM Executive Briefing
[39] A system of radar, beacons, flight-management services, communication systems, and servers that coordinate, organize, and manage all UAS traffic in the airspace.
[40] Air-mobility solutions: What they'll need to take off (McKinsey&Company), 2019

autonomous flight because this technology will be essential if the disease exists longer than expectation.

2. **Battery performance**. The energy density of lithium-ion batteries is growing by 5 to 8% every year and their lifespan is expected to double by 2025. This improvement will allow delivery drones to fly more than an hour without recharging.
3. **Detect-and-avoid technologies.** The detect-and-avoid systems can help drones avoid collisions and obstacles. Drones currently have such systems but are still unsophisticated.
4. **Location technologies**. Drones must be able to identify their position even in areas where GPS signals are limited, such as densely built cities and remote locations. The widespread rollout of a GPS alternative is more than ten years in the future.[41]

Social and behavioural
A survey on a total sample of 1465 people reveals that the majority of the population (44%) is in favour of the idea of drone delivery, against 34% opposed, while 23% say they are still undecided.[42] Analysing the reasons why citizens still do not trust drone technology, drone malfunction is the public's primary concern (46%) - far more than fears about intentional misuse (14%). In terms of generations, young people are more likely to accept the new delivery service: 65% of interviewed millennials say they are in favour, against just 24% of Baby Boomers. It also emerged that the people who had previously seen or heard about the drone delivery concept are more inclined to accept the idea (75%), compared to those who had never heard of it (24%). The services that arouse the most interest are (in order): one-hour delivery; delivery in cases of emergency; delivery to hard-to-reach locations (mountains, islands, etc); delivery to wherever I am, not just my home; delivery to remote locations where few people live; Sunday delivery; evening delivery.
Operational
Companies view delivery drones as an opportunity not only to increase the speed of delivery for customers but also to enhance the safety and efficiency of the overall transportation system by reducing road traffic. Delivery drones find application in the field of food delivery, as in the case of *Domino's*, whose drones have a delivery radius of 1.5 km. As for other applications for small goods delivery, in 2017 DHL started a trial in Tanzania using a Wingcopter to fly medical supplies from Mwanza, on the shores of Lake Victoria, some 60 km to a clinic on Ukerewe Island. The drone journey took 40 minutes, compared with six hours by road and ferry. In June 2019 Amazon executive Jeff Wilke presented its delivery drone; drones will be able to fly up to 24.1 km miles and deliver packages under 2.2 kgs to customers in less than 30 minutes. According to Wilke, despite the limited load capacity, between 75 and 90% of Amazon deliveries could technically be handled by the drone. Overall, the use of drone can be a reasonable solution to reduce traffic congestion and pollutions in small goods delivering, as well as to reach rural or remote areas.
Business

[41] Commercial drones are here: The future of unmanned aerial systems

[42] Office of inspector General - United States Postal Office, Public Perception of Drone Delivery in the United States, RARC Report, Report Number RARC-WP-17-001, October 11, 2016

Drone delivery could allow companies to bypass the many problems related to the last mile segment. On the one hand, e-commerce companies want to cut costs and delivery times; on the other hand, logistic service providers are accelerating experiments with drones, not being overwhelmed by start-ups and technology companies that see the drone delivery as an opportunity to access this market[43]. In any case it is estimated that the adoption of drones in companies is set to increase and it is estimated that worldwide drone deliveries will increase with a compound annual growth rate of 66.8% (CAGR) between 2017 and 2023 to reach 2.4 million, but a mainstream adoption will take place as regulations are put in place and drone technology improves.[44]

4.3.2. Market analysis

Market readiness
Incumbent firms (e.g., Amazon, Google, UPS and DHL) have tested drone delivery since 2005. Australia's Civil Aviation Safety Authority (CASA) recently gave approval to Wing, a Google-funded start-up, to deliver packages via drone after a trial proved successful. Therefore, the technological level is already sufficient to guarantee the service. From the market point of view, it can be stated that the Market Readiness Level of the delivery service with drones, in its most advanced applications (which can be observed in the countries where the civil aviation authorities have authorized the service), is 6 (i.e., proof of traction). However, some questions regarding the adoption of drones for delivery services have been raised. For example, concerning the need to relocate or build new distribution centres closer to customers. Currently, a drone can travel a maximum distance of 24 km. The economy of delivery services depends, among other factors, on the number of deliveries that can be made during each run. For now, drones are not capable of making many deliveries in one run, so companies would need a large fleet to guarantee their service quality. In any case, numerous investments and much research seem to show that different industries have considered drone delivery as an alternative solution. For example, Amazon Technology Inc. has just patented a fulfilment centre designed to accommodate landing and take-off of unmanned aerial vehicles in densely populated areas (called a drone-beehive).
Market positioning
Drone delivery is a relatively new market. The main players in the delivery drones' market are big companies such as Amazon (U.S.), United Parcel Service (U.S.), JD.com (China), Uber Technologies Inc. (U.S.), EHANG (China), DJI (China), Skycatch Inc. (U.S.), Airbus S.A.S (France), Zipline International Inc. (U.S.), Alibaba (China), Flirtey (U.S.), FedEx Corporation (U.S.), and Google (U.S.). It is worth emphasizing that several public sector entities also perceive the idea of delivery by drones as a potential opportunity. Remaining in the public perspective, the construction of tailored drone distribution centres could enable joined delivery systems where different freight carriers could cooperatively deliver goods to customers and potentially also collect from retailers.

[43] The Drone Delivery Report : Opportunities and challenges in automating logistics with drones
[44] Delivery companies are embracing drone technology

Market maturity
From a combination of technological and economic progress, drones for small package deliveries are still in the first stage of the path to industry (i.e., the concept is in the validation phase)[45]. However, at the moment several pilots have been placed and Drone Company Wing, part of Alphabet/Google, has received regulatory approval to make drone deliveries in Australia. US authorities have followed suit by granting Wing approval as a commercial airline in the US. Currently in US the regulatory scheme is in progress: FAA is working with industry, state, local, and tribal governments to identify benefits of drones, in order to define future rules and regulations[46]. The current pandemic would also be a potential driver to foster the development of drone delivery market.

4.4. Selected Business Model Cases in the Connected, Cooperative, and Automated Mobility Category

4.4.1. Case 1: Arrival

[Case background]
Arrival is a technology-based company that delivers exceptional products and services for communities around the world and accelerates the move to zero emission transportation. It creates iconic commercial electric vehicles at the same cost as petrol and diesel equivalents to make electric vehicles mainstream. Arrival has taken a ground-up approach to make vehicles in a new way – light, modular and efficient. Using design thinking, Arrival is reimagining the engineering and manufacturing of vehicles to confront legacy industry challenges that to date have prevented the mainstream adoption of EV technology.[47]

[Business model explained]
Currently, Arrival's main clients are large delivery companies. It develops and manufactures a number of different electric and semi-autonomous vehicles, with digital solutions that can potentially create an integrated transport ecosystem. These vehicles have an advantage over Internal combustion engine (ICE) vehicles because they are cleaner and quieter. In addition, Arrival's vehicles include a variety of electronic features, which allowing Arrival to offer exclusive solutions that make these vehicles more efficient in the market. Finally, Arrival aims to make the cost of these vehicles competitive with traditional ICE vehicles.
One interviewee noted that, "Arrival has developed close relationships with all fleet operators currently operating their vehicles. This allows them to constantly optimize their vehicles according to the needs of their customers". Indeed, the technological advancements, research

[45] Giones, F. and A. Brem (2017) From toys to tools: The co-evolution of technological and entrepreneurial developments in the drone industry, Business Horizons, 60 (6) 875–884
[46] Package Delivery by Drone (Part 135)
[47] Arrival (2020), Official Website

and development capabilities, and flexibility of digital solutions make it possible for clients to increase their efficiency significantly. Arrival stays in contact with their clients through personal contacts and regular meetings. Currently, all products that will be sold by Arrival are still in a prototype stage.

There are three key resources for Arrival to operate their business model. (1) Physical resources: the factory where the vehicles are manufactured and the workshop site where the vehicles are designed. (2) Human resources: the engineers and the technicians for the hardware of the vehicle, the software developers for the core software, and the designers for overall configuration of all elements. (3) Financial resources: as Arrival does not currently sell their products, they need to have access to sufficient funding to finance the development of their products.

Key activities that these resources perform are the development of all the essential driving systems on the vehicles, the development of the autonomous driving technology and other software and electronic features of the vehicle, and finally the manufacturing of the vehicles.

The cost structure that follows from this business model is mainly related to the research and development costs of the vehicles and all the associated technologies, the costs of the components and materials of the van, the production costs and the salaries of the workforce. In the future, Arrival also expects to have marketing and sales cost. Figure 1 summarizes the business model canvas of Arrival.

[Other factors influencing business model]

The legislation might have a huge influence on the business model of Arrival. Current legislation still does not allow for autonomous driving to happen without a driver in the car. This legislation affects the direction of the development of Arrival's product because it needs more consideration on human-technology interactions. Moreover, the general sustainable policies on ICE vehicles can make Arrival's vehicles even more cost competitive due to a decrease in the tax burden on these kinds of vehicles.

[Implications for decision-makers from authorities / public transport]

Although there is an increasing trend in developing electronic and autonomous vehicles, the above case shows that the legislation will significantly influence the R&D direction for new start-ups and other actors in the area of autonomous vehicles. It is therefore important for policy makers to design a regulatory framework that can guide these firms to develop something fitting with a government's long-term planning.

Moreover, this case also identified the difficulties of such new start-ups. To survive in the competitive market where ICE vehicles dominate, they might need to provide their clients with free products and services before the formal commercialization. In this situation, some companies might fail to succeed because of the financing issues. According to the interview, the transport authorities are encouraged to develop training programs/incentives that can educate the delivery companies or other relevant companies the benefits of using environmentally friendly electronic vehicles. In this way, there will become active customers who will seek new mobility solutions by themselves.

<table>
<tr>
<td rowspan="2">Key Partners
• Suppliers of components & raw materials
• Customers on trial projects (UPS, RM)
• Investors</td>
<td>Key Activities
• Development of driving systems
• Development of autonomous-driving systems
• Development of software
• Manufacturing of vans and buses
• Big data collection and analysis</td>
<td rowspan="2">Value Proposition
• Environmentally friendly (i.e., clean and quiet) vehicles, combined with autonomous driving characteristics and digital solution
• Cost compatible with ICE vehicles</td>
<td>Customer Relationships
• Close R&D with client
• Personalized seller-buyer relationship in the future</td>
<td rowspan="2">Customer Segments
• Delivery services (e.g. UPS, RM)
• Public transport operators</td>
</tr>
<tr>
<td>Key Resources
• Physical resources: manufacturing site, R&D and design workshop site
• Human resources: engineers, technicians, software developers and designers
• Financial resources</td>
<td>Channels
• B2B sales channels with sale representatives
• Website channel
• Word-of-mouth</td>
</tr>
<tr>
<td colspan="3">Cost Structure
• Components/materials cost
• R&D costs
• Production cost
• Employee salaries</td>
<td colspan="2">Revenue Streams
• Selling of products and solutions in the future
• Public funding</td>
</tr>
</table>

Figure 4-1: The Business Model Canvas for Arrival

4.4.2. Case 2: Griff aviation

[Case background]
Griff aviation was founded in 2015.[48] It aims to develop drones which can lift heavy weight objects and carrying them over short distance. Its business model is based on two points of sales. They sell a set of standardized drones on their website, and they R&D more complex and customized drones for large customers with specific requirements for their drones.

[Business model explained]
Griff's drones create value for their customers in two ways: 1) the drones can be used to transport heavy objects over a short distance, which is more cost effective than using helicopters that are traditionally used for these kinds of tasks and (2) producing drones that are specifically designed for customer needs, giving them the abilities to perform niche tasks.
The main customer segment of Griff is energy infrastructure construction. Their drones are also used for construction and wind-farm maintenance. Griff finds that customers often approach them through their website after they customers heard about the company from a media source or via word-of-mouth. With clients who buy a standard drone from Griff, the relationship is defined by a buyer-seller transaction. For the drones that are customized, Griff has an intensive interaction with the customers throughout the design period of the drone to ensure that both parties are satisfied with the drone once it is ready to operate. The revenue stream for Griff is mainly from the selling of drones.
To ensure the operation of the business model, Griff needs a number of key resources. These resources are 1) physical resources, including the drone factory and the workshop site where the drones are designed, 2) human resources which include all the people involved in the design and manufacturing of the drones, people who are specialized in the legal aspects of selling drones, and the sale team itself, and 3) financial resources, as it is very costly to develop new drones, Griff needs enough financial capability to finance new developments and improvements. These resources together perform the key activities for the business, which includes the designing of new and customized drones, the manufacturing of drones, and the communication with customers who have specific requirement for their drones.
The main costs that stem out of this business model are Aviation approvals by the Civil Aviation Authorities (CAA) and European Aviation Safety Agency (EASA), the costs of designing the drone, the cost of customising the "perfect" set-up of components in line with regulations, the costs of manufacturing the drones and the salaries paid to the workforce. Figure 2 summarises the key elements of business model canvas of Griff.

[Other factors influencing business model]
Another factor that plays a role in Griff's business model is regulation. At the moment, governments have regulated the drone industry to a minimum extent. This means that there is no or very little safety regulation when it comes to manufacturing and flying drones. Griff has responded to this by designing their drones in such a way that aviation authorities would approve them if there were stricter regulations.

[48] Griff Aviation (2020), Official Website

[Implications for decision-makers from authorities / public transport]

Griff should be prepared to respond to regulation by designing their drones in a way that aviation authorities would approve them. Griff's dedication to ensure they would comply with aviation standards strongly influences the design of their products and the type of clients that they choose. This implies that a well-established regulation or at least an adaptive but concrete governance framework is necessary for such companies.

To develop disruptive innovations, these drone companies often need to identify emerging customer needs, design an innovative porotype, and optimise the manufacturing process. However, without clear regulations, it will be difficult for drone companies to develop a long-term blueprint for next 20-30 years. Therefore, the policy makers need to develop an adaptive regulation framework and provide a transparent guidance for these start-ups and others. By doing so, mobility companies will be more confident to pursue disruptive innovations, which can prosper the development of modern transportation.

<table>
<tr>
<td rowspan="2">Key Partners
• Co-contractors
• Aviation authority
• Investors (e.g. Research Council of Norway</td>
<td>Key Activities
• Designing drones
• Manufacturing drones
• Communication with customers
• Big data collection and analysis
• Customizing components to meet aviation standards</td>
<td rowspan="2">Value Proposition
• Heavy weight lifting & air transportation over short distances with
• More economical than helicopters
• Drones tailored to specific customer needs</td>
<td>Customer Relationships
• Close R&D with client
• Seller-buyer relationship</td>
<td rowspan="2">Customer Segments
• Energy infrastructure companies
• Construction companies
• Wind-farms companies
• Filming companies</td>
</tr>
<tr>
<td>Key Resources
• Physical resources: factory and R&D workshop
• Human resources: engineers, software engineers, aviation specialists, legal specialists, sales team
• Financial resources</td>
<td>Channels
• Website
• UAV conventions air-shows
• Word-of-mouth</td>
</tr>
<tr>
<td colspan="3">Cost Structure
• R&D costs
• Production cost
• Employee salaries</td>
<td colspan="2">Revenue Streams
• Selling of products and solutions</td>
</tr>
</table>

Figure 4-2: The Business Model Canvas for Griff Aviation

4.5. Impact of COVID-19 on This Innovation Category

COVID-19 might have a lasting impact on CCAM category as it is driving significant changes in the macroeconomic environment, regulatory trends and public acceptance to disruptively new mobility technologies. This pandemic is a double-edged sword for the goal of sustainability. On the one side, as the world has shifted to a more home-based living and working environment, moving goods and services without human interaction is more important than ever before. It is therefore a turning point to accelerate the transition toward CCAM, with the introduction of CAVs, UAM and drones. On the other side, it might contradict to the goal of sustainability because of the potentially increased car ownership in the future. [49]

Although COVID-19 has slowed down the R&D of CAVs, it has created new opportunities for adoption of this technology in different areas. In particular, COVID-19 has speeded up the adoption of CAVs in the B2B markets as CAV technology is a critical component in response to emergencies and uncertainty during pandemic. CAVs has the power to fundamentally change the way of supply chain and delivery services.[50] For example, the application of CAV technology can help move goods from warehouse to specific stores and deliver meals from restaurants to customers' front door without the intervention of human.

From a long-term perspective, COVID-19 has reshaped the citizens' perception of public transport, which might potentially benefit CAV technology. As the pandemic progresses around the world, the use of public transport has a steep decline due to the trends such as working from home, closed schools, and local travel restrictions. According to an Automotive survey, [51] deployment of Level 3 and upwards of autonomous vehicles will also be delayed because of COVID-19; however, the potential for CAV adoption by commercial companies (e.g., logistics, delivery and food service companies) might boost CAV technology to the next level earlier than we expected.

In addition to the impact on CAVs, COVID-19 has fostered the application of drones in three areas. First, drones were used to pick up samples from potential patients and transport relevant medical supplies to minimise the spread of infection and decrease the transportation time for goods delivery. Second, some countries (e.g., China, UAE, Spain, and South Korea) have used drones to spray public areas in order to disinfect potentially contaminated places. [52] Third, some governments (e.g., China, Spain and Italy) have used drones to monitor and guide public space during lockdown and quarantine. The video surveillance and broadcasting of voice with a drone might reduce the possibility of direct contact with potentially infected people.

Overall, CCAM systems can run all day and night and avoid the issue of driver shortages and 14-day quarantines. During the pandemic, the capability to transport goods throughout the supply chain efficiently and reliably is more important than ever before, especially in times where the demand and supply is highly uncertain. Therefore, the policy makers could leverage this opportunity to transform the transport system and accelerate the introduction of CCAM.

[49] The impact of COVID-19 on future mobility solutions
[50] The Impact of COVID-19 on Adoption of Autonomous Vehicle Technology
[51] Column: Covid-19 and the future of autonomous vehicles
[52] How Drones Can Be Used to combat COVID-19

However, it is important to avoid potential contradict with the goal of sustainable mobility in Europe.

4.6. Conclusion

This chapter discusses the key factors that influence the implementation of CCAM, market analysis, business models of Arrival and Griff and the impact of COVID-19 on disruptive mobility innovations. The results of market analysis are summarized in the following table.

Table 4-1: Market Readiness Scale

New mobility service/technology	Market readiness	Market positioning	Market maturity
Connected and automated vehicle	4-5 (between small scale stakeholder campaign and large scale early adopter campaign)	New market / re-segmentation of existing market by employing a niche strategy	Introduction / development stage
Passenger urban air mobility	5-6 (between large scale early adopter campaign and proof of traction)	New market	Introduction / development stage
Drone last mile delivery	6 (proof of traction)	New market / re-segmentation of existing market by employing a niche strategy	Growth stage

The analyses also show that the main value propositions of connected, cooperative, and automated mobility is to 1) provide a more environmentally friendly, economical, efficient and digitalized vehicles and drones, 2) develop the most advanced technologies or services to satisfy emerging and unaddressed customer needs (e.g., long-distance healthcare) and 3) integrate various functions (e.g., technical functions and entertainment functions) in order to offer an integrated solution for future competitive markets. Their customers can either be B2B, B2C or even B2G customers. Although the B2B customers are their main focus now, B2C customers might also be highly profitable in the future.

