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The municipalities' action in Smart Mobility: current Italian initiatives and international projects

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Abstract (Italiano)

La Smart Mobility è modello di mobilità emergente che si propone di ottimizzare e semplificare il trasporto dei cittadini e delle merci nelle città, con il fine ultimo di ridurre il traffico e l'inquinamento presenti. I progetti riguardano tutti gli ambiti della mobilità in città e tutte le tipologie di mezzi: pubblici, di proprietà, in condivisione, ma anche mezzi adibiti a consegne. Il filo conduttore che lega tutte le iniziative è la tecnologia, le tecnologie di comunicazione vengono sfruttate per proporre soluzioni innovative ai problemi della città. Inoltre, tutte le iniziative Smart concorrono ad una visione della mobilità futura ininterrotta, verde, efficiente, sicura ed accessibile tenendo in considerazione oltre all'aspetto tecnologico quello ambientale e sociale.

L'elaborato si inserisce all'interno del lavoro di ricerca dell'Osservatorio Smart and Connected Car del Politecnico di Milano ed ha come obiettivi principali l'individuazione e descrizione dei principali trend per i comuni italiani nell'ambito della Smart Mobility, la mappatura delle iniziative presenti nel mondo e il confronto tra le due realtà per individuare similitudini e differenze. La tesi si conclude con un approfondimento del rapporto tra il grado di collaborazione pubblico-privato e il tipo di innovazione che viene generata.

Abstract

Smart Mobility is an emerging mobility model that aims to optimize and simplify the transport of citizens and goods in cities, with the ultimate goal of reducing traffic and pollution. The projects cover all areas of urban mobility and all types of transport: public, owned, shared, but also delivery vehicles. The common thread that links all the initiatives is technology, communication technologies are used to offer innovative solutions to the problems of the cities. Moreover, all Smart initiatives contribute to a vision of seamless, green, efficient, safe and accessible future mobility. Not only technological, but also environmental and social aspects are taken into account. The dissertation is part of the research work of the Smart and Connected Car Observatory of the Politecnico di Milano. The main objectives of the thesis are the identification and description of the main trends for Italian municipalities in the field of Smart Mobility, the mapping of the initiatives in the world in the same field and the comparison between the two realities to identify similarities and differences. The work closes with an in-depth examination of the relationship between the degree of public-private collaboration and the type of innovation that is generated.

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Executive summary

Smart mobility definition

The concept of Smart Mobility has been gaining ground in the last few years, especially in the implementation of the broader phenomenon of the Smart City. Finding the right definition and main characteristics is not immediate. The most straightforward and comprehensive definition is that by Lyons (2018, Lam & Head (2012), Banister (2008), Curtis (2008)):

"connectivity in towns and cities that is affordable, effective, attractive and sustainable."

This definition includes all the fundamental aspects of the phenomenon: technological, social and environmental dimensions. All smart initiatives aim to offer future mobility that is *"a personalized 'service' available 'on demand', with individuals having instant access to a seamless system of clean, green, efficient and flexible transport to meet all of their needs"* (Docherty, Marsden, Anable, 2017; Wockatz & Schartau, 2015). Since Smart Mobility is a broad and complex phenomenon, Trombin, Pinna, Musso, Magnaghi, De Marco (2020) fix some basic principles of the mobility experience it aims to offer: *flexibility, efficiency, integration, clean technologies, safety, accessibility.* These features represent the main drivers for solving problems in the city: traffic and pollution. The goal of Smart Mobility is to solve them and improve the quality of life of the citizen. (Papa & Lauwers, 2015).

To sum up, Smart Mobility is the transport of people or objects that uses innovative technologies in the ICT or automotive fields, with the main objectives of reducing traffic and pollution in cities and making transportation safer. It is articulated in 13 application areas defined by Faria, Brito, Baras, Silva (2017) and by Mandžuka (2018) (Figure 1).

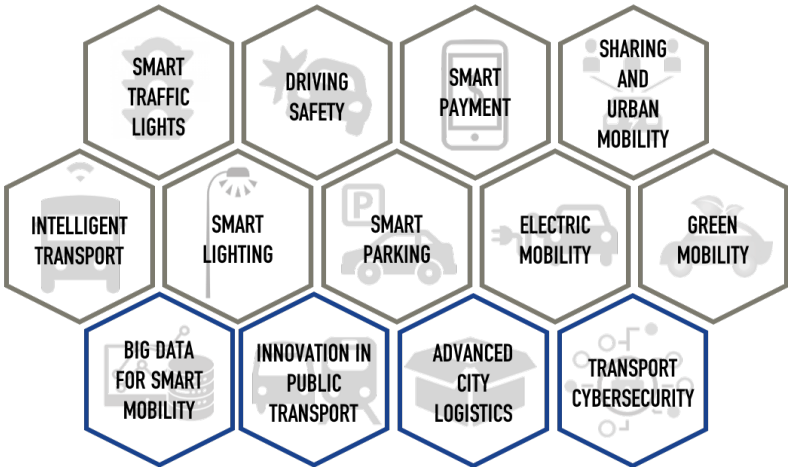

Figure 1 Main areas of the Smart Mobility phenomenon

Strategic and funding context: European context with global and Italian references

The main theme is transport that inevitably falls into environment, digital and research and innovation. The interest in this thesis develops from 2015, the year in which the COP21 marks a worldwide change of pace for the interest in the environment and climate change. At European level after 2015, Commission's actions are more focused on the environment and inevitably on emissions

from the transport sector, without neglecting interest in technological innovations. Like the other Member States, Italy structures its strategies in the sector following the European directions.

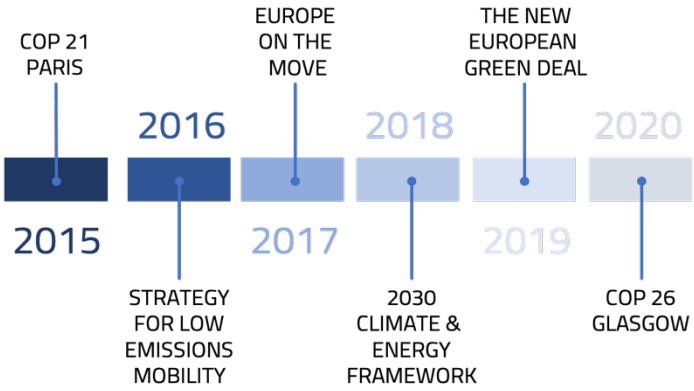

Figure 2 Timeline 2015-2020

Particular emphasis is directed towards transport funds at European level. They are analysed in detail and summarised in a table describing their main objectives and allocations (see Table 8, *Funding opportunities: goals and budgets*). European objectives in this field are mainly accessibility and environmental aspects, thus technology serves these objectives. The investments aimed at pure technological innovation for transport are minor, mainly aiming at the reduction of CO2 emissions, increase in resource efficiency, safety of European citizens and accessibility of the areas of the Union.

Objectives and methodologies

The objectives of this thesis are the following:

- Identifying the main trends in the Smart Mobility sector in Italy and the main similarities and differences with the rest of the world;
- Discovering the influence that the degree of public-private collaboration has on the type of innovation generated and how municipalities can benefit from collaborations in future initiatives.

The following steps have been performed to answer the questions:

a. Processing of the data coming from the survey made by the Observatory. The survey was sent to 363 Italian cities with more than 25.000 inhabitants aiming at collecting data on the Italian situation and the main projects in action;
b. Mapping of the active and developing projects through a search for secondary source: web sites focusing on the diffusion of ICT and the automotive industry were visited to collect projects and their characteristics. A large database has been created and then analysed;
c. Comparing of the two sets of data underlining similarities and differences in the two scenarios;

d. Creating and analysing the framework: definition of the axes with references to the survey and literature, positioning of the cases (representative countries), description of the sample initiatives to motivate the positioning, presentation of the results.

Italian scenario

Nowadays, the importance of the topic is recognised by most municipalities as shown in Figure 3, the theme is very relevant for 58% of them and fundamental for the 29%, adding to 86%. For the 12%, the topic is little relevant while only one of the municipalities considers it irrelevant.

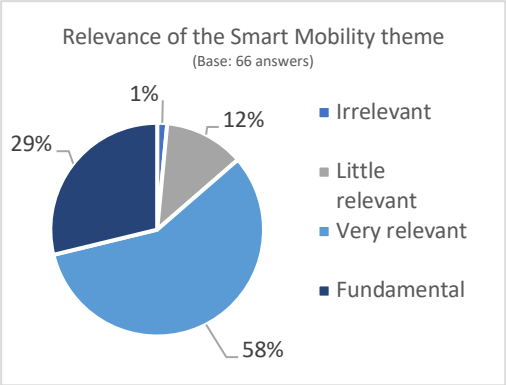

Figure 3 Relevance of the Smart Mobility team according to municipalities

Most cities among the respondents have already started Smart Mobility projects (Figure 4). A good portion of the municipalities, 36%, have recently implemented activities, in the three-year period from 2017 to 2019, 38% state that they have started projects before 2017 and instead only a quarter of the municipalities (25%) have never started projects in the past. The level of progress of the initiatives is another indicator for the level of development of Smart Mobility.

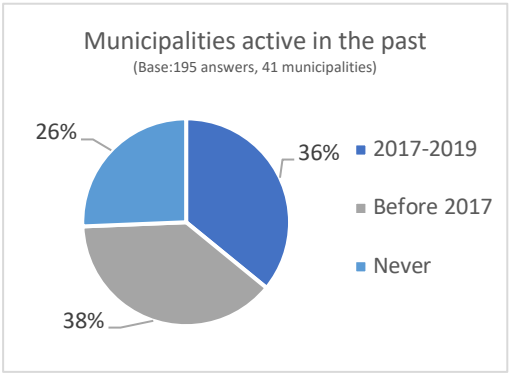

Figure 4 Municipalities active in Smart Mobility in the past

Actually, a very positive result emerges from Figure 5: 57% of the projects started are executive projects, while only 18% are pilot projects and 23% preliminary analysis. This is a positive result: feasibility and success have already been tested for many technologies and uses and Italian municipalities are taking concrete action in this field.

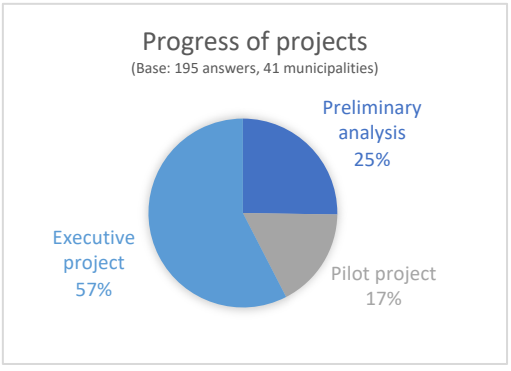

Figure 5 Distribution of past projects by progress

As illustrated by the chart on past projects distribution (Figure 6), the most widespread areas of application include electric mobility (21%), sharing mobility (17%) and parking management (16%). Data on future projects confirm the same areas as most widespread.

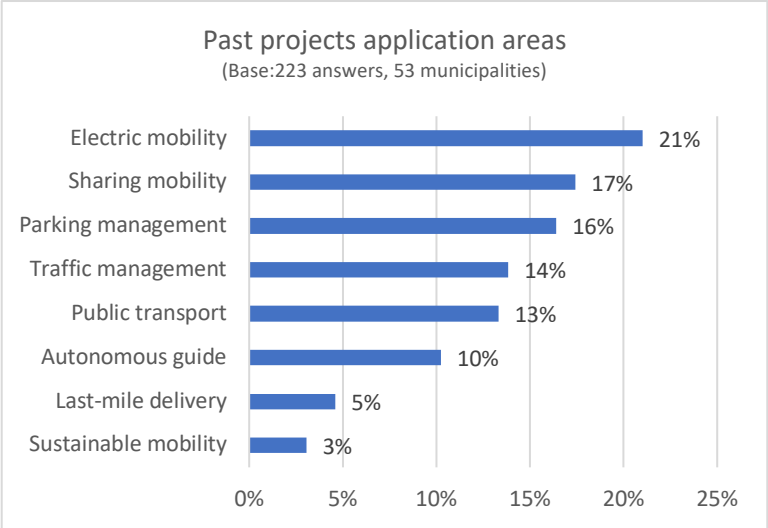

Figure 6 Distribution of past projects by application area

The municipalities create partnerships for the realization of projects. for projects already active the main actors are municipal companies (24%), universities and research centres (15%) and other municipalities (14%); all these partners are very close to the public administration. In the future the situation changes, actors less close to the municipality are involved, the prevalent ones are start-ups (15%), sharing companies (12%) and delivery companies (12%).

Then, municipalities identify as the major challenge in the implementation of smart mobility projects a fruitful collaboration between public and private (33%). Municipalities and private companies have different objectives and make different choices hard to reconcile.

Eventually, more than half of the Italian municipalities think that independent driving will not be a reality within the next 10 years: 49% thinks that autonomous driving won't probably be a reality and the 4% is sure about it. Despite of the tests and projects in place, today there is still scepticism toward this technology.

Global scenario

Among the 287 initiatives collected, many are linked to Europe (57%) and especially to Italy (36%, excessive percentage comparing to other countries). This geographical distribution is due to the influence of the research language and

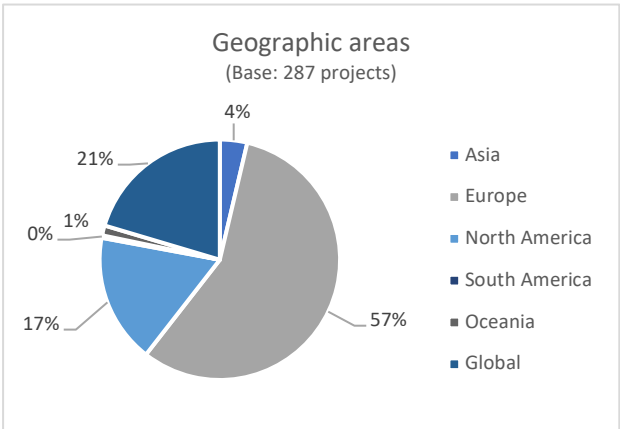

Figure 7 Geographic distribution of projects collected in the database

previous research. The relevant geographic areas are Europe (57%), North America (17%) and Global (21%), (Figure 7).

Going into country details and excluding Italy, the United States have the highest percentage of initiatives (16%) followed by the United Kingdom (8%) and Germany (7%) (Figure 8).

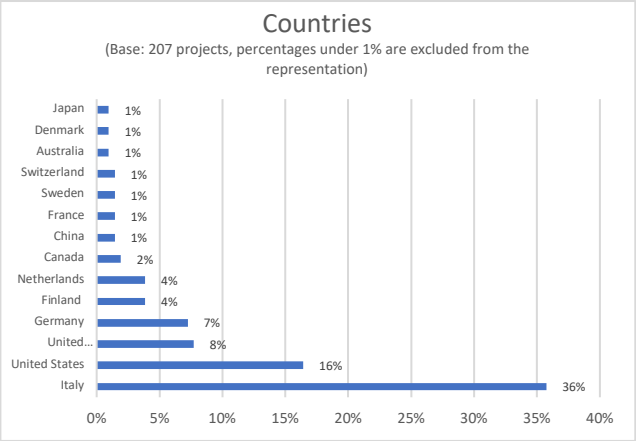

Figure 8 Distribution of projects by country

As displayed by Figure 9, the most widespread areas of application are sharing mobility with 18%, and electric mobility with 17% of the projects, of which more than half in Europe (61% and 65% respectively). They are closely followed by the autonomous guide projects (13%) which are developed at European (31%), global (27%) and North American level (24%).

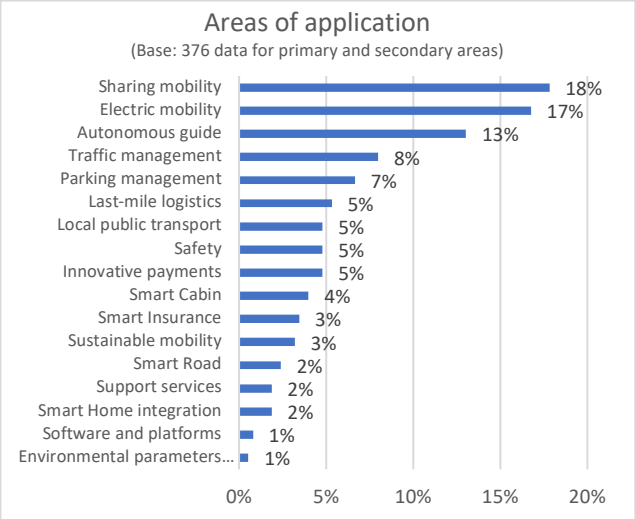

Figure 9 Dissemination of areas of application

There is a growing trend in the launch of projects until 2019, year of the analysis (see Figure 10). In 2018, percentage of projects increased by 72% compared to the previous year, in 2019 by 70%. As for the current year (2020) and future years, growth is expected.

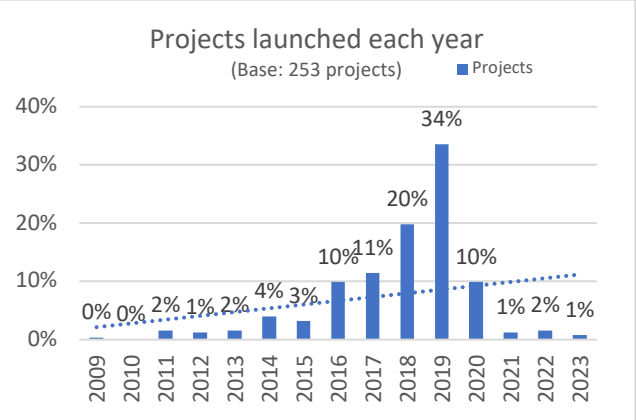

Figure 10 Distribution of project launches over the years

The largest number of the listed projects are executive (54%) and pilot (29%) projects (see Figure 11). There is less information and therefore less projects regarding preliminary analyses (15%) and prototypes (2%). The high number of executive projects is a positive sign once again.

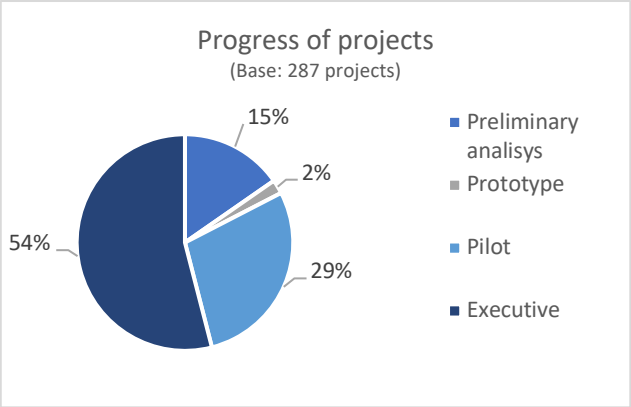

Figure 11 Distribution of projects by progress

In the world, the established companies are the main player with 55% of the projects, followed by the start-ups with 25% and finally by public administration with the lowest percentage of 10%.

Comparison

Similarities and differences emerge between the Italian municipalities situation created on the basis of the survey and the global representation generated through the database.

The first difference concerns the distribution of projects over time. For the municipalities the activity is constant, the percentages of projects before 2017 and after 2017 are comparable. For the world there is a gap between the two periods, although most of the initiatives are launched between 2017 and 2019, this last timespan represents the real development and expansion of Smart activities.

The most widespread areas are almost the same as shown in Figure 14. The diffusion of independent driving is the main difference. The spread of the autonomous guide on a world-wide level lightens the extremely negative result of the forecasts of the Italian municipalities. The other countries in the world, especially North America, believe more than Italian municipalities in the realization of this technology.

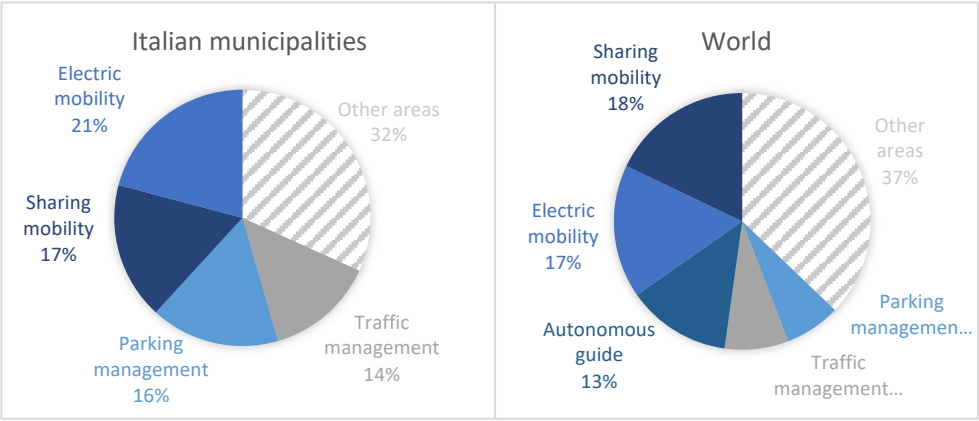

Figure 12 Comparison between the main areas of application: Italian municipalities vs. World

One more confirmation comes from the analysis of the status of the projects. More than half of the projects are executive both in Italy and in the world (57% in Italy, 54% in the world). A fundamental difference can be found in pilot projects and preliminary analysis a quarter of both categories are represented by autonomous driving initiatives, confirming the strong interest in this smart area worldwide.

The last difference concerns the actors involved, municipal companies, universities and research centres are the most relevant for past projects in the municipalities (those categories go under public administration in the database), start-ups for future projects. In both cases the situation is completely opposite to the global one where the established companies implement most of the projects.

A further consideration concerns Italy coming out of the survey and Italy described in the database. The representations are consistent in all aspects except for the time distribution. That could be due to the lack of some initiatives in the database such as sharing initiatives for which only illustrative initiatives have been taken, or to the inclusion of initiatives not technologically smart by municipalities.

Framework

The formulation of the framework starts from the consideration of the main challenge faced by the municipalities: the achievement of *a fruitful collaboration between public and private actors*. The latter is related to the type of innovation that is generated with the introduction of a new smart solution.

The first axis represents the degree of public-private collaboration, it can be:

- weak, when the partners are very close to the public administration, or even part of it;
- strong, when the partners are private companies extraneous to the public administration and diversified among themselves.

The second axis represents the type of innovation generated which can be:

- Incremental: when in reference to an application area or a service the smart solutions follow one another as a series of incremental improvements to the previous one (e.g. sharing mobility initiatives)

- Radical: when the new smart solutions disrupt the application area or service as they were before (e.g. last mile delivery through drones)

Italy (from the survey) and other countries are positioned in the matrix. For these countries, only projects implemented by public administration and partners are considered (private companies' projects are excluded from the matrix).

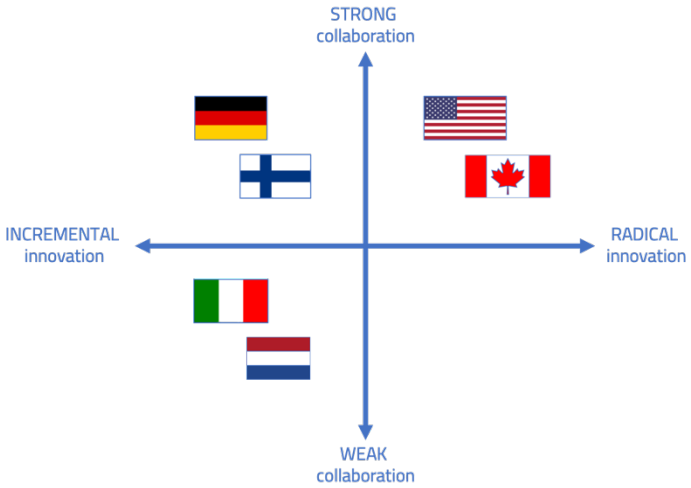

Figure 13 Collaboration - Innovation matrix

Italy is positioned in the first quadrant at the bottom left because it reflects the characteristics of weak collaboration with private actors and incremental innovation. Indeed, municipal companies, universities, research centres and other municipalities are the main partners in past initiatives and electric mobility, sharing mobility and parking management are the most widespread sectors. These sectors are characterized by incremental innovation as observed through the database initiatives (no information about specific projects in the survey). In the same dial is Netherlands characterized by weak public-private partnerships and initiatives in areas with incremental innovations. The sample initiative is Traffic lights in 's-Hertogenbosch, it is part of the traffic management area and involves sensors and intelligent traffic lights.

The second quadrant to be analysed is the upper left and corresponds to an incremental innovation and a stronger collaboration between public and private. Finland and Germany are located in this area. The sample initiative for Finland is Whim, an app integrating all the mobility offerings in Helsinki. It represents no radical innovation but a strong collaborative effort. For Germany, the emblematic initiative is WATERKANT Berlin, a public project for the construction of a residential district linked to a sharing electric mobility service and easy access to charging system. The solution does not foresee any technological novelty compared to classic sharing and charging.

U.S. and Canada are in the upper right quadrant, they are characterized by a stronger collaboration with private companies, but especially by initiatives in areas with radical innovations. In the case of

the U.S., Global Smart Logistic Network is the initiative for drone shipping of medical samples by UPS Flight Forward Inc. It involves a strong collaboration and a radical innovation: the introduction of drones in the last-mile delivery. The Driverless Shuttles project in Edmonton and Calgary is the one representing Canada, it involves autonomous driving shuttles accessible to the public supported by technology for connected vehicles. A strong collaboration which offer a disruptive service: the introduction of self-driving vehicle available to the public.

Following the analysis of the three quadrants, a relationship emerges between the level of collaboration and the type of innovation generated. Indeed, no country (i.e. no database initiative) is located in the lower left quadrant where a weak collaboration is linked to a radical type of innovation. Therefore, no initiative that has been developed by public administrations or collaborations between public entities has generated a radical type of innovation.

To sum up, the generation of a radical innovation has a necessary but not sufficient condition: a strong collaboration with private companies (both established and start-ups). There are strong collaborations that do not generate radical innovations, but there is no radical innovation generated by weak collaboration.

In the future, Italy could benefit from the stronger collaboration with private companies and experience the development and application of radical innovations. In this case Italy would move in the upper right quadrant reaching U.S. and Canada.

This trend is supported by:

- the survey data for the future, where percentages on radical innovation areas, in particular autonomous guide, are higher than before;
- the initiatives in the database, the first projects involving autonomous guide in Italy are collected (dated 2019, 2020, i.e. after the survey was compiled).

The dominant example is the municipality of Turin, which has already started several projects with its collaborations, including self-guided vans, electric and made with 3D printing, Olli vans, and drones for deliveries or transport of 1 or 2 people, Urban Air Mobility project.

Conclusion

Among the Italian municipalities the topic of Smart Mobility is very relevant, which is confirmed by the fact that most cities have launched and will launch initiatives in this field in the near future. The areas where the projects are already active or will be activated are mostly the same: electric mobility, sharing mobility and parking management and the projects are mostly executive. For active projects, the main actors are municipal companies, universities, research centres and other municipalities, for future initiatives collaborations with start-ups and sharing and delivery companies are expected. This is the picture of a country where the most traditional smart solutions are exploited, and also quite widespread in cities regardless of their size. When compared to the rest of the world, Italy is lagging behind in one of the most controversial areas of Smart Mobility, i.e. the use of solutions involving autonomous driving. In the world and especially in the U.S. autonomous driving projects are more widespread: they are the third application area for diffusion after sharing mobility and electric mobility. Their diffusion challenges the scepticism of Italian municipalities about the potential integration of autonomous driving in the near future. Even in the world most of the projects are executive but the autonomous guide makes the difference: many pilot projects and preliminary analyses are dedicated to it. Finally, established companies are responsible for the most part of the projects, once again they are linked to the numerous autonomous guide projects.

The degree of public-private collaboration has an influence on the type of innovation generated. Close collaboration with private sector actors (established companies and start-ups) is the necessary but not sufficient condition for the generation of radical innovations. As a matter of fact, there are collaborations that do not generate radical innovations (see the cases of Finland and Germany) but there are no radical innovations that are the result of weak or absent collaboration (see empty quadrant in the matrix).

Therefore, Italian municipalities have the responsibility to exploit future collaborations with actors from the private sector in the most profitable direction (from the point of view of innovation). The City of Turin is already benefiting from these collaborations from 2019. It has already launched several projects aimed at radical innovation in their sector, such as the use of autonomous vans to be combined with public transport and the use of drones as taxis or for rapid deliveries.

1. Smart Mobility

The concept of Smart Mobility is becoming increasingly popular in recent years, especially in relation to the Smart City phenomenon. Finding the right definition and main characteristics is not immediate, as over time several different ones have been given that focus on different aspects. However, in the following paragraphs, all the different aspects of Smart Mobility are defined and presented. Objectives, trends, actors, main areas, benefits and technologies will be addressed in the chapter.