For connected, cooperative, and automated mobility, they usually deliver their value proposition by website, conferences, and international exhibitions. Developing close buyer-seller relationships is also key for them to keep their customers and improve their products and services. The revenue stream depends on different business models. Many players focus on one area of the value chain. For example, some AV technology suppliers sell their solutions to OEMs and other companies start to provide integrated solutions for their clients. This means that revenue from services outside the products will become more and more important in the future transport industry. In these cases, most of them focus on R&D activities now because they are

very young start-ups. Nevertheless, the marketing activities will gradually become a critical activity as other competitors are emerged in the markets. These firms also need to form some strong partnerships with governments, and others from different industries in order to secure their competitive advantages. Based on the interviews, a close partnership with clients is a key for them to keep developing new solutions that will address future needs.

In addition to business model canvas, the interviews also point out that legislation is an important factor that determine their product and service features, which in turn, partially determine the direction of business model innovation. To develop a long-term innovation blueprint for the next 20-30 years, new mobility companies need to follow an adaptive regulation framework or regulation guidance from policy makers. The interviewees also concluded that the collection, analysis, and transformation of big data is critical to all the elements of their business models.

Finally, CCAM might be more important than ever before during COVID-19 pandemic. It is critical to adapt business models during and after COVID-19, in consideration of other new regulations and policies.

5. INFRASTRUCTURE, NETWORK, AND TRAFFIC MANAGEMENT

European cities are currently facing congestion issues because of massive concentrations of people in urban areas and the preferences for private vehicles. Traffic management has thus a great impact on health, economy and more generally on quality of life because it is an effective way to solve congestion problem.

Traffic management plans are currently established with information provided by traditional sensing and surveillance technologies located on the road, without considering information coming from the drivers themselves through the connected vehicles or the apps they use (Waze, Google Maps, etc.). The advent of these Internet of Things allows advanced monitoring technologies, and information improvement regarding traffic conditions. Cooperation between all the stakeholders could thus improve road traffic management, leading to decreased congestion and improvements in air quality. This will lead to innovative business models, arising from these new cooperation models that are currently being built through initiatives such as TM2.0[53], an innovative platform setup in order to provide new solutions on traffic solutions. Data exchange being at the core of these new business models, it is important to point out that the regulatory framework will be key to prevent from data privacy and security issues.

In addition, disruptive mobility solutions that require new infrastructure are currently being developed, such as ultrafast trains or urban air transport[54]. These low polluting mobility solutions can revolutionize our transportation system. For example, the ultrafast trains, with a velocity up to 700 km/h, could replace planes for medium-range distance. We can also imagine that this will revolutionize commuting in a way that people can live much further from their office, thus limiting the concentration of population and related congestion issues that cities and suburban areas are currently facing.

Policy makers are addressing congestion issues through different ways: the improvement of traffic management with real-time data (see case study 2), the incentivization of alternative and sustainable mobility solutions through the use of disruptive transport (see case study 1).

COVID-19 has also a significant impact, as real-time road traffic management data were used to define new policies related to the new transportation behaviours. Pilot projects were also interrupted, slowing down the development and deployment of new business models related to collaborative road traffic management.

5.1. Big Data for Fleet Management and Logistics

[53] See Deliverable D1.1 « Review of new technologies and services"

[54] Supraways (2019), Official Website.

5.1.1. Technological, social, operational and business factors

Technological
The rapidly changing customer demands and preferences are creating new demand patterns for the commercial freight transportation and logistics industry. Fleet operators can have major gains from advanced analysis of the data collected from the vehicles in their fleet, such as location, mileage, fuel consumption, driving behaviours, in order to improve fleet management but also to eradicate vehicle misuse by drivers. On the other hand, the major obstacles are the large amounts of data generated (processing terabytes of data can lead to some issues such as calculation time, storage, etc.), and the various formats in which they are provided.[55]
Social and behavioural
When it comes to behavioural aspects, big data provides fleet managers with the capability to better understand the behaviour patterns of drivers thanks to sensors installed in fleet vehicles which provide data on how drivers typically use their vehicles. This allows them to identify unsafe behaviour, such as speeding or accelerating aggressively.
Operational
The use of big data allows fleet managers to optimise their fleet's efficiency, productivity, and safety while reducing costs for the company. The use of predictive analytics enhances working conditions for drivers, as well as maintenance and repair scheduling for fleets, leading to a reduction in overall costs and avoiding expensive repairs later on. It also allows fleet managers to monitor the total fuel costs as well as how fuel is being used, therefore allowing them to make improvements to increase efficiency of fuel consumption.[56] From the point of view of national authorities, data access and data use is also very useful to improve efficiency of operations in order to enhance road safety and help enforcement authorities to fight against frauds and abuses.
Business
The big data extracted from trucks not only allows the OEMs to cut their costs (due to trajectory optimization, logistics sharing between several entities, parking, etc.) with improved quality and efficiency of the logistics, but this also helps fleet customers generate more revenue by enabling them to understand how their vehicles are being used, and reduce their operational costs based on these insights. In addition, this real-time information allows the customers to get more information on the delivery, reinsuring them regarding delays, and quality of the delivery (status of sensitive products).[57]

5.1.2. Market Analysis

Market readiness

[55] Artificial Intelligence and Automotive Fleet Security
[56] Big Data and the New Fleet Management
[57] 5 Examples of How Big Data in Logistics Can Transform The Supply Chain

Fleet management and e-commerce companies as well as other businesses have been investing into collecting and using big data to gain insight into their businesses and their customers, in order to optimise their processes and customer experience. Some solutions have been developed and exist at the "Traction" market readiness level. One example is LUCA fleet[58], developed by the big data unit of Spanish multinational Telefonica. The solution aggregates and analyses fleet's data based on frequent routes, fuel consumption, driving behaviour, POIs (points of interest) or maintenance and allows client autonomy to use, consult and interpret the data. Another example is TMT Predict developed by a US-based company Trimable, which is a predictive maintenance application that enables fleet professionals to anticipate and address potential vehicle breakdowns and other unscheduled service needs before they occur. However, logistics has been a bit slower to take advantage of the full potential of big data. According to Supply Chain Management World research, 64 percent of executives think that big data and the insights it brings will have a major disrupting power. There is an increasing need from the customers for real-time updates on product availability, manufacturing details, delivery dates, etc. In this sense, big data analytics help trace changes in customer behaviour and foresee their manufacturing preferences. This enables companies to expand their operation, simplify distribution, prevent risks, achieve faster shipments, etc. Powered by AI algorithms, logistics companies are able to get more insights into products, freight shipment methods, shipment locations, and more.[59]
Market positioning
Amazon, the e-commerce giant, has been investing in pioneering technologies disrupting the retailing and online retailing, including the use of big data in their fleet management operations. With using big data for an improved customer service and offering remote computing services via their Amazon Web Services, Amazon has moved away from a pure e-commerce player to a major big data company. A Chinese multinational e-commerce company Alibaba has also been focusing on big data to expand market growth and build logistics networks to reach even remote rural areas. It has been reported that Alibaba plans to handle 1 billion parcels per day and do 24-hour delivery across China and 72-hour delivery internationally, due to the correct big data usage. UPS offers an illustration in terms of route optimisation through the use of big data. One of their initiatives helps them to optimise its logistics network through the effective use of data, by using real-time data, advanced analytics and artificial intelligence to help employees make better decisions. They have been investing in ORION (On-road Integrated Optimization and Navigation), a fleet management system which uses telematics and advanced algorithms to create optimal routes for delivery drivers.
Market maturity
When it comes to the use of big data in logistics, there is a huge untapped potential for improving operational efficiency and customer experience (fleet managers, freight forwarder etc.) and creating useful new business models. One example is integration of supply chain data

[58] IoT and Big Data to optimize resources

[59] What is the impact of big data in logistics and supply chain management

streams from multiple logistics providers which could eliminate current market fragmentation and powerful new collaboration and services.[60]

5.2. Cooperative Road Traffic Management

5.2.1. Technological, social, operational and business factors

Technological
Traffic management 2.0 (TM2.0) is an innovative platform that was created in 2014 by ERTICO, an organization aiming at promoting and accelerating Intelligent Transport Systems in Europe. The objective of this platform is to create a Collaborative and Interactive Traffic Management System, by developing synergies between the public authorities, the private service providers and the drivers. "The TM 2.0 concept is based on the: • Provision of individual communication channels between TMCs (Traffic Management Centers) and road users/service providers; • Development of a new interface for data exchange between TMC's and service providers, necessary for individual and collective traffic information and signage; • Cooperation and information exchange with other transport modalities; • Development of (new) business cases with benefit to all stakeholders"[61]. Since the 1960s, many initiatives have been setup in order to deal with traffic management (TM)[62], from the first guidance highway programmes in the beginning of the 1970s which led to the first Traffic Management Centers to the current innovations brought by the development of Intelligent Transport Systems (ITS) due to the digitization of market sectors. Nowadays, mobile applications such as Waze, Google Maps, etc. provide alternative route guidance relying on drivers' data, while public authorities deliver traffic management plans and inform drivers according to data collected from sensors that are installed on the road: • Sensing and surveillance technologies63 used to assess the number of vehicles at a given time and place and the speeds of the vehicles: video vehicle detection, inductive loop sensors to count vehicles, magnetic sensors, laser sensors, ultrasonic sensors microwave radars and automated vehicle identification systems. • Communication technologies used to transfer data[64,65]: GNSS (Global Navigation Satellite Systems), with GPS and GALILEO (Europe) completed by the European

[60] Transforming Logistics Using Big Data
[61] Contractual Agreements in Interactive Traffic Management – looking for the optimal cooperation of stakeholders within the TM 2.0 concept, Tiffany Vlemmings & al., Paper number ITS-TP0785
[62] PANORAMA 2018
[63] A Review of Sensing Techniques for Real-time Traffic Surveillance, D. D. Romero & al., Journal of Applied Sciences 11(1)
[64] Information Technology Services for traffic control and visualisation
[65] PIARC

Geostationary Navigation Overlay Service (EGNOS), roadside variable message signs, websites, social media, Global System for Mobile communication (GSM), etc.

- Information technologies, data processing and analysis
- Traffic control: fixed-time control systems, systems with feedbacks, adaptive traffic control system (SCOOT, SCATS, RHODES)[66]; systems with feedback; adaptive traffic control systems: SCOOT (Split, Cycle, Offset, Optimisation Technique), SCATS (Sydney Coordinated Adaptive Traffic Systems), RHODES, aiming at managing the traffic signal timing changes, relying on the gathered data on intersections; public transport authority measure, giving priority to public transport vehicles at the intersections; travel time assessment; traffic signal control; ramp metering; variable speed limits; and queue tail warnings.

The enablers and barriers can be summarized as follow:

Enablers:

- Many sensors and devices available
- New communication channels (V2V, V2I)
- Important subsidies from Europe (H2020 programmes for instance)

Barriers:

- Lack of data interoperability
- Data security and reliability
- Data reliability
- Lack of cooperation between public and private parties

Social and behavioural
London was the 6th most congested city in the world in 2018, with 178 hours spent in traffic jams by UK drivers, representing a cost of $7.9 billion, according to INRIX Global Traffic Scorecard study[67]. This example highlights that traffic management has a direct impact on citizens' quality of life (fatigue, stress, irritability, accident risk increase) and consequently cities' attractivity and economy. Real-time information and coordinated traffic management strategies are thus required to improve road traffic flows that will address these issues. This is the objective that is targeted to be achieved by TM2.0. More reliable data will allow better guidance, thus leading to the reduction of congestion and sustainable behaviour change.
Operational
This cooperation model is very innovative in the way that no private-public partnership was set up regarding road traffic management before. It is also very challenging from a technical point of view, as larger amount of data will be processed.
Business
Cooperation models aim at defining the best win-win partnership between private and public stakeholders. Private service providers can resell data to public authorities and other services related to data processing and visualization.

[66] SCOOT= Split, Cycle, Offset, Optimisation Technique; SCAT= Sydney Coordinated Adaptive Traffic Systems

[67] Congestion Costs U.K. Nearly £8 Billion in 2018

5.2.2. Market Analysis

Market readiness
• This cooperation model is being tested in 4 cities in order to be ready for the market, thus the marketing readiness level is at 4. • Main barriers regarding market readiness are economic: businesses must remain profitable, while keeping public interests. • Data privacy is a public concern, data sharing is the main social issue. • Lack of trust on traffic flow data coming from third party sources for TMCs. • However, addressing congestion issues that significantly degrade air quality, citizens' health is a main current challenge that incentivises initiatives such as TM2.0.
Market positioning
• Competition will happen for service providers when they answer to public authorities' calls for tenders regarding the choice of partners when local pilots that will be implemented. But TM2.0 is an initiative for cooperation models and not a new service provider. • The main players in the market are public authorities, vehicle manufacturers, data providers (such as navigation apps -Waze, Google Maps, etc.- and sensor providers – Swarco, Leddar Tech, etc.), and data scientists (real-time traffic analysis provided by players such as GERTRUDE68, Kapsch, etc.). • Public authorities are the main customers for road traffic data. • This initiative will allow better reliance of data that are processed, thus leading to a better knowledge, real-time traffic guidance, which are competitive advantages compared to current situation. • Market positioning will rely on the success of TM2.0 pilots.
Market maturity
• Regarding the market lifecycle, TM2.0 is at an early stage: I-Introduction/Development. • The pilots that will be implemented will allow the first feedback from customers (public authorities, traffic management centres) and from the public who will take directly benefits from this cooperation. • This cooperation model will lead to a re-segmentation of the market, as data coming from guidance service providers (e.g. Waze, Google Maps, etc.) could be sold to public authorities, as well as usual service providers who are focused only on traffic assessment (e.g. Here), in order to provide better guidance. New business models have to be formulated and tested in order to find the most appropriate strategy for this re-segmentation.

5.3. Hyperloop

[68] Intelligent Transport Service

5.3.1. Technological, social, operational and business factors

Technological
A Hyperloop can be defined as an ultra-high-speed ground transportation system. It was proposed in 2013 by Elon Musk, cofounder of PayPal, Tesla Motors and founder of the space transport company SpaceX[69]. Hyperloop is a new means of ground transportation that is meant to carry passengers and cargo at speeds over 1000 km/h inside low-pressure tubes[70]. According to a report published by Elon Musk in 2013[71], Hyperloop consists of a low-pressure tube with capsules that are transported at both low and high speeds throughout the length of the tube. The capsules are supported on a cushion of air, featuring pressurized air and aerodynamic lift. The capsules are accelerated via a magnetic linear accelerator affixed at various stations on the low-pressure tube with rotors contained in each capsule. Passengers may enter and exit Hyperloop at stations located either at the ends of the tube, or branches along the tube length. Still according to the same report, the Hyperloop consists of several distinct components, including: • The capsules are separated within the tube by approximately 37 km on average during operation and are supported via air bearings that operate using a compressed air reservoir and aerodynamic lift. • The tube is made of steel. Two tubes will be welded together in a side-by-side configuration to allow the capsules to travel in both directions. Pylons are placed every 30 metres to support the tube. Solar arrays will cover the top of the tubes in order to provide power to the system. • The propulsion. Linear accelerators are constructed along the length of the tube at various locations to accelerate the capsules. Rotors are located on the capsules to transfer momentum to the capsules via the linear accelerators. Right now, there are 6 companies in the world working on the technology of the Hyperloop including for example: Hyperloop Transportation Technologies (HTT), Virgin Hyperloop one[72], TransPod[73], Zeleros. State of art of technology of the Hyperloop is different per company and thus per country. Currently there are test tracks existing in the world. One test track was built by the American company Virgin loop one in the Nevada desert, and it is 500 meters long. So far, the highest speed recorded on this test rack is 240mph. A first travel with passengers has just been carried out[74]. Another test track is also ready in Toulouse (south of France), built by Hyperloop TT[75]. Barriers: resolving continuing technical challenges (e.g. continuous straight line), developing a viable commercial model, and satisfying regulatory, safety and other stakeholder requirements[76]. Enablers: Hyperloop is meant to be a cheap, green, safe and self-sufficient transportation mean. Hyperloops attracts investors.

[69] Hyperloop
[70] Zeleros
[71] Gearbrain
[72] Virgin Hyperlop
[73] Transpod
[74] Virgin Hyperloop pod transport tests first passenger journey
[75] Toulouse : la piste d'essai de l'Hyperloop est prête
[76] Hyperloop: Coming Soon to a Station Near You?

Social and behavioural
A growing global economy requires faster, cheaper, safer and more efficient transportation modes. Roads, airports, and ports are congested. Hyperloop is meant to be ultra-fast, on-demand, direct, emission-free, energy efficient, quiet and has a smaller footprint than other high-speed transport modes. Hyperloop aim at changing our perception of distances and therefore to lead to less density in cities as current suburbs or suburban area would become more attractive living spaces. The goal of Hyperloop is to solve the housing crisis happening in many big cities in the world. The impact of Hyperloop is expected to be more important for people leaving in large cities. The development of Hyperloop also risks to potentially increase inequalities between urban and rural areas.[77] But considering the level of development of the Hyperloop technology it is still difficult to evaluate precisely the social and behavioural impact of Hyperloop. Hyperloop technology also presents critical features[78] which could generate a negative perception among potential commuters. One is that Hyperloop is vulnerable to not even elaborated terroristic attacks, since a single hole in the tube would be sufficient to be fatal for all passengers. Another issue is related to passenger comfort: Hyperloop, as planes, requires initial and uncomfortable acceleration, but the latter requires more time than for planes.
Operational
The Hyperloop's speed makes it innovative. It is meant to be as fast as a plane and faster than any high-speed train but it would be a means of ground transportation. When Elon Musk conceived of the Hyperloop high-speed transport system in 2013, he estimated that a route from Los Angeles to the San Francisco Bay Area would cost about $6 billion, or $11.5 million per mile.[79] In 2016 the estimated cost for Hyperloop One estimating the cost of a potential 107-mile Bay Area project to be somewhere between $9 billion and $13 billion, or $84 million to $121 million per mile. The route between Abu Dhabi and Dubai, which the company recently announced ahead of a new $50 million round of funding, would cost $4.8 billion, or $52 million a mile.
Business
The development of the infrastructure is likely to receive financial support from taxes like any other public transport infrastructure - and the price of tickets will support operating costs. So far, the price of a one-way ticket is estimated at around $20. It is meant to work exactly like a metro line. This technology is at the early stage of development, but other business models were also mentioned, such as focusing revenues on additional services[80] rather than on ticket price (even free for off-peak times![81]), which can be kept low due to low maintenance cost expected. Efforts have still to be pursued on this topic to define an economically sustainable business model.

[77] Societal Impact of the Hyperloop
[78] Is Hyperloop Overhyped And Underlooped?
[79] The Hyperloop will take a lot more money to build than Elon Musk anticipated
[80] Le business model Hyperloop décortiqué en Business Design
[81] Want to travel at the speed of sound? It's happening

5.3.2. Market Analysis

Market readiness
Hyperloop is not ready for the market. The main technological barriers are interoperability, speed and safety. Also, whereas railway infrastructure is mostly implemented by states, it is doubtfully whether it would be the same for hyperloop tubes. From an operational perspective, the barrier is the lack of testing possibilities. In this regard, moreover, a report of U.S.A. Department of Transportation states that uncertainty characterises both the infrastructure and the cost to construct it.[82] The main enabler for market readiness regarding Hyperloop is the fact that Hyperloop attracts investors.
Market positioning
Hyperloop is kind of alone in its segment. The only potential competition is with plane and high-speed trains. The main player in the market is the Virgin Hyperloop One company.[83] The main customers targeted by Hyperloop are people living in big cities or suburbs and people who are frequent travellers for work. The main competitive advantage promised by the Hyperloop is the price: it is meant to be way cheaper than planes and high-speed trains. It is still a bit early to discuss a potential scale up, but a cross border Hyperloop could potentially be foreseen to replace travels currently performed by short or medium-haul aircrafts.
Market maturity
Hyperloop is still at the introduction phase. The level of research is very high considering, as previously mentioned, the fact that several companies national and private are working on this project. There is no consumer testing yet as Hyperloop only has a very short test track so far.

5.4. Selected Business Model Cases in the Infrastructure, Network and Traffic Management category

5.4.1. Case 1: Zeleros

[Case background]

Zeleros, a Spanish start-up funded in 2016, develops hyperloop transport technology covering 400-1,500 km distance, with a unique approach based on cost-efficiency provided by the high scalability of the system and the reduction of infrastructure complexity through the introduction of the core technological bricks onboard. Zeleros hyperloop-inspired transport system relies on innovative levitation system and aerodynamic propulsion. The company recently completed a € 7 Million euros financing round, with the support of companies such as Altran, Grupo Red Eléctrica[84], to accelerate the development of this technology, demonstrating its potential on a 3-km test track. The company has also recently been awarded with the 2019 EIT Public Award,

[82] Technology today : volume 31 issue 3, Spring 2017
[83] Virgin Hyperlop
[84] Spain's Zeleros raises 7M€ in financing to lead the development of hyperloop in Europe

supported by EIT Climate KIC[85]. Zeleros is also involved regarding the standardization and the definition of a regulatory framework of this technology at the EU level, having the ambition to set up the first European hyperloop centre.

[Business model explained]
Zeleros is positioning itself as a transport manufacturer and supplier, selling the disruptive technology to railway operators (B2B) for the deployment of hyperloop mode of transportation. Electric freight forwarders and building constructors (elevators for skyscrapers) were also identified as customers:

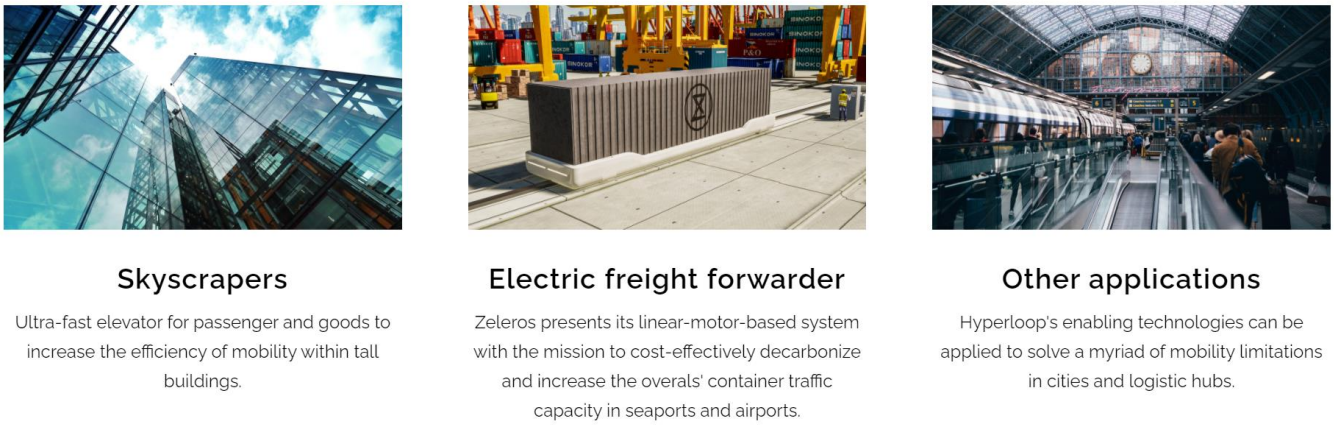


Figure 5-1: Zeleros targeted markets

[Other factors influencing business model]
There are also several factors that are important for the business model but are not reflected in the canvas:

- **Financing:**

Traction systems [86] and automated train operation technologies [87] developed in order to implement high-speed trains is part of the targeted achievements highlighted in the European Shift2Rail funding program.
The private sector has also a significant role regarding the financing, as reflected by the recent financing round achieved by Zeleros.

- **Policy and social acceptancy:**

The regulatory framework is a key point regarding the deployment of Zeleros hyperloop. As the ultrafast shuttle is very disruptive, a policy framework must be setup in order to standardize this mode of transportation which is at the interface between rail and air transport. This regulatory framework is key to ensure the safe deployment of the technology and increase public acceptance and trusts as regards to this ultrafast mode of transportation.

[85] Zeleros is designing new technologies for a more sustainable and efficient transportation of people and cargo worldwide
[86] Shift2Rail (2019), Innovation Programme 1
[87] Shift2Rail (2019), Innovation Programme 2

Recent initiatives were carried out in order to design this regulatory framework:
In February 2020, a joint initiative between hyperloop start-ups (Zeleros, Hyper Poland, TransPod, Hardt Hyperloop) has been created to design a regulatory framework at the EU level in order to ensure safety and interoperability of the transportation system[88].

- In July 2020, Tüv Süd published some guidelines to ensure safe deployment of this technology.[89]
- In USA, the hyperloop was recently recognized in the US Code of Transportation.

[Implications for decision-makers from authorities / public transport]
Public-private partnership is key in order to standardize the Hyperloop system, as mentioned before. Also, it is very important to point out that local authorities play an important role regarding the deployment of this solution, as they provide support for test tracks as a first step, such the Generalitat Valencia (regional Spanish authority) and Sagunt city hall that allow Zeleros to test hyperloop on a 2km track in Parc Sagunt; and they will be further involved for the large deployment of Hyperloop transportation system. In addition, public-private partnerships will facilitate professional training, as new jobs will be issued from the development of this technology.

[88] European Countries Agree to Establish Common Standards for Hyperloop Systems
[89] Hyperloop Transportation Technologies and TÜV SÜD Announce Publication of Industry First Complete Safety Guidelines

<table>
<tr>
<td rowspan="2">Key Partners
• Private investors
• Regional authorities, as well as international ones (EU level)
• Public funding programmes: EIT Climate KIC
• Universities: Universitat Politècnica de València, Institut Tecnològic de l'Energia, Centre d'Investigacions Energètiques, Mediambientals i Tecnològiques
• Private companies for technological collaboration, such as Siemens[90]
• Clusters & Associations: Asociación Valenciana de Startups, others, MAFEX, Railway Innovation Hub,</td>
<td>Key Activities
• Design and development of levitation system and electric aerodynamic propulsion system
• Training (Development of an Hyperloop centre)
• Design of a regulatory framework</td>
<td rowspan="2">Value Proposition
• Cost and energy-efficient, scalable and safe hyperloop-inspired transport system, combining aviation, railway and Maglev technologies
• Modular electromagnetic units on board
• Controlled tube environment that minimizes cost infrastructure
• Efficient linear motor
• Electrically powered</td>
<td>Customer Relationships
• Buyer-seller relationships
• Maintenance services</td>
<td rowspan="2">Customer Segments
• Rail operators
• Electric freight-forwarders
• Building constructors</td>
</tr>
<tr>
<td>Key Resources
• Infrastructure resources: Valencian test-track that will be set-up.
• Human resources: 50 people from leading aerospace, railway, and space sectors, business experts[91].
• Financial resources from private sector, public subventions</td>
<td>Channels
• Online Channels
• Tradeshows
• Conferences</td>
</tr>
</table>

[90] The German multinational joins forces with the Spanish startup to lead the future of the hyperloop
[91] Zeleros Hyperloop - Expanding the Limits

Plataforma Tecnológica Ferroviaria Española, etc. • Railways operators • Infrastructure stakeholders				
Cost Structure • Infrastructure development/maintenance cost • Employee salaries • Marketing and advertising fees • IPR costs			*Revenue Streams* • Selling products and services to customer segments • Private investment and public funding	

Figure 5-2: The Business Model Canvas for Zeleros

5.4.2. Case 2: Data-driven business model for real-time traffic management: Otonomo

[Case background]

Founded in 2015, the Israeli company Otonomo offers a cloud-based data exchange platform, gathering and reshaping car data, in order to create a connected car ecosystem, that will allow the development of new services relying on the use of these data, such as:

- Traffic management: incorporation of car data on existing traffic management systems
- Emergency warning (hazard information)
- Parking: open space detection, automated payments, etc.
- Predictive maintenance,
- Fleet management,
- Mapping and planning (navigation: route optimization and updated traffic information, including EV charging infrastructure notification),
- Insurance, supporting business models such as "Pay-as-you-drive"
- "Concierge" service to support drivers: roadside assistance, real-time hazard notifications, "car-as-a-wallet", in-car package delivery[92]

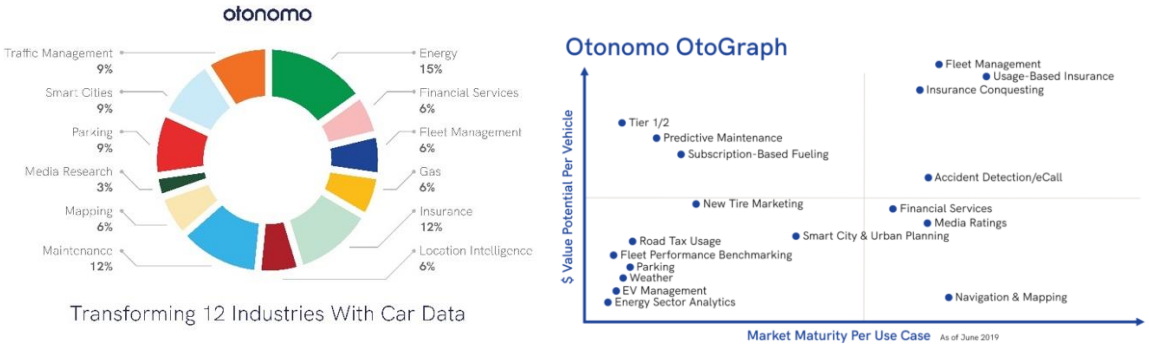


Figure 5-3: Development of new services with the creation of connected car ecosystem.

Source: https://otonomo.io/press-releases/otonomo-collaborates-with-12-industries-to-transform-their-business-with-car-data/

How it works?

As mentioned before, Otonomo collects and reshapes the data coming from the car, packaging them according to the considered service, within the process described in the chart hereafter.

Today more than 4 billion of data points are processed over 70 countries[93]. Otonomo's innovative pillars, besides the disruptive business model, rely on patented platform anonymization technologies, in compliance with GDPR Regulation and data protection regulations from other countries, developing a:

- "Consent Management Hub" to grant or refuse access data according to the considered service,
- A "Otonomo Data Blurring Engine", for data aggregation.

[92] Taking Car Data to New Places

[93] Otonomo's new self-serve platform and API deliver quick and secure access to aggregated car data

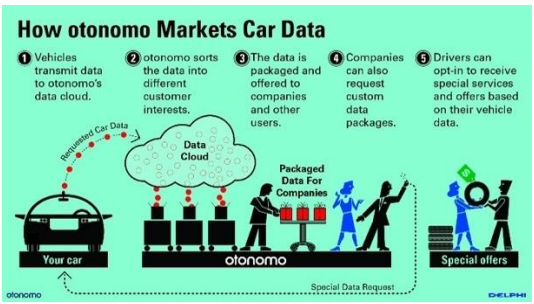


Figure 5-4: Otonomo : Car Data business model.

Source: https://www.futurecar.com/1057/Startup-Otonomo-Aims-to-Monetize-Connected-Car-Data

Added value

Otonomo's service brings value to drivers, OEMs, data service providers and local authorities, as summed up in the chart hereafter:

Figure 5-5: Otonomo's added value for the ecosystem stakeholders.

Source: https://otonomo.io/wp-content/uploads/2019/07/Otonomo-at-a-Glance.pdf

[Business model explained]

Otonomo positions itself as a "Neutral server platform provider", as defined through the ACEA (European Automotive Manufacturer Association) position paper[94], collecting and processing data from vehicle manufacturers' servers, that are solved to companies that develop new services related to car data.

[Other factors influencing business model]

Otonomo's business model relies on the car ecosystem network.

- As Otonomo is a neutral server platform provider, B2B agreements with car manufacturers are mandatory in order to get access to vehicle data.
- Otonomo's offer aims also at creating the generation of revenue streams for the drivers, thus developing another type of car data-based business models, incentivising car data sharing which is at the core of Otonomo's.

[Implications for decision-makers from authorities / public transport]

The regulatory framework plays a significant role, as Otonomo gathers and processes geolocation data. Data privacy and security is covered both at the EU and national level.

[94] Access to vehicle data for third-party services

<table>
<tr>
<td rowspan="2">Key Partners
• Private investors: Bessemer venture partners, MANIV mobility, etc.
• OEMs
• Car manufacturers (Mercedes Benz, BMW)
• Drivers
• EV Infrastructure providers</td>
<td>Key Activities
• Secure Car data collection and processing
• R&D</td>
<td rowspan="2">Value Proposition
Marketplace for vehicle-generated data
• Secured car data management
• Data privacy at the core of Otonomo’s innovations
• Data filtering and aggregation
• Data interoperability
• Support to the development of car data-based services and business models</td>
<td>Customer Relationships
• B2B agreements
• Buyer-seller relationships</td>
<td rowspan="2">Customer Segments
• Car manufacturers
• Traffic management consulting companies (e.g. PTV Group)
• Insurances
• Local authorities
• Parking service providers
• Fleet management service providers
• Retailers</td>
</tr>
<tr>
<td>Key Resources
• R&D centre in Israel, antenna in USA and Germany,
• Business team
• Data scientists, architects, back-end and front-end developers
• Patented anonymisation technologies</td>
<td>Channels
• Online channels
• Tradeshows
• Conferences</td>
</tr>
<tr>
<td colspan="2">Cost Structure
• Software development
• Human resources
• Marketing and advertising fees
• IPR costs
• Servers</td>
<td colspan="3">Revenue Streams
• Pay-as-you- access payments (60$ per 1M points or 60$ per 20k Trips). This does not include all the services
• “Custom plans” personalized according to the use case</td>
</tr>
</table>

Figure 5-6: The Business Model Canvas for Otonomo

5.5. Impact of COVID-19 on This Innovation Category

Big Data was used to analyse the impact on COVID-19 on mobility, supporting decision-making process for long-term policy. Traffic patterns were studied, as well as travel demands and driving behaviours were analysed[95,96].

As described in D2.5, policy measures were implemented to incentivize active modes, such as walking or cycling, changing the urban mobility landscape, thus impacting road traffic management.

It is also to point out that experimentation projects were interrupted, slowing down the deployment of collaborative road traffic management, such as SOCRATES 2.0 initiative[97]. Indeed, traffic monitoring during the lockdown period was considered as irrelevant to assess the impact of the collaborative tool.

5.6. Conclusion

The Network, Infrastructure and Traffic Management mobility category studied in the framework of the GECKO project encompasses three aspects:

- Big Data for fleet management and logistics: the emergence and rapid growth of Big Data analysis allow logisticians and freight forwarder to improve delivery traceability, optimize the fleet management (route and parking optimization, predictive maintenance of the vehicle, etc.) to improve logistics productivity, which is even more crucial during COVID-19 crisis. Connected deliveries and carrier vehicles allow the emergence of new business models, such as the uberization of logistics (shared fleet for different entities).
- Cooperative road traffic management: Road traffic management is operated separately by the traffic management centres and the current apps used by the drivers (Waze, Google Maps, etc.). Route optimizations and drivers' warning are sent by different authorities, with their own data collected, without any exchange within stakeholders. At a time when problems related to traffic jams and driver safety need to be solved, the exchange of data and the development of cooperation models thus appears very important to revolutionise traffic management in order to make mobility more sustainable and safer. Traffic Management 2.0, followed by the SOCRATES 2.0 project appears as a pioneer on this topic.
- Hyperloop: This disruptive mode of transportation is one of the new transport infrastructures revolutionizing the mobility landscape, by bringing a solution that is the compromise between plane and train, able to achieve fast medium and long-range distances in an environmentally (electrically powered) and economically (low infrastructure cost) sustainable way, thus being a high competitor to planes and ultrafast

[95] Z. Cui & al., « Traffic performance score for measuring the impact of Covid-19 on Urban mobility",
[96] COVID-19 transport data: methodology note
[97] SOCRATES project and the Corona virus

trains. Business models still need to be further defined, as well as the regulatory framework through the definition of international standards, interoperable with private companies developing this mode of transportation.

The results of market analysis are summarized in the following table.

Table 5-1: Summary of Market Analysis

New mobility service/technology	Market readiness	Market positioning	Market maturity
Big data for fleet management and logistics	6 - Proof of traction (paying customers)	New market (introduction of big data in logistics not available before)	Growth (multiplication of service offers)
Traffic management 2.0	4 - Small scale stakeholder campaign	Re-segmentation of existing market by employing a niche strategy	Introduction/Development stage
Hyperloop	3 - Needs validation	New market (introduction of a new mode of transport)	Introduction/Development stage

The case studies that were performed highlighted two ways of improving traffic management and fostering sustainable mobility solutions: the use of disruptive transport and the taxation of private car owners.

- Case study 1: Zeleros

Regarding disruptive transport, the ultrafast Hyperloop technology is a disruptive transport mode that could completely change commuting and incentivize the use of sustainable mobility solutions for medium-range travel distances (travel between two border countries for example). Zeleros presents competitive advantages allowing the reduction of infrastructure costs thanks to an innovative design, relying on expertise on innovative levitation system and aerodynamic propulsion. The sale of these innovative components will provide first revenue streams (elevator for skyscrapers, electric freight forwarders).

The deployment of this kind of technology was supported by high investment, in particular from the private sector. In addition, Zeleros is involved in the definition of the European regulatory framework with other Hyperloop providers to define standards and ensure operational safety, as well as professional training (construction of Hyperloop centre) required by the new jobs that will be created through large-scale deployment.