1.1 Definitions & phases of development

Smart Mobility is often presented as a solution to the enormous negative impact that a poorly managed mobility system has. It is a set of coordinated actions concerning the transfer of people, goods and information and aims at improving cities' efficiency, effectiveness and sustainability (Benevolo, Dameri, D'Auria, 2016). The use of the term 'Smart' today implies the involvement of ICT. As stated by Trombin, Pinna, Musso, Magnaghi, De Marco (2020), Smart Mobility is "*a set of transport and logistics systems supported and integrated by the ICT*" (Jeekel, 2016). The definition encompasses several dimensions: technology (both ICT and automotive), infrastructures (e.g. parking lots, recharging networks, signage, vehicles), new mobility solutions and models, people (Arena, Cheli, Zaninelli, Capasso, Lamedica, Piccolo, 2013). Smart mobility is one of the six topics of Smart City according to Giffinger's classification (Giffinger, Fertner, Kramar, Kalasek, Pichler-Milanović, Meijers, 2007). It is one of the most important topics and has a lot of implication on the level of smartness of the city (Benevolo et al., 2016).

Different definitions of Smart Mobility are available in literature. According to Staricco (2013), there are two main definitions depending on the relevance given to ICT. The term Smart Mobility refers to:

- An efficient and effective mobility system. Using the most "*appropriate*" technologies, the system becomes smart, regardless of the level of innovation of the technology.
- A mobility system characterized by a consistent and systematic use of technological innovation, both in terms of ICT (used to provide information, to streamline traffic, to manage public transport fleets, to improve logistics) and means of travel (electric cars, buses on demand, bike and car sharing). Therefore, the most innovative technologies are applied regardless of the cost/benefit rate.

Two main aspects emerge from these definitions: the sustainability and liveability of the mobility system and the constant innovation in technology. These aspects coexist according to Staricco (2013), while Papa & Lauwers (2015) see an evolution of the concept.

Since the earliest common usage in 1990s, until the early 2000s, the techno-centric approach was widespread. The term indicated a mobility system "*capable of maximizing its efficiency thanks to a large and widespread use of ICT".* Focusing on technology and innovation of the infrastructure, the techno-centric approach has been largely supported by multinational companies, leaders in the sector of ICT. In the second half of 2000s the focus shifted on the human side with a consumer-centric approach: *"the human component represents the crucial element for building up a smart mobility system"*. The technologies are more and more widespread, but now they are "*enabling tools*" only, not sufficient to make smart a mobility system by themselves. Therefore, Papa & Lauwers (2015) stress the importance of an integrated approach, involving technology, sustainability and quality of life.

The need of a comprehensive definition arose. Lyons (2018; Lam & Head, 2012; Banister, 2008; Curtis, 2008), in his attempt to align the paradigms of smart and sustainable, wrote a comprehensive definition outlining the main features of the phenomenon. Smart Mobility is defined as:

"connectivity in towns and cities that is affordable, effective, attractive and sustainable."

Firstly, Smart Mobility is connectivity, thus "*the state of being connected*" (Oxford Learner's Dictionaries) from a physical and digital point of view. Physical connectivity is the reduction in distances, lessening the need for motorized mobility, and therefore enabling active mobility (cycling and walking). Digital connectivity is the digital supply of goods and services that concerns mobility in itself (sharing solutions), but also avoiding the physical transfer of people and goods (logistics and last mile services). Secondly, affordability, effectiveness and attractiveness characterize the answer to the different needs and interests of all users; as well as the alignment of technology and sustainability from an economic (traffic flow and congestion level), social (greater equity in the distribution of costs and benefits of travel) and environmental (reduction of consumption and emissions) point of view (Staricco, 2013).

Hence, technology plays a relevant role, but commercial attractiveness and innovative potential could jeopardize the importance of providing all users with mobility that is "*affordable, effective, attractive and sustainable*". There is a need to put technological and social considerations on an equal footing and to ensure their due importance. Therefore, policymakers, providers and researchers should be aware that "*Smart and sustainable need to be brought together*" (Lyons, 2018).

Following this principle, the future of mobility as stated by Docherty, Marsden, Anable (2017; Wockatz & Schartau, 2015) seems conceivable. Mobility will be *"a personalized 'service' available 'on demand', with individuals having instant access to a seamless system of clean, green, efficient and flexible transport to meet all of their needs"* (Docherty et al. 2017; Wockatz & Schartau 2015).

Since Smart Mobility is a broad and complex phenomenon, Trombin et al. (2020) fix some basic principles of the mobility experience it aims to offer (Table 1):

Flexibility	The possibility to choose the best among the multiple means of transport available in a given context.
Efficiency	The ability to arrive at the desired destination with minimum effort and in the shortest time possible.
Integration	The chance to plan a trip without taking into account the kind of mean involved thanks to their integration.
Clean technologies	With the aim of reducing emissions, we are moving from pollution-causing vehicles to zero-emission vehicles.
Safety	By exploiting technologies for safer mobility, the rate of injuries and deaths is drastically reduced.
Accessibility	Different forms of Smart Mobility should be accessible to everyone.

Table 1 Background principles of Smart Mobility, reworking of the author on Trombin, Pinna, Musso, Magnaghi, De Marco, 2020

To offer a *flexible, efficient, integrated, clean, safe and accessible* experience, individual initiatives are not sufficient. The development of different initiatives and their coordination drives the smartness of a mobility system. Moreover, Benevolo et al. (2016) argue a positive correlation between the Smart Mobility maturity and the use of ICT and define three phases of Smart Mobility:

- *starting phase – only a small number of activities, which are usually not coordinated with each other, and cover only a small portion of the urban area;*
- *intermediate phase – a number of wider-aiming activities, pursued by the city authorities, and the introduction of pilot projects and the measuring of results;*

- *mature phase – the integration of Smart Mobility solutions, the use of Intelligent Transport Systems, the collecting and sharing of data, i.e. open data.*

(Orlowski & Romanowska, 2019; Benevolo et al., 2016)

Several authors define Smart Mobility giving less importance to the ICT and the automotive technologies, thus, including actions which do not exploit them. As stated by Baucells Aletà, Moreno Alonso, Arce Ruiz (2016), Smart Mobility entails a range of initiatives which promote user's mobility, on foot, by bicycle or on public or private transport that seek a shared goal: to cut economic, environmental and time costs. According to the authors, "*planning must prevail over technology*" with projects aiming to organize transport modes and to encourage walking, followed by means of transport with lower emissions and noise pollution (Rodríguez Bustamante 2015).

Finally, Lyons (2018) asserts that urban design can be considered a valid form of Smart Mobility. It generates attractive environments to live and work for citizens, lessening the need or aspiration for motorized mobility (Lyons, 2018; Rode, Floater, Thomopoulos, Docherty, Schwinger, Mahendra, Fang, 2014).

Therefore, we will refer to the definitions that consider technological contribution fundamental, ranging from the innovations in the use of ICT to those in the automotive sector.

1.2 Objectives

The main problems concerning mobility in cities are traffic and pollution: smart initiatives act on both aspects, trying to improve the quality of life of citizens (Papa & Lauwers, 2015).

Trombin et al. (2020) deepen the problems of cities:

- The particulate level regularly exceeds the limit values (Climate Change Conference Paris 2015) multiple times.
- The traffic volume in large and medium metropolitan regions often outstrips any acceptable and sustainable standard.
- The traffic connections are not coordinated enough and ticket and booking management are inefficient.

- The first and last-mile issue: how to travel from A to B with lowest impact and highest efficiency.

The authors state that concrete solutions are required: an extreme transport system transformation is needed and will become a critical policy issue. They also identify three classes of objectives:

- Present objectives: decarbonization through fuel efficiency, fuel substitution, end-of-pipe carbon capture.
- Future objectives: joint and synergetic effects of the integration of energy, infrastructure and mobility urban systems, extension of the proposal of public transport, and sustainable land utilization.
- Ultimate goal: reducing both traffic and pollution, building intelligent and continuous flows, enhancing economies of scale to foster accessible mobility.

Eventually, Benevolo et al. (2016) summarize the objectives collected analysing the literature in six categories:

1. Reducing pollution;
2. Reducing traffic congestion;
3. Increasing people safety;
4. Reducing noise pollution;
5. Improving transfer speed;
6. Reducing transfer costs.

Docherty et al. (2017) see these benefits for the city and the citizen as side-effects of a more important objective for the smart mobility suppliers. They aim to satisfy significant unmet lifestyle needs of a range of traveller types to make the mobility market grow (Docherty et al.,2017; Wockatz & Schartau, 2015). Hence, the paradox of the Smart Mobility is grafted in: it "*simultaneously create(s) the promise of a system that can reduce demand, whilst at the same time fulfilling previously unmet demand and creating new demand*" (Docherty et al., 2017).

1.3 Trends

The main trends in the Smart Mobility phenomenon are identified through the analysis of *"The governance of Smart Mobility"* by Docherty, Marsden, Anable (2017), and *"Multimodal divide: reproduction of transport poverty in smart mobility trends"* by Groth (2019):

- Mobility as a Service: vehicle ownership is gradually replaced by vehicle usership, the concept is included in the broader phenomenon of sharing economy;
- Interconnected mobility: connected vehicles and intelligent infrastructures able to interact in real-time with the user through data;
- Electrification: increasing usage of vehicle exploiting battery power, plug-in hybrid or other technologies;
- Automated vehicles: new frontier of the car industry, automated cars do not need a driver;
- Intermodality: use of different transport modes on the same trip, transition from modal-centric to user-centric approach;
- Multimodality: the flexible usage of more than one transport mode for the travels within a specific period;
- Transition in the role of citizen: citizen as source and user of the information (User-generated and user-centered information); citizen as provider and user of the service (collaborative mobility).

Transport infrastructure, services and information and payment services will form a cooperative and interconnected ecosystem which will reflect the needs of customers. Borders between the different means of transport will be blurred or quite disappear (Docherty et al., 2017).

1.4 Actors

Analysing the literature three types of actors emerge:

- Citizens: centre of the smart mobility phenomenon, sources and users of information, providers and consumers of the service;
- Corporate & Public providers: services are offered from private or public organization or both;
- Policy makers: policies regulating Smart Mobility are essential, some initiatives require new regulation or territorial intervention.

According to Staricco (2013), for service providers, it is important to integrate technologies into citizens' mobility behaviours and to take into account the individual and social dynamics that ensue. Focusing only on the diffusion of technologies would limit improvement from the point of view of sustainability.

Furthermore, it is important to integrate innovations with spatial planning. The initiatives often require interventions to change the road space, in order to equip the infrastructure with sensors or instruments able to interact with the apps made available to users (Staricco, 2013).

Concerning Smart Mobility policies, the centre should be the citizen with his behaviour. These policies must be accompanied by transport, socio-educational and territorial policies/strategies that guide behaviour in the right direction (Staricco, 2013).

Docherty et al. (2017) noted that the state often acts as a *passive facilitator,* but they suggest greater involvement: it should address market failures that could hamper innovation or finance or offer resources to accelerate the adoption of innovation.

1.5 Main areas

The main areas of application of the Smart mobility phenomenon are presented in Figure 14.

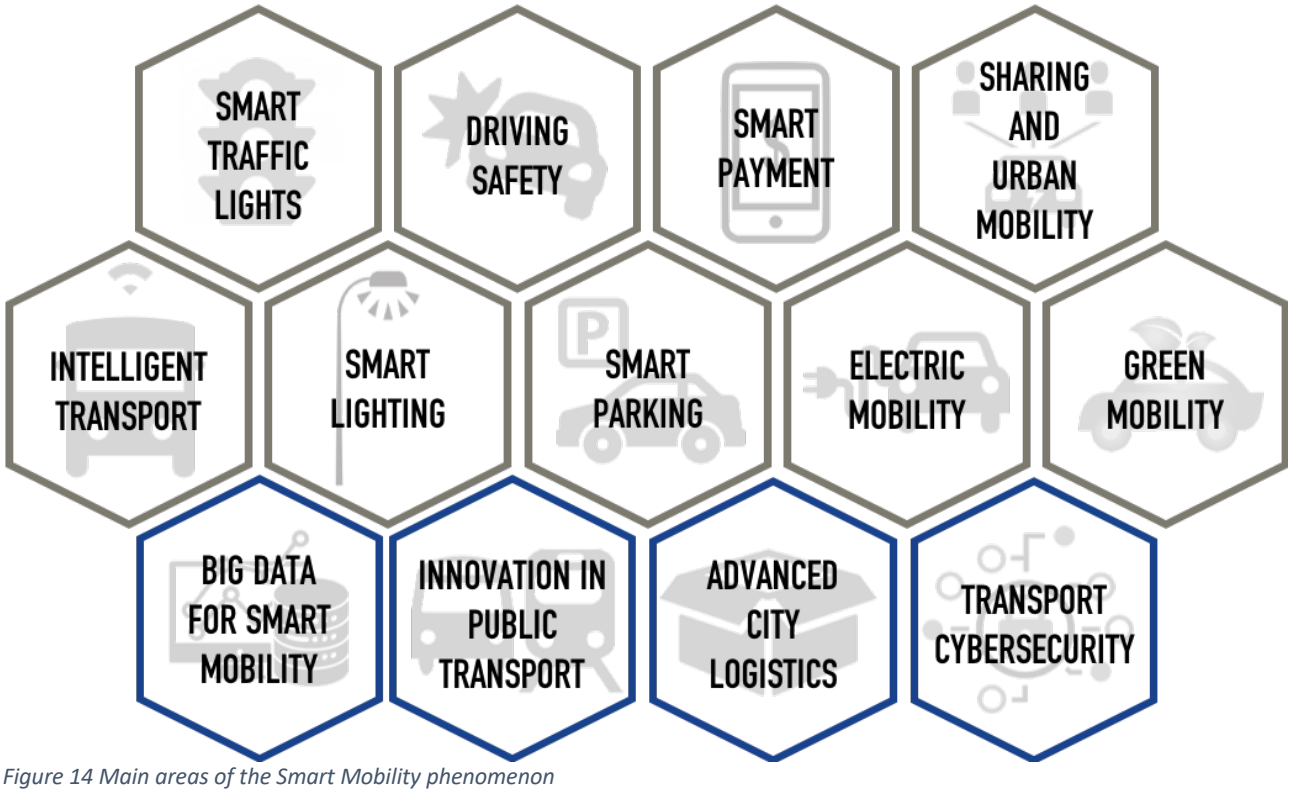

Figure 14 Main areas of the Smart Mobility phenomenon

In 2017, Faria, Brito, Baras, Silva defined the following areas of Smart Mobility (Grey in Figure 14):

- *Smart Traffic Lights Systems:* a traffic control system that combines sensors, cameras and artificial intelligence with traditional traffic lights. Unlike the traditional systems, which work on a fixed-time basis, it follows the traffic congestion by optimizing light cycle programs. It allows to improve the flow, save energy, reduce emissions and noise.
- *Driving Safety*: electronic driving assistance systems developed to protect the driver and passenger as much as possible (e.g. ADAS Advanced Driving Assistance Systems). They allow cars to interact with other vehicles or infrastructures.
- *Smart Payment Systems*: technologies that allow innovative payments (e.g. smartphone payments) or innovative toll calculation solutions that exploit the car connectivity.
- *Sharing and Urban Mobility*: shared transport systems include car sharing, bike sharing, carpools, and vanpools. Multimodal systems aim to make urban transport more sustainable by optimising travel combining different modes of transport.
- *Intelligent Transportation Systems*: technologies that solve characteristic transport problems. Through *advanced sensing, vehicular communication, and computing technologies, an individual vehicle can quickly detect traffic anomalies and then notify neighbouring vehicles.* These systems increase productivity of existing infrastructure avoiding the need for more, e.g. additional lanes on the roadway.
- *Smart Lightning Systems*: the lighting infrastructure is made smart through the use of LEDs with connected controls. They provide better lighting, cut energy consumption, reduce traffic congestion and improve traffic flow.
- *Smart Parking Systems*: sensors and cameras detect the arrival and departure of vehicles. Mobile applications or car systems provide information about available parking spaces, allowing drivers to save time and fuel and cities to have reduced air pollution and congestion.
- *Electric Mobility*: private, public or shared electrically powered means of transport that allow for a sustainable redesign of mobility that is climate- and environmentally friendly, efficient and resource-saving.
- *Green Mobility*: mobility that minimises the environmental impact caused by the transport sector without affecting the momentum of growth.

In 2018, Mandžuka added some points to the list (Blue in Figure 14):

- *Big data for Smart Mobility:* analysis techniques applied to urban domains to effectively use data.
- *Innovation in public transport:* use of ICT which allows public transport to satisfy traveller's needs by improving the quality of service, reducing costs and increasing effectiveness.
- *Advanced city logistics*: innovative solutions to increase efficiency of the transport of goods in urban environment (e.g. smart routing, automated delivery robots)
- *Transport cybersecurity: actions concerning cyber-attacks in the transport system, reducing the consequences, mitigating malfunctions.*

1.6 Benefits

The "*Automobility Transition*" (the mass adoption of motor vehicles) was one of the main socio-economic transformations of the 20th century (Geels, 2012) and the spread of Smart Mobility is considered as a transformation of the same magnitude (Docherty et al., 2017). The Smart Transition focuses on a number of positive changes in the way we travel, the mobility of the future will be a seamless service, personalised, available on-demand and with instant access. The transport system will be *clean, green, efficient and flexible*, and will also include connected and autonomous vehicles to meet needs of all users (Docherty et al., 2017; Wockatz & Schartau, 2015). It is argued that "Smart Transition" will bring enormous benefits.

Analysis of:

- *"Smart Mobility: Opportunities and Conditions"* by Staricco, 2013
- *"Smart Mobility and Smart Environment in the Spanish cities"* by Baucells Aletà et al., 2016
- "*The governance of smart mobility"* by Docherty et al., 2017
- *"Smart Mobility: A survey"* by Faria et al., 2013

This analysis revealed the theoretical benefits of Smart Mobility initiatives which will be presented in three groups. Each group corresponds to who or what enjoys the benefits: the people, the city (Smart Mobility is one of the main characteristics of Smart City) and the environment.

Benefits to the people:

- Improvement of services by saving time, enhancing the journey, saving money thanks to the availability of real-time information (Baucells Aletà et al., 2016);
- Increase in safety levels thanks to the adoption of connected and automated vehicles (Docherty et al., 2017);
- Transportation costs for the user will be lower because the capital of the mobility system, mainly infrastructure and vehicles, will be used much more efficiently (Docherty et al., 2017);
- A much wider choice for consumers thanks to new shared mobility solutions, real-time data aggregation and peer-to-peer mobility matching that reduce the power of large, monolithic suppliers over transport offer (Docherty et al., 2017);
- Users have at their disposal a benevolent mobility system to which everyone can access seamlessly and on demand thanks to technological advances (Docherty et al., 2017).

Benefits to the city:

- Reduction of gridlocks and accident rates, improvement of air quality, reduction of the urban footprint needed for parking spaces; these factors allow the sustainable development of the city (Faria et al., 2013);
- Better quality of life in the city, reduced costs, more efficient use of energy through applications such as streetlight control, smart parking and road traffic management (Faria et al., 2013);
- Reduction of noise pollution thanks to the increase in the use of electric cars due to smart initiatives (Staricco, 2013) and the improvement of traffic flow due to the use of smart traffic lights (Faria et al., 2013);
- Increase in safety levels on a large scale thanks to the adoption of connected and automated vehicles (Docherty et al., 2017);
- Improvement of quality and liveability in streets and squares following the redesign for Smart Mobility initiatives (e.g. for sensors placement) (Staricco, 2013);
- Reconfiguration of the elements of the mobility system such as land use patterns, employment and housing locations (Docherty et al., 2017).

The benefit to the environment is unique: the reduction of CO_2 emissions. Various types of initiatives contribute to this decrease:

- Initiatives that reduce the use of private vehicles and facilitate the integration of transport modes (Baucells Aletà et al., 2016);
- Initiatives providing real-time information which allow to save time and money and enhance the journey (Manville et al. 2014) (Baucells Aletà et al., 2016);
- Initiatives offering seamlessly and on-demand transport services available for all avoiding of much of waste, pollution and environmental degradation (Docherty et al., 2017);
- Initiatives to encourage the use of electric cars in conjunction with the production of energy from renewable sources (Staricco, 2013).

1.7 Technologies

Analysing the main innovations in Smart Mobility, Trombin et al. (2020) state that smart mobility finds its origins in a combination of innovations in transport, infrastructure and services and that the current scope of smart mobility is defined by four domains:

- *Vehicle technology: power trains, electric car technology, fuel technology, autonomous automation, driver assistance systems, but also new types of bicycles.*
- *Intelligent Transport System: cooperative adaptive cruise control, traffic management, connected automated driving, platooning of trucks.*
- *Data: travel information, logistics planning, advanced IT systems for matching supply and demand, big data solutions.*
- *New mobility services: seat management, car sharing, ride sharing, connecting transport modes, new cycling systems.*

(Trombin et al., 2020)

As stated by Orlowski & Romanowska (2019), the foundation of Smart Mobility is ICT (Information and Communication Technology) which encompasses all technologies able to handle and transfer information: e.g. internet, mobile network, wireless network and all the infrastructure which allow these channels to operate such as computers, smartphones, servers.

According to Cohen- Blankshtain & Rotem-Mindali (2013), the smartphone can be recognized as the heart of smart mobility. For travellers in the smart mobility system, the smartphone (and corresponding applications) is becoming the central access media to the various mobility services.

The main elements which enable communication extracted from the text by Faria et al. (2013) are: connected objects, types of communication, communication technologies and sensors whose characteristics are listed in Table 2.

Connected objects (IoT)	Smart infrastructure	Integration of the infrastructure with IoT, it is able to sense, measure and communicate data.	Infrastructure + Sensors & cameras + Communication technology
	Smart and connected car	Cars with these fundamental functionalities: localization, perception, path planning, control, management	Non-connected car + GPS + Sensors/Cameras + Electronic actuators
	Smartphone	It can be connected to the infrastructure, the car or both as intermediary	Applications enable the usage of the services.
	Smart devices	Devices that allow to implement additional functions on the car. e.g. Air quality sensing device or black boxes	Sensors/cameras/GPS+ Communication technology
Type of communication	V2V, V2I, V2X (Network used: VANET)		
Communication Technologies	5G, 4G GPS Bluetooth, ZigBee Wi-Fi		
Sensors	Infrastructure sensors	Magnetic sensors Ultrasonic sensors Wireless sensors BLE (Bluetooth Low Energy) sensors Infrared / Passive Infrared sensors UHF frequency, RFId WLAN network	
	Smartphone sensors	Low energy micro electromechanical systems (MEMS) Accelerometers Gyroscopes	

Table 2 Main elements enabling communication

Source: Faria et al., 2017; Coppola & Morisio, 2016

In addition to the technologies currently deployed, Trombin et al. (2020) define some *"Strategic technological dimensions in the next future"* which describe the use of the most advanced technologies that will be applied to the mobility sector:

- *Autonomous things:* in the mobility sector, the Internet is transforming itself from an information technology in support of drivers and passengers to a real entity able to

autonomously control the means of transport. This will happen thanks to the diffusion of intelligent sensors in the environment and in the objects, especially thanks to the characteristics of the 5G area (large capacity and very low latency).

- *Augmented analytics*: data analysis is simplified through the use of machine learning and artificial intelligence. Therefore, it is possible even for the less experienced to identify hidden patterns by eliminating subjective or unconscious prejudices. The accessibility of data becomes a fundamental factor for the engagement of citizens.
- *AI-driven development:* mobility is made smarter through the use of artificial intelligence that allows different applications making it more comfortable, accessible and efficient. Indeed, autonomous objects can interact with the environment and perform tasks usually performed by human beings.
- *Digital twins:* the application of this model to mobility involves first of all IoT. It allows the connection in real time with the physical situation to be monitored and controlled. In addition, big data analytics and artificial intelligence are involved. These technologies enable insights that allow to improve the city in its physical and social environment.
- *Edge computing:* with this approach, data analysis takes place as close as possible to where it was produced. It is defined as distributed computing; processing takes place at the edge of the network. The advantages are the reduction of the delay for the calculation of the tasks offloaded from the devices to the cloud and the reduction of the backhaul load. Edge computing can be applied to mobility through connected infrastructures, data analytics and machine learning. The latter can optimize the traffic system and identify high accident intersections, thus reducing traffic accidents. The joint use of these technologies reduces the flow of data and minimizes the delay in communication which finally reduces the cost.
- *Immersive experience*: *by 2028,* conversational platforms (e.g. virtual personal assistants or chatbots) and technologies such as augmented reality, and virtual reality will allow immersive experiences which increase productivity. in the mobility sector, they will enable overhaul and servicing though unmanned vehicles, operator training through augmented reality and remote assistance.
- *Blockchain*: this technology is finding application in many fields. many experiments are underway for the application to the field of mobility in an attempt to improve its services and decisive aspects.

2. Context

This chapter deals with global, European and Italian strategies and investment plans (focusing more on EU) regarding the topics covered by the definition of Smart Mobility. Smart Mobility is the transport of people or objects that uses innovative technologies in the ICT or automotive fields, with the main objectives of reducing traffic and pollution in cities and making transportation safer. Therefore, the main theme is transport that inevitably falls into environment, digital and research and innovation. The interest in this thesis develops from 2015 (see Figure 15), the year in which the COP21 marks a worldwide change of pace for the interest in the environment and climate change. At European level after 2015, initiatives are more focused on the environment and inevitably on emissions from the transport sector, without neglecting interest in technological innovations. Like the other Member States, Italy structures its strategies in the sector following the European directions.

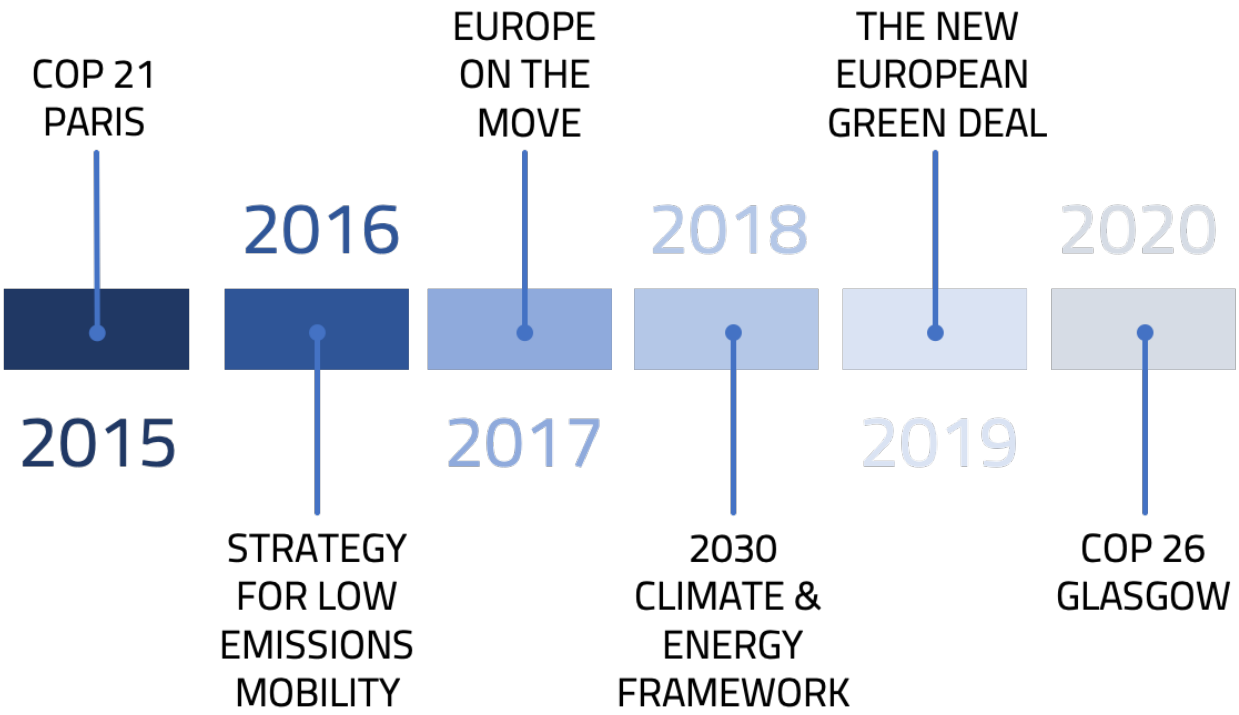

Figure 15 Timeline 2015-2020

2.1 World

All European and Italian proposals are in line with world-wide targets, mainly those defined by COP 21. During the Paris Climate Conference in December 2015, 195 countries signed *the first universal and legally binding global climate agreement.* The deal represents a global action plan to get the

world back on track to avoid harmful climate change by limiting global warming far below 2°C and continuing efforts to limit it to 1.5°C. It also aims to enhance countries' capacity to address the impacts of climate change and to assist them in their efforts. The Paris Agreement is a bridging link between current policies and climate neutrality by the end of the century.