- Case study 2: Otonomo

Real-time traffic data monitoring leads to the emergence of disruptive business models, such as Otonomo's, offering a marketplace for vehicle-generated data. Otonomo positions itself as a third-party data provider, collecting and packaging data collecting from vehicle, to support new business models stemming from real-time road traffic data (smart parking management, predictive maintenance, real-time traffic management, fleet management, "pay-as-you-drive" insurance model, drivers can also generate revenue by offering their vehicle data, etc.).

Data security, privacy, and interoperability (making data exploitable for the various end-users), are at the core of Otonomo's innovations, ensuring public acceptancy which is required to develop the car ecosystem network.

6. MAAS AND PLATFORMS

MaaS is a mobility management and distribution platform that connects multiple private and public mobility providers' offerings to end-users. By integrating mobility-supportive and other localized services across cities and states – based on dynamic databases – MaaS is expected to significantly disrupt the current transport ecosystem, making transportation more efficient, equitable, and environmentally responsible. This complex socio-technological phenomenon creates challenges across regulatory fields spanning from the delineation of property rights and data governance to urban planning and competition.

6.1. MaaS

6.1.1. Technological, social, operational and business factors

Technological
MaaS is a new concept aiming to provide consumers with flexible, efficient, user-oriented and ecological mobility services covering multiple modes of transport on a one-stop-shop principle. MaaS could offer multimodal route planners and different services under one fare and on the same ticket.[98] As an intermediate between mobility service providers and users, MaaS operator uses the data that each MSP offers, buys capacity from the MSPs in order to propose the ideal combination of transport modes to answer user's need within the possibilities offered by the network in real time. MaaS can involve the integration of ticketing, integration of payment, ICT support and it can rely on different payment methods such as monthly package subscription and pay-as-you-go. However, integration is often only partial. Wireless networks, especially, provide a key enabling technology fulfilling the physical requirements. For instance, the evolvement of 5G and 4G/3G mobile network technologies together with the integration and expansion of local wireless communication networks pave the way towards a seamless access environment to MaaS systems. The MaaS idea is built on information and communication technology and to the machines' capability to handle a huge mass of data in real time. In this way, the Internet of Things represents an essential starting point for the raising of a new and smart mobility ecosystem. Following this line of reasoning, MaaS encompasses public transport system as well as all the sharing and automated transportation services that are rising all over the world.
Social and behavioural
As one of its main features would be to meet customized needs, MaaS could significantly improve traffic network efficiency by changing ridership habits, allowing to tap into underutilized mobility capacities and thus solve the problem of waiting. It is expected that

[98] About MaaS concept and MAASiFiE project

data-driven capacity will synergize well with the forthcoming self-driving to provide additional reduction of CO2 emissions[99].

MaaS effectively compares the available transport options and prioritizes the least costly combination that fits the user's preferences. The effect of minimizing the overall transportation costs presumably raises transport efficiency and helps ensure citizens' mobility more equitably. Beyond cost minimization, MaaS could contribute significantly to achieving goals in sustainable urban planning. Indeed, including public authorities in MaaS can connect package prices to road maintenance costs.[100] It could also lead to integrated and data-driven decision-making on parking fees, congestion charging, limitations of city-center accessibility for different transport modes, and bus/bicycle route planning.[101]

The future of MaaS is still not decided, and numerous opportunities are being considered. First, the spatial limits of MaaS do not have to be those of a specific city – technology allows further scaling up. MaaS could not only bridge the gap across MSPs in the same city but also across different cities, which may initiate the idea of roaming in the transport sector. Furthermore, MaaS providers could cover the travel needs of their customers not only in a specific area but anywhere around the world where they operate. From this perspective, a proper development of interoperable MaaS systems could imply a kind of globalization of the services at stake[102]. From cooperation between MaaS operators would stem urban transport standardization across the globe. Every single user could theoretically find the same services in different cities feeling more confident and capable to understand how trips work in a certain city. This could imply new sovereignty issues due to the fact that the transport sector – which during the last decades has been strongly rooted to a certain territory – has now the possibility to rapidly shift to a complete digitalization and centralization of the services[103].

Secondly, technology in the basis of MaaS enables further integration so that mobility supportive service providers (such as fuel providers, parking or highway operators), and entertainment services providers (such as Wi-Fi providers or movies and games providers) could become part of the MaaS systems. Finally, the data gathered through MaaS could become a valuable resource beyond the use of direct customers. Between the multiple modes, trips, and payments, data is gathered and used to help people's journeys become more and more

[99] See European Commission, Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions – Sustainable and Smart Mobility Strategy – putting European transport on track for the future, COM (2020) 789 final, 9.12.2020

[100] These can be based on time of day, geography and modal efficiency. See Wong, Y. Z., and Hensher, D. A. (2018). The Thredbo story: A journey of competition and ownership in land passenger transport. Research in Transportation Economics, 69, 9-22

[101] See Sheller, M. (2012). The emergence of new cultures of mobility: stability, openings and prospects. In: Geels, F.W., Kemp, R., Dudley, G., Lyons, G. (Eds.), Automobility in Transition? A Socio-Technical Analysis of Sustainable Transport. Routledge, New York and Holmberg, P. E., Collado, M., Sarasini, S., and Williander, M. (2016). Mobility as a Service-MaaS: Describing the framework. Viktoria Swedish ICT

[102] Kamargianni, M., and Goulding, R. (2018). The Mobility as a Service Maturity Index: Preparing the Cities for the Mobility as a Service Era. In Transport Research Arena (Vol. 7). Zenodo.

[103] Gueham, Farid. "Digital Sovereignty-Steps Towards a New System of Internet Governance." Paris: Fondapol (2017).

efficient – it could also help decision-makers make more effective improvements in terms of infrastructure and governance of transport in general.
Operational
For the operational feasibility viewpoint, parties involved in transport and mobility service provision are expected to be influenced by MaaS development. From the supply side, different service suppliers (e.g. public transport, rail, bike sharing, car sharing, carpooling, taxi, etc.) have the potential to join MaaS and leverage this new platform to create more business opportunities. Moreover, existing ride sharing ICT-based platforms which operate in a city/region might benefit from operating in a MaaS ecosystem, by enjoying a larger potential market. From the demand side, MaaS offering should enable users/customers to enjoy savings in travel expenses and journey time, enhancing transport's accessibility, encouraging sustainable modes, etc.
Business
For businesses, MaaS development means generating new business by profitable markets for new transport services, renewing opportunities for the traditional transport business sectors as part of innovative services concepts, providing smarter transport connections for all sectors, etc. The aim of MaaS is to be the best option for its users, providing an alternative to the private use of the car that may be as convenient, more sustainable and even cheaper. As infrastructure measures mostly entail high investment costs to be covered by the public sector, planning measures delivering more efficient and sustainable resource utilization are of high relevance including digital networks, new ICT technologies, shared mobility as well as new types of mobility offers. MaaS aims at establishing integrated and personalised mobility services. A MaaS provider could introduce a pay as you go system or subscription packages offered to individuals or organization such as companies or university.

6.1.2. Market analysis

Market readiness
Currently the availability of each transport mode (e.g. carsharing, bikesharing, ridesharing etc) is very low or fragmented. Hence the MaaS operators face several obstacles to tailor and supply a good combined service. Legislation in the countries varies a lot and in majority of cases, is delaying the MaaS process. In most cities, "parts of the MaaS puzzle exist already, but not the entire picture"[104]. Therefore, the readiness of the MaaS depends strongly on the characteristics of the offer of mobility and on the degree of collaboration of the stakeholders in each local reality. In this regard operators are reluctant to cooperate within a single framework with actors they consider competitors. This issue is especially relevant as for MaaS to be properly developed and implemented, these operators should share their data and fares with other operators. Juniper[105] ranked 15 world cities based on their readiness for large-scale MaaS service deployment. Metrics considered included the existing/planned stage of deployment,

[104] MaaS Readiness Level Indicators for local authorities
[105] Helsinki Ranked as Leading City for Mobility-as-a-Service Implementation

cohesion of public transport services and infrastructure development. The top 5 ranked cities were: Helsinki, Stockholm, Vienna, Amsterdam, Austin. Research author Nick Maynard explained: "Helsinki has achieved its winning position in MaaS driven by collaboration between government and MaaS vendors. MaaS Global, which provide the service in Helsinki, can be considered at transaction level (level 6/7) as it received the fourth funding round (venture round) in May 2019 but stable pipeline and strong understanding of the market, solid revenue projections do not seem to be available yet. Results from a survey[106] submitted to around 400 private and public stakeholders showed that ticketing/payment, journey planning and customisation constitute the three main service features enabling MaaS. On average around 60 % believed that MaaS concept must include at least these service features facilitating easy access and providing a unique, integrated service supply over one common interface.
Market positioning
The same survey shows most of the interviewees believes that the organisation of MaaS services will be strongly triggered by public transport (PT) providers/operators. On the other hand, the integration of road operators or private transport organisations such as motorist associations constituted only minor importance. The second place, mobility service providers are seen as essential key-player. In any case, stakeholder partnerships are fundamental to MaaS to develop a viable multi-modal system delivering significant cost- and time-savings to the user but cases that have achieved this goal are still very few. To ensure a fair competition and a fair service, it is important that the access to the data generated by the MaaS Operator should be somehow shared with the city. By doing this, the city can check that the best travel is proposed to each customer on a fair basis (to ensure that the MaaS operator does systematically propose the best possible mix of trips to each customer (and not the mix of trips which are the best for the MaaS operator's revenues).
Market maturity
Apart from a few particularly advanced cases, MaaS is still in the Introduction/Development stage of market lifecycle though technology that makes MaaS work is already available (e.g. smartphones and 4G/5G networks, deep learning and artificial intelligence, autonomous drive, dynamic routing). Therefore, in the first place it would be necessary to use existing technology to better use already existing infrastructure and services. In principle, MaaS is about integrating transport modes through the internet.[107] However, the achievement of a potential market share is still strongly hampered mainly by the lack of data passing between organizations.

6.2. MaaS Platforms

6.2.1. Technological, social, operational and business factors

Technological

[106] Kohti eksponentiaalista toivoa – VTT:n strategia vuosille 2021–2025 on julkistettu
[107] ICT-based tools supporting Value-Added Services implementation-Solez Interreg 2018

The MaaS Platform(s) is the IT structure that is used by the MaaS operator(s) to provide the final service of mobility to the end-users. The MaaS Platform is split into two elements: the front-end and the back-end, both of which are made up of components developed by the IT Providers.[108] This platform manages all the data and functionalities needed for MaaS operators to offer services.[109] The MaaS platforms can be developed by MaaS operators or IT providers.

In general, MaaS platform(s) has multiple functions (as presented in Figure 2): including 1) information and availability (e.g., information about mobility service providers and integrated transport service providers, journey details and location details), 2) journey planning (e.g., trip suggestions, route planning and time constrain filter), 3) booking and payment (e.g., management and cancelation of booking), and 4) reporting (e.g., aggregate reports to MaaS operators, to MaaS end-users, and to MaaS mobility service providers). To support these functions, relevant application programming interfaces (APIs), real-time data, and ICT infrastructure (e.g., mobile network coverage and smart ticketing infrastructure) needs to be available.

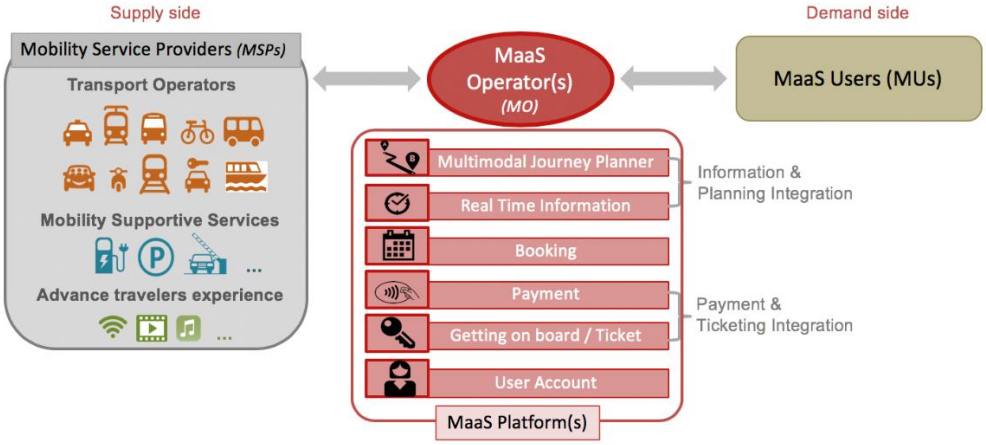


Figure 6-1: The MaaS platform

(source: MaaSLab, The MaaS Dictionary: https://docs.wixstatic.com/ugd/a2135d_d6ffa2fee2834782b4ec9a75c1957f55.pdf)

Social and behavioural

Public authorities in urban areas have been looking for ways to improve the transport system. The MaaS platform(s), therefore, becomes a practical tool for the cities to efficiently establish and manage the transport system and a MaaS ecosystem. The development of MaaS platform(s) might also change transport operators' behaviour. With a solid MaaS platform in cities, transport operators will actively become a supplier of MaaS solution and redesign their business model to maximise revenue.

With MaaS, the community of users engages in a direct daily interaction through use and valuation of mobility resources within defined spatial coordinates. Through its interface and algorithm, MaaS provides a more dynamic representation of the mobility market mechanism. The users provide input and make decisions based on other users' input in real time. This could lead to highly responsive coordination between the participants opting for either the train or the freeway that would be based on hourly changes in weather, traffic, and other relevant

[108] MaaS Dictionary
[109] Mobility as a Service (MaaS) and Sustainable Urban Mobility Planning (SUMP)

transport conditions. With MaaS the transportation marketplace becomes able to process a larger quantity of more detailed information in real time, leading to the reallocation of mobility resources between modes of transportation and providers for a more efficient outcome. From this perspective, the abandonment of a 'modal-centric' transportation paradigm implies a significant innovation in the ways in which public and private legal-institutional arrangements collaborate. Traditionally, transportation generally involved a clear and stable separation between public and private, in terms of division between transportation modes. Car, motorbike, and bicycle transportation were typically privately owned, whereas bus, train, and others, would be divided between public and private service providers. Mobility-sharing has already disrupted this separation as it has created an opportunity for commodities acquired for private use to be utilized for the provision of services to others. MaaS goes further as it creates a continuum of mobility by integrating these private arrangements with the system of public transport, which previously monopolized a strictly separate set of transportation modes.

Operational

MaaS platform could change the transport ecosystem entirely. All stakeholders (e.g., mobility service operators, MaaS operators, other service providers) must change their daily operation, which may indirectly increase or decrease costs of operation.
Strong contractual work is to be done with each transport operator whose services are proposed in the MaaS. These contractual issues are the major operational barrier to be considered. Sometimes, cities organise themselves such contractualisation when they select their transport operators. The contractual obligation to collaborate within the Urban MaaS system might be part of the 'transport service' deal.

Business

As discussed above, MaaS platform is developed by either MaaS operators or IT providers. For MaaS operators who own the MaaS platform, their main revenue source comes from MaaS subscription fees pay-as-you-go fee, and advertising fee. For IT providers, their revenue mainly comes from the cities and regions who buy the tailored MaaS platform that can address their cities' needs.

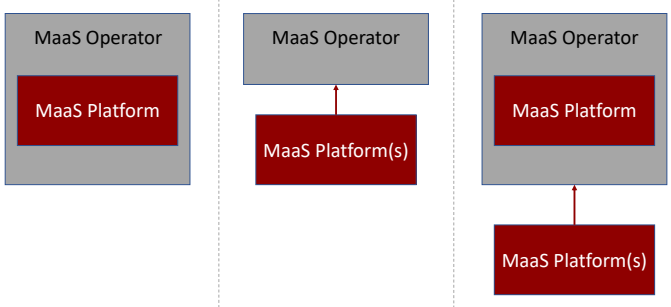


Figure 6-2: Potential options for the MaaS Platform Provider(s)

(source: MaaSLab, The MaaS Dictionary: https://docs.wixstatic.com/ugd/a2135d_d6ffa2fee2834782b4ec9a75c1957f55.pdf)

6.2.2. Market analysis

Market readiness

MaaS markets are already in place in some locations, but their development is at different stages. Some solutions exist at a first state of development state, such as the Communauto/Bixi project in Quebec, where some public transport companies are proposing packages including also bike sharing and carsharing. The more advanced solution is that of WhimAPP in Helsinki, at "TRACTION" level.

Still, the development of MaaS platforms is limited in its territorial scope and in its diversity of supply. The main barrier is the lack of interoperable databases, namely the main infrastructure that MaaS relies on. Indeed, the development of complex journey solutions require huge amounts of transport data, including fares. The other main barrier is the reluctance of transport operators to coexist (and cooperate) in the same platform, as they consider themselves competitors. Thus, public policy could help developing proper infrastructures also by obliging operators to share their data, as well as proper developed MaaS platforms would be attractive for operators.

In this light, the main foundational challenge for capturing the benefits that the introduction of MaaS is expected to create, originates from the risk that the central role of operator entails. The operator could engage in preferential treatment of a particular transport provider at the expense of others. After providing their input, the user's actual choice of one or another provider (say public bus service or private car-sharing), depends on the options offered by the operator. The operator could use its discretionary power to offer what are supposedly the best options to support some transport providers over others.

The operator could also engage in rent-seeking leading to increased journeys, contrary to the alleged optimisation benefit of MaaS. While this has implications for the competition regulation, it is also relevant for the design of the ownership-and-control bundle appropriate for MaaS. Namely, the ownership-and-control bundle[110] best suited for attaining mobility-related social goals must balance the traditional cost-minimization goal with the need to avoid preferential treatment of a particular service.

Market positioning
MaaS is a new market. The ecosystem is mainly composed by transport operators, platform providers and insurance companies. Whereas public transport companies play the leading roles, the major actors are ride-sharing companies. The key players are BMW Group (Germany), Alliance Corporation (Canada), Apple Inc. (U.S.), Xerox Corporation (U.S.), Lyft, Inc. (U.S.), Uber Technologies Inc. (U.S.), MaaS Global (Finland). (Germany), Daimler AG (Germany), and Communauto (Canada), Didi Dache (China), Lecabs (France), Wiwigo (India). The provision of tailored and multimodal journeys solutions by using a single app represent the main competitive advantage of MaaS.
Market maturity
MaaS solutions are positioned in different stages of market lifecycle depending on regional areas. In some areas of US and Canada, MaaS systems are in development, as stakeholders are formulating new solutions combining public and private transport offers. In Helsinki MaaS is growing, with local authorities adopting new policies to enable an evolution of the system and drafting regulations to allow a sustainable development for the city and the commuters.

[110] Creation of MaaS can be initiated both from the private side as in the case of Uber partnering with Denver Transit and from the public side as in the case of Berlin's Jelbi

The most far-reaching legislative attempts to address MaaS through the lenses of multimodality and integration come from Finland and France. In 2016, the Finnish government has proposed a regulatory review of the Transport Code, *Liikennekaari*, aiming to support the development of a sustainable multimodal transport system. [111] In July 2019 the French parliament has approved the drafted legislation on the future orientation of mobility, *Projet de loi d'orientation des mobilités* (*LOM),* [112] delivered by the French Minister of Transport. Facilitation of multimodality is included among of measures conceived by the LOM to conduct an ecological transition of French mobility.

6.3. Selected Business Model Cases in the MaaS and MaaS Platform Category

6.3.1. Case 1: Transdev

[Case background]
Transdev is a worldwide company, operating 17 modes of transport and the first European operator of zero-emission mobility solutions. Relying on their expertise regarding sustainable mobility solutions deployment, and the good knowledge regarding public service and their experience regarding relationships with local policy makers, Saint Etienne Metropole chose Transdev to be one the first cities to develop MaaS in France. A first version was setup in 2016, including real-time and multi/intermodal information (road traffic, bike-sharing, trains and planes), parking, booking and transport payment (public transport, bike-sharing). The payment of transport was performed through e-beacons, parking via QR codes. In 2019, a new MaaS application was deployed, including new mobility services (car sharing, carpooling, taxis), predictive information, ticket selling for all modes and new payment solution.

[Other factors influencing business model]
Regarding the business models, customers receive a bill at the end of the months for the payment of all transport modes they used. The price is fixed for each transport mode, there is not yet a "mobility package" regarding pricing. The funds are thus redistributed to service providers with charged fees. Three levels of services could be sold:

- Global offer: Transdev develops MaaS technology for cities, but also ensures MaaS operation and other services operated by the MaaS operation service department (customer support, data analysis to propose custom-made offers);
- MaaS operation: cities (medium-sized to metropoles, large transport network) could launch tenders for MaaS operation. Transdev can answer this call and provide both technology solution and MaaS operation.

[111] Säädösvalmistelu ja kehittämishankkeet valtioneuvostossa
[112] Projet de loi d'orientation des mobilités, modifié par l'Assemblée nationale, n° 2135

- MaaS solution provider: Transdev can provide a MaaS technical solution to smaller cities. MaaS operation will be performed by public transport.

Big cities to regions	Medium-sized cities, metropoles with large transport network	Smaller cities, small or medium-sized transport network
MaaS operation complementary services (customer support, data analysis to propose custom-made offers)	MaaS operation and technology supply	MaaS technology supply

[Data • policies • incentives • financing • taxation structure]
It is important to point out key parameters that have not been highlighted by the business model canvas:

- **Data exchanged:**

Data sharing is carefully considered regarding MaaS to keep users' privacy and safety. All Transdev development are compliant with GDPR rules. In addition to that, cities and local policy makers (main customers) own data, and make them available to Transdev after anonymization process. This allows Transdev to analyse data in order to improve transport organization and mobility service offer.

- **Policy:**
- Policy could be an enabler regarding MaaS deployment, as many initiatives are being setup in order to change the mobility paradigm (Low-Emission Zone, dedicated ways for car sharing users…).

[Implications for decision-makers from authorities / public transport]
Decision-makers and public transport have to set-up a regulatory framework for the cooperation between public and private parties to have guidelines to build win-win partnerships, thus guaranteeing policy objectives while preserving interests of private sector.

<table>
<tr>
<td rowspan="2">Key Partners
• Public policy makers
• Transport manufacturers
• Transport service provider: STAS (Transdev branch), Citiz (carpooling), Mov'ici (carsharing), Karhoo and local taxis, Vélivert and Smoove (bike sharing)
• Specialized technology providers (GPS, payment, analytics, and specialised API)</td>
<td>Key Activities
• Operator and integrator of mobility services: bus, cars, tramways, metros, trains, ferry, taxis (85% public transport)[113]
• Sustainable mobility solution provider: "green vehicles" for transport (alternative fuels, electric mobility), development of services such us on-demand and carpooling transport (smartphone apps, autonomous shuttles)
• Pioneer regarding multi-modal mobility and MaaS, developing smartphone solutions: route calculating and real-time information (Moovizy in Saint-Etienne, Triplin in Toronto), "M ticketing & SMS ticket services" (public transport purchase)</td>
<td rowspan="2">Value Proposition
• Seamless and integrated planning, payment, and ticketing interface
• Enhanced end-to-end customer experience with multi-modal transport choices: data analysis to propose custom-made mobility packages</td>
<td>Customer Relationships
• Automated services and self-services, with personal assistance in specific situations thanks to data analysis and predictive data processing.</td>
<td rowspan="2">Customer Segments
B2G:
• Cities

B2C:
• Urban young commuters
• Students

⇨ Diary travels, local MaaS deployment</td>
</tr>
<tr>
<td>Key Resources
• Physical resources: Software enabling platform (ticketing services, real-time travel times) for smartphone applications, transportation</td>
<td>Channels
• App-based channel</td>
</tr>
</table>

[113] Propos recueillis par Virginie de Kerautem (2018), Transdev est-il un acteur public ou privé ?

	technologies. Technologies are developed in Citiway Transdev branch. • Human resources: strong expertise with 82 000 employees worldwide over 20 countries. • MaaS operation service: this new department will be setup in order to provide operation services as well as a call centre to guarantee customer support			
Cost Structure • Software development • Transport service providers payments • Employee salaries • Marketing and advertising fees • 20-25 M€ investment per year for innovation • Investments on other MaaS initiatives		*Revenue Streams* • Contracts with public authorities • Fees charged regarding the distribution of funds to mobility service providers.		

Figure 6-3: The Business Model Canvas for Transdev

6.3.2. Case 2: Urbi

[Case background]
Urbi was founded by the app developer, Emiliano Saurinin, in 2014. The birth of Urbi was possible thanks to the funding activity of the tourist platform Lastminute.com. At the core of Urbi lies a MaaS platform, aggregating different third parties sharing mobility services. During the years, Urbi has expanded up to reach 15 major European cities, with 200,000 downloads in total. In 2017 the tolls company Telepass became the main shareholder (70%) of the company.

[Business model explained]
Urbi, is an aggregator of shared mobility services active in a city, simplifying their use. In addition, Urbi gives the end user the opportunity to plan their travel, in real-time. By accessing the application, the user can geolocate in real time on a map all the shared media available.
Furthermore, by selecting the desired destination, Urbi shows all the possible alternative routes, with indications on costs and times, taking into consideration the traffic on the selected route. It delivers an overview of all the shared resources available in the city, detecting those available and nearest to the user, and calculating the best route.
Recently, the offer was implemented by adding indications on taxis and Uber. Moreover, the aim for the near future is to integrate public transport.
As for payment, Urbi relies on a pay-as-you-go model. In addition, Urbi offers the opportunity to buy different package/voucher combining some of the mobility services available on the platform.
Urbi is not part of the deal between mobility service suppliers and users. This because of the bargaining power of the partners, which are difficult to be convinced by Urbi difficulty to be incorporated into the aggregator. Currently, Urbi includes 46 services and is available in 23 cities between Belgium, Italy, Spain, Germany, the Netherlands and Austria.

[Other factors influencing business model]
Data collection is at the core of Urbi functioning. Data are collected in order to provide the users suitable solutions for their travel. As mentioned above, due to its strong shareholder, the company financing relies on debt capital instead of risk capital.

[Implications for decision-makers from authorities / public transport]
The implications for decision makers and public transport are those related to the development of MaaS platforms. More specifically, public transport companies could decide to enjoy a MaaS platform such as Urbi, but to do so, access to the ticketing system should be granted to the aggregating platform. Public authorities and decision makers should establish a set of rules dealing with some sensitive issues, such as data treatment as platforms as Urbi can collect a huge amount of users' data.

<table>
<tr>
<td rowspan="2">Key Partners
• Transport service providers
• Payments Providers
• Cloud Providers</td>
<td>Key Activities
• Third parties' mobility services aggregator</td>
<td rowspan="2">Value Proposition
• Traffic jam reduction
• CO2 reduction
• Unique platform for different mobility services (car sharing, scooter sharing, bike sharing)</td>
<td>Customer Relationships
• Automated services and self-services.
• Personal assistance through Contact Service in specific situations</td>
<td rowspan="2">Customer Segments
• Commuters' resident and non-residents in the major European cities
• Smart and non-car owning workers/ students residing in the major city centres
• Companies</td>
</tr>
<tr>
<td>Key Resources
• Physical resources: Software enabling platform.
• Human resources: website and App designers and developers (IT), marketing and sales team (Marketing and Sales), and CRM team (Customer Relationship)</td>
<td>Channels
• App-based channel
• Website channel</td>
</tr>
<tr>
<td colspan="3">Cost Structure
• Network implementing
• Software development/maintenance cost
• Marketing and advertising fees</td>
<td colspan="2">Revenue Streams
• Revenues from commission on third parties services</td>
</tr>
</table>

Figure 6-4: The Business Model Canvas for Urbi

6.4. Impact of COVID-19 on This Innovation Category

MaaS is expected to play a significant role in the way that the current pandemic changes the way cities approach the use of technology in movement of citizens and goods. In the context of the lockdown of non-essential business, robust restrictions on citizens' movement and social distancing rules a surge in walking, cycling[114] and transportation by electric vehicles could be observed,[115] intensified use of ecommerce and delivery networks[116] and significant reliance on automated vehicles[117], all of them strictly relate with MaaS.

6.5. Conclusion

The abandonment of a 'modal-centric' transportation paradigm implies a significant innovation in the ways in which public and private legal-institutional arrangements collaborate. Traditionally, transportation generally involved a clear and stable separation between public and private, in terms of division between transportation modes. Car, motorbike, and bicycle transportation were typically privately owned, whereas bus, train, and others, would be divided between public and private service providers. Mobility-sharing has already disrupted this separation as it has created an opportunity for commodities acquired for private use to be utilized for the provision of services to others. MaaS goes further as it creates a continuum of mobility by integrating these private arrangements with the system of public transport, which previously monopolized a strictly separate set of transportation modes.

The results of the market analysis are summarized in the following table.

Table 6-1: Summary of Market Analysis

New mobility service/technology	Market readiness	Market positioning	Market maturity
MaaS	5-6 (between large scale early adopter campaign and proof of traction)	New market / re-segmentation of existing market by employing a niche strategy	development stage
MaaS platforms	5-6	New market /	development stage

[114] Pandemic spells uncertain future for bikes and scooters as mobility services confront new realities
[115] Coronavirus inspires cities to push climate-friendly mobility
[116] How the coronavirus and retail closures are accelerating the rise of Amazon
[117] How coronavirus is accelerating a future with autonomous vehicles

	(between large scale early adopter campaign and proof of traction)	re-segmentation of existing market by employing a niche strategy

7. SHARED ON-DEMAND MOBILITY

Sharing mobility in last years is facing different challenges in a view of maturity of the business. The sector is challenging not only economic troubles, but also legal and operational aspects. The last happening, COVID-19 spread as well as economic troubles, are accelerating questions that if not now would be tackled surely in following years.

It must in any case be reported that different actors of the business were confronting financial headwinds even before COVID-19 drastically reduced market shares worldwide. Faced with plummeting usage, different companies have yanked their fleets and services off the market and retreated from entire continents.

For most of the firms the next future of them is the collaboration of the business, with partnerships, mergers and diversification of the services proposed.

The ability of using recent technological advances such as, optimized algorithms, GPS navigation devices to determine a route and arrange the sharing rides are features that will be more used in the next future, and elements that positively characterize the sharing mobility business. Within this sector travellers can easily request a ride through a smartphone from wherever they happen to be, they can use social networks to establish trust and report their experience and use the same smartphone to pay the services used.

The flexibility of the system is one of the most appreciated elements of this business, involving a diverse set of phenomena, vehicles such as cars of different sizes, bicycles and others, last-minute as well as first-minute demand, set pick-up and drop-off points, etc.

Furthermore, also the ability to direct contact with customers, and the possibility to understand their preferences makes the sharing systems really attractive for wider functionalities and markets. Not only to private companies but also with local transport authorities and operators.

Finally, these services are not have necessarily limited to urban centres or even places with strong public transportation, but the proposed alternatives and flexibility give them the possibility to localize and develop services specifically adapted to particular locations and time frame. This is the reason why the business, especially for partnerships, is interesting also for locations and administrations with lack of good urban public and complementary transport to ease travel experiences.

The value added to users is the ease with which they can transfer between different modes of transportation. This type of operating makes the business interesting for solutions that keep people moving through urban and extra urban areas and demonstrate the importance of multimodal transportation initiatives. Companies and authorities have recognized that multimodal transportation provides them with a huge opportunity to expand and build partnerships, especially in this period.

7.1. On-demand Ride Sharing

7.1.1. Technological, social, operational and business factors

Technological
On-Demand Ridesharing involves a system that matches riders and drivers to share transportation at random times and locations. Whereas On-Demand Ridesharing is a service in which members give rides to other members mainly for profit, carpooling is a service in which 2 or more people who must make the same journey share the ride, with the aim to reduce costs for all. This system makes use of recent technological advances such as GPS navigation devices to determine a driver's route and arrange the shared ride, Smartphones for a traveller to request a ride from wherever they happen to be, Social networks to establish trust and accountability between drivers and passengers and E-payments systems. These elements are coordinated through a network service, which can instantaneously handle the driver payments and match rides using an optimization algorithm. On-Demand Ridesharing involves a diverse set of phenomena, involving vehicles such as cars of different sizes, bicycles and others, last-minute as well as first-minute demand, set pick-up and drop-off points. Implementation of this type of systems faces multiple barriers related to low flexibility in adaptation to local conditions of density and transport network, belief that private cars bring convenience and flexibility and lack of good urban public and complementary transport to ease first mile travel. At the same time On-Demand Ridesharing is enabled by its advantages such as lower prices, shorter waiting times and higher safety. Passengers using ride-sourcing and ride-sharing services also mention quality elements such as drivers' courtesy and vehicle condition as a reason for their preference. Finally, multiple systems operating in the same locality can adopt data sharing protocols among platforms that help improve the service.
Social and behavioural
Success of On-Demand Ridesharing as an innovation that fulfils a precise social need that stems from increased population density, the ongoing change of users regarding car ownership. In this context On-Demand Ridesharing offers lower costs in comparison to existing transport provides such as taxis, transparent fares. In a non-regulated market for transportation services, improvements of public transport infrastructure and facilitating local government policies it can improve the level of satisfaction of transport needs in many cases of the individuals and households that would not be in the position to use transport services otherwise. At the same time implementation of these systems leads to reduction of vehicle usage, ownership and vehicle miles travelled, rise of environmental awareness and postponement of car purchase and selling.
Operational
Three main innovative practices identified with ridesharing are the improved use of public station infrastructure, increased mobility for non-car owning individuals and households and general lowering emission. A 2010 survey at the University of California, Berkeley found 20% of respondents willing to use real-time ridesharing at least once a week; and real-time ridesharing was more popular among current drive-alone commuters (30%) than transit or non-motorized commuters. The top obstacles to using real-time ridesharing were short trip lengths and the added time of ride logistics. As for the companies that set up ridesharing systems, their operation can be impeded by high initial expenses to set up service related to vehicle fleet and insurance and lack of public infrastructure
Business

The revenue model is based on cost recovery. Riders pay drivers proportionally to cover journey expenses. In Italy, the average distance is of 340 km with an average cost per passenger of 18 euro[118].

7.1.2. Market analysis

Market readiness
On-demand ridesharing services are particularly affected by the consequences of the ongoing pandemic outbreak. Since many Countries have chosen to decrease or utterly stop people's movements to lower the spreading of the virus. This aspect has underlined the economic, legal and operational issues that On-Demand Ridesharing services were facing even before the COVID-19 pandemic. As a consequence, the On-Demand Ridesharing market is currently adapting itself to the current challenges, with a pooling of the Ridesharing companies. Moreover, EU Member States are finally introducing On-Demand Ridesharing- specific legislation, such as the French "*Loi du 24 décembre 2019 d'orientation des mobilités*"[119].
Market positioning
On-demand ridesharing services have only recently been introduced in the European market. Actually, the number of European Union citizens using On-demand ridesharing services have reached detectable levels only around the year 2017.
Market maturity
On-demand ridesharing services have experienced a sustainable growth in in the last three years as for the number of users. From 2017, on On-demand ridesharing services have been a more and more common sight in the European Member States, especially in the corporate field. As an example, Italian corporate carpooling services were used by almost half a million users in 2019[120].

7.2. Bike Sharing

7.2.1. Technological, social, operational and business factors

Technological
Self-service bike sharing allows users to access a means of travel for short trips (mostly urban) that is faster than using public transport and greener and more convenient than using a car. It is a collaborative mobility practice because the bikes are used by several users. They belong either to private operators or to public operators.

[118] Brescia C., Luè A., Colorni A., Studer L., - Carpooling : facts and new trends. Politecnico di Milano. July 2018
[119] Loi du 24 décembre 2019 d'orientation des mobilités
[120] 4° Rapporto nazionale sulla sharing mobility

Today, we can differentiate three services that use different technology. The first is the self-service bike, in a station provided for this purpose. The operation is unlocking the bike by paying at a terminal, and then being charged once the bike is locked again at a station (which can be a different station from the first one). The second is similar, but the self-service bike is available anywhere in a predefined perimeter and geolocatable via a smartphone ("free-floating"). The third is the "semi free-floating" option, which requires users to leave their bike in places that are provided for this purpose (parking, bike racks, etc.). They are also generally better secured (with a chain) to try to prevent damage and theft. There are also electric bikes, which have no technological differences in the use of the service. Three obstacles to cycling are eliminated thanks to this service: parking at home, theft and maintenance.
Social and behavioural
This service gives the greatest number of people access to a bike to get around town at a reduced price and encourages exercise and convenience. Electric assistance can further increase the number of users by allowing less sporty people to opt for cycling (especially for hilly roads). The improvement of this service could lead to an almost exclusive use of bikes in cities, with both social (accessibility, health) and environmental benefits (however we would still need to pay attention to pollution and the recycling of abandoned bikes). Degradation and theft would still be a major problem. The quality and safety of the cycle network plays a role in people's willingness to use such a system.
Operational
User Services: • "Overflow": system, allowing people to deposit their bikes even if the station is full. • USB socket to charge laptops. Operating costs cover theft (renewal of the bike fleet), damage (maintenance), the installation of the stations (maintenance and new stations) and changing batteries for electric bikes. Another operational service needed from the bike sharing operator is linked to the necessity, often, to reallocate, several times a day, the bikes fleet where the demand is the highest.
Business
Revenue: • Daily, weekly, monthly or yearly subscription – the ride is free for the first 30 minutes, and when this time has been exceeded, the user is charged from the time the bike was unlocked; The user is charged from the time when the bike was unlocked if they do not have a subscription.

7.2.2. Market analysis

Market readiness
Market readiness is valued between 6 - 7 and its size over USD 4 billion in 2018. It is anticipated to register a CAGR of over 6.5% during the period 2020 – 2025.