Governments have accepted:

- a long-term objective to keep the global average temperature increase far below 2°C, compared to pre-industrial levels;
- a target to limit the increase to 1.5°C, as this would considerably mitigate the threats and effects of climate change;
- the need for global emissions to reach their peak as soon as possible, acknowledging that this will take more time for developing countries;
- to pursue rapid reductions subsequently in line with the best available knowledge, in order to reach a balance between emissions and removals in the second half of the century.

Countries submitted national climate action plans (nationally determined contributions, NDCs) to contribute to the objectives of the agreement. These are not yet sufficient to achieve the agreed temperature targets, but the deal opens the way for further action. Under the agreement, governments will meet every five years to assess collective and individual progress towards long-term goals, to inform the public about climate action and to track progress through a transparency and accountability system.

The agreement recognizes the role of cities, subnational authorities, civil society and the private sector in tackling climate change. They should increase efforts and support actions to reduce emissions, develop resilience and reduce vulnerability to the negative effects of climate change and promote cooperation both regionally and internationally.

Being at the cutting edge of international efforts to fight climate change, the EU has been crucial in brokering the Paris Agreement and still holds a global leadership position.
Source: https://ec.europa.eu/clima/policies/international/negotiations/paris_en

2020 is a turning point as the 26th climate conference will take place in November in Glasgow (COP26). Governments will have to come up with new and more ambitious projects to reduce greenhouse gas emissions in an effort to meet the COP21 targets.
Source: https://www.lifegate.it/persone/news/cop-26-glasgow

2015 was a landmark year for international policy shaping, beside COP 21, also *the 2030 Agenda for Sustainable Development* was enacted. All the United Nations Member States adopted this roadmap for actual and future *peace and prosperity of people and the planet*. The agenda presents *17 Sustainable Development Goals (SDGs)* constituting *a call for action by all countries - developed and developing - in a global partnership.*

Goals are *sustainable* not in environmental terms only: they cover a wide range of topics such as *ending poverty, improving health and education, reduce inequality, spur economic growth all while tackling climate change and working to preserve oceans and forests.*
Source: https://sustainabledevelopment.un.org/?menu=1300

Some of the 17 goals inevitably deal with mobility. As stated by Sustainable Mobility for All (SuM4All), born in 2017. The initiative aims to bring together a heterogeneous group of influential transport stakeholders with the aim of speaking with one voice and taking collective action to respect the *Sustainable Development Goals (SDGs)* and transform the sector to reach sustainable mobility.
Source: http://www.sum4all.org/who-we-are

In 2017 SuM4All published the first global assessment of the transport sector: *"Global Mobility Report 2017: Tracking Sector Performance"*. The report showed that progress in mobility is necessary to achieve various objectives, not only directly related to transport.

- *SDG 2 (Zero hunger); SDG 3 (Good health and well-being); SDG 4 (Quality education); SDG 5 (Gender equality): sustainable transport systems are necessary to provide food security, healthcare, access to schools and employment for women.*

- *SDG 11 (Sustainable cities and communities):* the target 11.2 is directly related to transport.
  Target 11.2: Providing access to safe, affordable, accessible and sustainable transport systems for all.

- *SDG 3 (Good health and well-being):* the target 3.6 is directly related to transport.
  Target 3.6: Halving the number of global deaths and injuries from road traffic accidents.

- *SDG13 (Climate action):* a change in mobility is necessary to reduce air and noise pollution, and address climate change.

Source: https://sdg.iisd.org/news/sustainable-mobility-crucial-for-achieving-sdgs/

2.2 Europe

In line with global targets, the European Union defines strategies and investments that provide the framework for the development of Smart Mobility initiatives in all its Member States. 2020 is a turning point at European level, previous plans expire, and the Union prepares the entry into future plans. The expiring plans constitute the environment in which the initiatives collected have developed, the future plans allow to see what has changed and what is expected for the future.

2.2.1 European Commission strategies

Europe 2020 is the on-going strategy of growth and the first topic addressed. Only a few of its areas are analysed in detail, those influencing some of the aspects of Smart Mobility or its development. Then, in the hottest years for the sustainability issue, the Committee took more targeted actions. In 2016, the *European strategy for low-emission mobility* defined a change of direction for the European mobility strategy; in 2017, the Commission moved on to implementation with the three actions included in the *Europe on the Move* package, in 2018, the 2030 climate and energy framework was adopted. In 2019, the new growth strategy was proposed by the new Commission: it has a clear focus on environmental sustainability, but also digital and research and innovation are covered by its priorities.

Europe 2020

Europe 2020 is the growth strategy for the EU from 2010 to 2020. The European Commission defines a strategy aiming at coming out from the 2008 crisis. *Years of economic and social growth* have been

wiped out exposing structural weaknesses of the Union's economy. *Globalisation, pressure on resources and ageing* intensify, and a *smart, sustainable and inclusive* economy is necessary to deliver *high levels of employment, productivity and social cohesion*.

The Commission sets three complementary priorities:

- Smart growth: *knowledge and innovation* are drivers of the *future growth.* Europe should focus on enhancing the quality of education, reinforcing the research performance, encouraging innovation and knowledge transfer within the Union, exploiting information and communication technologies potential. Combining with entrepreneurship, finance and market needs, innovative ideas become new products and services that contribute to job creation, growth and help to face European and World societal challenges.

- Sustainable growth: a resource efficient, sustainable and competitive economy is the engine of growth. Europe should focus on taking advantage of its leadership in developing new processes and technologies (especially green ones), expediting the roll out of smart grids, exploiting EU-scale networks and reinforcing the competitive advantage of its businesses. Acting in a sustainable way means to Europe to reduce emissions and exploit fully the potential of new technologies such as carbon capture. Moreover, improving resource efficiency would significantly limit emissions, save money and boost economic growth. *Economic, social and territorial cohesion will increase.*

- Inclusive growth: ensuring everyone has the same opportunities allows Europe to grow. A cohesive society is fundamental, and Europe should act *empowering people through high levels of employment, investing in skills, fighting poverty and modernising labour markets, training and social protection systems.* Economic growth should be spread to all the Union, including peripheral regions, thus increasing territorial cohesion. Furthermore, Europe should focus on social cohesion through policies promoting gender equality.

The Commission proposes the following targets to be achieved by 2020:

- *75 % of the population aged 20-64 should be employed;*
- *3% of the EU's GDP should be invested in R&D;*
- *The 2020 climate & energy targets should be met;*

- *The share of early school leavers should be under 10% and at least 40% of the younger generation should have a tertiary degree;*
- *20 million less people should be at risk of poverty.*

These objectives are interrelated and representative of the previous three priorities. Achieving them is fundamental for the whole Europe success, but not only. Indeed, the Commission has translated them into national targets suitable for each Member State.

A broad variety of initiatives will be necessary at national, EU and international levels. The Union developed seven *flagship initiatives* which combine priorities and targets and involve EU and Member States. The *flagship initiatives* are:

- *"Innovation Union";*
- *"Youth on the move";*
- *"A Digital Agenda for Europe";*
- *"Resource efficient Europe";*
- *"An industrial policy for the globalisation era";*
- *"An Agenda for new skills and jobs";*
- *"European Platform against Poverty".*

Some of them directly contribute to the development context of Smart Mobility projects and will be described below.

The implementation of the Europe 2020 strategy and flagship initiatives should be ensured through other European policies (Cohesion Policy, in particular) and national ones since they do not have their own budget.

Innovation Union

In 2010, R&D expenditure in Europe was less than 2%, compared to 2.6% in the US and 3.4% in Japan. The gap is mainly due to lower private investment. It is not only the absolute amounts spent on R&D that count, but also the composition of expenditure, e.g. half the gap with the US is due to fewer high-tech companies. Therefore, Europe needs to focus on the impact and composition of research spending and also to improve the conditions for private sector R&D in the EU.

This flagship initiative starts in 2010 and ends in 2015. It seeks to improve conditions and access to finance for research and innovation, thereby ensuring that innovative ideas can be translated into products and services that generate both growth and jobs. Europe should refocus its research and innovation policy on *climate change, energy and resource efficiency, transport, health and demographic change.*

This focus on issues related to smart mobility is relevant for its development in Europe.

A Digital Agenda for Europe

In 2010, the global demand for information and communication technologies is a market worth €2000 billion, but only a quarter of it originates from European companies. Europe is also lagging behind in high-speed internet, which impacts on its innovation performance, as well as on the online spread of knowledge and the online supply of goods and services.

This flagship initiative aims at accelerating the spread of high-speed internet and gaining the advantages of a *digital single market for households and firms.* The targets are:

- *broadband access for all by 2013;*
- *access to much higher internet speeds for all (30 Mbps or above) by 2020;*
- *50% or more of European households subscribing to internet connections above 100 Mbps.*

The *digital single market for online content and services* includes:

- *borderless and safe web services and digital content markets, with high levels of trust and confidence;*
- *a balanced regulatory framework with clear rights regimes;*
- *the fostering of multi-territorial licenses;*
- *adequate protection and remuneration for rights holders;*
- *active support for the digitisation of Europe's rich cultural heritage, and to shape the global governance of the internet.*

The objective is to deliver sustainable economic and social benefits from a digital single market built on fast and ultra-fast Internet and on interoperable applications.

A favourable environment for digital initiatives also facilitates the development of Smart Mobility. Indeed, all smart initiatives (except for those particularly innovative in the automotive sector) include the digital aspects that are touched by this *flagship initiative.*

Resource Efficient Europe

This flagship initiative contributes to decoupling economic growth from resource use, shifting to a low-carbon economy, boosting the use of renewable energy sources, upgrading the transport industry and fostering energy efficiency. Europe will gain a competitive advantage and also reduce its external dependence on raw materials and commodities.

Concerning the transport sector, the aim is to modernise and decarbonise it, therefore contributing to increase the competitiveness. This is possible throughout various measures:

- Infrastructure measures, including early installation of grid infrastructures of electrical mobility, intelligent traffic management, better logistics;
- Measures aiming at reducing CO2 emissions for road vehicles, for the aviation and maritime sectors;
- An important European green car initiative aiming to boost new technologies such as electric and hybrid cars through research, common standards and infrastructure support.

The interest in resource efficiency and the transition to a low-carbon economy stimulate the mobility sector to create and implement smart solutions.

Source: https://ec.europa.eu/eu2020/pdf/COMPLET%20EN%20BARROSO%20%20%20007%20-%20Europe%202020%20-%20EN%20version.pdf

The 2020 climate & energy package

The 2020 climate & energy package is a series of binding rules whose ultimate goal is to guarantee that Europe will achieve its objectives concerning climate and energy by 2020. Three main targets are:

- Reduction of greenhouse gas emissions by at least 20% compared to 1990 levels;
- Increase to 20% of the share of renewable energy sources in our final energy consumption;
- Increase by 20% in energy efficiency.

These targets were set by EU leaders in 2007 and were transposed into national legislation in 2009. They are also the main objectives of the Europe 2020 strategy for smart, sustainable and inclusive growth and the EU is taking initiatives in several sectors to reach them.

The Emissions Trading System (ETS) is the EU's main tool for reducing greenhouse gas emissions from energy and industrial sectors and aviation. The ETS affects around 45% of the EU's emissions. For 2020, the goal is to reduce emissions from these sectors by 21% compared to 2005. Other sectors (not included in ETS) are regulated according to national emission reduction targets. Construction, agriculture, waste, transport (excluding aviation) represent around 55% of the total EU emissions.

EU countries have implemented the annual binding targets for reducing these sectors by 2020 (compared to 2005), agreed at the "Effort Sharing Decision". The objectives vary according to national income, from a 20% reduction for the wealthiest countries to a maximum increase of 20% for the less wealthy ones. The Commission monitors the progress made each year. EU Member States have also transposed national targets for the increase in renewable energy consumption by 2020 under the Renewable Energy Directive. These objectives depend on the starting situation of the various countries regarding the production of energy from renewable sources and the ability to further increase it (from 10% in Malta to 49% in Sweden). The overall effect will allow the EU as a whole to achieve: the 20% target by 2020 (more than double compared to 9.8% in 2010) and a 10% share of renewable energy in the transport sector.

Achieving the objectives of the 2020 package should also help to:

- increase the EU's energy security by reducing dependence on energy imports and helping to create a European Energy Union;
- create jobs, stimulate green growth and make Europe more competitive.

Source: https://ec.europa.eu/clima/policies/strategies/2020_it

European strategy for low-emission mobility

In 2016, following the COP21, the global transition to a circular low-carbon economy had started and its pace was accelerating. In this context, the Commission's objective was to ensure that Europe remained competitive and was able to respond to the growing mobility needs of people and goods. Therefore, the Commissioners established fair and clear guiding principles for member states to

prepare for the future: the *European strategy for low emission mobility*. It framed the Commission's initiatives for the following years by mapping the sectors involved and possible synergies between them. The strategy was one of the key instruments for modernising the European economy and strengthening the internal market.

Following, the main objectives pursued by the strategy:

- *Increasing the efficiency of the transport system* by exploiting digital technologies, in particular the Commission wants to stimulate the use of technologies (its) that allow communication between vehicles and between vehicles and infrastructure; by introducing systems that enable smart pricing, the Commission wants to improve tariffs to better reflect the polluter-pays and user-pays principles; and by creating seamless logistics chains, the Commission wants to promote initiatives to link the different means of transport.

- *Speeding up the deployment of low-emission alternative energies for transport*, such as advanced biofuels, electricity, hydrogen and renewable synthetic fuels through strong incentives for innovation; *and removing obstacles to transport electrification*, either by seeking better synergies between the energy and transport systems, to facilitate vehicle recharging or by requiring Member States to implement common plug standards and create an infrastructure for alternative fuels.

- *Moving to zero-emission vehicles*, the Commission wants to accelerate the transition by proposing and implementing improvements in the measurement and verification of vehicle emissions; working on improving customer information to support users' demand, offering incentives in public procurement rules and reducing carbon dioxide emissions from trucks, buses and coaches. Finally, Europe remains committed, in line with global efforts, to controlling emissions from international aviation and maritime transport.

The Commission recognizes the importance of cities and local authorities in delivering this strategy. They should offer incentives for low-emission vehicles and energy, encourage active transport (cycling and walking), public transport and shared mobility with the aim of reducing traffic and pollution.

Full implementation in the Member States will lead to improved air quality, reduced noise and congestion levels and improved safety. Consumers will enjoy more efficient cars, better infrastructure for alternative fuels, better connections between modes of transport, greater safety and fewer delays through the introduction of digital technologies. Better information will enable them to take informed decisions for their daily needs for mobility; e.g. the labelling of cars will be updated, and the respective advantages of alternative fuels will be clarified.

The strategy builds on existing funds such as President Juncker's Investment Plan for Europe which plays a very important role, with significant progress already made with projects being funded under the European Strategic Investment Fund.
Source: https://ec.europa.eu/transport/themes/strategies/news/2016-07-20-decarbonisation_en

Europe on the Move – 2017

The measures outlined in the Low Emissions Mobility Strategy have been implemented through the set of initiatives under the name Europe on the Move in 2017-2018. With this package, the European Commission aimed to help the mobility sector to remain competitive in a socially equitable transition to clean energy and digitisation.

Europe on the Move" is a package that brings together several initiatives aimed at making traffic safer, offering smarter road pricing, reducing CO2 emissions, air pollution and congestion, as well as bureaucracy for businesses. At the social level, they will combat undeclared work and ensure appropriate conditions for workers. Thus, the long-term benefits of these measures will go far beyond the transport sector, boost growth and job creation, improve social equity, increase consumer choice and steer Europe towards a zero-emission economy.

The EU will lead this transition through well targeted legislation and supportive measures, covering investment in infrastructure and research and innovation. This will ensure the development, supply and production in Europe of the best clean, connected and automated mobility solutions, transport equipment and vehicles. The Commission publishes the initiatives in three different packages between May 2017 and May 2018.

First package

In May 2017, the first Europe on the Move package has been enacted. It is made of 8 legislative initiatives addressed to road transport. This sector is very important as it directly employs 5 million Europeans and contributes about one fifth of EU greenhouse gas emissions. The proposals will improve the functioning of the road haulage market and social and employment conditions of workers. This will be achieved by intensifying enforcement, combating illegal employment practices, reducing the administrative burden for businesses and clarifying existing rules, for example as regards the application of national minimum wage laws.

In addition, the Commission aims to make it easy for citizens and businesses to travel across Europe by promoting seamless mobility solutions. on the one hand, it is helpful to make toll systems interoperable to enable users to use a single system across the EU. On the other hand, common data specifications for public transport allow passengers to plan their journey better and to travel the best route even if they cross a border.

Source: *https://ec.europa.eu/transport/modes/road/news/2017-05-31-europe-on-the-move_en*

Second package

In November 2017, the second package has been enacted and it is called the *Clean Mobility Package.* This sets new targets for the reduction of average CO2 emissions from new cars and vans that will be applied from 2025 to 2030. The analysis involving stakeholders of the industry has set the reduction target for average CO2 emissions at 30% less in 2030 compared to 2021 for both new cars and vans.

With the imposition of this target, ambitious but realistic rules are established to help ensure a level playing field between actors in the sector in Europe. Furthermore, the package shows a clear direction towards the commitments agreed by the EU under the *Paris Agreement* and stimulates both innovation in new technologies and business models and a more efficient usage of all goods transport modes. These proposals will be accompanied by dedicated financial instruments to ensure rapid deployment.

Following documents constitute the package:

- *New CO2 standards* to push manufacturers towards innovation and the shift from conventional to low emission vehicles. The 2030 target provides stability and a long-term

direction to investments, but an intermediate target for 2025 is present to ensure that investments start immediately.

- *The Clean Vehicles Directive* to foster clean mobility solutions in public procurement and thus deliver a strong impetus to the demand for and further spread of clean mobility options.
- *An action plan and investment solutions* for the trans-European network for alternative fuels with the aim of increasing the ambition of national plans, increasing investment and improving consumer acceptance in this area.
- *The revision of the Combined Transport Directive*, which encourages the use of combinations of different modes of goods transport (e.g. trucks and trains), will facilitate companies to apply for incentives and thus promote the combined use of trucks and trains, barges or ships for the transport of freight.
- *The Directive on Passenger Coach Services*, with the aim of encouraging the creation of long-distance bus connections throughout Europe and offering alternative solutions to the use of private cars, help to further reduce emissions from transport and road congestion.
- *The battery initiative* is strategically relevant for the EU's integrated industrial policy, to ensure that tomorrow's vehicles, other mobility solutions and their components are developed and manufactured in the EU.

Source: https://ec.europa.eu/commission/presscorner/detail/en/IP_17_4242

Third package

In May 2018, the third and final set of measures has been enacted. With this third *Europe on the Move*, the Commission is completing its ambitious agenda for the modernisation of mobility.

The aim is to enable all Europeans to benefit from safer traffic, less polluting vehicles and more advanced technological solutions, while continuing to support the competitiveness of European industry. therefore, the initiatives in the third package include *an integrated policy for the future of road safety with measures for vehicles and infrastructure safety; the first ever CO2 standards for heavy-duty vehicles; a strategic Action Plan for the development and manufacturing of batteries in Europe and a forward-looking strategy on connected and automated mobility.*

- *Safe mobility*

The Commission suggests that new vehicle models should be equipped with advanced safety systems, including advanced emergency braking, lane assist or pedestrian and cyclist detection features for trucks (see full list here). Furthermore, the Commission is assisting Member States to regularly detect unsafe road sections and to target investments better.

- *Clean Mobility*

  The Commission sets the first CO2 emission standards for heavy duty vehicles: in 2025, average CO2 emissions from new trucks will have to be 15% lower than in 2019, in 2030 30% lower. To further reduce emissions, the Commission is making it easier to design more aerodynamic trucks and is improving the labelling of tyres. Finally, the Commission is presenting a comprehensive battery action plan that will help create a competitive and sustainable "ecosystem" for batteries in Europe.

- *Connected & Automated Mobility*

  The Commission presents a strategy to make Europe a world leader in fully automated and connected mobility systems. The strategy foresees a new level of cooperation between road users, which could bring huge benefits to the mobility system as a whole. Moreover, the Commission suggests creating a totally digital environment for the exchange of information in goods transportation.

The package is supported by the Connecting Europe Facility which provide funds to support projects improving road safety, digitisation and multimodality in the Member States.

Source: https://ec.europa.eu/transport/modes/road/news/2018-05-17-europe-on-the-move-3_en

2030 climate & energy framework

In 2018 EU's emissions are on track to achieve the 2020 target, therefore the Commission frames the new legislation to meet the climate and energy target for 2030. Based on new targets, Member States are planning their actions.

Latest figures:

- Reduction of EU greenhouse gas emissions by 23% and economic growth by 61% between 1990 and 2018 (the target was 20% by 2020 compared to 1990);

- Reduction of emissions by 2% between 2017 and 2018. The sectors covered by ETS, in particular power plants, reached the greatest result: decline by 4.1% compared to 2017. After three years of slightly increasing emissions, the sectors not covered by the ETS, decreased by 0.9%;
- International aviation continued to increase emissions in 2018, reaching 19% over the last five years. Theoretically, it is covered by the ETS, but for the moment they are limited to flights in the European Economic Area (EEA).

Source: https://ec.europa.eu/clima/policies/strategies/progress_en

The *2030 climate & energy framework* is a set of targets and policy objectives for EU for the period from 2021 to 2030. It includes the EU's nationally determined contribution (NDC) under the Paris agreement, i.e. the reduction of greenhouse gas emissions by at least 40% by 2030 compared to 1990. The main EU legislation to implement these targets was adopted by the end of 2018.

Key targets for 2030:

- Reduction by at least 40% in greenhouse gas emissions (from 1990 levels);
- Increase by at least 32% of energy consumption from renewable energy;
- Increase by at least 32.5% in energy efficiency.

In October 2014 the European Council adopted the framework, whose targets were revised upwards in 2018; the original target was at least 27% increase for both consumption of renewable energy and energy efficiency. Likewise, 2030 targets will be revised in 2023.

The target on greenhouse gas emissions will enable the EU to move towards a climate-neutral economy and meet its commitments under the Paris Agreement. To reach the objectives:

- ETS sectors have to reduce emissions by 43% (compared to 2005); the ETS has been revised for the period after 2020;
- Non-ETS sectors have to reduce emissions by 30% (compared to 2005); this has been translated into national emission reduction targets for Member States.

As part of the European Green Deal, the Commission raises this target to at least 50% and towards 55% in a responsible way.

Member States are required to draft integrated National Energy and Climate Plans (NECPs) 2021-2030 and national long-term strategies and ensure consistency between the two documents.

The framework helps drive progress towards a low-carbon economy and build an energy system that

- *ensures affordable energy for all consumers,*
- *increases the security of the EU's energy supplies,*
- *reduces our dependence on energy imports,*
- *creates new opportunities for growth and jobs and*
- *brings environmental and health benefits – e.g. through reduced air pollution.*

Source: https://ec.europa.eu/clima/policies/strategies/2030_en

The new Political Guidelines for Europe

In 2019 was established the new European Commission, President Ursula Von Der Leyen presented six Political Guidelines for Europe over the next five years (2019-2024). These are the Commission's new priorities:

- *A European Green Deal*
- *An economy that works for people*
- *A Europe fit for the digital age*
- *Protecting our European way of life*
- *A stronger Europe in the world*
- *A new push for European democracy*

Source: https://ec.europa.eu/info/strategy/priorities-2019-2024_en

Among the Guidelines, the *European Green Deal* and the *Europe fit for the digital age* will define the development environment of smart mobility in the coming years. The European Green Deal is the new growth strategy which replace Europe 2020; the "Europe fit for the digital age" is the new European digital strategy.

European Green Deal

Europe 2020 was the response to the 2008 crisis, just as the *European Green Deal* is the response to current challenges mainly involving environment and climate. Global warming leads to the loss of many species and their habitats, forests are being destroyed and the oceans are increasingly polluted.

Therefore, the new growth strategy aims to transform the EU into a *fair and prosperous* society, with a *modern, resource-efficient and competitive economy*, where climate neutrality is achieved in 2050 (no net greenhouse gas emissions) and where economic growth is dissociated from the use of resources. The aim is also to protect, preserve and enhance the EU's natural capital and the health and well-being of its citizens from environmental risks and impacts. The Commission wants this transition to be *just and inclusive*: putting people first and paying attention to regions, industries and workers will stimulate their active participation and confidence, which are key to success.

Among the main elements of the Green Deal, the first concerns the transformation of the EU economy for a sustainable future. This transformation must take place through the design of a series of policies that profoundly transform the Union by giving priority to the environment and sustainability in many areas such as energy, industry, transport, but also construction, the food system and the conservation of ecosystems. In addition, the Committee aims to integrate sustainability into all EU policies by pursuing green finance and investment, greening national budgets, sending the right price signals. Finally, it will mobilise research and promote innovation, activate education and training to ensure a fair and equitable transition.

One of the transformation policies focus on transport. This has the objective of accelerating *the transition to sustainable and smart mobility*, which is fundamental to achieving the basic objective of the strategy: climate neutrality in 2050. As transport accounts for a quarter of greenhouse gas emissions, a 90% reduction is needed by 2050. In 2020 the Commission will adopt a strategy to address this challenge. All means of transport will be involved to achieve sustainability. This means offering *more affordable, accessible, healthier and cleaner* solutions to the user. Some of the issues that will certainly be addressed are the improvement of multimodal transport, connected and autonomous mobility, the production and development of alternatives to fuels and a particular attention will be paid to the problems of cities with measures addressing emissions, traffic and public transport. The second key element of the Green Deal concerns the position of the EU in relation to other global entities: the EU wants to maintain a leadership position by being an example and convincing and supporting others in their actions towards sustainability. The third and final fundamental element is the European Climate Pact which will focus on three ways of involving citizens in climate action. First, the Commission will promote information sharing, then it will create virtual and real spaces for people to express their ideas and creativity and finally it will try to create

the skills to facilitate the implementation of initiatives to protect the environment and fight climate change.

Souce: https://eur-lex.europa.eu/legal-content/EN/TXT/?qid=1576150542719&uri=COM%3A2019%3A640%3AFIN#footnote6

Europe fit for digital age

This is the new digital strategy for the EU. It aims to make digital transformation work for people and businesses and to help achieving climate-neutrality target by 2050. Furthermore, it presents a clear strategy for artificial intelligence (AI) and data aiming to encourage businesses to work with these technologies and people to trust them.

The strategy is based on three main actions: a generic digital strategy, *Shaping Europe's digital future,* a strategy for AI, *Excellence and trust in artificial intelligence,* and a strategy for data, *European data strategy.*

The generic digital strategy includes three streams of action which make sure technology serves people and adds value to their daily lives, businesses and planet.

Streams of action are:

- *Technology that works for people*
- *A fair and competitive digital economy*
- *An open, democratic and sustainable society*

Therefore, the Union's objective is to be a model of the digital economy at global level, to help developing economies in the digital switchover, to deploy digital standards and to internationally promote them.

The strategy for AI is to increase confidence by citizens, make them embrace these new technologies and empower businesses to start, scale up and innovate, competing on fair terms.

EU will act to:

- achieve excellence, through new public-private partnerships, connecting AI research centres, creating at least one AI digital hub for Member State, introducing AI in public processes and providing more equity financing with the help of the European Investment Fund;

- achieve trust, adapting legislation to the risks of AI, forcing risky AI systems to be transparent, traceable and under human control, making authorities able to check AI systems, ensuring unbiased data sets and launching an EU-wide debate on remote biometric identification (e.g. facial recognition).

An AI application is risky when it involves *a critical use in a critical sector* such as *healthcare, transport, police, legal system.* The use of AI can generate *legal effects, risks of death, damage or injury* through *medical equipment, automated driving, decisions on social security payments,* for example. To enforce a trustworthy AI, high-risk AI need to be subject to strict rules *(compliance tests, controls, sanctions).*

The objective of the strategy for data is to make the EU a leader in a data-driven society through the creation of a single market for data and attempting to make EU more competitive globally.

The EU will establish a single market where data can flow freely within the EU and across sectors in the interest of enterprises, researchers and administrations. The European rules will be fully respected, in particular laws on privacy, data protection and competition. The rules for access and use of data will be *fair, practical and clear.*

The EU will be *attractive, secure and dynamic* as data economy by setting clear and fair rules on access and re-use of data; investing in tools, infrastructures and cloud capacity; pooling data in key sectors enabling innovative processes, products and services. Eventually users will keep control on their data.