The demand for bike-sharing services is increasing due to the rising pollution, health and noise concerns, especially in major cities. These elements are driving the market mainly in developing countries, Asia and South America. The industry is witnessing a rapid growth in these regions owing to changing consumer preference, with governments influence, toward more energy-efficient transport solutions. Asia Pacific bike sharing market is expected to grow at over 15% CAGR from 2019 to 2025. The Indian government is developing dedicated bicycle routes to ensure maximum pedestrian and cyclist safety, contributing to industry expansion. The increasing demand for low-cost transportation alternatives in Latin American countries, including Brazil and Mexico, is expected to provide lucrative opportunities to industry expansion[121].
Market positioning
The market has a more urban focus, and this is perfectly coupling with the increasing governments' initiatives across the globe for the development of reliable bike-sharing infrastructure together with the vision of smart cities. These service kinds are majorly used in urban areas due to the rise in traffic congestion and increased fuel prices. Growing concerns related to the rise in environmental pollution are leading toward the adoption of environment-friendly transport solutions including bicycles and electric bikes, supporting industry growth. Various urban administrations and national governments are offering subsidies to providers and operators for developing services and expanding their reach to a large number of commuters. For instance, in 2018, Chinese Municipal governments subsidized the Public Bike Sharing Program (PBSP) development to encourage non-motorized transport and offer convenient, flexible, and low-cost mobility options.
Market maturity
The industry is still moderately fragmented owing to the presence of various local as well as global service providers across the globe. Companies are making large investments in technological innovations such as AI and IoT to offer reliable performance to commuters. The industry is witnessing a huge demand for dock less bike solutions due to enhanced flexibility. The operators are focusing on expanding their fleet to sustain the increasing competition. Players are developing user-friendly smartphone applications to offer increased usability to the operator. Some of the most prominent players operating in the bike sharing market are Lime, Mobike, Ofo Inc., Lyft, SG Bikes, and Tembici. In recent period, companies are adopting several strategies such as collaborations & partnerships and mergers & acquisitions to expand their business operations. Several leading enterprises are making large investments in start-up companies to enhance their business operations. For instance, in March 2018, Alibaba Group announced an investment of around USD 866 million in Ofo Inc[122]. Players are also partnering with other shared mobility companies & public transport companies to expand their performance. A major factor that is hampering industry growth is the increase in bike vandalism & theft. Several such incidents have been reported globally by the dock less bike-sharing service

[121] Bike Sharing Market Size By Type (Conventional Bikes, E-Bikes), By Model (Station-based, Free Floating, P2P) Industry Analysis Report

[122] Chinese bike-sharing startup Ofo raises $866M in new financing led by Alibaba Group

providers in recent years. For instance, in September 2018, Mobike abandoned its services in Manchester due to theft & vandalism in the city, resulting in huge bike losses. However, companies are making large investments to enhance the security of free-floating bikes, which should reduce the impacts of such incidents and will ensure bike safety. Despite hampering, the free-floating model is expected to witness high growth due to its enhanced flexibility, accessibility, and affordability. Service providers are increasingly deploying dock less cycles on the roads to reduce the cost of building large docking stations.
Together with free-floating solutions, the market demand is also aiming to increasing e-bikes fleets owing to their fast & flexible operations and zero carbon emissions. The growing consumer inclination toward the usage of e-bikes as cost-effective & eco-friendly transport solution is facilitating to bike sharing market expansion. The increasing investments in research & development activities to enhance battery performance and improve bicycling infrastructure are expected to provide lucrative opportunities for the business expansion. These cycles are majorly used by commuters for hill climbing and carrying heavy loads, where pedalling manually is a critical task. Bike-sharing service providers in North America and Europe are replacing conventional bikes with e-bikes to offer reliable and efficient performance to their users.

7.3. E-scooter sharing/ Micromobility

7.3.1. Technological, social, operational and business factors

Technological
Electric scooters give users access to a means of travel for short trips (mostly urban) that is faster than using public transport and greener than using a car. It is a shared mobility practice because scooters are used by several users. They belong to private operators. The technological operation is similar to the "free-floating" bike, available anywhere within a predefined perimeter and geolocatable via a smartphone. Three obstacles to soft mobility are eliminated through this service: parking at home, theft and maintenance.
Social and behavioural
This service lets more people move around the city in a flexible way. The improvement of this service could reduce car ownership with the use of this soft mobility solution, which is accessible to all, electric, leading to environmental benefits such as reduced GHG emissions (however, we would still need to pay attention to pollution and the recycling of abandoned scooters). Degradation and theft would still be a major problem. Electric scooters have relatively low lifespan. The intensive use, rough handling and vandalism considerably reduce the durability of these machines. In addition, regarding urban management, e-scooters could be a nuisance, blocking pavements and public spaces, leading to strong regulations and fines for companies proposing this service though this depends on how each city chooses to manage it.
Operational

Boston Consulting Group calculated that the average price of a journey was $ 3.50. The operator, after deducting operating costs, then takes a profit of 65 cents, which means $ 3.25 per day for five daily errands. Boston Consulting Group has found that it takes 115 days - nearly 4 months - to amortize a scooter acquisition cost, which is longer than its average lifespan. The main cost (50% of the total cost), and therefore the main problem, comes from the "juicers" - the employees who, every night, recover, repair and redistribute scooters abandoned. Hence the question of the robustness and autonomy of scooters, to do without as many of these workers as possible. Boston Consulting Group estimates that, if the scooters last at least six months, the scooters could generate a profit.
Business
There is still the question of the economic viability of these services, which are far from being profitable (world market at 1.5 billion dollars today could reach between 40 and 50 billion dollars by 2025 according to BCG). The current strong competition will lead to an erosion of the number of operators, where only those with a real strategy will survive.

7.3.2. Market analysis

Market readiness
Level 7 - 8 Since the first deployments in 2016/2017, e-scooter sharing service has been exploding, available now in nearly 200 US and European cities. The market players thus started to get significant revenues, due to strong customer demand[123]. However, as we will see on market maturity discussion, several steps are still needed to achieve market maturity and demonstrate full market scalability and maturity.
Market positioning
B – New market E-scooter sharing disrupted the mobility market by proposing a new mobility service that did not exist before to address first/last mile issues (distance of a few kilometres) in congested urban areas. This service is part of the new trend of shared mobility reflected by the emergence of new services such as bike-sharing, car-pooling, etc. The market is dominated by a dozen of players such as Bird, Lime, Tier [124]. The competition becomes more and more stronger, as local regulations limit the number of operators (e.g. three in Paris[125]).
Market maturity
II – Growth As mentioned before, the service has been exploding since the first deployments. However, several factors hinder the acceleration of this industry. First, the local regulatory framework is decisive. Some cities removed the dock-less e-scooters from the streets due to safety reasons (injuries, accidents) or environmental reasons (short

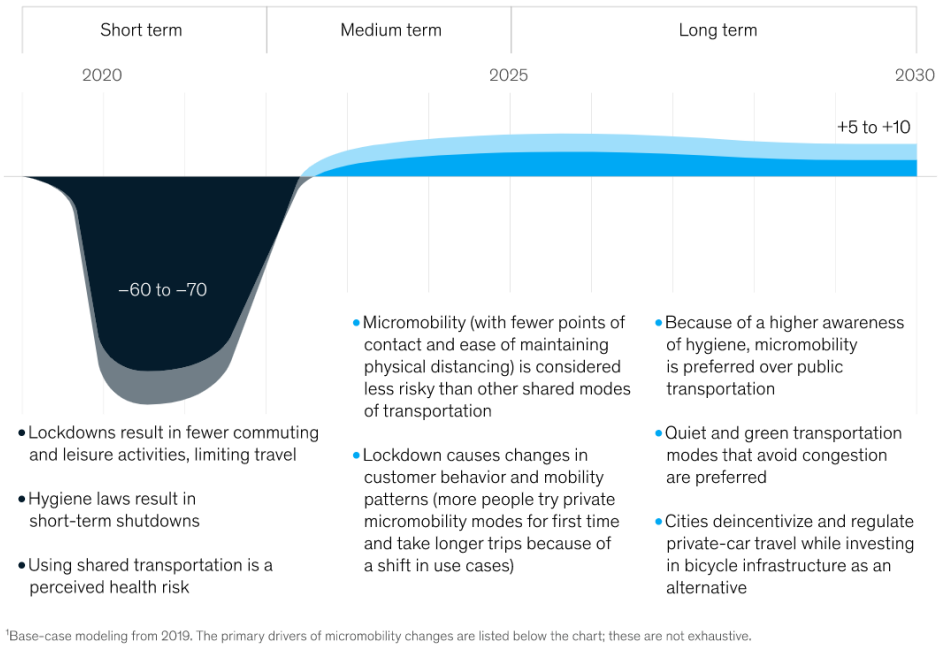
[123] As Lime Looks To Raise More, Scooternomics Still Appears Strained
[124] The Promise and Pitfalls of E-Scooter Sharing
[125] Paris: Voici les trois opérateurs de trottinettes retenus par la Mairie Partager Twitter

lifetime, pollution created by the accumulation and congestion of vehicles on pavements or in the rivers in which the vehicles are sometimes thrown in[126]). This is for example the case in Montreal, Canada, where the service was banned after a trial[127].

In addition, despite the strong growth in sales, the service is unprofitable today due to the short lifetime of the vehicles, the additional costs related to operation and maintenance (transferring e-scooters to balance the numbers of available vehicles in stations, battery charging, etc.). These costs have to be reduced below 50% of revenue to make the companies profitable, according to BCG, with an extended lifetime (3,8 months)[128].

Finally, the COVID-19 was a strong hindering factor to the market growth, with 60%-70% decrease due to lockdown[129]. This pandemic crisis will have consequences over several years on companies' revenues, slowing down the race towards market maturity.

Impact of COVID-19 crisis on global shared and private micromobility,[1] % passenger-kilometers traveled



[1]Base-case modeling from 2019. The primary drivers of micromobility changes are listed below the chart; these are not exhaustive.

However, it is important to point out that the market is still expected to grow, as some people consider this mode of transportation as safer than public transport (social distancing, etc.) and adopted the service during this crisis, after the first lockdown. An increase of trip duration was also observed during this period[130]. Another driving force of the market is also the multiplication of cycling lanes[131], and environmental concerns that incentivize people to abandon private car ownership[132].

[126] E-scooters suddenly appeared everywhere, but now they're riding into serious trouble
[127] City of Montreal bans electronic scooters
[128] The Promise and Pitfalls of E-Scooter Sharing
[129] The future of micromobility: Ridership and revenue after a crisis
[130] The 3 Most Compelling E-Scooter Trends Post-COVID
[131] COVID-19 cyclists: Expanding bike lane network can lead to more inclusive cities
[132] The Covid Crisis Could Finally Make the Scooter Industry Profitable

7.4. Ride Hailing

7.4.1. Technological, social, operational and business factors

Technological
These emerging platforms in the mobility market evolved from the concept of carpooling, which as such has already existed for a while in the form of online platforms. The main difference is that ride hailing apps offer transport on demand, meaning that the ride is not planned in advance. The journey is requested and only taken because of this request. Most of the time, destinations are not shared between passengers, making the trip more individualized than with carpooling. Some resemblance to taxi services can be identified, by offering a ride in exchange for a fare. For ride hailing platforms, however, anyone with a driving license and a private car who fulfils the specific criteria set up by the company can sign up as a driver to chauffeur people around, meaning the companies behind the ride-selling application do not own a fleet of cars. This allows these companies to expand rapidly.
Social and behavioural
Ride hailing and "traditional" taxi are experiencing strong competition. The disruptive ride hailing presents some competitive advantages: • High service quality: more attentions to customers by providing bottles of water or tailored support. • Ease of use: a smartphone app allows the customers to book the journey, knows exactly the price in advance and manages payment. • Lower cost: it is more affordable than taxi. However, some drawbacks can be highlighted, due mostly to lack of regulation of this service: • Poor wage/social protection for the drivers, who are on their own, in a position of insecurity, if they experience unforeseen events that could prevent them from working (vehicle stopped, disease, etc.). • No dedicated lanes for ride hailing drivers, resulting to time loss for the journey. • A smart phone or credit card might also be a social issue to exclude disadvantaged users.
Operational
Transactional platforms for ride hailing match passengers who need a ride with drivers who want to offer a seat in their vehicle through mobile applications. Some of these trips can be shared with customers that are looking for rides with similar destinations. For every ride sold, the platform gets a commission. As a first step, a smart phone, a valid credit card and registration of customers is required. Customers can then use the app via their smart phone to request a ride, by setting their pickup location and entering their destination. A fare quote will be given to them. They can then track registered vehicles in their area and request a ride, waiting for the driver to accept. Once accepted, the passenger will receive information on the driver and the car and is able to track the car on the map. The passenger is notified on their smartphone of the imminent arrival of their driver. After pickup, the app will show the driver the route, using GPS navigation.

Payments are handled through the service provider directly by billing the rider's credit card that is linked to the app. A rating system asking the driver to rate the rider and vice-versa is in place, with the aim to ensure a form of reliability and safety. After the ride, the passenger immediately receives an invoice on their smartphone stating the exact route, distance and time travelled.
Business
Price per trip depends on distance, time and location, and is fixed before taking the customer. Nonetheless, some users complained about rates multiplied by more than 10 times during peak hours and holidays, as the company had inflated its rates. Pricing is flexible, and ride selling companies usually increase the fares during peak hour services or special events or whenever demand is high (surge-pricing). A fare quote is shown to the user by the app, calculating the approximate amount based on the expected time and distance. Most ride-selling apps also allow splitting the fare with a co-passenger, further reducing the cost for the passengers.

7.4.2. Market analysis

Market readiness
The market readiness for ride hailing is between 8 (stable pipeline and strong understanding of the market, solid revenue projections) and 9 (KPIs matched and predictable growth). Incumbent firms such as Uber, Lyft, and Didi have been a disruptive force in the urban mobility landscape around the world and foster the development of the market.
Market positioning
The ride hailing market starts from the re-segmentation of existing market. It focuses on the similar customer segments with taxi market. However, as this innovation become more affordable and prevailing, new customer needs are emerged. This trend has created a new market for different types of ride hailing users and for different ride hailing service providers. There are increasing low-cost players enter the market who offer appealing offers to attract new customers, which in turn, fundamentally change the market positioning from a long-term perspective.
Market maturity
The ride hailing market is in the rapid growth stage. The revenue for ride hailing and taxi market is expected to show an annual growth rate (CAGR 2021-2025) of 10.4%, resulting in a projected market volume of USD 385,942 million by 2025.[133] With the increasing penetration of smartphone and Internet, the demand side keeps growing, which foster the supply side simultaneously. The ride hailing market is a platform market which is expected to growth steadily in the following decades, especially when CAV technologies become more mature.

[133] Ride-Hailing & Taxi

7.5. Crowd Shipping

7.5.1. Technological, social, operational and business factors

Technological
Crowd shipping, also known as crowd-sourced delivery, is an emerging method that uses free capacity available in various transport modes leveraging on non-professional couriers to perform freight delivery. While it is now a common practice in grocery delivery, this model is arousing interest also in other retailers who are interested in cutting delivery costs and maximizing supply chain efficiency[134]. Crowd shipping involves "not necessarily an additional trip but a trip that leverages the typical travel patterns of the courier. The selected courier may be the closest to the delivery route, offer the cheapest delivery fee, or have the best reputation in the system"[135]. However focusing on environmental impacts some researchers outlined that crowd shipping could offer a sustainable alternative only if the crowd exploits existing vehicles trips[136]. Rouges and Monreuil[137] add that the number of vehicles is supposed to be reduces basing on the fact that crowd shipping principle should be based on the utilization of "drivers already en route" and because the companies promote alternative transportation modes (such as bicycled or public transportation systems); in this sense they observe that the most promising start-ups rely mostly on professional couriers or people who are dedicated to delivery rather than commuters or occasional travellers. To enable such a system, deregulation of delivery markets and the definition of laws that protect crowd shippers' labour, liability and insurance are needed. However, there are some downsides that cannot be overlooked such as the risk that the package is stolen, lost or damage or, unbeknownst to the crowd shipper, illegal. Crowd sourcing is an app-based platform and one of the greatest strengths of this freight delivery system is precisely being tech-heavy and asset-light. Therefore, one of the biggest success factors of crowd shipping relies on the effectiveness of the application in managing offer and demand. The use of apps offers customers the possibility to select a time slot and GPS tracks their order in their smart phones or choose to receive an alert SMS, to identify the nearest available courier and companies to meet customers' demands for instant gratification with the certainty that the package arrives at its destination when someone is at home or in other defined places (e.g. areas daily frequented by commuters), thus avoiding loss of time and money delivery[138]. Another technological enabler toward a widespread adoption of the system is the use of Automated Parcel Lockers (APLs); the customer receives an alert message and the unique code of the parcel as soon as the courier drops it off in the locker.
Social and behavioural

[134] Crowdsourced delivery explained: making same day shipping cheaper through local couriers
[135] Le, T., Ukkusuri, S., Review of crowd-shipping services for last mile delivery: current business model, challenges, and opportunities. Submitted to the Transportation Research Part E. 2018.
[136] Buldeo Rai, H.; Verlinde, S.; Macharis, C. Shipping outside the box. Environmental impact and stakeholder analysis of a crowd logistics platform in Belgium. J. Clean. Prod. 2018, 202, 806–816.
[137] Rougès, J-F Montreuil, B. (2014) Crowdsourcing delivery: Near interconnected business models to reinvent delivery
[138] Crowdsourced delivery explained: making same day shipping cheaper through local couriers

An exploratory investigation aimed to identify conditions under which crowd shippers will produce the service and customers buy it. Furthermore, the study shows that the maximum deviation accepted compared to the usual route is 1.5 km if the crowd shipper uses a non-motorized transport mode and 3.1 km if using a private mode of transport. As for the demand, 93% would accept to receive goods delivered with crowd shipping but the percentage decreases if the customer cannot directly contact the crowd shipping company or the crowd shipper or if it is not possible to trace the order[139]. By analysing 18 start-ups in the crowdsourced delivery industry, Rouges and Motreuil[140] identified different ways to reinforce trust between demand and couriers: the most business-oriented companies have implemented a rigorous selection process for couriers (requiring questionnaires, face2face or online interviews, copy of licence and vehicle registration, complete a secure background check etc), while most companies rely on feedback systems (e.g. star rating system and comments) to evaluate their couriers. Furthermore, companies are encouraging direct contacts between requesters and couriers through telephone and email. Finally, some companies have insurance but encouragers its couriers to buy additional coverage for higher-value packages.
Operational
Walmart is studying the possibility of involving its in-store customers to deliver items that online customers order in exchange for discounts, using company drivers just to deliver occasional unforeseen orders. However, from the point of view of city logistics, this system could increase the number of freight movements, making coordination and consolidation of direct-to-consumer deliveries less efficient[141]. More interesting applications of crowdsourcing are those that use Automated Parcel Lockers, because they allow to minimize the deviations of the shippers from their original path since they are positioned in areas daily frequented by commuters, such as metro, train and bus stations. In particular, the metro stations are the most strategic points as the higher train frequency makes an additional stop / deviation more acceptable[142]. A study conducted on the Rome underground based on the hypothetical scenario in which packages can be picked-up / dropped-off in APL, shows that the positioning of APLs is an even more relevant factor than remuneration. The article also investigated how e-commerce users might be willing to accept the crowd shipping service to receive their orders. It emerged that the most relevant factor would be the possibility of planning the date and time of delivery[143]. Another important issue is linked to the achievement of a critical mass. Certainly, a certain number of couriers are needed to provide a flexible and efficient service, but, on the other hand, a certain number of customers is also required to attract couriers. Therefore companies have

[139] Marcucci, E., Gatta, V., Le Pira, M., Carrocci, C. S., Pieralice, E., 2017d. Connected shared mobility for passengers and freight: Investigating the potentialof crowdshipping in urban areas, 5th IEEE international conferenceon models and Technologies for Intelligent Transportation Systems, MT-ITS 2017 - Proceedings 8005629, pp. 839–843

[140] Rougès, J-F Montreuil, B. (2014) Crowdsourcing delivery: Near interconnected business models to reinvent delivery

[141] Martin Savelsbergh1 and Tom Van Woensel, City Logistics: Challenges and Opportunities, H. Milton Stewart School of Industrial & Systems Engineering, Georgia Institute of Technology, U.S.A., School of Industrial Engineering, Eindhoven University of Technology, The Netherlands, February 7, 2016

[142] Gatta et al. European Transport Research Review, 2019

[143] Gatta et al, Public Transport-Based Crowdshipping for Sustainable City Logistics: Assessing Economic and Environmental Impacts, Sustainability 2019, 11

implemented numerous strategies such as hiring a team of professional couriers to start the service or partnering with high-volume retailers in order to ensure critical volume to attract courier.

In an interview[144] the Roadie CEO Marc Gorlin explained how the company approaches crowd shipping. He gave an example of a Delta ticket agent who delivers lost luggage to travellers located along routes the agent uses when driving home. Delivering misplaced baggage is just one example of crowdsourced fulfilment. However, retail can also benefit in nimble ways that online retail giants cannot exactly match. Roadie, which has also worked with retailers and supermarkets, uses data science to match drivers with routes. The company operates in "nearly 89 percent" of the US, with some 120,000 drivers available for work. Unlike the general case with ride-hailing services, these delivery drivers can "see where they are going and how much they are going to be paid for it," Gorlin said.

According to Belgium-based crowdshipping company PiggyBee, a majority (58 percent) of its community is made up of travellers that tote and deliver items in their luggage for delivery to other countries[145]. Two of the top routes are U.S. to France and U.S. to India. Popular items transported include official documents, clothing, cosmetics and e-cigarettes.

In a similar vein, Entruster is a platform that uses mail forwarding services to enable shoppers to buy internationally and have purchases delivered by travellers.

Business

Five types of business models can be identified in the crowdsourced delivery industry[146]

Name	Clients	Offer	Couriers
Courier	B2C	Deliver an order from a shop, restaurant, pharmacy, etc. intra urban	Professional or non-professional Dedicated couriers
Interdant	B2C	An order is placed on the platform. It is the courier who purchases the article from a shop and delivers the article to the customer. Intra urban	Professional or non-professional Dedicated couriers
Intra-urban	P2P or B2B	Deliver a parcel. Intra urban	Professional or non-professional Dedicated couriers, Commuters
National	P2P or B2B	Deliver a parcel. Intra urban/National	Travelers
Social delivery	P2P or B2B or network	An order is placed on the platform. The courier proceeds to purchase and then to delivery. National/International	Travelers

Table 7-1: Crowd shipping business models

7.5.2. Market analysis

Market readiness

[144] Why Retailers Are Crowdsourcing Delivery

[145] Piggybee

[146] Rougès, J., Montreuil, B., 2014. Crowdsourcing delivery: New interconnected business models to reinvent delivery. In: 1st Int. Phys. Internet Conf., pp. 1–19.

Several delivery services (grocery, food delivery, and all non-hazardous items) with crowd shipping are already operational. Roadie, which raised more than $37 million in series C[147] funding in February 2019, is strengthening its partnerships with mobility service providers) to expand the service therefore carpooling can be considered at 8th- Proof scalability level of the Market Readiness Level.
Market positioning
With the growth of demand for delivery determined by e-commerce, numerous crowd shipping companies have been founded. To date there are many crowd shipping platforms that are already providing the service (Postmates, Zipments, Deliv, Roadie in the USA, PostRope in Australia, Renren Kuaidi in China, Nimber in Norway, Trunkrs in Netherlands, PiggyBaggy in Finland just to name a few) and big companies such as Amazon, Walmart, DHL, and Uber are conducted city - level pilots projects. Therefore, the crowd shipping service can now be considered an existing market. To date the Amazon "Amazon Flex" crowd shipping service is available in nearly 80 cities in the US alone[148]. In 2016 Alan McKinnon, in his "crowd shipping white paper" pointed out that crowd shipping platforms are essentially intermediaries, Amazon is one of the world's biggest sources of packages and main users of last mile delivery services. Therefore, "Amazon's entry into the crowd shipping market could prove a game-changer, so long as it is able to entice sufficient numbers of self-employed 'partners' into its Flex operation". On the other side smaller retailers rely on crowd shipping platforms to guarantee fast delivery services to compete with large e-commerce companies[149].
Market maturity
Given that different companies already provide the service, crowd shipping can be considered in the growth phase compared to the market lifecycle. Le and Ukkusuri[150], point out that there are still few behavioural studies on crowd shipping to date, but various questions are emerging regarding the exploitation of couriers, their discontent and the consequent quality of the delivery service. Ultimately, according to McKinnon, the scalability of crowd shipping will depend on three-way inter-dependence in the growth of supplier, courier and customer numbers.

7.6. Selected Business Model Cases in the Shared On-demand Mobility Category

7.6.1. Case 1: Taxistop

[Case background]

[147] Series C funding is one of the stages in capital.raising process for a startup. The series C is the fourth stage of the startup financing, usually the last stage of venture capital financing.

[148] Become an independent Amazon Flex Delivery Driver

[149] Crowdsourced delivery explained: making same day shipping cheaper through local couriers

[150] T.V. Le and S.V. Ukkusuri, Crowd-shipping services for last mile delivery: Analysis from American survey data

Taxistop is a non-profit organization which provides sharing mobility services such as carsharing and carpooling. For the carpooling service their app Carpool.be helps its users find a carpool partner for regular or single rides.

[Business model explained]

Taxistop provides carpooling services for individual travellers and companies, but with the increasing competition (big platforms such as Uber, BlaBlaCar) in recent years they are focusing more on commuters and B2B models especially in the Belgian market.

Compared to its competitors, the value proposition of Taxistop is that they offer personal contact with expertise and dedication, working together with their partners to create customized services and being also available by telephone (which create more trust in customers). In the future the focus will probably be directed to interconnected mobility, leveraging on past research projects (e.g. SocialCar) and MaaS schemes for multimodal travels.

In the past, revenue streams came mainly from the government (subsidies in general), while now it is much more from businesses. In fact, the government cannot intervene in the market, so it was risky to rely only in one customer.

Key resources for Taxistop are the IT platform, marketing and mobility experts. Innovation is also very important to them, to the point that they have recently created a new role whose main responsibility is innovation. Other resources come from Google for geodata and maps, from Oracle for databases and some licenses but there are no direct relationships with suppliers.

Given that carpooling is a difficult market, among other activities that Taxistop is carrying out in the field of carpooling there are also activities aimed at finding new strategies, such as: the promotion of carpool software for individual travellers in cooperation with the government, the collaboration of young student population to try to innovate their business model, try to offer carpool journeys linked to other tools, even investigating in how they can be valuable to MaaS operator.

Taxistop's main partnerships are mainly with companies but also with regional governments and public transport operators. In particular, regional governments such as Wallonia, Brussels and Flanders sometimes finance their innovations.

Two examples of services realized and financed by local authorities and transport agencies are the CAMBIO Car Sharing and the Less Mobile Service in Flanders.

Less Mobile Service is a kind of Uber service for elderly people with reduced mobility, not disabled people. Like a kind of peer-to-peer service, also drivers are elder people, and they are volunteers. The service is organized with local municipalities. Taxistop provides support for software, insurance, couching, but not directly the service that is managed directly by municipalities. For drivers this is not a profit-making activity and they are refunded 30 eurocents per km. Members are using the service around once a month on average. Considering the way customers use the service, often this is not adopted as a mobility service but more a social service activity.

[Other factors influencing business model]

There are also a number of factors that are important for the business model but are not reflected in the Canvas, for example regarding how the business model has evolved over time according to internal and external factors.

The difficulties that Taxistop had to face and that led to the change of their business model over time are mainly linked to the fact of being a non-governmental organization (although over the years this type of organization has increasingly acquired a modus operandi similar to that of companies) and, sometimes, the lack of the resources needed to implement the large number of ideas and initiatives. This has made it difficult to compete with international platforms like Blablacar or Uber, that have more financial capacity. Furthermore, from a technological point of view, Taxistop cannot compete with larger companies with some 30-40 developers.
For these reasons Taxistop has decided to focus on more specific services and to limit its offer to the Belgian market, taking advantage of its experience, bond and knowledge of the territory, of the main players, and of the regulatory framework (including tax and insurance systems). At present Taxistop intends to further integrate users' feedback. They already have a rating system with stars and descriptions, but they have also started working with user groups to evaluate in advance any updates on tools or features in their software. In the future, the main intentions are to integrate connectivity into their service offerings.
The impacts of COVID-19 have not really changed operations and models in the Taxistop business. Regarding Car Sharing service, CAMBIO CarSharing has registered impacts in revenues: -80% in May, -30% in November. The service for now is not subsidized by regional Flemish government due to the presence between shareholders of local Public Transport Operator, so a different public support.
For the CarPooling sector, Taxistop operates with annual licence fees from companies so, for now Taxistop has felt impacts in usage of service but not in related revenues. If COVID-19 will remain in longer than one year, then Taxistop will face problems in revenues due to necessity to renovate with companies/customers the licence fees.
For Taxistop the prediction of post-COVID situation is still difficult. But for now, Taxistop has registered a shift from collective modes of transport to individual ones. More people are using bicycles, but Taxistop registered also more solo car users and solo trips. In between the waves of COVID pandemic, Taxistop has registered also more interest in car sharing usage. Because cars are shared but trips are individual.
Carpooling also is a mode of transport more individual than public transport, so carpooling should also see an increase of usage after the COVID period. But this is not what Taxistop wants, as a mission driven organization: first cycling, then public transport and then solo car drivers as target group.
Regarding Less Mobile Service, for this service Taxistop had to tackle with the fact that not only customers but also service providers, the drivers, are part of the “risky group for COVID”. This is the reason why the service is not so much in use in this period. In any case, Taxistop has registered how both customers and drivers are shifting to other kind of services, like grocery service, and the use of the service only for having a chat between customer and driver. For elderly people, the journey is not only for the journey itself but also as a kind of daily event to leave the house and meet someone else. This is not the service that Taxistop wanted to propose, but this is an element that in the future can be considered for the update of the proposal as a kind of “shopping service” for elderly people.

[Implications for decision-makers from authorities / public transport]

In general, carpooling can be seen as a complementary transport service to public transport, managing to serve, on demand, areas that can be characterized by low demand levels.
In particular, some of Taxistop's main partners are regional governments and public transport operators and in the future the organization would also like to focus on MaaS schemes for multimodal travellers. Therefore, the service offered is harmonized with the local authorities and is a support for public transport. This will be even more true when the services will be brought together under a single MaaS platform.
The dependency on local authorities has revealed its limits in this period of pandemic where governments have different priorities than subsidizing of carpooling services. "Carpooling is never at top of priorities, but now it is even lower in priorities".
The City of Ghent is the only authority that has decided to finance car sharing and bike sharing due to their direct impacts during COVID.

<table>
<tr>
<td rowspan="2">Key Partners
• Mobility companies
• Regional governments
• Public transport operators</td>
<td>Key Activities
• Platform maintenance
• Customer experience optimisation</td>
<td rowspan="2">Value Proposition
• Facilitating carpooling rides between drivers and passengers;
• Supporting companies in deploying carpooling initiatives by means of expertise and personal contact with (in-house consultancy) and dedicated campaigns.</td>
<td>Customer Relationships
• Automated services and self-services
• Personal contact</td>
<td rowspan="2">Customer Segments
• Individual travellers
• Organizations in charge to optimize mobility in their area/domain</td>
</tr>
<tr>
<td>Key Resources
• IT platform
• Marketing team
• Mobility experts</td>
<td>Channels
• App/website
• Direct contacts</td>
</tr>
<tr>
<td colspan="3">Cost Structure
• Software development and maintenance costs
• Marketing and advertising fees
• Employee salaries</td>
<td colspan="2">Revenue Streams
• Public funding
• Pay-as-you-go</td>
</tr>
</table>

Figure 7-1: The Business Model Canvas for Taxistop

7.6.2. Case 2: Helbiz

[Case background]
Helbiz company, was founded by Salvatore Palella in 2015. At the time of its foundation, Helbiz was conceived as a car sharing platform which should have exploited both the blockchain and ethereum smart contracts technologies.
By evolving, Helbiz has become a micromobility provider. Besides offering a scooter-sharing service with HelbizGo, the company also offers a peer-to-peer car-sharing service (Helbizcar), and autonomous drone taxi service (Helbizair). The focus in on HlbizGo.

[Business model explained]
HelbizGo is a dockless intra urban transportation solution, allowing commuters, via an app, to rent and to leave electric scooters curb side once they have arrived at their destination.
The services refer to the scooter-sharing and bike-sharing customer segments: users from the main cities, those not owning a car and environmentally friendly youngsters, using the specific app.
Besides the typical value proposition of scooter sharing services (as easy parking, and not expensive transportation costs), Helbiz adopts the charging sharing formula: in the United States commuters are paid when recharging the scooters. As for the payment methods, Helbiz relies on a pay-as-you-go model.

[Other factors influencing business model]
Helbiz platform for fleet management includes artificial intelligence and augmented mapping system.
This technology optimizes operations and guarantees profitability. The information on the travel made, drivers, vehicles and personnel employed which are collected anonymously by the platform and treated through advanced analysis. These data are thus used to correctly implement, monitor and reposition the fleet so as to satisfy demand in different areas and maximize the number of trips.
As for the founding, Helbiz has a double quotation in the Stock market.

[Implications for decision-makers from authorities / public transport]
The fast growth of the free-floating scooters services has become a relevant issue for public authorities. In this vein, recently some major cities (among the others Milan, Rome, Paris) have regulated both the scooter driver's conduct and the parking. These initiatives try to manage the total amount of scooters in certain areas of the cities and, at the same time, aim to reduce the areas where is possible to use them. Moreover, some speed limitation has been introduced to balance scooters usage with public safety.

<table>
<tr>
<td rowspan="2">Key Partners
• Investors
• Public policy makers (electric scooter regulations)
• Scooter manufacturers
• Specialised technology providers (GPS, payment, analytics, and specialised API)
• Cloud service providers
• Payment service providers</td>
<td>Key Activities
• Free-floating mobility service providing (scooters)
• Peer-to-peer Scooter and bike sharing providing
• Services are usually developed thanks to a franchising network.</td>
<td rowspan="2">Value Proposition
• Vehicle availability
• Easy parking (free-floating float)
• Charging sharing formula</td>
<td>Customer Relationships
• Automated services and self-services, with personal assistance in specific situations.</td>
<td rowspan="2">Customer Segments
• Young commuters (students and youngsters)
• Smart commuters, either car and non-car owners (environmentally-friendly lifestyle)</td>
</tr>
<tr>
<td>Key Resources
• Physical resources: Software enabling platform (managing float, real-time environment mapping).
• Human resources: website and App designers and developers (IT), marketing and sales team (Marketing and Sales), and CRM team (Customer Relationship)
• Information Resources (data gathered and collected via app)</td>
<td>Channels
• App-based channel
• Website channel</td>
</tr>
<tr>
<td colspan="3">Cost Structure
• Float purchasing and maintenance costs
• Software development and maintenance costs
• Employee salaries
• Marketing and advertising fees
• Payments for charging e-scooters</td>
<td colspan="2">Revenue Streams
• Revenues from service fees (pay-as-you-go)</td>
</tr>
</table>

Figure 7-2: The Business Model Canvas for Helbiz

7.7. Impact of COVID-19 on This Innovation Category

Sharing mobility operators like Bird, Lime, Jump, and Spin were confronting financial headwinds even before COVID-19 drastically reduced urban trips worldwide. Faced with plummeting usage, the companies have yanked their fleets off the street and retreated from entire continents. Their financial outlook is bleak: Bird recently laid off nearly 40 percent of its staff, while Lime is reportedly seeking an emergency round of financing at a sharply reduced valuation.

The rapid rise of sharing services was fuelled by huge investments from venture capital, with Bird alone raising over $500 million from firms including Sequoia, Accel, and Index Ventures. Investors were already pushing the operators to show profitability before the coronavirus struck, and it is not at all clear that venture capital firms will double down on their shared micromobility investments to keep companies afloat during the coming months and also after the pandemic.

Micromobility's biggest uncertainty is no longer the extent to which cities will accommodate a new form factor, but whether shared scooters will still be available when we emerge from the current pandemic. Generally, an idea is growing between public administrations that would have seemed anathema a few months ago and that different analysts are considering: Should municipalities and governments stop imposing fees on sharing mobility operators and start subsidizing them?

Several signs say yes. The problem is that sharing mobility is living in a dual reality, in a limbo where it is not clear if and how that business will operate. People look hesitant to use shared services and are invited to not move if not necessary. But at the same time the sharing services (scooters and bikes) look positive to be used because can maintain the recommended social distance from others. This is the reason why Citi Bike in New York City trips rose 67% when the virus emerged. Bikeshare and shared e-scooters can fill gaps where bus and train service has been cut in response to the virus. In USA, cities including Denver, Tampa, and San Francisco have classified e-scooter businesses as essential.

Officials in Portland, Oregon, have provided financial incentives to keep e-scooter service available. On April 6, the city announced a partnership with Spin in which the city will temporarily waive e-scooter daily fees of up to $0.20 per scooter and $0.25 per trip in exchange for Spin reducing the cost of a ride by around 50 percent.

The recovery of shared mobility providers is also relevant to the OEMs and suppliers that create vehicles and components since they may need to improve their designs to increase safety in consideration of the pandemic. To keep customers and invite more people to use their services even during the pandemic, if resources are available, operators were required to optimize the frequency of cleaning and sanitizing their equipment. This might be tricky, though; during this period of decreased ridership (and accordingly diminished staff), French operators Dott and Pony have each confirmed that disinfecting vehicles every eight to ten rides is the best they can do for now.

With so much uncertainty in the market, micromobility providers are advised to prioritize the right kinds of services for different regions and allocate resources accordingly. That may even include entering some non-mobility businesses, such as grocery e-commerce and package delivery, for added growth.

Companies such as Voi, Dott, and Gotcha have launched B2B partnerships, offering up their fleets to ferry goods to those sheltering in place around the world. Despite their limited capacity to carry cargo, these vehicles have been useful in the delivery of, among other things, pharmaceutical products, groceries, and takeout. This is a risky experiment for these companies, however: as operators are offering access to their vehicles at a discount in these partnerships, their margins will get even thinner.