Policy areas:

- *Data protection: Reforming data protection to give people control over their data and help businesses comply. Ensuring that non-EU countries protect data of EU citizens;*
- *Better access to online goods for consumers and businesses: Helping to make the EU's digital world a seamless and level marketplace to buy and sell;*
- *The right environment for digital networks and services: designing rules that match the pace of technology, such as the rollout of next generation 5G mobile connections or the Action Plan on Financial technology* (Blockchain and other IT applications)*;*
- *Economy and society: Ensuring that citizens and businesses can take full advantage of the opportunities digitalisation can offer.*

- *European data strategy: To make sure the EU becomes a role model and a leader for a society empowered by data.*

Source: https://ec.europa.eu/info/strategy/priorities-2019-2024/europe-fit-digital-age_en

Background data and AI

Since 2014, the Commission has been interested in measures to facilitate the development of a data-based economy:

- *the Regulation on the free flow of non-personal data*
- *the Cybersecurity Act*
- *the Open Data Directive*
- *the General Data Protection Regulation*

The new AI strategy builds on previous EU initiatives: the first strategy of 2018, agreed by the Commission and the Member States, and the ethical lines defined in 2019 by high level experts on artificial intelligence.

Source: https://ec.europa.eu/info/strategy/priorities-2019-2024/europe-fit-digital-age_en

First AI strategy

In 2018, for the first time, the Union was interested in establishing a strategy for AI. The Commission wanted to grow investments in the public and private sector, to prepare the EU for the social and economic changes that new technologies are introducing and ensure an appropriate ethical and legal framework.

Europe reaches excellence in researchers, laboratories, start-ups in the AI field and, furthermore, in robotics. Transport, healthcare, and manufacturing sectors can compete at a world level: these sectors should adopt AI to preserve their advantage. This is not enough to face fierce international competition: to be at the forefront of AI development Europe should put in place some coordinated actions.

In response, the Commission foresees that investment in research and innovation in AI should achieve at least €20 billion by the end of 2020, including both public and private sectors and more than €20 billion per year from public and private investments over the following decade. Supporting

this effort, the Commission increases its investment to €1.5 billion in 2018-2020 under the Horizon 2020 research and innovation program, 70% more than 2014-2017 period.

The investment will help exploiting AI in key sectors, from transport to health, and testing and experimentation in research centres across Europe which will be strengthen and connected. Therefore, it will support the creation of an *AI-on-demand platform* which will allow access to significant AI resources in the EU for all users.

Furthermore, the European Fund for Strategic Investments will additionally support companies and start-ups to invest in AI.
Source: https://ec.europa.eu/commission/presscorner/detail/en/IP_18_3362
https://ec.europa.eu/commission/news/artificial-intelligence-2018-dec-07_en

2.2.2 Funding opportunities for transport research and innovation

In line with the strategies put in place, European funds related to mobility are spent to build integrated and efficient infrastructures that allow EU's growth and strengthen its competitiveness. Therefore, funds have been addressed to two main types of initiatives: the first targeting the single European market for transport, energy and telecommunications (under the TEN-T policy) and the second the research and innovation in the sector.

Funding opportunities

The EU aims to build a modern and integrated transport system that strengthens its global competitiveness and is able to meet the challenges of *sustainable, smart and inclusive growth*.
On the one hand, it is essential to ensure an effective infrastructure network at European level for efficient, safe and sustainable freight and passenger transport. This is the objective of the Trans-European Transport Network Policy (TEN-T) linking regional and national infrastructures to create coherent European systems. It concerns the development of transport links and hubs of all kinds, rail, road, maritime, air transport with the ultimate aim of removing barriers and bottlenecks by strengthening social, economic and territorial cohesion in the EU. Finally, it is not only about transport interconnection and interoperability, but also about energy system networks to ensure a resilient Energy Union with a forward-looking climate policy and about information and communication technologies to support a connected and interoperable Digital Single Market.

On the other hand, research in the mobility sector is essential to increase competitiveness of the players in the sector and improve the transport system for the benefit of all. The main research topics are defined by the Strategic Transport Research Agenda (STRIA) through seven roadmaps which concern: *Electrification*, *Alternative fuels*, *Vehicle design and manufacturing*, *Connected and automated transport*, *Infrastructure*, *Network and traffic management systems*, *Smart mobility and services.* Acting in this fields, research will offer greener, smarter and more efficient means of transport and safer and more inclusive mobility.
Source: https://ec.europa.eu/info/research-and-innovation/research-area/transport/stria_en

To follow the funding programmes and initiatives that support the implementation of the TEN-T and research and innovation in the transport sector:

- *Horizon 2020*: *provides funding for research and development projects with the aim of transferring great ideas from the lab to the market.*
- *Connecting Europe Facility (CEF*): *financial support for strategic investment in transport, energy and digital infrastructure.*
- *European Fund for Strategic Investment (EFSI): supports investment in key sectors through financial guarantees.*
- *European Structural and Investment Funds (ESIFs), including notably:*
    - *Cohesion Fund (CF): supports projects reducing economic and social disparities and promoting sustainable development in 15 cohesion Member States.*
    - *European Regional Development Fund (ERDF): aims to strengthen econo*mic *and social cohesion in the European Union by correcting imbalances between its regions.*
- *European Investment Bank (EIB): is the lending branch of the European Union and one of the World's major suppliers of climate finance.*
- *LIFE Programme: is an EU funding instrument for the environment and climate action.*

As the objective is efficient, safe and sustainable mobility, these funds include those dedicated to Smart Mobility initiatives. Often it is very difficult to extract the share spent on smart initiatives, but it is possible to try to isolate the categories of funds that include them.

Source: https://ec.europa.eu/transport/themes/infrastructure_en

https://www.eib.org/en/projects/sectors/transport/tens/index.htm

Horizon 2020

Horizon 2020 is the largest EU research and innovation programme ever. It offers about €77 billion of funding during 2014-2020, in addition to the public and private investments that these funds will trigger. The program will support the Europe 2020 strategy, aiming to achieve *smart, sustainable and inclusive growth. The goal is to ensure Europe produces world-class science and technology, removes barriers to innovation and makes it easier for the public and private sectors to work together in delivering solutions to big challenges facing our society.*

Source: https://ec.europa.eu/research/participants/docs/h2020-funding-guide/grants/applying-for-funding/find-a-call/h2020-structure-and-budget_en.htm

https://ec.europa.eu/programmes/horizon2020/en/h2020-section/smart-green-and-integrated-transport

Horizon 2020 includes the *Transport Challenge* which is allocated €6 339 million for the period 2014-2020, 8% of the total budget. Funding opportunities are defined in multiannual work programmes which are presented every two years. *Smart, green and integrated transport* is the transport work programme which has been presented for 2014-2015, 2016-2017 and 2018-2020. This programme is driven by four lines of activity that are defined at the beginning:

- *Resource efficient transport that respects the environment:* aiming at improving efficiency of resources and reducing dependence on fossil fuels, to reduce the impact of transport on climate and environment (including noise, air and water pollution);

- *Better mobility, less congestion, more safety and security:* aiming at exploiting innovative solutions including modern ICT (which make transport inclusive, accessible, safe and robust) to reconcile increasing mobility needs with greater fluidity of transport;

- *Global leadership for the European transport industry:* aiming at maintaining or creating leadership position for EU; Europe is a leader in aviation already, thus it has to maintain this position and improve transport and services to be a leader in other mobility sectors;

- *Socio-economic and behavioural research and forward-looking activities for policy making:* aiming at promoting innovation and meeting the challenges raised by transport with the aid of socio-economic research and support for policy improvement

The first work programme is divided into three calls *Mobility for Growth, Green Vehicles and Small Business Innovation for Transport*. The first two calls remain constant, the third one is excluded from the next programme in which a call dedicated to *Automated Road Transport* is included. *Mobility for Growth, Green Vehicles and Automated Road Transport* will remain until 2020. These three calls for projects have been analysed in detail and represented in Figure 16.
Source: https://ec.europa.eu/research/participants/data/ref/h2020/wp/2018-2020/main/h2020-wp1820-transport_en.pdf

Over the years, the call *Mobility for Growth* changes its internal division: initially it focuses on different sectors (aviation, rail, road, waterborne) and integration (urban mobility, logistics, intelligent transport systems, infrastructure, socio-eco); then on objectives, reflecting the four lines of activity mentioned above. Therefore, the themes in general are the same from the beginning. In this section, funding is allocated to initiatives that aim at environmental sustainability of transport (then deepened in *Green Vehicles*), safer and more integrated transport systems or which allow to reach or maintain a leadership position for the EU paying particular attention to the socio-economic aspect. *Mobility for Growth* is the call for which a significantly higher amount of money is allocated from the beginning and throughout the validity period of *Horizon 2020*. The greatest value can be attributed to the breadth of the topics covered; indeed, the other two calls are more specific.

Automated Road Transport deals with the transformation of the European transport industry related to the use of digital technologies. It includes initiatives concerning the automation of road transport and all issues related to it ICT infrastructure, safety, coordination between normal vehicles and autonomous ones, and first tests, with a greater focus on the operational level in the last work programme. *Automated Road Transport* is not included in the first work programme and therefore investment in the first years is zero, in the last year it reaches the same level as *Green Vehicles*, a sign of the importance acquired by the sector.

The last call, also specific, is *Green Vehicles* this call finances initiatives that aim at a climate resilient and low-carbon future through the development and diffusion of zero- (or low-) impact vehicles. The lower values are due to the specificity of the calls and also to the fact that some actions traceable to these sectors are included in the first call.

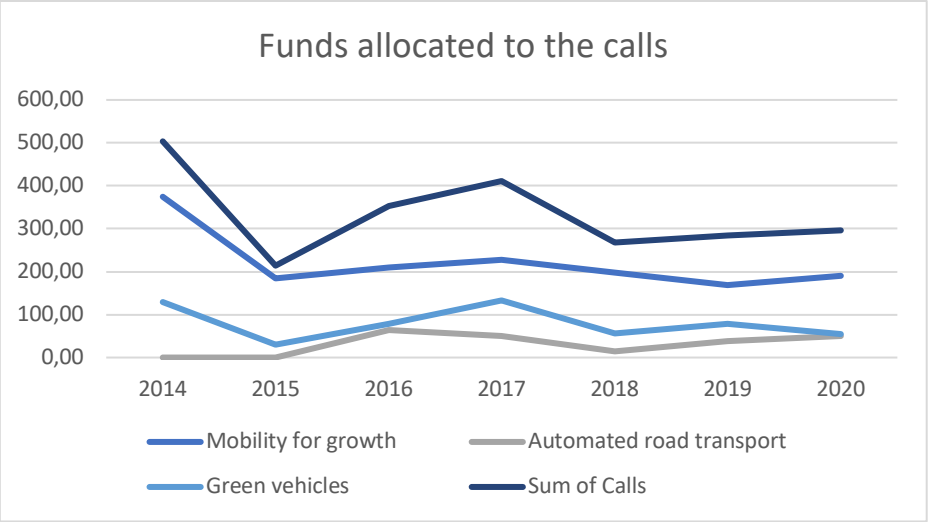

Figure 16 Funds allocated to each call included in "Smart, green and integrated transport"

The transport budget, as well as the *Horizon 2020* budget in general, is not spent entirely on calls for proposals. There are also cross cutting calls and other expenses under *Other actions*. Furthermore, synergies are possible with other EU programmes such as *CEF* (see details in *CEF* paragraph) or even with the *European Structural Investments Funds.*

Source:

https://ec.europa.eu/research/horizon2020/pdf/press/fact_sheet_on_horizon2020_budget.pdf

As mentioned at the beginning, *Horizon 2020* is the largest European research and innovation program in history (see Figure 17). Looking at previous ones, the increase in investment is considerable already from the programme active between 2007 and 2013, while looking beyond *Horizon*

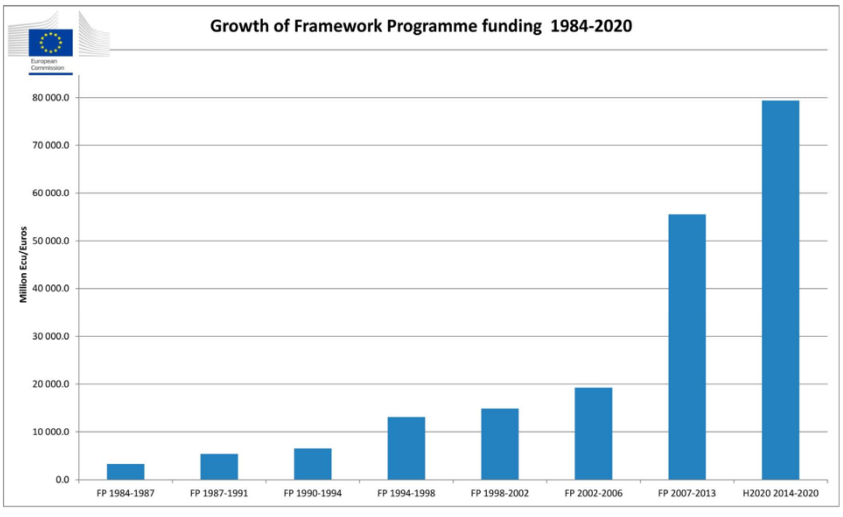

Figure 17 Evolution of EU's budget for research and innovation programmes, Source: Factsheet H2020 budget by European Commission

2020, the growth continues with *Horizon Europe* expected for the period 2021-2027.

Source:

https://ec.europa.eu/research/horizon2020/pdf/press/fact_sheet_on_horizon2020_budget.pdf

Horizon Europe

Following Horizon 2020, the Commission makes an ambitious proposal for 2021-2027: Horizon Europe, a €100 billion research and innovation program. Horizon Europe aims to:

- improve the EU's scientific and technological assets and the European Research Area (ERA)
- increase Europe's capacity for innovation, competitiveness and employment
- meet citizens' priorities and support the European model and its socio-economic values

Preliminary structure:

- *Pillar 1: Excellent science (€25.8 billion)*
- *Pillar 2: Global challenges and European industrial competitiveness (€52.7 billion)*
- *Pillar 3: Innovative Europe (€13.5 billion)*
- *Widening participation and strengthening the European Research Area (€2.1 billion)*
- *Euratom: activities to reduce nuclear safety and security risks, development of safe nuclear technologies and optimal radiation protection. (€2.4 billion)*

In addition to funds dedicated to research and innovation in general (pillar 1 and 3), there are funds dedicated to 6 specific research clusters (pillar 2). Each of them focuses on a current challenge and Europe's competitiveness in the industry at World level. *Climate, energy and mobility* cluster faces climate change and energy consumption and involves the transport industry.

In addition, the program provides for missions and related mission areas. These are new compared to Horizon 2020 and represent portfolios of actions dedicated to a particular objective (to be reached within a timeframe) and which have a measurable impact for a significant part of European citizens, at society, environment or policy level. Horizon Europe establishes mission specifications and governance under five mission areas:

- *Adaptation to climate change, including societal transformation;*
- *Healthy oceans, seas, coastal and inland waters;*
- *Climate-neutral and smart cities;*
- *Soil health and food;*

- *Cancer.*

Climate-neutral and smart cities is the area including the transformation of transports.

Source:

https://ec.europa.eu/info/sites/info/files/research_and_innovation/strategy_on_research_and_innovation/presentations/horizon_europe_en_investing_to_shape_our_future.pdf

CEF transport

The European Union implements the Connecting Europe Facility (CEF) programme to promote the objectives of the TEN-T policy: the development of efficient, sustainable and interconnected trans-European networks in the fields of transport, energy and digital services (CEF Transport, CEF Energy, CEF Telecom respectively). Thus, CEF investments concentrate on activities leading to deeper integration of the European single market. Connected and sustainable transport networks, but also connectivity infrastructures and interoperating digital services are crucial for an integrated and properly functioning economic area and for its social and territorial cohesion. The CEF serves the benefit of people and businesses in all Member States. It increases the ease and sustainability of travel, improves EU's energy security and enables the broader use of renewable energy, and simplifies cross-border interaction among public authorities, enterprises and individuals.

Many initiatives funded by the CEF involve more than one sector among those concerned (transport, energy, digital services): activities related to alternative fuels often have an energy or telematics dimension, while all ITS actions have an ICT dimension. The 2018 WiFi4EU initiative is the first to involve all three sectors in a single infrastructure development programme. In addition to synergies between sectors, synergies in investments with other EU programmes are possible. The programme supports complementarity with Horizon 2020, the EU flagship programme for research and innovation, with the European Structural and Investment funds, such as the Cohesion Fund, and with the European Strategic Investment Fund (EFSI).

The CEF is implemented through a mix of grants, procurement and financial instruments. The level of CEF funding between 2014 and 2020 is unprecedented, with a total budget of €30.5 billion, of which an indicative budget of €28.8 billion is available for grants. Over the 5-year period since the start of the programme, the European Commission has earmarked €26.4 billion in grants (representing over 92% of the CEF grant budget) for actions in the three areas of action. More than

€55.5 billion of investments have been triggered by this support. CEF-related financial instruments, including those from previous programmes, have generated additional investments in the three CEF sectors for €13.9 billion, of which about €4.5 billion from 2014.

The European Investment Bank is in charge of the implementation of the CEF financial instruments, in particular the CEF Debt Instrument. These financial instruments cover four areas of action: cleaner transport, traffic management systems, connecting infrastructure, future mobility.

CEF funds are distributed in CEF Transport, CEF Energy and CEF Telecom and also in the two items concerning the WiFi4EU synergy project and the synergies between the sectors (CEF Synergy). As shown in the chart (Figure 18), considering only CEF Funding, the transport sector is allocated €22,8 billion covering 86% of the total funds, this percentage that is reconfirmed considering combined investments (private and public) reaching €48 billion in the sector.

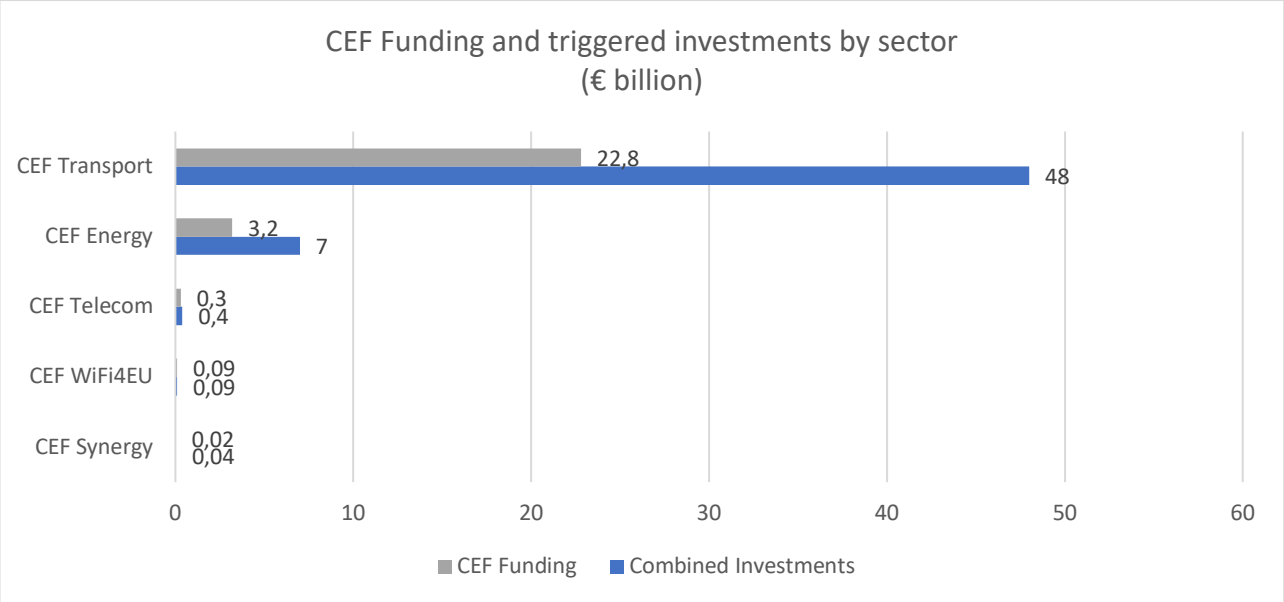

Figure 18 CEF Funding and combined investments allocation by sector

CEF Transport currently contribute €22.8 billion in EU grant support to the realization of transport infrastructure actions, for a total investment of €48 billion. As illustrated in Figure 19, 83% of the funds are spent with the objective of *building cross-border infrastructure and bridging missing links*, the rest of the funds cover the other two objectives *deploying sustainable and efficient transport* and *interconnecting transport modes and enhancing interoperability*. Observing the graph (Figure 20), it emerges that the sustainability of the CEF programme is mainly expressed through the construction of rail links which make a strong contribution to the decarbonisation of the EU. The CEF funding allocated to railway accounts for €16.3 billion, 72% of the total funding. Investments in road and air

transport focus on cross-border and missing links, traffic management and alternative fuels, thereby enhancing safety and sustainability. As a result, the investments of the CEF programme also contribute to the achievement of the EU's climate objectives.

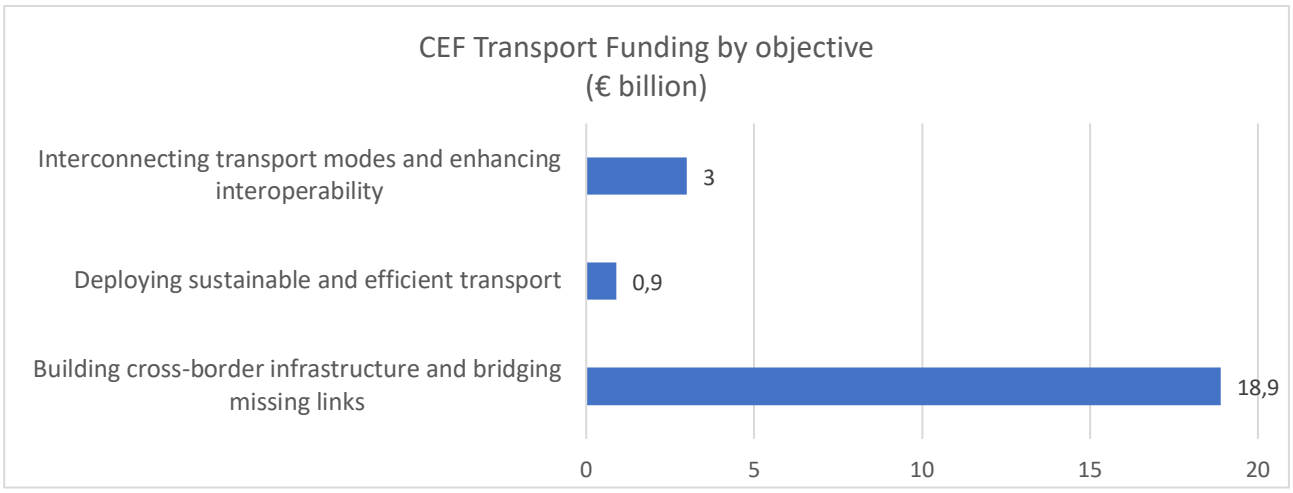

Figure 19 CEF Funding allocation by objective in the transport sector

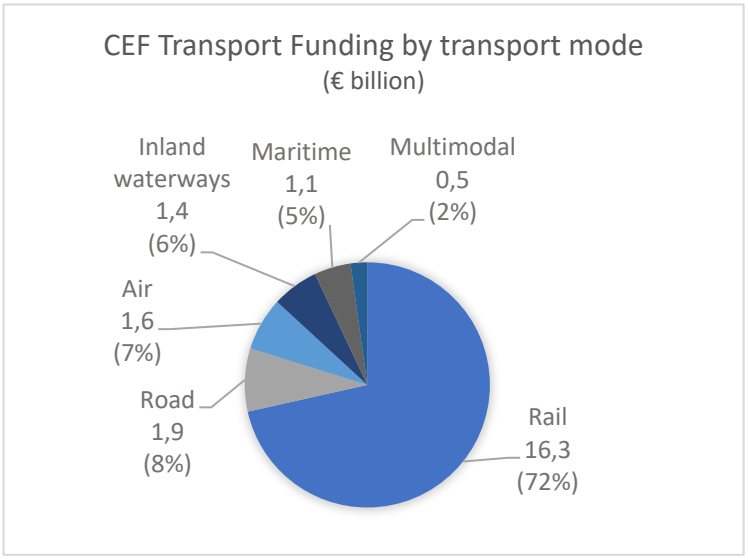

Figure 20 CEF Funding for transport by transport mode

Whereas CEF focuses on the construction of modern infrastructure (in transport, energy and telecommunications sectors), Horizon 2020 projects develop and test new clean energy, transport and digital technologies that can be deployed in the next generation of modern infrastructure. As the graph on technology readiness levels shows (Figure 21), Horizon 2020 deals with phases from research and principle formulation to the prototype and demonstration level, while CEF Transport starts from the prototype to the operational level.

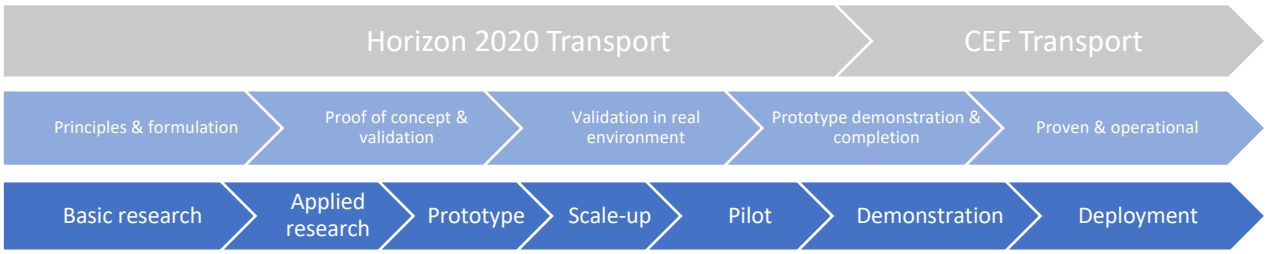

Figure 21 CEF Funding and Horizon 2020 synergy reworking of the author on the "Technology readiness level graph" in the CEF report of 2019

Source: https://ec.europa.eu/inea/sites/inea/files/cefpub/cef_implementation_brochure_2019.pdf

In 2007-2013 period, two funding programmes contributed to the TEN-T objectives. The first one was the TEN-T programme which involved €8 billion of funding and was focused on the TEN-T targets. The second one was Marco Polo programme tackling freight transport. The programme aims at reducing congestion, pollution and costs shifting as much transport of goods as possible from roads to other modes of transport. Whilst roads are excessively used, rail, sea and inland waterways often have spare capacity and also pollute less. Calls for proposals were published during 2007-2013 with an annual budget for grants of about €60 million.

Source:

https://ec.europa.eu/inea/sites/inea/files/download/MoS/mp_projectbrochure_en_web_final.pdf

https://ec.europa.eu/inea/en/ten-t/follow-funding-process

EFSI

The European Fund for Strategic Investments (EFSI) is an initiative jointly launched by the EIB Group (the European Investment Bank and the European Investment Fund) and the European Commission in 2014 to help overcome the existing investment gap in the EU (European investment levels were 15% lower than pre-crisis levels). EFSI is one of the three pillars of the Investment Plan for Europe* which seeks to boost investment in strategic projects across the EU to guarantee that money reaches the real economy. Lastly, the initiative is demand-driven and supports projects across all the EU, including cross-border projects.

The EFSI is a guarantee of €26 billion from the EU budget, supplemented by an EIB equity allocation of EUR 7.5 billion. The total amount of €33.5 billion aims to release additional investments of at least €500 billion by 2020. The initial aim was to attract €315 billion by mid-2018, but given the success of

the programme, in late 2017, its duration has been extended. The so-called *"EFSI 2.0"* extends the duration of the fund from mid-2018 to the end of 2020 and increases its investment target from €315 billion to at least half a trillion.

EFSI is managed by the EIB Group, so the projects supported are subject to the EIB's usual procedures. By offering EFSI funds, the EIB Group finances economically viable projects, in particular projects with a higher risk profile than that normally taken on by the Bank. Funds are dedicated to sectors of key importance for the European economy, such as:

- *Strategic infrastructure including digital, transport and energy;*
- *Education, research, development and innovation;*
- *Renewable energy and resource efficiency;*
- *Support for small and mid-sized businesses.*

Following the EFSI 2.0 exemption, the proportion of sustainable projects increases. At least 40% of infrastructure and innovation projects contribute to climate action in line with the Paris Agreement. In addition, EFSI 2.0 explicitly targets new sectors: sustainable agriculture, forestry, fisheries and aquaculture.

According to 2020 data (Figure 22), infrastructure initiatives involved 33% of EFSI funds, with 17% for energy, 9% for digital, 7% for transport. Research and development covered an important percentage of the funds, reaching 26%. Finally, only 4% was invested in environment and resource efficiency.

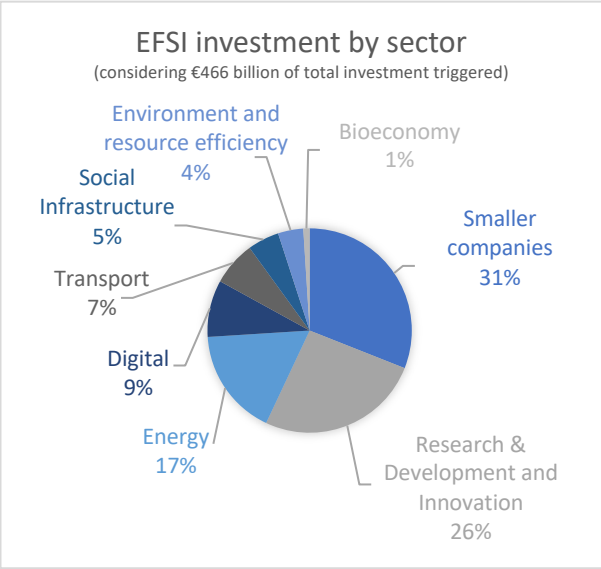

Figure 22 EFSI investment by sector, reworking of the author on data by EBI report in 2020

Source: https://ec.europa.eu/commission/strategy/priorities-2019-2024/jobs-growth-and-investment/investment-plan-europe-juncker-plan/investment-plan-results_en

**The Investment Plan for Europe, the Juncker Plan, consists of:*

- *The European Fund for Strategic Investments (EFSI)*
- *The improvement of the European regulatory environment*
- *Supporting the investment environment in Europe through the European Investment Advisory Hub and the EU Investment Project Portal*

Source: https://www.eib.org/en/efsi/what-is-efsi/index.htm
https://ec.europa.eu/commission/priorities/jobs-growth-and-investment/investment-plan-europe-juncker-plan/european-fund-strategic-investments-efsi_en

InvestEU

The InvestEU Programme presented by the new European Commission is based on the successful model of the Investment Plan for Europe and will replace it in the next years. It will bring together, *under one roof*, the European Fund for Strategic Investments and 13 EU financial instruments actually available, including CEF, as shown in Figure 23. With just one set of rules and procedures and one point of contact for advice, InvestEU will make EU funding simpler to access and more effective.

Exploiting the EU budget guarantee to crowd-in other investors, the InvestEU Fund will give an added boost to investment, innovation and job creatioon in the EU. InvestEU is expected to trigger at least €650 billion in additional investment between 2021 and 2027.

Figure 23 Previous funds covered by InvestEU and its four main policy areas, Source: European Commission website

The InvestEU Fund will support four main policy areas:

- *Sustainable Infrastructure: financing projects in sustainable energy, digital connectivity, transport, circular economy, water, waste and other environment infrastructure;*

- *Research, Innovation and Digitisation: financing projects in research and innovation, taking research results to the market, digitisation of industry, scaling up larger innovative companies, artificial intelligence;*
- *Small and Medium Businesses: facilitating access to finance for small and medium-sized companies (SMEs), small mid-cap companies;*
- *Social Investment and Skills: financing projects in skills, education, training, social housing, schools, universities, hospitals, social innovation, healthcare, long-term care and accessibility, microfinance, social enterprise, integration of migrants, refugees and vulnerable people.*

Source: https://ec.europa.eu/commission/priorities/jobs-growth-and-investment/investment-plan-europe-juncker-plan/whats-next-investeu-programme-2021-2027_en
https://ec.europa.eu/commission/sites/beta-political/files/budget-june2018-investeu-finance_en.pdf
https://www.eib.org/en/efsi/what-is-efsi/index.htm

ESIF

European Structural and Investment Fund (ESIF) involve five main funds that work together to support economic development across all EU countries, in line with the objectives of the Europe 2020 strategy. ESIF includes European Regional Development Fund (ERDF), Cohesion Fund (CF), European Social Fund (ESF), European Agricultural Fund for Rural Development (EAFRD), European Maritime & Fisheries Fund (EMFF), for a total of € 460.9 billion over the period 2014-2020. The funds involved in the transport initiatives are ERDF and CF for a total of €262 billion (2014-2020), under the priority areas *Network infrastructures in transport and energy* and *Low carbon economy*.

As part of the broad theme *Network Infrastructure in Transport and Energy*, the ERDF and the CF are addressing a range of investment priorities to foster sustainable transport and eliminate bottlenecks in key network infrastructures, including energy networks. In the period 2014-2020, €57.83 billion were allocated to this theme, 13% of the ESIF, 22% of the ERDF and CF. For

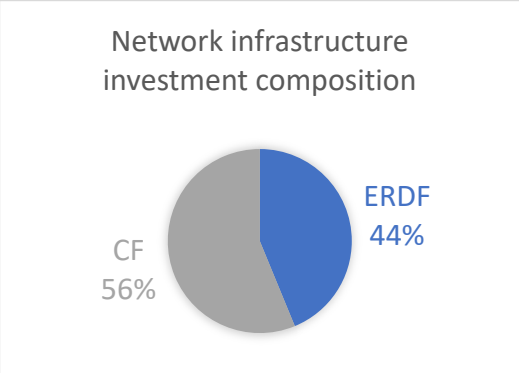

Figure 24 Composition of investment under "Network infrastructure in Transport and Energy" priority

this theme, funds are split between ERDF (44%) and CF (56%) only (Figure 24).

Source: https://cohesiondata.ec.europa.eu/themes/7

Under the low-carbon economy theme, which is also quite broad, ESI funds invest in a number of investment priorities to support the transition to a low-carbon economy in all sectors. In 2014-2020, €44.33 billion were allocated, 10% of ESIF, 17% of ERDF and CF. This €44.33 billion is not just ERDF and CF, but the funds are split between CF (15%), ERDF (74%), EAFRD (11%), EMFF (less than 1%) as shown in Figure 25.

Source: https://cohesiondata.ec.europa.eu/themes/4

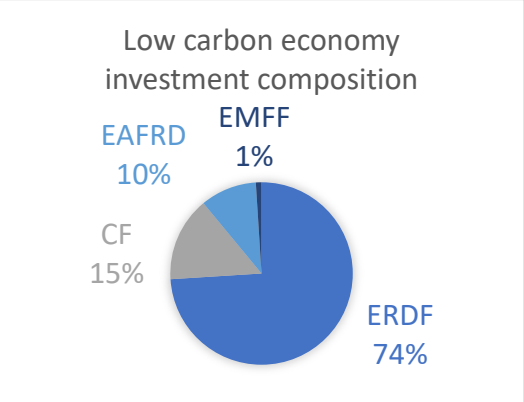

Figure 25 Composition of investment under "Low carbon economy" priority

All the budgets and percentages mentioned are summarised in Table 3.

	€ billion	% total budget	% on ERDF+CF
ESI Funds total budget	460.9		
ERDF+CF budget	262		
Network infrastructure in transport and energy	57.83	13%	22%
Low carbon economy	44.33	10%	17%

Table 3 Funds total budgets and percentage allocation to priorities of interest

Source: https://cohesiondata.ec.europa.eu/overview

ERDF – European Regional Development Fund

The European Regional Development Fund (ERDF) supports all countries and invests under all ESIF thematic objectives. It is highly focused on four main priority areas: *Research and Innovation, Digital Economy, SME Competitiveness and Low Carbon Economy*. Thus, the ERDF finances cross-border, transnational and interregional cooperation (e.g. Interreg). The total budget is €199 billion, of which €32 is allocated to *Low carbon economy* (16%) and €25 to *Network infrastructure in transport and energy* (13%).

Source: https://cohesiondata.ec.europa.eu/funds/erdf

https://ec.europa.eu/regional_policy/en/funding/erdf/

CF – Cohesion Fund

The Cohesion Fund is addressed to Member States whose Gross National Income (GNI) per inhabitant is less than 90 % of the EU average. It aims to reduce disparities in economic and social terms and to foster sustainable development. It deals with four priorities of the ESIF: *Network Infrastructures in Transport and Energy, Environment Protection & Resource Efficiency, Low Carbon Economy, Climate Change Adaptation & Risk Prevention.*

To sum up, activities funded by the Cohesion Fund can be traced back to the following categories:

- trans-European transport networks, in particular the priority projects of European interest selected by the EU. The Cohesion Fund will help infrastructure projects under the Connecting Europe Facility;
- environment, the Cohesion Fund may finance energy or transport projects which have a positive impact on the environment in terms of energy efficiency, renewable energy use, rail transport expansion, intermodality and public transport improvement.

The Cohesion Fund allocates a total of € 63.4 billion of which €8 billion are allocated to *Low carbon economy* (13%) and €33 billion to *Network infrastructure in transport and energy* (52%).

Source: https://cohesiondata.ec.europa.eu/funds/cf
https://ec.europa.eu/regional_policy/en/funding/cohesion-fund/

Over the period 2007-2013, an amount of €270.9 billion was made available to Member States through the ERDF and the CF to co-finance projects to reduce imbalances between EU regions. The funds were spent with two main objectives: *Convergence and regional competitiveness and employment*. Furthermore, a third objective pursued concerns cross-border cooperation among Member States.
Source: https://ec.europa.eu/regional_policy/en/newsroom/news/2018/09/09-07-2018-esi-funds-open-data-an-overview-of-implementation-of-the-2007-2013-erdf-and-cf-allocations

Interreg

Previously it was Interreg IVC (2007-2013), then Interreg Europe (2014-2020). It is an ERDF-funded programme that allows regional and local authorities to cooperate on policy issues. Thanks to the environment and sharing opportunities created by Interreg, authorities come into contact with

partners in other regions with the same interest, build a project with them and can obtain funding from Interreg. The aim is to improve regional and local policies by sharing solutions between governments across Europe.

All projects developed with financial support from Interreg Europe fall into one of the following four areas:

- *Research and innovation;*
- *SME competitiveness;*
- *Low-carbon economy;*
- *Environment and resource efficiency.*

The total budget increased from €321 million for Interreg IVC to €361 million for Interreg Europe, with a 12% increase. The main difference is the shift in investment priorities: the categories to which investments are dedicated change and in particular the Low carbon economy category is added. The latter includes projects dedicated to sustainable transport and 21% of the Interreg Europe budget is dedicated to this theme (€76.20 million). Budgets and categories are listed in Table 4.

Interreg budget	€ million	% allocated	
2007-2013	321	55%	Innovation and the knowledge economy
		39%	Environment and risk prevention
		6%	Technical assistance
2014-2020	361	24%	Research and innovation
		22%	SME competitiveness
		21%	Low carbon economy
		23%	Environment and resource efficiency
		4%	Policy learning platform
		6%	Technical assistance

Table 4 Interreg total budget and percentage allocation to themes

Interreg Europe is in the process of preparing the new programme for interregional cooperation from 2021 to 2027, priorities and the complete programme will be drafted during 2020.

Source: https://www.interregeurope.eu/about-us/what-is-interreg-europe/

https://www.interregeurope.eu/about-us/facts-and-figures/

http://www.interreg4c.eu/programme/funding/

URBACT

URBACT aims to help cities cooperate and develop integrated solutions to shared urban issues by networking, learning from each other's experiences, drawing lessons and finding good practices to enhance urban policies. URBACT is funded by ERDF and national and local contributions.

Participation in URBACT is a decisive element in making the best use of national and European resources in urban development and encourages the emergence of new approaches and ways of governing local processes. Moreover, URBACT has fostered a renewed focus by local governments on local growth and development processes carried out by local stakeholders, thematic communities and urban practitioners, thus creating a network of local innovation actors in different sectors.

URBACT deals with different areas of interest: *Physical urban development, Economy, Environment, Governance, Inclusion. Physical urban development* involves an urban mobility section. Cities in Europe are increasingly facing problems caused by transport and traffic. Meanwhile, the global climate change challenge makes the shift towards clean mobility options necessary. Therefore, the issue of ways to improve mobility and at the same time cut congestion, accidents and pollution is a challenge shared by all major European cities.

In 2007-2013, URBACT II had a budget of €67.8 million, there is an increase of 42% for URBACT III of 2014-2020 with €96.3 million allocated (Table 5).

URBACT budget	€ million
URBACT II (2007-2013)	67,8
URBACT III (2014-2020)	96,3

Table 5 URBACT II and URBACT III budgets

Source: https://urbact.eu/our-funding

https://urbact.eu/urbact-glance

In 2020, the development of an URBACT IV programme for 2021-2027 began.

Source: https://urbact.eu/urbact-iv-che-punto-siamo-con-il-prossimo-periodo-di-programmazione

Urban Innovative Actions

Urban Innovative Actions (UIA) is a European Union initiative that supplies urban areas across Europe with resources to test new and untested solutions to urban challenges and experience how they work in practice and react to the complexities of real life.

The Initiative has a total ERDF budget of €372 million for 2014-2020. The UIA actions are implemented in 14 different topics covering all aspects of city life. Five projects (listed in Table 6) have been developed under the topic of Urban mobility, in 2014-2020. These projects use only 5% of the budget, but the topics are very specific, e.g. environmental initiatives are not included in this budget.

UIA – Urban mobility projects 2014-2020	€ million
Albertslund - TUPPAC	3,371
Ghent - Tmaas	3,465
Szeged - SASMOB	2,607
Lahti - CitiCAP	3,799
Toulouse - COMMUTE	4,192
TOTAL BUDGET SPENT	17,434

Table 6 Urban mobility projects under Urban Innovative Actions in 2014-2020

Source: https://www.uia-initiative.eu/en/uia-cities

No information is available for the period 2021-2027.

Source: https://www.uia-initiative.eu/en/about-us/what-urban-innovative-actions

https://www.uia-initiative.eu/en/topics

EIB – European Investment Bank

The European Investment Bank (EIB) not only contributes to the initiatives mentioned above, it also offers financial means to support the economy, create jobs, foster equality and improve the lives of citizens of the EU and developing countries.

The European Investment Bank is the lending branch of the European Union, the World' s largest multilateral financial institution and one of the major suppliers of climate finance. The EIB Group

consists of the European Investment Bank and the European Investment Fund (EIF). The EIF specialises in finance for small and medium-sized enterprises.

The EIB Group provides loans to the public and private sectors, supports small businesses through local banks and lends money to innovative start-ups. Medium-cap enterprises can receive direct support for investment in research and development. The Bank does not lend more than half the cost of a project because it aims to crowd in funding from private investors and other public financial institutions. Investment is triggered by the Bank's guarantee and also by the stamp of approval of its specialists (economists, engineers, financial analysts and climate specialists).

The EIB offers a wide range of financial products at favourable terms and is willing to accept higher risk than a commercial bank for projects supporting innovation and skills in Europe. It also offers technical assistance to help prepare and implement projects. The EIB is financially autonomous: it raises money by issuing bonds on the international capital markets. Thanks to its excellent credit rating, it raises money at good rates and then passes these benefits on to its customers.
Source: https://www.eib.org/en/about/index.htm

The European Investment Bank focuses on six areas: *Climate and environment, Development, Innovation and skills, Small businesses, Infrastructure, Cohesion.* Its action in the transport sector involves three of these priorities:

- *Climate and environment*

  This is one of the top priorities for EIB. Today EIB commits more than 25% of its financing to climate change adaptation and mitigation. It will gradually increase the share of financing dedicated to climate action and environmental sustainability to reach 50% of operations in 2025 and beyond. The bank is providing €94 billion to climate-related projects in the five years from 2016 to 2020, as it will align all its financing activities with the principles and goals of the Paris agreement by the end of 2020. The EIB Group will aim to support €1 trillion of investments in climate action and environmental sustainability in the critical decade from 2021 to 2030.

  Source: https://www.eib.org/en/about/priorities/climate-and-environment/index.htm

- *Innovation and skills*

The EIB Group is committed to breaking down barriers to investment and supporting the EU in taking the lead in the next wave of emerging technologies such as artificial intelligence, quantum computing and advanced production. Highly skilled people and quality research underpin the EU's ability to innovate with success. For this reason, the Bank also promotes skills and training to create new job opportunities and assist workers and companies in adapting to market needs and rapid technological change. Since 2000, the EIB has supported innovation and skills with over €210 billion of investment. In 2019 only, it provided €14.4 billion to support innovation and skills. This support has taken several forms:

- Supporting the development and marketing of innovative products, processes and business models;
- Promoting investment in research and development, education, upskilling and training;
- Improving connectivity and access by investing in broadband and mobile networks;
- Adopting and disseminate digital and other emerging technologies.

Areas of investments: Fundamental research, Education, Digital economy (5G, AI, IoT), Health, Industry.

Source: https://www.eib.org/en/about/priorities/innovation/index.htm

- *Infrastructure*

As an EU bank, the EIB has cleaner transport, digital networks, energy efficiency and sustainable urban development among its key investment priorities. Since its operations began in 1958, the Bank has supported infrastructure development through long-term financing. Nowadays, they have an important role in shaping a low-carbon future in Europe and beyond. In 2019, the EIB provided €15.74 billion to support infrastructure projects involving:

- *energy efficiency;*
- *smart, accessible and sustainable mobility;*
- *sustainable urban development;*
- *water and wastewater management.*

Areas of investment: sustainable transport, clean energy, water management, sustainable communities, infrastructure for those who need it most, interconnected Europe.

Source: https://www.eib.org/en/about/priorities/infrastructure/index.htm

To sum up, projects financed by the EIB in the transport sector are:

- *Green*: the aim is to tackle climate change and environmental sustainability encouraging the deployment of alternative fuels and cleaner technologies, through the Cleaner Transport Facility (CTF) launched jointly with the European Commission.
- *Innovative & Efficient*: the aim is to shift to low-carbon, cleaner and safer transport and tackle EU's congestion issue through innovation. EIB finances the development of cutting-edge technologies such as *alternative fuels and fuel cells, green batteries, e-mobility, autonomous driving, and artificial intelligence.*
- *Safe & Secure*: the aim is to make transport safer and reduce the number of accidents. The EIB and the European Commission launched *Safer Transport Platform - Road Safety Advisory* which fosters projects improving road safety.
- *Inclusive & Accessible*: the aim is to tackle challenges arising from ageing, migration and geography and make transport inclusive and accessible for all, in the Member States and neighbouring countries.

Source: https://www.eib.org/en/projects/sectors/transport/index.htm

In conclusion, the European Investment Bank aims to boost the take-up of sustainable transport solutions by attracting private and public investment and ensuring a balanced regional development at the same time. Moreover, the Bank provides technical assistance and advisory support through a range of programmes.

Cleaner Transport Facility CTF

The Cleaner Transport Facility (CTF) is an EIB and EC initiative to support the diffusion of new and cleaner technologies in the transport sector. The aim of the CTF is to accelerate the deployment of clean transport and the development of the necessary infrastructure, such as recharging and refuelling. The deployment of this type of transport promotes socio-economic benefits, including reduced health costs through cleaner air and less noise.

Source: https://www.eib.org/en/projects/sectors/transport/cleaner-transport-facility.htm

Through the EIB's financial products and advisory services, the initiative also seeks to leverage private sector funds. In addition, EFSI and CEF can provide funding, as can the InnovFIN programme (under Horizon 2020) focusing on electromobility, hydrogen and fuel cell demonstration projects.

Safer Transport Platform – Road safety Advisory

The STP - Road Safety Advisory is a gateway to consultancy services to support the adoption of funding for projects that improve road safety. It fosters road safety, vehicle safety and user safety offering guidance and support to potential promoters of public and private sector projects.

There are several sources of funding available for project promoters that make transport safer. ESIF, CEF, EIB, Other International Financial Institutions (IFIs) and National Promotional Banks and Institutions (NPBIs) can offer loans and guarantees for eligible investments. Such public sector financial support should attract and mobilise the investments from the private sector in projects for safer transport. National, regional and local authorities, major transport providers and authorities with responsibility for communication and enforcement can benefit from these investments.

Source: https://eiah.eib.org/about/initiative-safer-transport-platform.htm

Advising

Advisory services complement the EIB's lending activity. Services available are:

- *EIAH: European Investment Advisory Hub helps Member States and other private or public entities to identify investment needs and to prioritise, prepare and structure projects in the EU.*
- *ELENA: European Local ENergy Assistance is a grant funding for technical assistance for the preparation of sustainable transport projects for public and private entities.*
- *JASPERS: Joint Assistance to Support Projects in European Regions is a technical assistance programme and constitutes an important instrument of EU Cohesion Policy.*
- *EPEC: European PPP Expertise Centre helps to strengthen the capacity of its public sector members to enter into Public Private Partnership (PPP) transactions.*
- *InnovFin: InnovFin Advisory guides its clients (private and public) on how to structure their research and innovation (R&I) projects in order to improve their access to finance.*

Source: https://www.eib.org/attachments/thematic/cleaner_transport_facility_en.pdf

LIFE

The LIFE Programme is an EU funding instrument created in 1992 for the environment and climate action. The funding period 2014-2020 has a budget of €3.4 billion, previously €3.1 billion had been spent between 1992 and 2013. In 2020, €450 million is available for calls for proposals.

LIFE is organized in two sub-programmes:

- Environmental sub-programme: funds for nature conservation and biodiversity, environment and resource efficiency, environmental governance and information;
- Climate action sub-programme: Climate change mitigation, climate change adaptation, climate governance and information funds.

Budget available to subprogrammes in 2018-2020 are presented in Table 7. The financial instruments available are loans and equity investments provided by the EIB for natural capital and energy efficiency projects.

LIFE budget 2018-2020	€ billion
Total budget	1,66
Environment subprogramme	1,24
- Environment and resource efficient use	0,45
Action for climate subprogramme	0,42

Table 7 LIFE budget and allocation to subprogrammes

Source: https://eur-lex.europa.eu/legal-content/IT/TXT/PDF/?uri=CELEX:32018D0210&from=EN

2.2.3 Overview of funding opportunities

Table 9 summarises the funding opportunities focusing on the specific objectives of the transport sector. European investments have accessibility and environment as a priority and technologies (i.e. smart initiatives) serve these objectives.

Funding opportunities	Objectives (transport sector)	Budgets and funds allocated
Horizon 2020	- Resource efficient transport that respects the environment - Better mobility, less congestion, more safety and security - Global leadership for the European transport industry - Socio-economic and behavioural research and forward-looking activities for policy making	€77 billion: total budget 2014-2020 €6.3 billion: transport challenge funds 2014-2020
CEF	- Interconnecting transport modes and enhancing interoperability - Developing sustainable and efficient transport - Building cross-border infrastructure and bridging missing links	€30.5 billion: total budget 2014-2020 (€55.5 billion triggered) €22.8 billion: transport budget 2014-2020 (€48 billion triggered)
EFSI	- Strategic infrastructure - Renewable energy and resource efficiency	€33.5 billion: total budget 2014-2020 (€466 billion triggered- 33%infrastructure of which 17% for energy, 9% for digital, 7% for transport & 4% environment and resource efficiency)
ESIF	- Network infrastructure in transport and energy - Fostering sustainable transport - Eliminating bottlenecks in network infrastructures - Low carbon economy - Transition to a low-carbon economy	€57.83 billion: network and infrastructure budget 2014-2020 €44.33 billion: low-carbon economy budget 2014-2020
EIB	- Tackling climate change and environmental sustainability (cleaner transport) - Offering low-carbon, cleaner and safer transport through innovation - Safer and secure transport, reducing the number of accidents - Inclusion and accessibility for all	€94 billion: funds to climate related activities 2016-2020 €210 billion: funds to innovation 2000-2020 (€14.4 billion in 2019) €15.74 billion: funds to infrastructure in 2019
LIFE	- Environment and resource efficiency	€1.66 billion: total budget 2018-2020 €0.45 billion: funds to environment and resource efficient use 2018-2020

Table 8 Funding opportunities: goals and budgets

2.3 Italy

The strategies that guide actions in the field of transport and mobility in Italy are defined in the Infrastructure Annex to the Economic and Financial Document year by year. The Annex acts as a strategic link between the investment choices adopted by the Government and Parliament and the EU guidelines.

Connecting Italy

In 2016 the Ministry of Infrastructure and Transport launched a process of reform of infrastructure planning in Italy with the document "Connecting Italy" (Annex Infrastructure to the 2016 Economic and Financial Document). The document defines objectives, strategies and lines of action to implement structural reforms in the sector and define policies for the implementation of the Vision of the Transport and Infrastructure System to 2030. This Vision emerged from an analysis of the transport and logistics infrastructure in Italy and the trends in progress at international level. According to the Vision:

Connecting Italy means equipping the country with a modern and efficient infrastructural system, built with clear rules, adequate resources and certain timescales, with the aim of guaranteeing full mobility (of people and goods) and accessibility to Europe for all areas of the national territory, while making Italian cities livable for citizens and welcoming for visitors, and the country competitive on international markets.

The new approach focuses on citizens and businesses and their needs, promoting infrastructure as a tool to meet the demand for mobility of passengers and goods and to connect areas of the country.

Four strategic objectives have been defined to boost Italy's competitiveness in a globalised economy, where it is essential to establish adequate transport and logistics connections and services towards Europe and the Mediterranean and thus allow the full mobility of people and goods and to serve some specific "strategic markets", such as workplaces, tourist centres and cultural attractions. The objectives are as follows:

- *Accessibility to territories, Europe and the Mediterranean;*
- *Quality of life and competitiveness of urban areas;*
- *Support to industrial supply chain policies;*
- *Sustainable and safe mobility.*

Accessibility to the main nodes of the country, but also to the peripheral areas, in this the national strategy aligns with the Community's TEN-T strategy. accessibility to the Mediterranean is strongly linked to economic opportunities in terms of trade and results in improved connections with the countries of the Mediterranean area.

A country's competitiveness is measured in urban areas by assessing the services (transport first and foremost) and the opportunities it offers. Italy is at a disadvantage with respect to the parameters of air quality, traffic and transport usability, so it is necessary to act to strengthen and integrate public transport systems but also cycle-pedestrian mobility and exploit the opportunities offered by digital innovations for shared mobility services.

Support for industrial supply chain policies is expressed in the creation of synergies between infrastructure and industrial strategy to foster innovation-oriented investments in the production of public transport, infrastructure and technological systems ("smart" infrastructure, ITS intelligent transport systems) and in the provision of innovative services in line with market needs.

Sustainable and safe mobility has become an integral part of the MIT strategy. Sustainable means economic, environmental and social. From the economic point of view, infrastructure policies will pursue the balanced satisfaction of the needs expressed by the territories, with interventions whose usefulness and efficiency in terms of consumption of economic and environmental resources is guaranteed. From the environmental point of view, infrastructure policies will contribute to the achievement of the targets set by the Paris Conference, COP21, in terms of pollution reduction, biodiversity and landscape protection and energy efficiency. Therefore, they will promote investments towards transport modes and project initiatives that prefer the use of renewable and/or low polluting energy sources. From the social point of view, the focus is on inclusion and infrastructure as elements to reconnect the suburbs of cities and marginal areas of the country, to promote participation in social practices, to recover the sense of civic and community belonging, and to design interventions with attention to the classes of weak and disabled users.

The plan to achieve the objectives is based on 4 Strategies: Useful, lean and shared infrastructure; Modal integration and intermodality; Enhancement of existing infrastructure heritage; Sustainable urban development. They are transversal to the objectives and modes of transport and each one foresees concrete actions (listed in Table 9).

Useful, lean and shared infrastructure	Modal integration and intermodality	Enhancement of existing infrastructure heritage	Sustainable urban development
Unified national planning; Programming of interventions through the identification of priorities and monitoring of investments; Improved planning.	Accessibility to nodes and interconnection between networks; Rebalancing of demand towards sustainable modes of transport; Promotion of intermodality.	Scheduling of maintenance work on existing infrastructure; Improvement of service levels and safety of infrastructure; Efficiency and technological upgrading of infrastructure; Incentives to the development of Intelligent Transport Systems; Measures for the efficiency of air transport.	Iron care specifically targeted to urban and metropolitan areas; Accessibility to urban and metropolitan areas; Quality and efficiency of Local Public Transport; Sustainability of urban transport; Technologies for smart cities; National housing policies.

Table 9 "Connecting Italy" main strategies and concrete actions

Source: http://www.mit.gov.it/sites/default/files/media/notizia/2018-05/Allegato_3%20bis_-_Connettere_lxItalia.pdf

Integrated National Energy and Climate Plan 2030

As far as the environmental and climate aspect is concerned, the Integrated National Energy and Climate Plan 2030 is the fundamental instrument that marks the beginning of an important change in Italy's energy and environmental policy towards decarbonisation.