Established players and new entrants have the opportunity to grow through M&A. In fact, the industry already shows signs of accelerated consolidation via M&A. For instance, a European micromobility provider acquired an e-scooter business earlier in 2020, while a US-based mobility company acquired a global transportation company's bikesharing brand [151].

Another option that companies are pivoting is the offer of longer-term rentals (daily, monthly, etc.), which would allow them to eliminate the time-consuming disinfection between riders required under their normal model and would still ensure good rates of vehicle usage. Despite potential advantages, this option is still very much in the beta testing phase, as evidenced by the major price discrepancies among the monthly rental offers from Pony (US $43), Spin (US $60) and Wheels (US $89). These might serve as good "try before you buy" options for riders; both Wheels and Pony (through its Adopt-A-Pony program) are now also selling their vehicles directly to consumers.

Forecasting that regular commuting will again represent a greater share of ridership as lockdowns ease up, operators are also planning to work directly with companies keen on offering their employees alternatives for getting to the office. Launching B2B offers is considered by operators another effective way to attract new riders, as their employers would subsidize subscriptions or ride credits. In Paris, Velib and Cityscoot have released "Pro" offers in anticipation of the end of the confinement period; Voi and Tier had already had these sorts of offers available, though their conditions were not publicly disclosed.

Together with fleet floating shared services, another service that is facing the pandemic reduction of rides is the docked bike share. Like e-scooters, docked bikeshare can replace car trips (research suggests bikeshare ridership is inversely correlated with gas prices), and serve as a first-mile, last-mile connector for transit. The difference and problem of this kind of service is that but bikeshare wouldn't exist without generous operating subsidies from marketing partners like Blue Cross Blue Shield in Chicago and Citigroup in New York City as well as from local governments. For instance, Los Angeles' Metro Bike Share receives more than $15 million in funding per year from the city and the LA Metro transportation agency.

Different researchers and policy makers are analysing the necessity of waiving fees from sharing mobility providers and offering public funding to the sector. The problem is the illusion that it would be easy to do so in the current fiscal environment. With the collapse of transit ridership, local transport agencies have lost most of their farebox revenue. Local governments are facing their own financial reckoning due to falling tax revenues and emergency health spending. In USA, $25 billion allocation in federal emergency funds provides an immediate lifeline but may not be enough to keep local agencies afloat until ridership fully returns.

[151] Why shared mobility is poised to make a comeback after the crisis

7.8. Conclusion

With shared on demand mobility solutions, travellers can easily request a service (travel, parcel delivery, etc.) through a smartphone from wherever they happen to be, or when they want. This kind of modality aims to be easier, faster, greener, and more convenient than using a "common way" and a usual service provider (as public transport).
Even if the real convenience of sharing services market is still not completely confirmed, the power of this business is based on the direct contact of users with providers. The realization of software interfaces and portals that can ensure easy ways for customers to book and to interface with what they need can help to build loyalty users and can attract them more than with standard services. With these systems, users can interface with services they need and can establish trust and report their experience and use, for example, their smartphone to pay services used. Furthermore, for service providers, the application of their offers through apps and internet platforms can help them to understand customers preference and so increase their service quality and functionalities. Not only to private companies but also with local transport authorities and operators. The results of market analysis is summarized in the following table.

Table 7-2: Summary of Market Analysis

New mobility service/technology	Market readiness	Market positioning	Market maturity
On-demand ride sharing	8 (Proof of scalability)	New market	Growth
Bike sharing	6 - 7 (between proof of traction and Proof of satisfaction)	Existing market	Growth/Maturity
E-scooter sharing / micromobility	7 – 8 (between Proof of satisfaction and Proof of scalability)	New market	Growth
Ride-hailing	8 – 9 (between Proof of scalability and Proof of stability)	Re-segmentation of an existing market as a low-cost player	Growth
Crowd shipping	8 (Proof of scalability)	New market	Growth

Local authorities can benefit from sharing systems to handle lack of urban public and complementary transport to ease first/last mile travel where public services are not enough. The implementation of these systems can lead to reduction of vehicle usage, ownership and vehicle miles travelled, to improve use of public station infrastructure, to rise of environmental awareness and postponement of car purchase and selling. Finally, furthermore, a correct coordination of local service providers can lead to adoption of data sharing protocols among platforms that help improve the local service provision.

The implementation of these solutions are, unfortunately, facing different obstacles that have limited up to now the spreading power of these services. Some of the top obstacles to using real-time sharing services are: the trip length, the added time for ride logistics, reliability to people that provide service and with whom share the service (safety of user).
While for service providers some of the most common obstacles happen to be: damages of vehicles, thefts, proper maintenance, presence of proper infrastructure (e.g. lockers, charging stations, etc.), reallocation of vehicles in operating areas. Evaluation that still does not look to be solved is the lifespan of vehicles. Depending on the operating region, electric scooters, cars and bicycles change the resisting time for being operating, and often this depends on the local weather and from users' behaviour. For example, depending on the degradation range, electric scooters can have a lifespan between three and six months.
One element that in recent years is showing all its influence and importance is the regulation (local and national) that shapes the sharing services world. A couple of questions are, for example, the legality of ride hailing services, regarding possibility to ride people in exchange for a fare and the way they engage drivers, and the urban management in accordance with electric scooters, often reason of nuisance, blocking pavements and public spaces, leading to strong discussions with companies proposing these services. Finally, the necessary deregulations enabling the crowd shipping market and the definition of laws that protect crowd shippers' labour, liability and insurance, together with regulations able to protect customers from package stolen, lost or damage or, unbeknownst to the crowd shipper, illegal.
Established players and new entrants are now looking to opportunities derived by strategies based on merges and acquisitions for aggregating services and increase market size. The industry already shows signs of accelerated consolidation via merges and acquisitions. A general restructuring from "sharing economy outbreak" of last years is leading companies to reorganize their business with a more rational analysis of right kinds of services for different regions and allocation resources accordingly. For example, micromobility's biggest uncertainty is no longer the extent to which cities will accommodate a new form factor, but whether shared scooters will still be available when we emerge from the current situation.
The situation often is also leading to a diversification of services, not only limited to transport sector but also with non-mobility businesses, such as grocery e-commerce and package delivery, for added growth.
Key resources that will determine the future of the business are IT competence, marketing, mobility experts and, mainly, the centrality that often these companies give to customers, to expertise and dedication to customize constantly their services. Important, together with diversification of services and consolidation of business, will be the interconnection of different mobility systems, in a view of Mobility as a Service ecosystem for multimodal travels.
The lack of resources is leading to analyse and implement the larger possible number of ideas and initiatives, together with a new and deeper interface with local administrations that need to promote social distancing without however causing explosion of private traffic. Forecasting that regular commuting will again represent a relevant number of ridership in next future ease up, some operators are planning to work directly with companies keen on offering their employees alternatives for their mobility. Launching business-to-business offers is considered by operators another effective way to attract new riders.

8. FUTURE SCENARIO ON NEW MOBILIY SERVICES AND TECHNOLOGIES

This deliverable has selected one future scenario to investigate how companies will change their business models in the future and explore what regulatory changes and support are needed to make business model transformation successful. After initial research on existing future mobility scenarios, the consortium partners agreed that "Greener Community 2040 Scenario" from UK Government Office for Science might be an appropriate one because it is relatively more consistent with GECKO's objective. The outcomes of this chapter are mainly based on GECKO stakeholder workshop 2.

8.1. Greener Community 2040 Scenario

"Greener Community 2040 Scenario" is one of the four scenarios developed from a cross-governmental workshop of UK Government Office for Science. It aimed to identify the critical uncertainties that will influence mobility between now and 2040.

Different uncertainties are considered when building this scenario, including transport users' willingness to share data and adopt new technologies, the extent to which transport will be shared or used exclusively, future levels of automation; future rates of electrification; the extent to which physical mobility will be replaced by online alternatives; future use of active transport; the relative roles of public and private actors; future levels of social inequality; and the trade-offs between individual choice and overall social and environmental values.[152] The details of Greener Community 2040 Scenario was shown in Figure 8-1.

This scenario is used as a basis to facilitate the discussions between policy makers and industry practitioners during the stakeholder workshop. The participants discussed how the business models might need to be changed according to this scenario and what regulatory support are essential for this business transition.

[152] A time of unprecedented change in the transport system

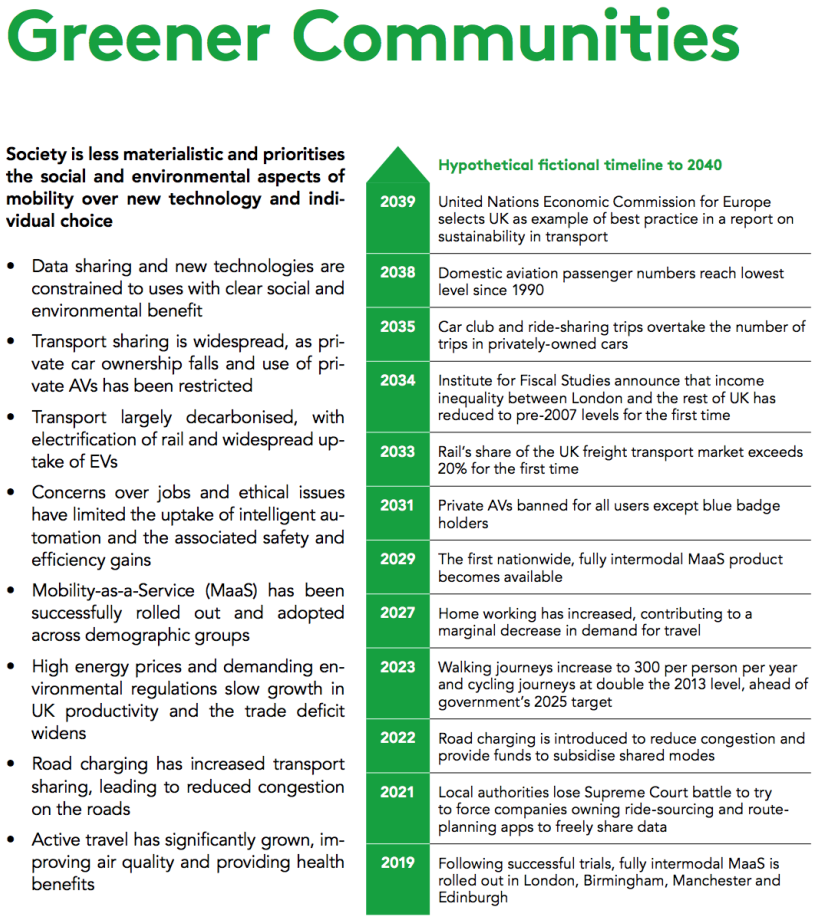


Figure 8-1 Greener Communities 2040 Future Scenario

8.2. Changes of business models in the future scenario

Prior to the stakeholder discussion, the participants were asked to complete the stakeholder survey. In the survey, the industry practitioners were asked if they would need to make significant, minor or no changes in various aspects of their business model in order to be prepared for a Greener Communities scenario. They were asked for a brief description of the types of changes they would expect needed. Overall, 17 stakeholders answered this survey. The results are summarized in Figure 8-2.

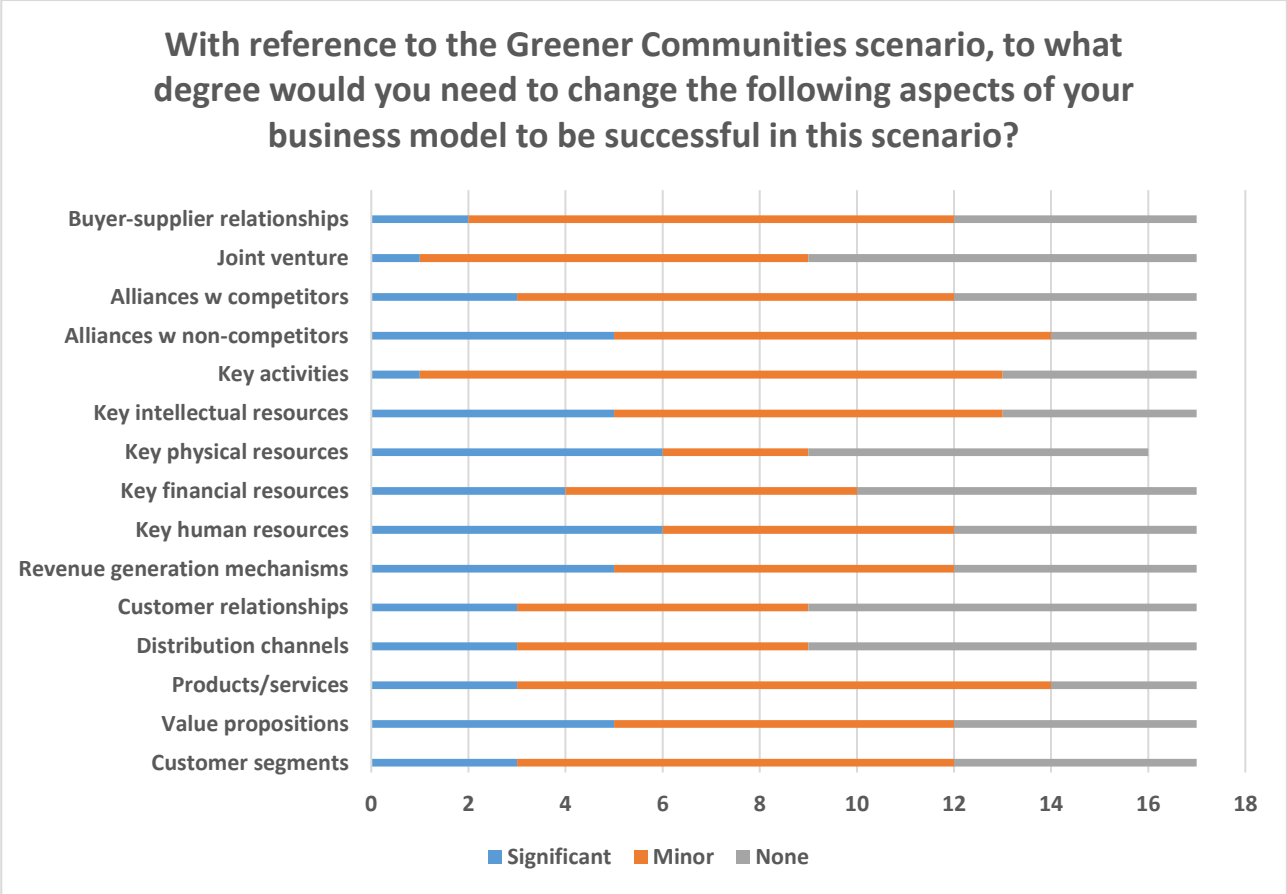


Figure 8-2 Stakeholder Survey Results on Business Model in Future Scenario

More detail analysis of responses on changes of business model elements are shown as follow:

1. **Changes in Customer Segments:**
   - Customer segments are from B2B+B2C to more B2B+B2G focused.
   - The change of business models is an evolutionary process in this future scenario (compared to COVID-19, for example).

2. **Changes in Value Propositions:**
   - The value proposition needs to convince that a car-ownership is non-prioritization.
   - The main proposition needs to address the safety and harmony issues between "old" and "new" technologies.
   - The resources and technologies will need to be changed to offer reliable and convenient services.
   - Autonomous minivans might appear to elevate the suburban public transport experience.

3. **Changes in Channels:**
   - It will shift towards digital ticketing.
   - Some services need to be present in Maas applications.
   - Some channels will be through national / government agencies.
   - Services are clustered in one platform (i.e., digital channels with integrated services)

4. **Changes in Business Relationships:**
   - Customer relationships will become more automatised and digitalised.
   - Direct B2B & B2C multilingual communications will be common.

5. **Changes in Revenue Generation Mechanisms:**
   - New service fees will emerge from this scenario as the technologies are ready for combining with value-added services.
   - Public funding might be an important source of funding during this scenario.
   - Annual, monthly, weekly or daily subscription fees are supplemented with B2C rich media advertising, connecting community services through geo-tracking.
   - There might be fees on environment related tax collection and fees on charging/energy bills.
   - New offering based on public-private partnership

6. **Changes in Key Resources:**
   - Data-driven design expertise is a key resource for competitive advantage.
   - It will require heavy investment unless the business adopts a public–private partnership model.
   - Transport infrastructure will need to be changed to accommodate these new mobility technologies and services.
   - Service design and the application of AI in transport might be the mainstream.

7. **Changes in Key Activities:**
   - Analysis of environmental footprint (aggregated) will be conducted frequently.
   - The mobility-related activities might be secure 24/7 operation.

8. **Changes in Key Partnerships:**
   - Cities and new mobility providers (train, bus, autonomous vehicles) are even more important than today because strategic alliances would help incumbents to compete in this sustainability-oriented scenario.
   - Mobility services is very likely used by other companies (competitors) who provide similar offers.

9. **Changes in Cost Structure:**
   - It is difficult to clarify specific cost structure as the supply chain might be significantly different from the current stage.
   - One of the new costs is to maintain outstanding service quality in this scenario.

9. CONCLUSION

D1.4 reviewed the most disruptive new services and technologies in the transport industry. Each disruptive innovation is critically evaluated by key factor analysis, market analysis and Osterwalder business model canvas, with different case studies. Findings of D1.4 depict the overview of these innovations to help understand the current market readiness, positioning and maturity of new mobility services and technologies. Furthermore, the analysis shows that different technological, social, operational and business factors are relevant to the implementation of innovations. Policy makers and industry leaders therefore should carefully evaluate each factor and see how it will influence their decision making on market expansion or regulation design.

In addition, the business model analysis suggests that the value creation, delivery, and capture mechanisms of each new mobility services and technologies can vary significantly though it was identified some similarities when grouping into four innovation categories.[153] Further data analysis on business model suggests that each innovation category has its own distinctive value proposition, which keeps evolving because of the uncertainties of rapidly changing market status and regulations. These value propositions are unique selling point of new mobility services and technologies. When policy makers intend to promote specific new mobility, they need to consider the alignment between the evolving value proposition and regulatory support.

D1.4 investigated the impacts of COVID-19 on these innovations as well because the pandemic has significant influences on the sustainable urban mobility and might potentially facilitate / deter some disruptive innovations. For instance, COVID-19 might have a lasting impact on CCAM innovation category as it is driving significant changes in the macroeconomic environment, regulatory trends and public acceptance to disruptively new mobility technologies. This pandemic is a double-edged sword for the goal of sustainability. On the one side, as the world has shifted to a more home-based living and working environment, moving goods and services without human interaction is more important than ever before. It is therefore a turning point to accelerate the transition toward CCAM, with the introduction of CAVs, UAM and drones. On the other side, it might contradict to the goal of sustainability because of the potentially increased car ownership in the future. It is therefore important to avoid contradiction with the goal of sustainable mobility in Europe.

Finally, a sustainability-oriented future scenario was used in the GECKO stakeholder workshop to verify our findings and further explore how business models and regulatory policies might be changed in the future. Overall, the findings provide guidance for public authorities to design more appropriate policies to prosper the development of the transport industry.

[153] D1.2 has thoroughly discussed these similarities and differences of business models.

GECKO CONSORTIUM

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

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