The Ministry of Economic Development has published the text prepared with the Ministry of the Environment, Land and Sea and the Ministry of Infrastructure and Transport. The document takes into consideration both the novelties contained in the Climate Law Decree and those on investments for the Green Deal provided for in the 2020 Budget Law.

The Plan is structured in 5 lines of action, which will be developed in an integrated manner:

- Decarbonisation;
- Efficiency and energy security;
- Internal energy market;

- Research and innovation;
- Competitiveness.

This Plan sets national targets for 2030 on energy efficiency, renewables and the reduction of CO2 emissions, as well as targets for energy security, the internal energy market and competitiveness, sustainable development and mobility, and outlines for each of them the actions that will be carried out to ensure their achievement. The citizen is the center of the energy transition, the recipient and an active part of climate and environment policy.

The final objective is to implement a new energy policy that will ensure full environmental, social and economic sustainability of the national territory and accompany this transition.
Source: https://www.mise.gov.it/images/stories/documenti/Energia_Clima_2030.pdf
https://www.mise.gov.it/index.php/it/198-notizie-stampa/2040668-pniec2030

3. Research questions and methodology

The aim of this chapter is to illustrate the objectives of the thesis and the research questions it answers. The approach and methodology are described below. This dissertation is part of the research work of the Smart & Connected Car Observatory of the Politecnico di Milano.

3.1 Research questions

This investigation tries to analyse the spread of Smart Mobility projects and the main trends in the sector in Italy. It is important to understand which of the areas of Smart Mobility have more projects underway or planned, how active the Italian municipalities are in the usage of data, what is the perception of the barriers and the main challenges for the implementation of Smart Mobility, the objectives they pursue with the initiatives and finally what types of actors are involved. In addition, the thesis includes a collection and analysis of the Smart Mobility initiatives around the World with the purpose of describing the current status. Some adding data complete the analysis concerning the World. In this case it is interesting to understand the geographical distribution of the initiatives, the launch of the projects over the years (the years with more projects but also the diffusion of the various types over the years) and the stage of the projects. Eventually, the dissertation aims to make a comparison between the Italian and World situation in order to

highlight the main similarities and differences. Furthermore, starting from the major challenge for Italian municipalities, a framework has been created and analyzed: it correlates the degree of collaboration between public and private and the type of innovation generated by their initiatives.

The considerations above lead to the formulation of the research questions that this thesis wants to answer:

RQ1: Which are the main trends in the Smart Mobility sector in Italy and the main similarities and differences with the rest of the world?

RQ2: Does the degree of collaboration between the private and the public sector influence the type of innovation generated? How can Italian municipalities benefit from this type of collaborations in the process of implementing future initiatives?

3.2 Methodology

The following steps have been performed to answer the questions:

1. Processing of the data coming from the survey made by the Observatory. The survey was sent to 363 Italian cities with more than 25.000 inhabitants aiming at collecting data on the Italian situation and the main projects in action. The filled out surveys (68 in total) allowed a detailed analysis on the relevance of the Smart Mobility concept, on past and future projects, their typology, their progress, on the use of data, on the barriers, on the objectives, on the actors involved, on the major challenge, on the Smart Car and city integration and on autonomous driving. The analysis has been made on two levels: the overall level and the dimension level dividing the cities in small (25-40.000), medium (40-80.000) and large ones (more than 80.000).
2. Mapping of the active and developing projects through a search for secondary source: web sites focusing on the diffusion of ICT and the automotive industry were used to collect the different projects and their characteristics. A large database has been created and used in the analysis eventually.
3. Comparing of the two sets of data underlining similarities and differences in the two scenarios.

4. Creating and analysing the framework: definition of the axes with references to the survey and literature, positioning of the cases (representative states), description of the sample initiatives to motivate the positioning, presentation of the results.

3.2.1 Survey

The survey was created by the Smart and Connected Car Observatory and was sent by email to the Assessors and Managers of the 363 Italian municipalities with more than 25.000 inhabitants.
The aim of this study is to explore the state of the art of Smart Mobility projects.

The survey is made by 11 questions with multiple answers and the possibility to add notes. The first question concerns the relevance of the smart mobility issue within the municipalities and the second one asks about the past projects and the year of implementation. Afterwards, the survey has been divided in two sections. The first part is dedicated to municipalities that have started projects in the past. It allowed the gathering of information about which municipalities have started projects, in what application area, in what progress they are and if the municipality makes or plans to make use of the data collected through smart initiatives. The second part is dedicated to everyone and concerns the barriers, the future projects, their application area and implementation period, the objectives which push municipalities towards Smart Mobility, the actors involved or to be involved, the main challenges, the most useful integration services in the future, the actuation of the autonomous guide in the next 10 years. Therefore, the questionnaire collects interesting information from all the interviewees, even from those who have never undertaken smart projects.
On the basis of the answers obtained, very useful graphs have been created to describe the situation of the Italian municipalities, which will be described in chapter 4.1.

3.2.2 Database

The research was carried out mainly thanks to the analysis of the industries (automotive and ICT) and the cities sites and those created ad hoc for the implementation of the singular projects. The search for secondary sources was done in English and Italian language, therefore the results give priority to initiatives of countries speaking these languages or wide range projects (international). Local initiatives (which do not present the website in English) are certainly excluded from the collection.

A large database containing the most important information related to the Smart Mobility initiatives was created. To outline a representative picture of the International scenario, these drivers were used:

- Initiative name: name of the project formal or informal;
- Partners name: name of the companies or administration involved;
- Description: brief description of the project;
- Geographic area: one or more of the World's areas (*North, Central, South America, Europe, Asia, Africa, Oceania*) or *Global* for projects not focusing a specific area or targeting the whole world;
- Country: the country where the project is carried out;
- Company type: definition of the partners as *Established company, Start-up or Public administration*;
- First area of application: the first area to which the initiative refers among those described in the chapter 4.2.1;
- Second area of application: the possible second area to which the initiative refers (chapter 4.2.1);
- Launch year: starting year of the project;
- Progress: the state of the project among *Preliminary analysis, Prototype, Pilot, Executive*;
- Prevalent technologies: the main technologies relating to the project;
- Essential hardware/device: the hardware or device necessary to the implementation of the project;
- Sources: the websites from which the information on the project is taken;
- Notes: details concerning the initiative or one of the previous items.

On the basis of the data collected, useful graphs have been created to describe the World's scenario, which will be described in chapter 4.2.2.

4. Description of main trends and comparison

This chapter answers the first research question of this thesis. The first step is the presentation of the Italian scenario and its trends, then the world's scene is described and finally the outputs are

compared. The chapter ends with a consideration about the portrait of Italy from two perspectives, one coming from the survey and the other from the database.

4.1 Italian scenario

The purpose of this chapter is to introduce the survey sample and to describe the state of projects in Italy from the municipalities point of view.

4.1.1 Survey sample

In 2019, a survey has been sent to 363 Italian municipalities with more than 25.000 inhabitants, aiming at analysing in detail the Italian scenario. This resulted in 68 filled in surveys, 19% of the municipalities reached. Therefore, municipalities different for area of origin and size helped create a picture of the current Italian situation.

Concerning the area of origin, the sample does not respect the real distribution of Italian municipalities, as shown in Figure 26. Most of the answers come from Northern cities, but a sufficient number of answers allows to collect data also from the Centre and from the South & Islands.

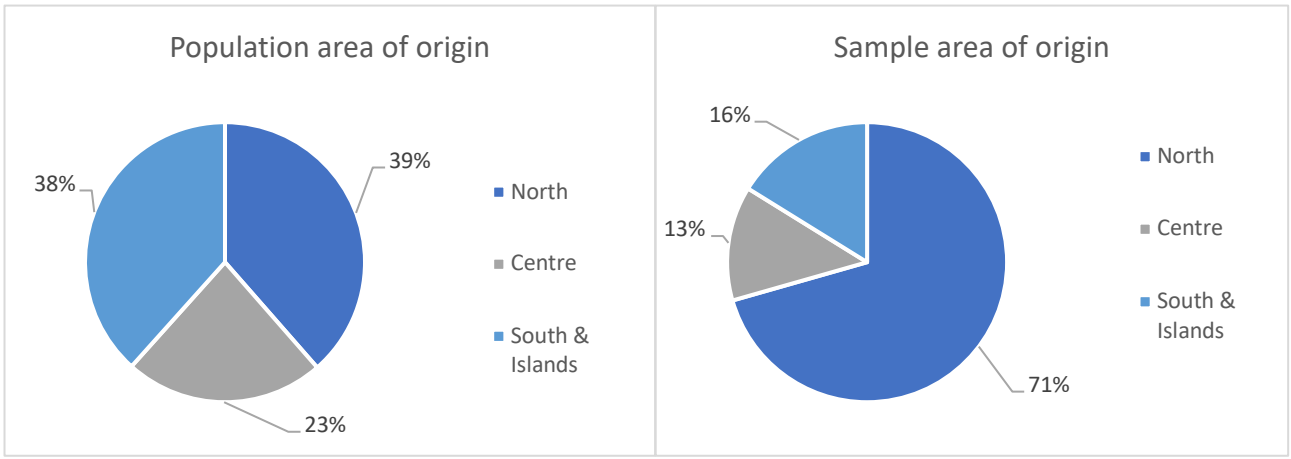

Figure 26 Real distribution of Italian municipalities by area vs. distribution of the sample

Concerning the size, the sample is equally distributed on three categories of population: large municipalities with more than 80.000 inhabitants, medium municipalities from 40.000 to 80.000 inhabitants and small municipalities from 25.000 to 40.000 inhabitants (smaller municipalities are excluded from the survey). This allows to have a good representation of the different characteristics of the categories, while not perfectly representing the real proportion of Italian municipalities, as shown in Figure 27.

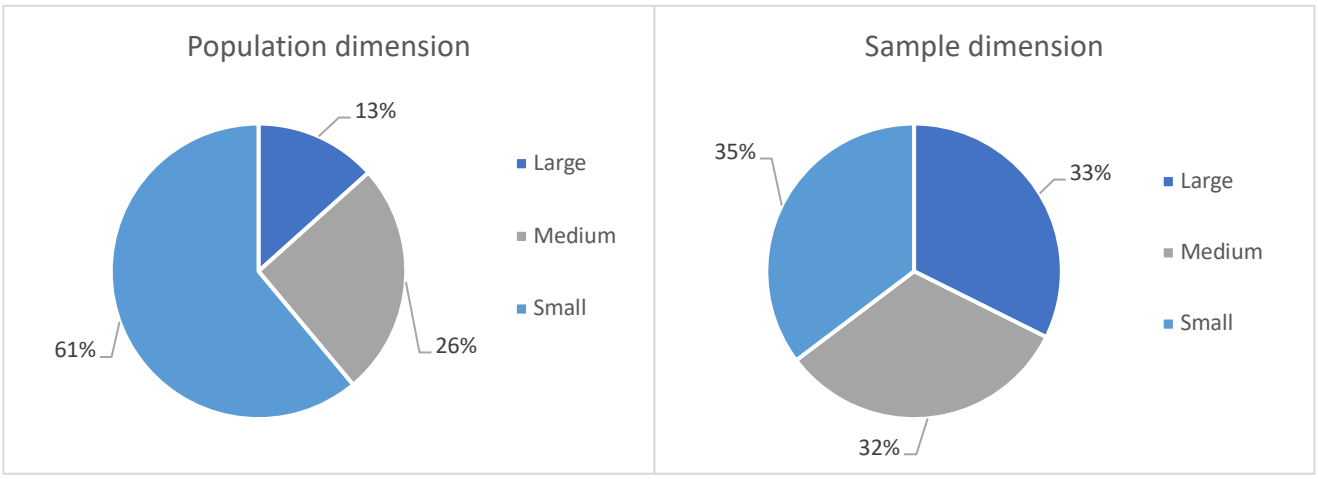

Figure 27 Real distribution of Italian municipalities by dimension vs. distribution of the sample

4.1.2 Actual situation of the municipalities

The Smart Mobility is important to the majority of the municipalities: as shown in Figure 28, the theme is very relevant for 58% of them and fundamental for the 29%, adding to 86%. For the 12%, the topic is little relevant while only one of the municipalities considers it irrelevant (Montebelluna in the 25-40.000 cluster). Therefore, the municipalities recognize an importance to the theme even if it is marginal for someone.

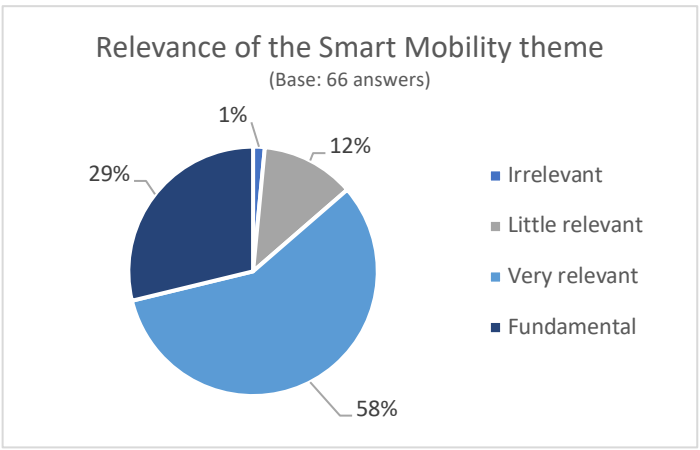

Figure 28 Relevance of the Smart Mobility theme according to municipalities

The majority is also confirmed at the level of the individual size categories (see Figure 29). For the large municipalities (80+), 95% of the respondents consider the topic relevant or fundamental. This high figure is not surprising: the largest cities are those with the greatest traffic and pollution problems and the first that try to find solutions. Trying to exploit the most innovative tools, big cities see the Smart Mobility as a priority. The percentage decreases slightly for the other categories: the medium municipalities reach 76%, while the small ones 87%. A surprising and positive figure regards

the smaller municipalities that recognize the importance of such a new theme. In conclusion, the relevance recognized to this theme does not depend on the size of the municipality.

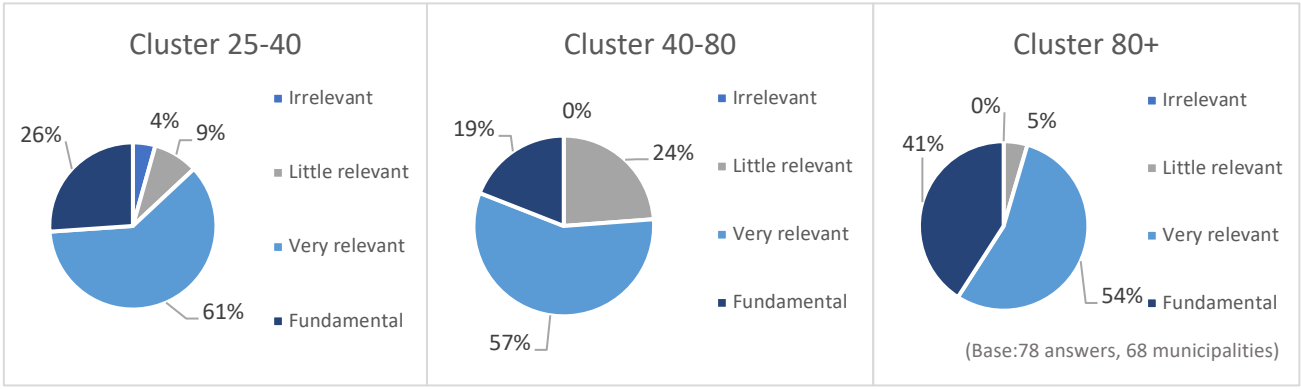

Figure 29 Relevance of the Smart Mobility theme by population clusters

As displayed in the graph (Figure 30), most cities among the respondents have already started Smart Mobility projects. A good part of the municipalities, 36%, have recently implemented activities, in the three-year period from 2017 to 2019, 38% state that they have started projects before 2017 and instead only a quarter of the municipalities (25%) state that they have never started projects in the past. In detail of the three-year period between 2017 and 2019, the cities are divided equally over the years with 11% in 2017, 12% in 2018, 13% in 2019.

In general, only 26% of municipalities have not started projects, while in the case of large ones the percentage drops to 6% thus, almost all of the major municipalities have launched smart initiatives. For the other categories the percentages are much higher: 47% for medium municipalities and 38% for small ones.

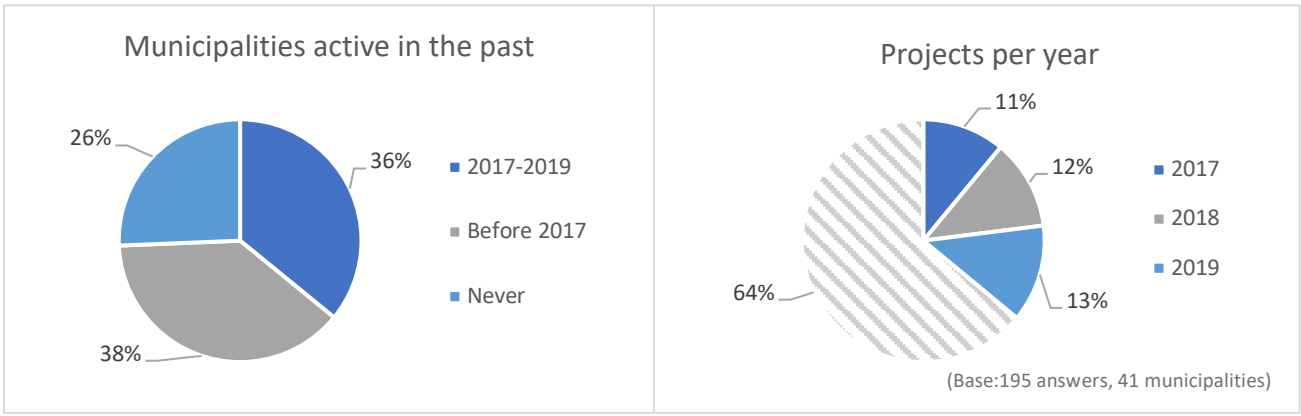

Figure 30 Municipalities active in Smart Mobility in the past, detail of the years 2017,2018,2019

An indication of the level of development of Smart Mobility is given by the status of the initiatives. Actually, a very positive result emerges from Figure 31: 57% of the projects started are executive projects, while only 18% are pilot projects and 23% preliminary analysis. This is a positive sign: for

many technologies and uses feasibility and success have already been tested and also Italian municipalities are taking concrete action in the field of mobility. The majority of executive projects is confirmed in all the size-categories.

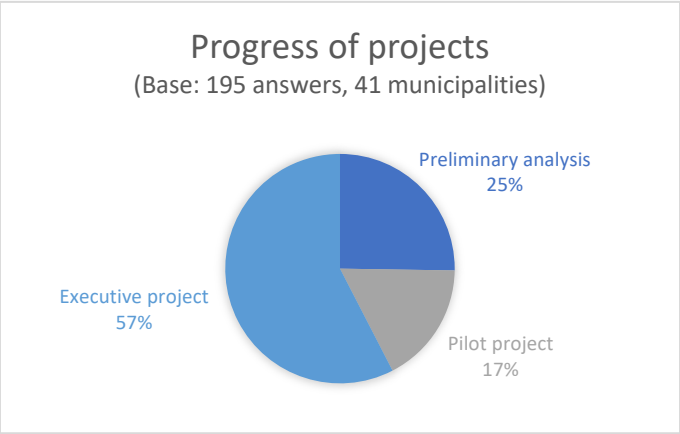

Figure 31 Distribution of past projects by progress

As illustrated by the chart on past projects distribution (Figure 32), the most widespread areas of application include electric mobility (21%) and sharing mobility (17%), which are the areas with the most projects for both large and small municipalities. They are followed by parking management (16%) and traffic management (14%), which are in first and second place for medium-sized municipalities which proves how they can be applied throughout the territory.

Looking at the status of projects in these areas, in general the projects are executive for the most part: electric mobility 71% , sharing mobility 65%, traffic management 59% of executive projects. The case of parking management stands out: the projects are divided between the three stages, in particular 44% of them are at the preliminary analysis and only 34% at the executive stage.

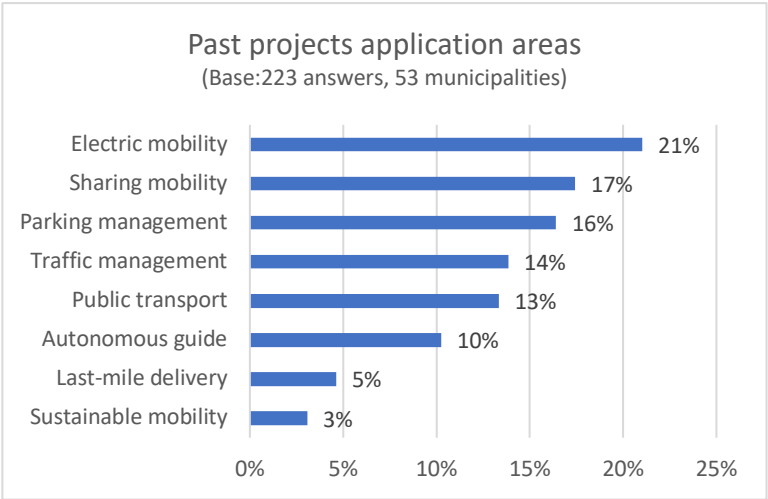

Figure 32 Distribution of past projects by application area

Looking to the future (Figure 33), the same areas tend to be confirmed with a similar order. The large municipalities give priority to parking management and traffic management in line with the type of problems they face. Electric mobility and sharing mobility retain their relevance in this and the other two size categories.

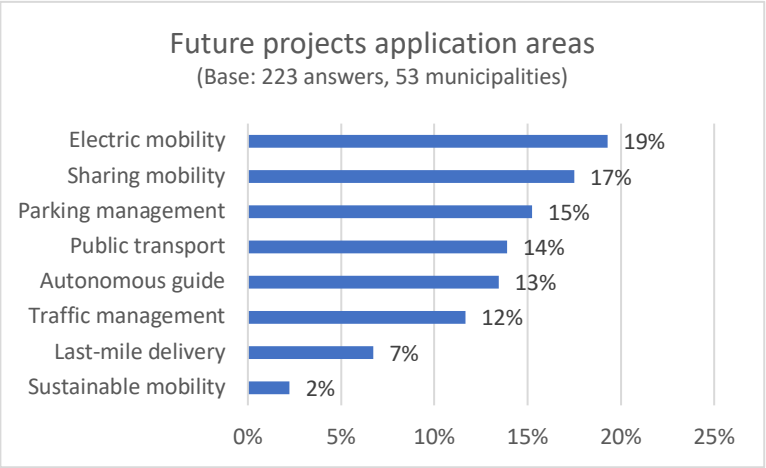

Figure 33 Distribution of future projects by application area

Comparing the horizons of achievement, the ranking changes slightly (see Figure 34). Among the projects planned within 12 months the majority are electric mobility (28%), sharing mobility (15%) and parking management (15%) initiatives. In the horizon of 2-3 years sharing mobility (21%) and parking management (16%) remain in the top positions while the interest in autonomous guides is growing to 16%.

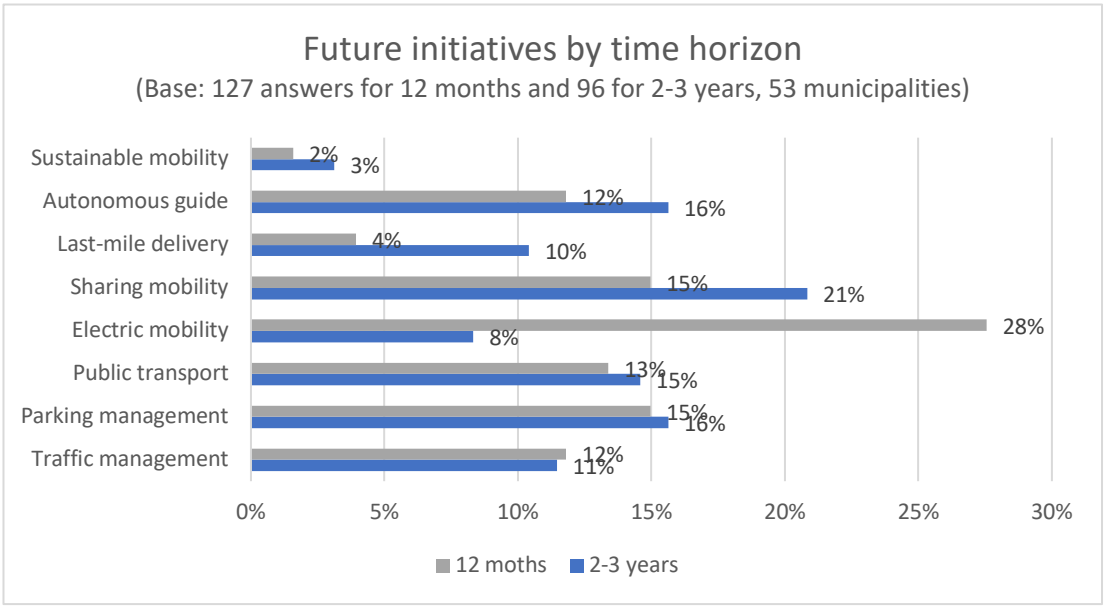

Figure 34 Distribution of future projects by application area and time horizon

Comparing the composition of future projects regarding size categories, in the 12 months horizon large cities make the largest contribution, reaching 54% of the initiatives launched. In the 2-3 years period small and medium-sized municipalities reach higher percentages (37% and 28% respectively) and cover more than a half of the planned projects (see Figure 35).

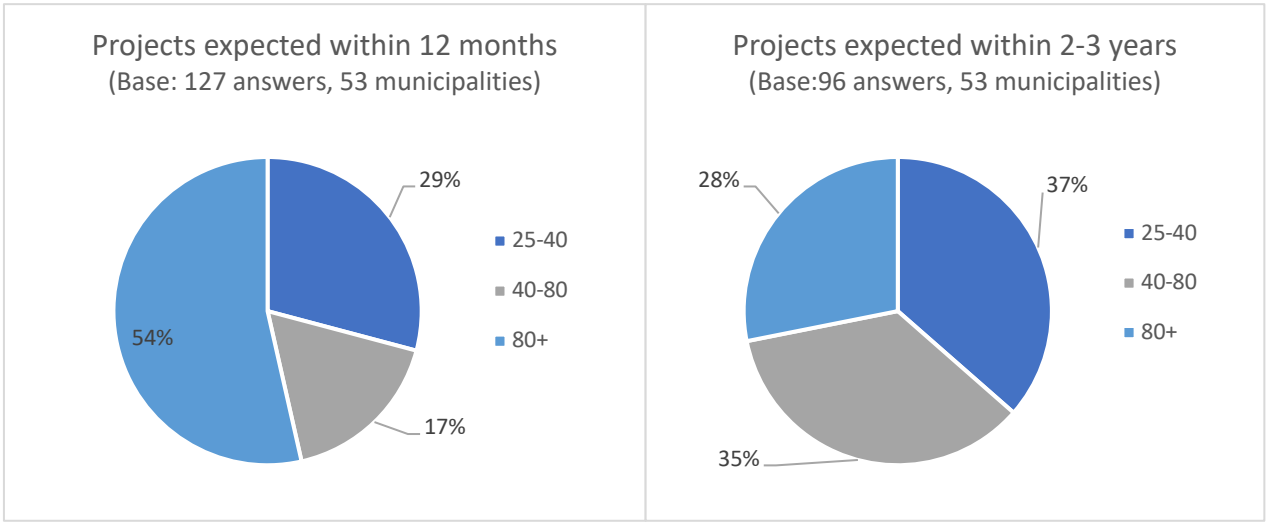

Figure 35 Distribution of projects expected within 12 months and projects expected within 2-3 years by cluster of dimension

Changing perspective, the city assets that are considered most important to start future Smart Mobility projects are: parking assets (36%), for example systems for signalling free parking spaces and enabling payment from the car, and traffic lights (27%), such as systems optimizing the flow or empowering services as the priority of ambulances (see Figure 36). There is consistency with previous results regarding the types of projects that will be implemented. Another asset whose importance is recognized is the charging columns (15%), the lowest percentage may be due to the fact that many projects in this field have already been started in the past.

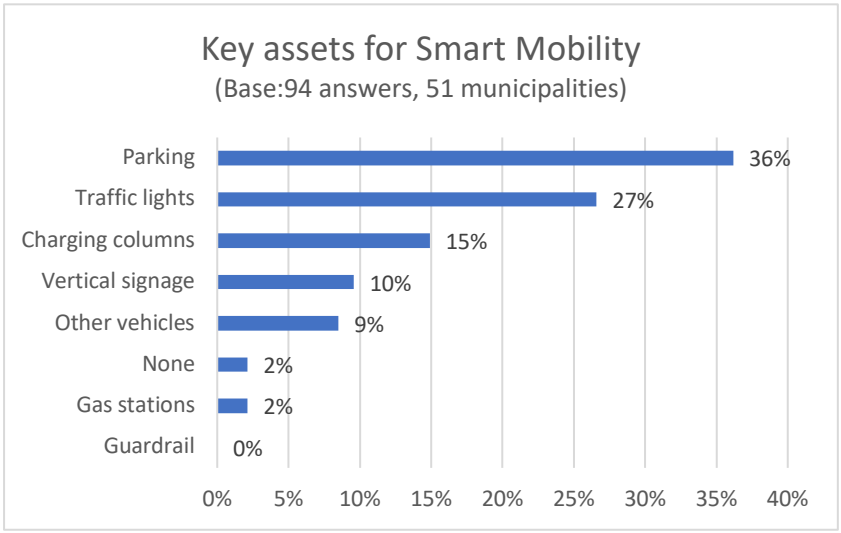

Figure 36 Distribution of key Smart Mobility assets according to municipalities

Another component that can be considered an asset for many smart projects is data. First of all, the importance of the data generated is recognized by most municipalities as shown in Figure 37, 63% currently use the data. In addition, among those who still do not exploit its potential, 29% think of using data in the future, understanding the potential benefits. Only 8% will not use it.

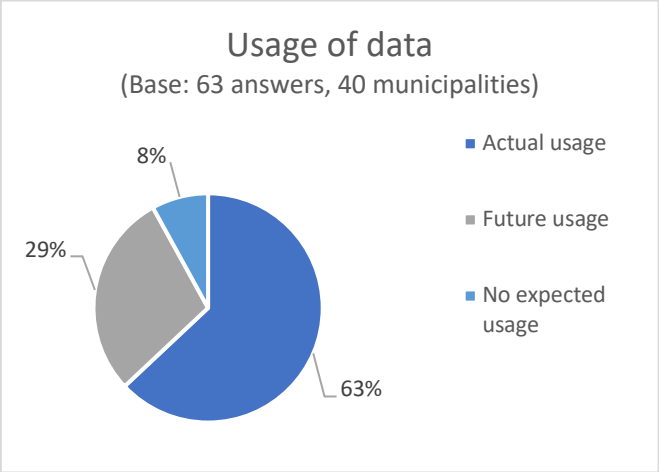

Figure 37 Usage of data by municipalities

None of the large municipalities state that they do not use and will not use the data, among the medium ones only 9%, while among the smaller ones the percentage rises to 24%. This result is due to the fact that the amount of data makes it useful: the more means in circulation and the more inhabitants, the better and more useful results can be achieved. Talking about Big Data, they are linked to purely digital initiatives, such as car sharing applications and electronic money payments.

Among those who currently use data, 30% declare to use it for internal purposes for example to learn about mobility flow and make decisions related to traffic management, 17% for services to citizens such as providing information on which areas of the city have a better level of air quality, or making data available in open data logic and finally, 16% for the municipality and outsiders (see Figure 38).

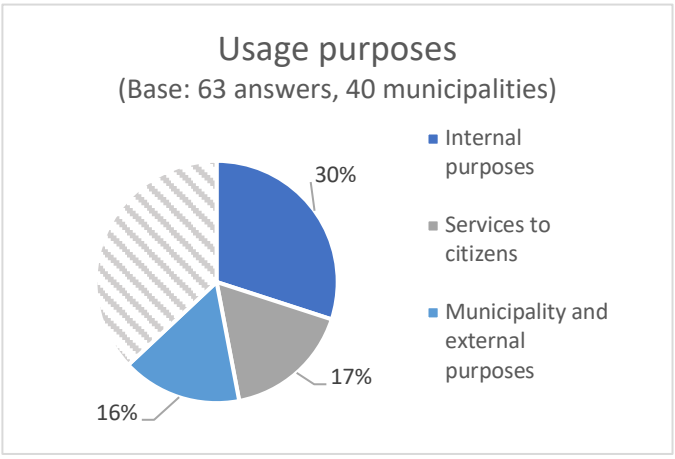

Figure 38 Detail of usage purposes of municipalities which are already using data

The goals which push cities to Smart Mobility are different between each other and depending on the area of application of the initiative. As far as Italian municipalities are concerned, environmental sustainability (27%) and the desire to offer better services to citizens (24%) are at the top of the list in Figure 39. Sustainability is consistent with previous responses: electric mobility and sharing have important repercussions in terms of sustainability. It is important and positive that municipalities demonstrate awareness of the sustainability issue nowadays. Moreover, this objective is in line with those expressed by EU strategies and funds. The willingness to offer better services is an objective consistent with current trends that put the customer/user at the centre. In third place there is road safety with 14% of the responses, the percentage rises much in detail of the size categories. Safety is perceived as a problem by the medium and large municipalities that therefore put in place initiatives with the aim of improving the level.

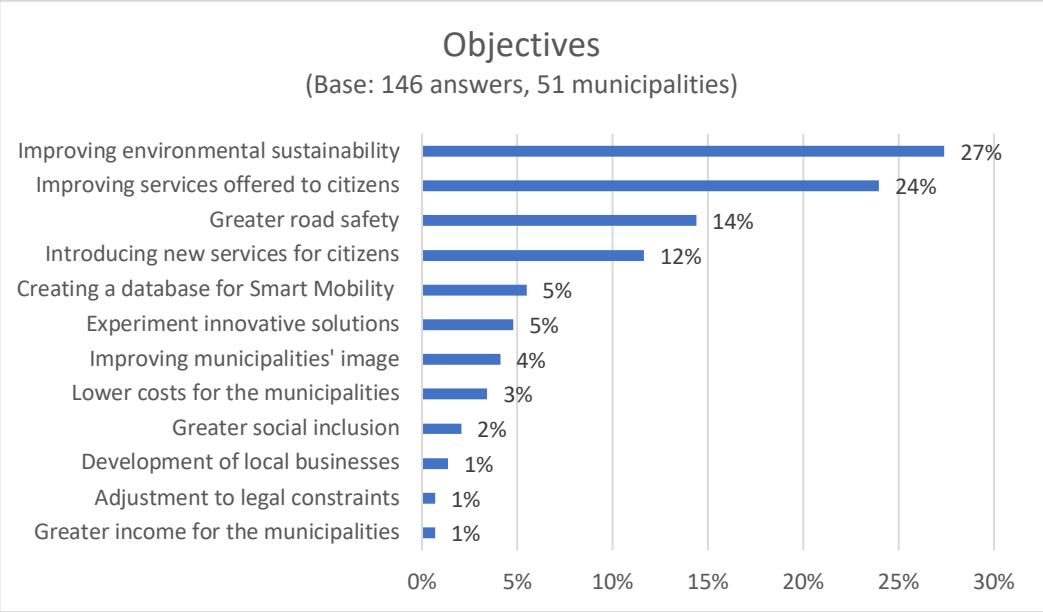

Figure 39 Objectives pursued by municipalities through Smart Mobility projects

Between the definition of the objective and its achievement there are various barriers that municipalities face. More than a quarter of Italian municipalities find that economic resources are scarce. This has to do both with the resources necessary for the development and implementation of the project and with the recruitment of staff to be dedicated to it. Four barriers follow, with percentages very close to each other: poor knowledge and lack of internal skills (13%), complexities related to bureaucracy (14%), lack of understanding by the citizens (12%) and difficulties in coordinating different actors (11%) (as shown in Figure 40, leaving aside the barriers with irrelevant percentages).

The lack of economic resources is the main barrier also encountered by the individual size clusters. Other barriers are more specific: the lack of skill is an obstacle for small municipalities, but not for large ones thanks to the availability of people and companies they enjoy. The coordination of the actors threatens the large municipalities and their bigger projects.

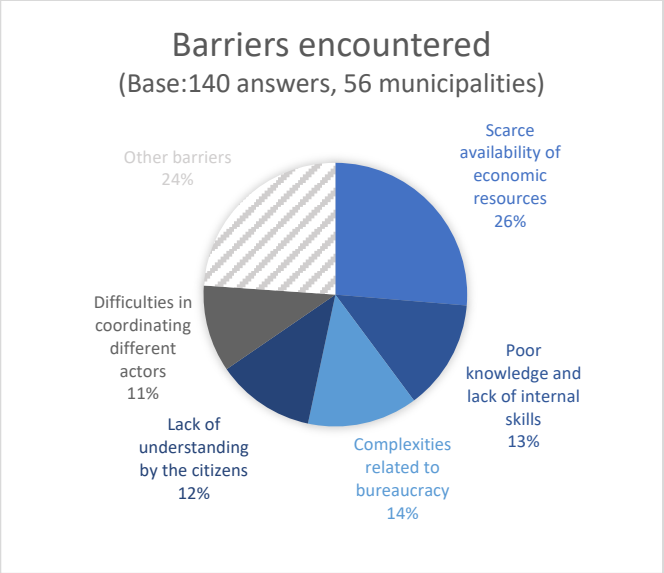

Figure 40 Barriers encountered by municipalities

To implement Smart Mobility initiatives, municipalities are forced to involve other actors whose categories are listed in Figure 41. In the past, municipal companies have been the most involved actor (24%). They are a key player and very integrated with the municipality for all size categories. They are followed by universities and research centres (15%) that are always active in experimentation and often look for partners and contexts to apply new models and technologies. In this case the partner cities are medium or large. Finally, a relevant player is made up of other municipalities (14%), a relevance more perceived by small and medium municipalities that try to reach critical mass in order to start projects that have a significant impact on the territory.

In the future the situation changes, answers are more spread, actors less close to the municipality are involved and the differences between the dimensions are less significant. First of all, there is a clear opening towards the world of start-ups (15%), there are many active ones in the field of mobility; after that the interest towards sharing companies (12%) and delivery companies (12%) is growing. The strong growth in interest in collaborations with delivery companies is linked to last mile delivery issue, the impact that deliveries have on city traffic and the desire to reduce it.

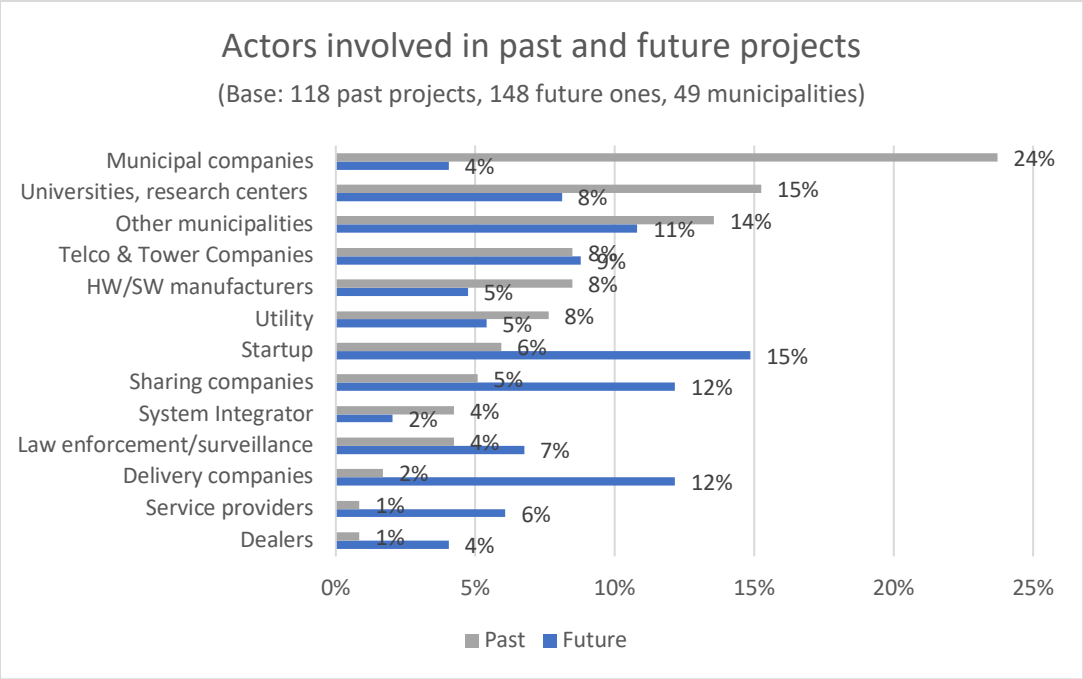

Figure 41 Actors involved by municipalities in past and future projects

Figure 42 displays the main challenges for urban centres when it comes to developing Smart Mobility projects: fruitful collaboration between public and private (33%), municipalities and private companies, have different objectives and make different choices; active participation by citizens (25%), in the choice of projects but also in the use of solutions that determine their success or failure; finally, the ability to move from a pilot project to an executive one (21%), the transition from a project on a limited area or limited time to a permanent one involving the whole city.

The main challenge for the 25-40 cluster is the cooperation between public and private; for the 40-80 the development of a winning business model; for the 80+ the ability to pass from the pilot project to the city-wide implementation. For smaller cities it is more difficult to reach agreements with supplier companies or with entities since they have lower bargaining power and represent lower investment but also less return in the eyes of suppliers. In addition, the problem of citizen participation mainly concerns small and medium-sized cities. These are usually characterized by less extensive public transport and citizens are accustomed to use private transport, thus it will be difficult to see active participation in projects such as car sharing or bike sharing. For large cities it is difficult to switch from pilot to executive over the entire city because the transition is complex, and the investments required are very high.

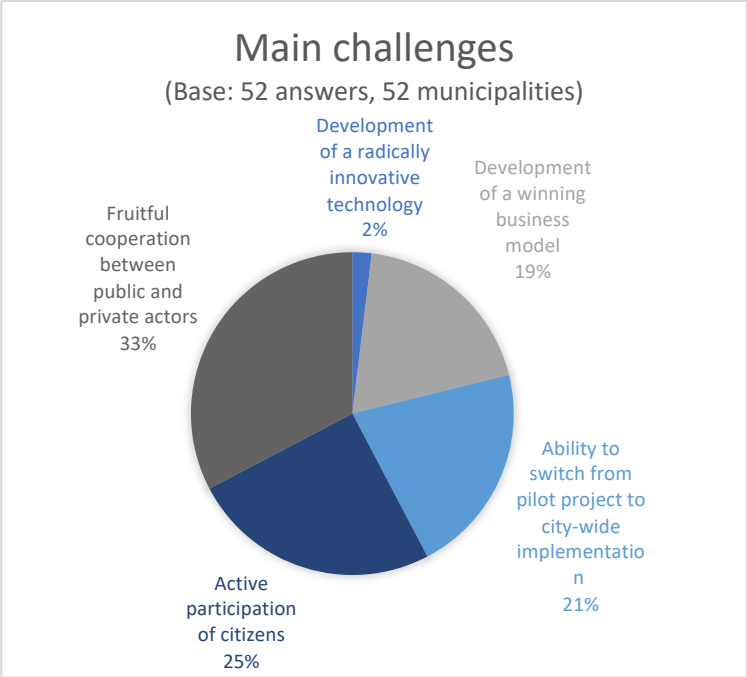

Figure 42 Main challenges identified by municipalities

One of the most innovative areas of Smart Mobility is autonomous driving. To date, about half of Italian municipalities think that autonomous driving will not be a reality in the next 10 years. As illustrated in Figure 43, the 49% thinks that autonomous driving won't probably be a reality and the 4% is sure about it. 37% of municipalities is partially hopeful, while only the 10% expresses a strong optimism. Therefore, despite the tests and projects in place, today there is still huge scepticism about the full use of this type of solutions. It is very interesting to note the case of large municipalities where no one answers definitely no and the 21% believes that autonomous driving will certainly be a reality.

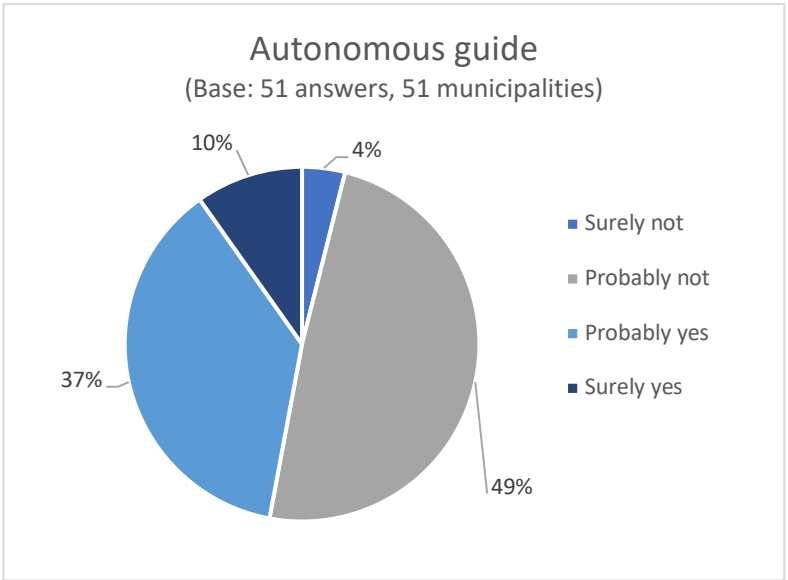

Figure 43 Municipalities' view on the possibility of autonomous driving being a reality within 10 years

4.2 World scenario

This chapter aims to present the new classification of application areas created ad hoc for the database, to describe the current situation at international level and to present the use in practice of some of the most innovative technologies.

4.2.1 Application areas definition

The areas of application used in the database arise from the combination of the classifications coming from the literature, the one present in the survey and from some changes implemented during the data collection due to the need to classify particular initiatives. The following categories are included in primary and secondary classification:

- Parking management: all the initiatives concerning parking. Search and localization, booking and payment but also sharing of private parking lots. Usually involving geolocation technologies, mobile applications, innovative payments methods, sensors and cameras.

- Traffic management: all the initiatives concerning the control and handling of traffic in cities. Usually based on intelligent infrastructure, sensors and cameras. The aim is to lessen traffic when it is possible, but also make it smoother.

- Autonomous driving: not autonomous car itself, but all the initiatives related to shared transport, public transport and safer urban mobility. Projects concerning the development of autonomous vehicles are not included in the database, projects exploiting the autonomous technology in transportation initiatives which aim to improve mobility are included. Robotaxis, autonomous shuttles, autonomous busses are some examples of the included initiatives.

- Innovative payments: all the projects including new payments methods applied to mobility such as payment through the smartphone or other devices. The initiatives mainly concern parking and toll payment. Mobile applications are involved. Sometimes a device is necessary, e.g. Telepass.

- Smart Home integration: initiatives related to the interaction between the car system and the Smart Home system. Bringing the car out from the garage or checking the fuel level from home are some of the actions allowed from projects in this cluster. The car system is linked to home virtual assistant; thus, it is not only Smart Cabin.

- Last-mile logistics: all the innovative ways to deliver which aim to reduce traffic caused by couriers. Delivery in the back of the car, delivery through drones, delivery through autonomous robots. Mobile applications, connected vehicles, autonomous vehicles and robots are the starting point for these initiatives.

- Sharing mobility: all the possible ways of sharing. Not only car sharing, but also sharing of different means of transport (e.g. bikes and scooters), ride-hailing, company carpooling, sharing of taxis, sharing vehicles for specific contexts such as sharing between condominiums or between hotel guests. In addition, there are aggregator platforms for various sharing services and fleet management platforms. Geolocation and mobile applications are essential.

- Electric mobility: not the projects to develop electric cars, but those incentivising electric mobility. Initiatives facilitating the charging process or increasing the charging network, sharing services with electric vehicles or bikes, electric autonomous transportation. Mobile applications are often involved.

- Sustainable mobility: initiatives incentivising a more sustainable way of moving. Projects facilitating the use of bike or other non-polluting means or limiting the use of polluting ones. Mobile applications are often involved, innovative means and devices sometimes.

- Monitoring of environmental parameters: all the initiatives concerning the detection of environmental parameters with the aim of limiting the use of pollutants vehicles.

- Support services: generic services such as devices that make any car a connected car and allow for remote opening and closing and controlling of the level of fuel, or applications allowing to order a washing of the car where it is parked. Mobile applications are essential, and devices are used sometimes.

- Safety: projects are divided into two categories: systems for the car and those for the infrastructure. The systems in the connected car warn in case of danger thanks to communication between vehicles or with the infrastructure, with the possibility to warn the telephone contacts in case of a serious accident, give signals to counter sleepiness or remember the children in the car. The systems for the infrastructure are sensors and cameras for road safety (monitoring and reporting of accidents), safety of bridges or other infrastructures, control of road for maintenance purposes (also via black box, even in public transport).

- Smart Cabin: connected vehicle projects, concerning entertainment, internet connection, smartphone connectivity and usage from the dashboards, data collection, and some unexpected usage of digital inside the cabin, e.g. innovative sun visors

- Smart Insurance: insurances linked to new mobility: insurances on the person which uses different sharing systems, insurance on the kilometres made, insurances based on a profile created through smart systems on the car or black boxes.

- Smart Road: projects involving particular stretches of road or part of cities. Including intelligent transport systems, cameras, sensors.

- Software and platforms: they are able to incorporate different data (mobility services, traffic, parking, charging stations) and offer the data to the user or other agents involved in the transport ecosystem. Also, B2B platforms enabling companies to launch their mobility services thanks to a turnkey solution.

- Local public transport: two main types of initiatives, new public transport solutions, e.g. autonomous shuttles/busses; applications simplifying and incentivising the use of actual means of transport, e.g. delivering information on time, interchanges, real time info.

4.2.2 Actual situation

287 initiatives were collected, mainly implemented in Europe (57% of the projects per geographic area) and Italy (36% of the projects per country). The geographical distribution of the initiatives is strongly influenced by the language of the research and the proximity of the results to previous research. A striking case is that concerning Asia, in the database the number of initiatives is minimal (4%), even if the area is very advanced in the sector this is due to the linguistic difficulties for the research of local initiatives. Finally, the relevant percentages concern Europe (57%), North America (17%) and Global initiatives (21%), as shown in the chart (Figure 44).

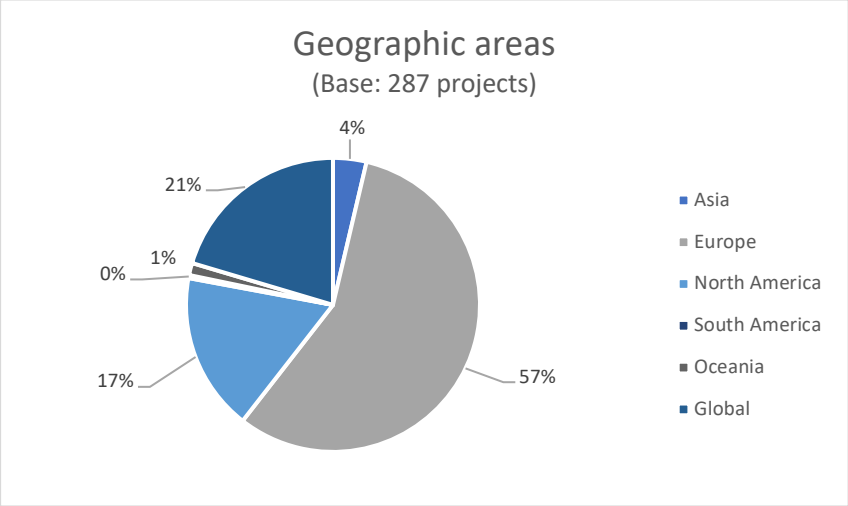

Figure 44 Geographic distribution of projects collected in the database

The number of European projects is very high especially because many of them involve Italy in the expansion process even if they were not born in Italy and for Italy. Language compatibility with North America allows to gather many initiatives from a very advanced continent. Global initiatives are very big projects with English websites, and it is easier to find information about them.

Going into more detail, Figure 45 presents the initiatives by country. Italy appears to be the state with the most initiatives, with a disproportionately higher number of them, therefore it is temporarily excluded from the comparison with the other states. Some initiatives that include continents in full or global initiatives are not included in this classification per country. The United States has the highest percentage of initiatives (16%) followed by the United Kingdom (8%) and Germany (7%).

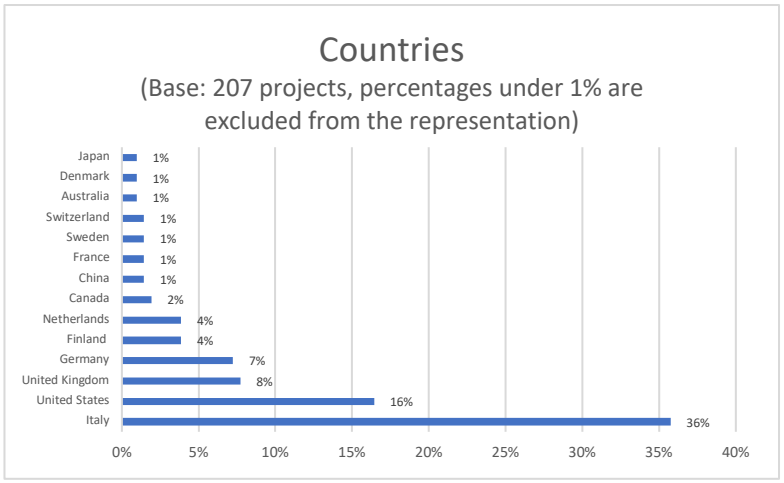

Figure 45 Distribution of projects by country

Each initiative was classified in its primary application area. Numerous projects can be traced back to multiple areas, thus a secondary application area has been introduced. Secondary does not mean less important but only that the initiative involves two of the areas defined in the database. Thus, the analysis focuses on the results coming from the sum of the data.

As displayed by Figure 46, the first areas for diffusion are sharing mobility with 18%, and electric mobility with 17% of the projects, of which more than half in Europe (61% and 65% respectively). They are closely followed by the autonomous guide projects (13%) which are developed at European (31%), global (27%) and North American level (24%).

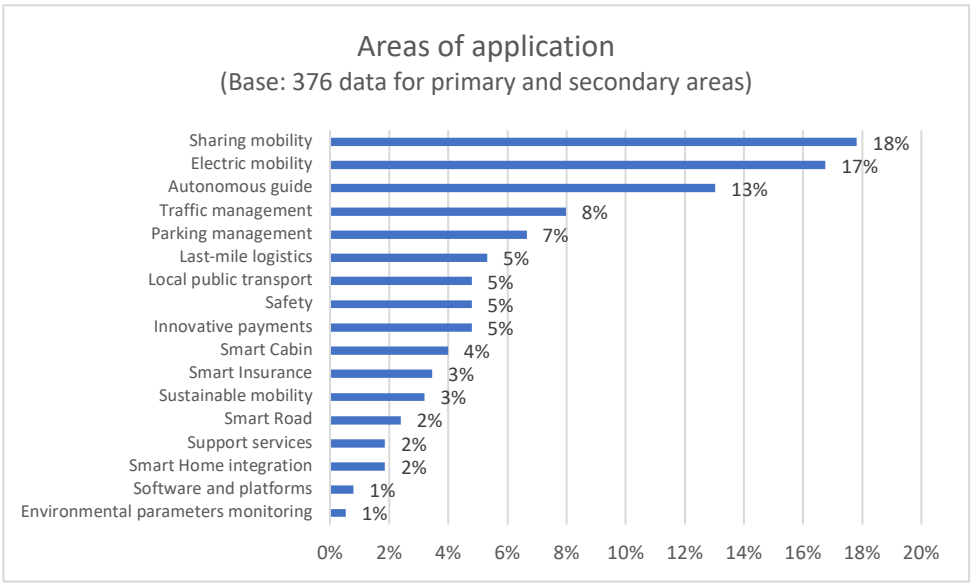

Figure 46 Dissemination of areas of application

Looking at the different geographical areas, the most widespread application areas are:

- Sharing mobility (19%) and electric mobility (19%) for the European continent;

- Autonomous guide (17%) and sharing mobility (16%) among the global initiatives;
- Autonomous driving (24%) in North America.

The United Kingdom is the nation with the most initiates in parking management and innovative payments. In many of the cases attributed to the United Kingdom the two application areas are expressed in the same projects. In fact, the initiatives make it possible to view or book empty parking spaces and, in most cases, also to pay for parking.
For public transport initiatives UK and Finland share the podium. The most interesting case is the Finnish one. In Helsinki, citizens can enjoy the greatest expression of mobility as a service through a single app. Through a single interface, they have access to a "multi-modal" type of mobility, ranging from public transport (buses, ferries and bicycles) to car rental and taxi calls. Therefore, it involves local public transport and sharing mobility areas of application.

The United States are the country with the most traffic management, autonomous guide and last-mile logistics projects. For traffic management, the Netherlands is equally important. The Dutch case is interesting because it differs from the management of other big cities. In fact, in addition to car traffic, there are initiatives here that aim to regulate bicycle traffic. The autonomous driving initiatives of the United States concern trucks, shuttles for the transport of goods and people and taxis. The last mile delivery area involves the use of the autonomous vehicles mentioned above, but also drones and, above all, robots capable of reaching their destination autonomously, created specifically to reduce road traffic due to deliveries.

Germany is the state with the highest number of electric mobility initiatives. The most interesting case concerns an executive project for the construction of a residential area in which e-mobility will play a key role. Tenants will be offered electric car sharing and easy access to charging stations.

Information relating to the launch year have been collected for each project (some projects are not dated in the sources, especially future launches). As shown in the chart (Figure 47), there is a growing trend until 2019, year of the analysis. In 2018, percentage of projects increases by 72% compared to the previous year, in 2019 by 70%. As for the current year (2020) and future years, growth is expected, obviously the information on projects not yet started or being analysed are less and more

difficult to find. In the comparison between geographical areas and launch years all areas (Asia, Europe, North America, Global) reach the highest value in 2019.

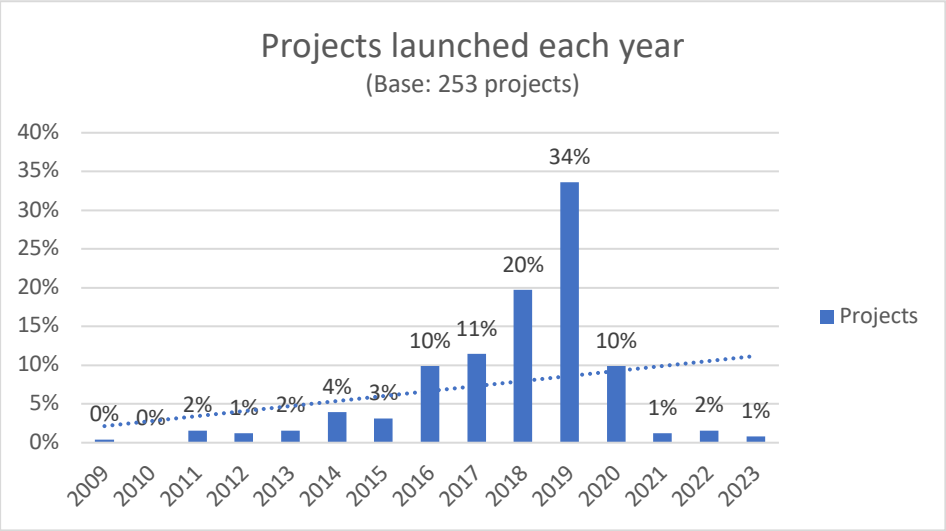

Figure 47 Distribution of project launches over the years

The years between 2016 and 2020 gather the majority of projects and allow interesting observations. Below a list of the years and areas of greatest interest (also illustrated in Figure 48):

- 2016: sharing mobility (31% of total projects);
- 2017: traffic management (17%), electric mobility (14%);
- 2018: sharing mobility (18%), electric mobility (15%), last mile logistics (14%);
- 2019: electric mobility (21%), sharing mobility (15%), autonomous driving (14%);
- 2020: autonomous driving (35%).

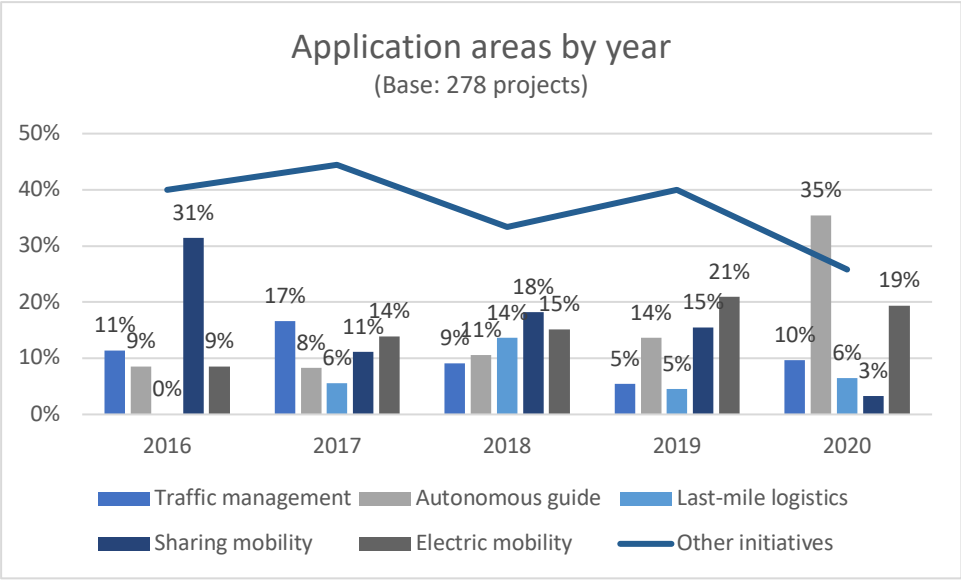

Figure 48 Dissemination of areas of application over the years, detail of the most widespread areas

The data related to these years allow to make considerations about the evolution of the most widespread areas of application: sharing mobility, electric mobility, autonomous guide and traffic management.

In 2016, sharing mobility is the sector of greatest interest and outstrips all the others. It involves car/bike/moped sharing, peer-to-peer vehicle sharing, taxi sharing and aggregation apps involving sharing services. In 2017 the percentage of initiatives is lower, but in 2018 sharing mobility is on the top again with a high percentage of projects. The novelty of the initiatives concerns the introduction of scooters in sharing and shuttles, taxis, ride-hailing exploiting autonomous guide. Finally, in 2019 the percentage of projects in the area is second only to electric mobility with which, however, the link becomes very strong. Most of the initiatives in this year concern the sharing of electric vehicles.

The percentage of projects in the area of electric mobility is growing from 2016 to 2019. The initiatives for charging are already present since 2016. In 2017 and 2018 there have been some innovative solutions for charging at the experimental stages (no executive project). In 2019 projects of this kind increase in number and include very innovative and high-impact initiatives such as the realization of the vehicle to grid. The remaining initiatives are related to sharing mobility or autonomous guide. The link with sharing mobility can be seen from 2016 with the moped-sharing initiatives and in the following years with electric bikes, cars and scooters. In 2017 the first self-guided shuttle initiative has been collected; this is the starting point of a growing trend. In 2018, the percentage of initiatives rises in relation to both sharing mobility and self-driving. In addition, business and long-term rental solutions are being added. In 2019, the synergy between e-mobility and self-driving grows.

The percentage concerning autonomous driving grows from 2016 to 2019, most of these projects concern preliminary analyses or pilot projects. In the period 2016-2017 the initiatives concern trucks or shuttles for passenger transport. In 2018 testing for taxis and ride-hailing starts. In 2019 buses and delivery vans are added. Among the most innovative initiatives, modular vehicles emerge: two or more components can be combined to transport more passengers or interchanged depending on whether the transport is for passengers or goods. For this area, 2020 collected data is remarkable (data considers only the firsts moths of the year). This is the only sector that has a relevant number of projects. Two innovative uses of artificial intelligence are particularly interesting: the predictive

gearbox that chooses the optimal gear according to road and traffic conditions, and the sound sensors that through noise suggest the optimal choice to the driver.

The largest number of the listed projects are executive (54%) and pilot (29%) projects (see Figure 49). Less information and therefore less projects regarding preliminary analyses (15%) and prototypes (2%).

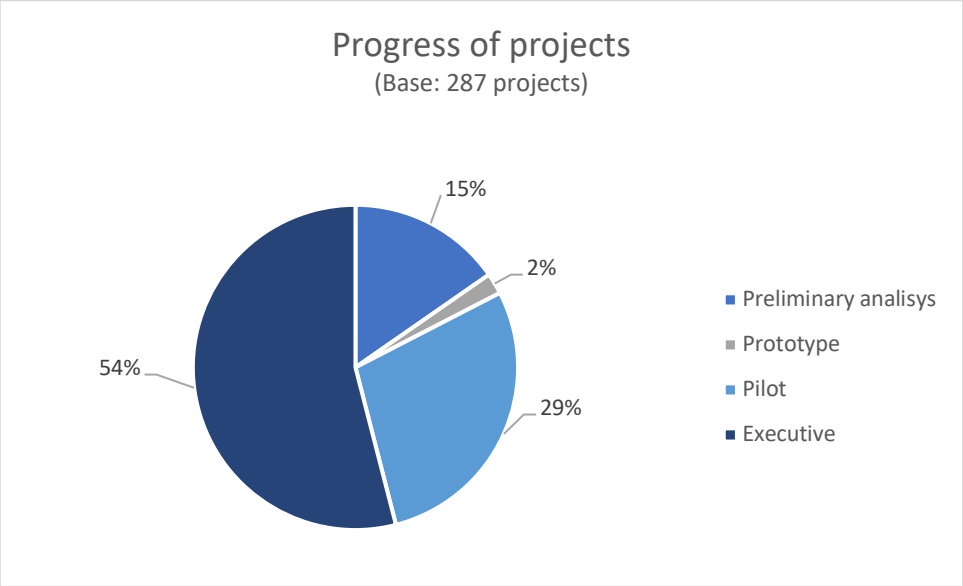

Figure 49 Distribution of projects by progress

The high number of executive projects is a positive sign once again, it means that technologies have been already tested and now are giving real benefits to the cities. Moreover, the number of pilot and executive projects is increasing in the years up to 2019.

Sharing mobility accounts for 26% and electric mobility for 15% of executive projects. The results are consistent with the diffusion of the areas, in fact these two are the most widespread application areas. Other areas at the same stage are parking management, traffic management and innovative payments that reach about 10% each. The Autonomous Guide is the third area by diffusion, but unlike the first two it is still at a study stage. It accounts for 25% of the preliminary analyses and 24% of the pilot projects.

The highest percentage in Europe is reached by executive projects which make up 62% of the total as well as globally where they make up 52% of projects. In America, on the other hand, the stage with the highest percentage is the pilot one which reaches 44% of the projects. This is mainly due to the high number of initiatives concerning autonomous guide which makes it a very innovative country

despite the low percentage of executive projects. Coherently, the United States is the state with more pilot projects, while the record for executive ones is held by the United Kingdom (again excluding Italy).

It is important to understand which actors are driving smart mobility: established companies, start-ups or public administration (which includes various types of bodies such as municipalities, universities, research institutes). Collaborations between these actors are also fruitful, as shown in Figure 50.

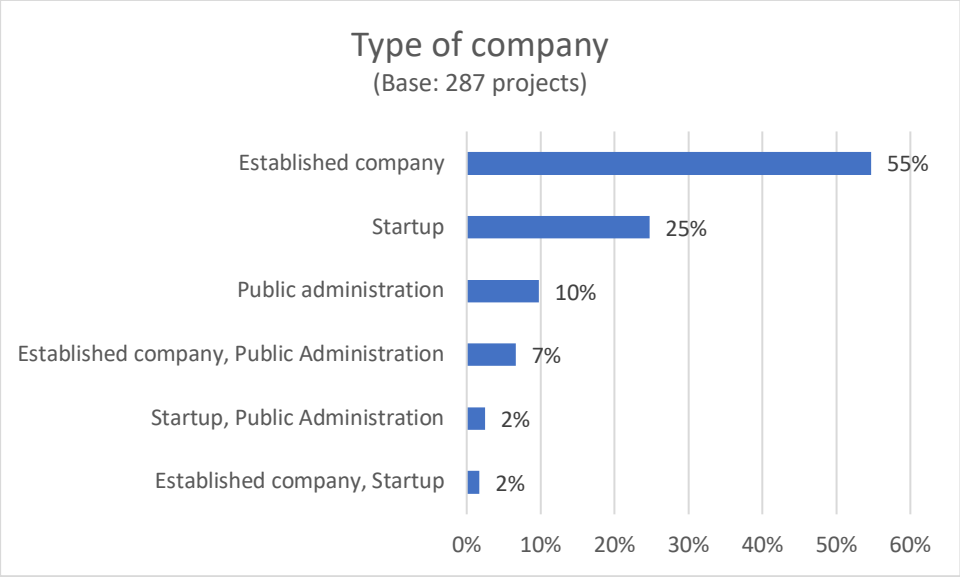

Figure 50 Typologies of companies and partnerships involved in the projects

The first actor for percentage is established companies (55%) that focus mainly on the sectors of autonomous driving and electric mobility (20% and 11% respectively). These areas need high investments and previous research which an established company can offer. Start-ups are the second actor for percentage (25%), they are very active in the Smart Mobility field, especially for initiatives concerning sharing mobility (37%). Eventually, public administrations reach the lowest percentage of projects (10%) and focus mainly on traffic management (29%). On the other hand, they collaborate within a high number of projects.

Among the collaborations those between public administration and the established companies reach the 7% of projects. This partnership is followed by public administration and start-up and start-ups and established companies with 2% of projects both. A reason for the little partnerships for start-ups can be found in the fact that some of them are spin offs of large companies or have been acquired by large companies, therefore a sharing of knowledge or resources is inherent in the relationship.

Between 2016 and 2019, the percentage of initiatives attributable to start-ups fell from 28% to 18% of projects. The same is true of initiatives implemented by public administration, which dropped from 24% to 11% in 2019. On the other hand, the number of initiatives implemented by established companies increased from 40% to 56% of the total (peak in 2017 with 62% of initiatives). This is a strong signal of the growing interest in new business models by large companies.

Among the states with a considerable number of projects, in Germany and the United States established companies have an advantage. Despite being two of the most favourable states for the development of start-ups, more than a half of their initiatives in the smart mobility field are implemented by the large companies, 67% in Germany, 50% in the United States. In the case of Germany, the result is consistent with the high percentage of electric mobility projects and in the United States with the high percentage of autonomous driving initiatives. In the United Kingdom, start-ups are in the lead with 50% of the initiatives mainly concerning parking management, innovative payments and smart insurances.

4.3 Comparison

The aim of this chapter is to compare Italian municipalities' situation and the global one. Furthermore, a final consideration on Italy is presented: the similarities and differences between the questionnaire and the database descriptions are outlined.

4.3.1 Comparison between Italian scene and world's one

Similarities and differences emerge between the Italian municipalities situation created on the basis of the survey and the global representation generated through the database.

Concerning the time distribution of the projects, the situations are very different. According to the declarations of the municipalities, the shares of projects carried out before 2017 and between 2017 and 2019 are comparable. The two time-period are characterized by the same level of activity. In the global scenario, the majority of projects is located between 2017 and 2019: the interval before 2017 reaches 22% of projects, although including a higher number of years; while between 2017 and 2019, 65% of projects are located. In this case, therefore, the two periods have completely different levels

of activity and the second timespan represents the real development and expansion of Smart activities.

First of all, Italian municipalities may have included projects that were not exactly Smart in the first period making the percentage higher than the global one. Some municipalities may consider as Smart some initiatives that do not involve ICT; for example, projects aiming at improving or facilitating mobility (with all means of transport). As stated in the notes to the questionnaire, the construction of a bike path is considered a Smart Mobility action from some municipalities. These types of initiatives are not included in the database because they do not meet the technological requirement. An opposite reason could explain the very low worldwide percentage of the first period. The database does not include all the sharing initiatives of the world that were generally born in those years. This is because only a few initiatives were taken for example for the category.

Also, the trend of the three years taken individually is different: there is a constant level of activity in the municipalities and a strong growth around the World (11% in 2017, 20% in 2018 and 34% in 2019).

The percentages for the most widespread areas are different due to the much more detailed classification in the database, with more categories. This is not an issue because the areas at the top of the two rankings are the same or almost the same (see Figure 51). Indeed, first and second place are occupied by electric and sharing mobility in both cases even if exchanged. Third and fourth place for municipalities are parking and traffic management; in the World, they are fourth and fifth inverted. The substantial difference in the two rankings is the position of independent driving. It is in fact in third place for diffusion in the world while in Italy it is third last in the ranking. The autonomous guide makes the difference also for future initiatives, in fact it is at the first place globally and covers a third of the initiatives, on the other hand in Italy it is not included in the first three areas that are electric mobility, sharing mobility and parking management. The difference in the diffusion of the autonomous guide on a world-wide level lightens the extremely negative result of the forecasts of the Italian municipalities. The other countries in the world and especially in North America believe more than Italian municipalities in the realization of this technology. Another confirmation in this sense comes from the analysis of the status of the projects.

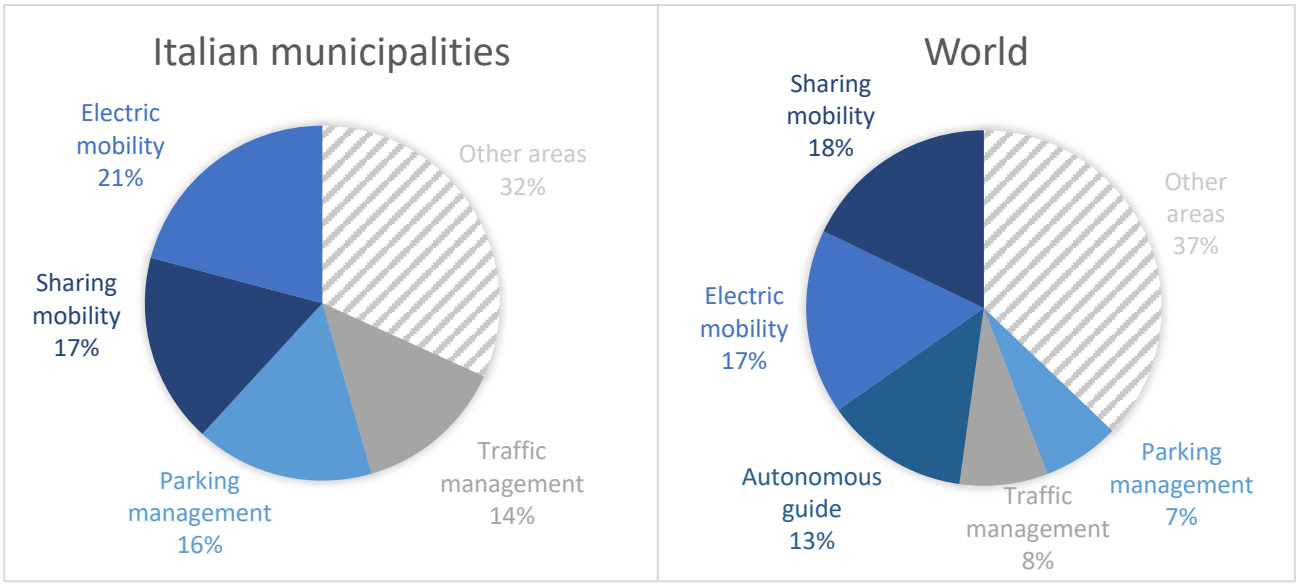

Figure 51 Comparison between the main areas of application in Italian municipalities and in the World

More than half of the projects are executive both in Italy and in the world (57% in Italy, 54% in the world) and the areas that most represent this stage are electric mobility and sharing mobility in both contexts. Therefore, they confirm themselves as areas of advanced development. A fundamental difference can be found in pilot projects and preliminary analysis. In the Italian case the projects are more distributed and involve different areas, while a quarter of both categories are represented by autonomous driving initiatives, confirming the strong interest in this smart area worldwide.

Comparing the situation of the actors involved, some considerations emerge. In the survey, the actors most involved in past initiatives are municipal companies, universities and research centres and other municipalities. They cover more than half of the initiatives and refer to the public administration category of the database. For future initiatives the main actors in Italy are start-ups. In both cases the situation is completely opposite to the global one where the established companies implement most of the projects.

In conclusion, the two situations disagree on most points. The main difference lies in the position towards self-driving. Whereas for most municipalities this will not be a reality in the next 10 years, in the rest of the world it is established as one of the most widespread application areas. Differences in the progress of the projects and the actors involved can also be traced back to the autonomous driving and the United States is the furthest from the situation in the municipalities.

4.3.2 Further consideration on Italy

A further consideration concerns Italy coming out of the survey and Italy described in the database. At a general level the two representations are consistent. A detailed examination of the different aspects follows.

In Italy the types of companies involved in the database are mainly established companies, this data may seem to disagree with the survey data that give more importance to public administration. The importance of the latter is also highlighted in the database, Italy has a percentage of public administration 3 times higher than the world average, thus confirming the importance of the sector described in the survey. The difference is due to the fact that the survey does not include initiatives which are not linked to any municipality directly. According to the database, there are projects such as the development of new technologies and functionalities related to vehicles or smart insurances in Italy.

In the database, electric mobility (23%) and sharing mobility (17%) are the first two application areas for percentage of implemented projects. This situation perfectly reflects that of the survey, where the same areas are in the first places and with very similar percentages (21% and 17% respectively).

The time distribution of the projects is the biggest difference between the two representations. In the case of the database only 5% of projects are implemented before 2017, while 77% between 2017 and 2019. This strong gap between the two periods is very different from the constant activity level found in the questionnaire. In this case the Italy from the database is much more in line with the world situation most likely for the same reasons. Even looking at the individual years 2017, 2018 and 2019 at the Italian level, there is a growth in the percentage of projects (14%, 23% and 41% respectively), a situation more in line with the world situation than the stability of the municipalities.

Finally, as far as the progress of the projects is concerned, the representations are consistent as both show more than half of executive projects.

In conclusion, the representations are consistent in all aspects except for the time distribution. As stated in the comparison with the World, that could be due to the lack of some initiatives in the

database such as sharing initiatives for which only illustrative initiatives have been taken, or the inclusion of initiatives not technologically smart by municipalities.

5. Framework and final considerations

In this chapter a final framework is presented; it links two important characteristics emerging from the previous analysis: the level of collaboration between public administrations and private companies and the category of innovation generated. Lastly, the final considerations of the thesis are illustrated.

5.1 Framework

Following the analysis, it emerges a qualitative observation described through a framework linking the Italian municipalities and some of the states involved in the database. In particular, the formulation of the framework starts from the consideration of the main challenges faced by the municipalities.

Fruitful collaboration between public and private actors emerges as the main challenge. It is interesting to compare the level of public-private collaboration with the type of innovation which characterizes the initiatives implemented by public administrations and their partners. As the survey also reveals data concerning the partners involved in the future, it is compelling to understand in which innovative direction the path of the municipalities could turn.

The first axis of the matrix concerns the degree of collaboration between public and private and is defined by the data emerging from the survey.

Past projects see a weak collaboration between public and private:

- partnerships mostly involve actors which are very close to the municipalities or part of it,
- municipal companies, universities and research centres, other municipalities.

Future projects see a stronger collaboration with private companies:

- actors completely outside the public administration and different from each other,
- start-ups, sharing companies, delivery companies.

Therefore, the degree of collaboration with private companies can be:

- weak, when the partners are very close to the public administration, or even part of it;
- strong, when the partners are private companies extraneous to the public administration and diversified among themselves.

The second axis concerns the type of innovation generated by the initiatives and is defined starting from two extremes: incremental innovation and radical innovation. These two categorizations of innovation have been defined by Henderson & Clark (1990) as follow:

- *"Incremental innovation refines and extends an established design. Improvement occurs in individual components, but the underlying core design concepts, and the links between them, remain the same."*
- *"Radical innovation establishes a new dominant design and, hence, a new set of core design concepts embodied in components that are linked together in a new architecture"*

For Smart Mobility initiatives, the definitions are mainly related to services and application areas incorporating them (not to physical products). Thus, between the two edges all the smart initiatives can be located considering that they are characterized by a more incremental or more radical type of innovation.

Hence the category of the innovation generated can be:

- Incremental: when the new solutions result as a sequence of incremental improvements of the service or the application area. The most obvious example is that of Sharing mobility: the technologies are almost the same from the beginning (geolocation and remote control via GPS and app) with gradual changes for example those leading to the transition from station based to free floating and from fossil fuels to electric engines.
- Radical: when services or related application areas have been radically disrupted (or will) by a technological innovation. For example, the use of drones and robots for deliveries will disrupt last-mile delivery services in the near future, as well as the inclusion of autonomous driving in public transport or taxi/ride-hailing/vans service will change the world of transport.

The matrix is then created (as in Figure 52) and, in addition to the Italian case emerging from the survey, other countries have been placed. Only projects implemented by public administration and partners are considered (private companies' projects are excluded from the matrix).

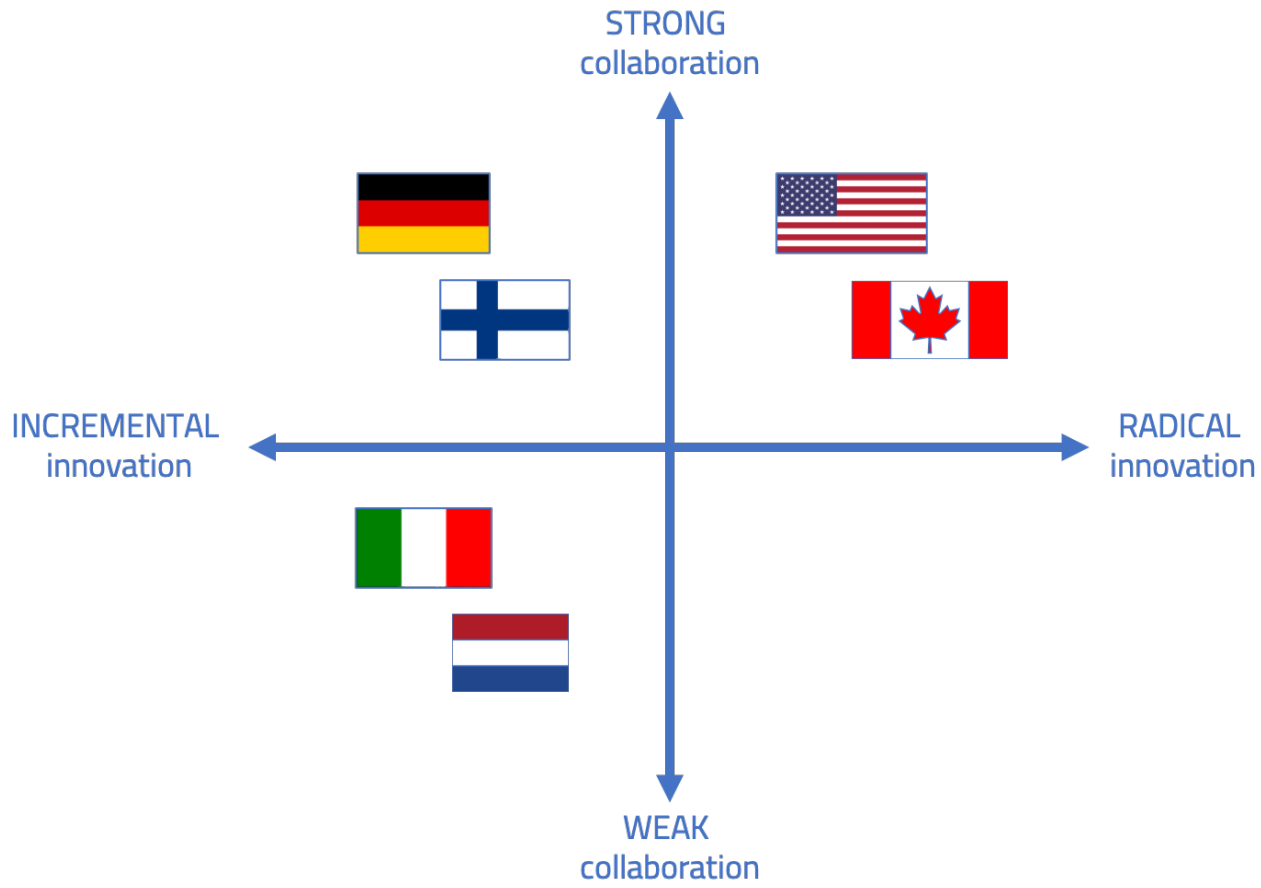

Figure 52 Collaboration-Innovation matrix

Italy is positioned in the first quadrant at the bottom left because it reflects the characteristics of weak collaboration with private actors and incremental innovation according to survey results. Indeed, municipal companies, universities, research centres and other municipalities are the main partners in past initiatives (as mentioned above) and electric mobility, sharing mobility and parking management are the most widespread sectors.

To define the type of innovation as incremental, reference is made to Italian initiatives in the database (carried out in the past by public administrations or through collaborations) because there are no indications of specific initiatives in the survey. General remarks can be drawn regarding initiatives in these areas in the database: electric mobility solutions mainly represent alternative methods for charging or apps or devices that integrate previously independent recharging systems;

sharing mobility solutions concern the introduction of electrical means (including micro-mobility) while maintaining the same service structure and the same underlying technologies; parking management solutions use similar location systems involving no radical innovation in recent years.

An example combining the areas of electric mobility and sharing mobility is I-sharE Life, a European project developed by E-Vai (Ferrovie Nord Milano) with several municipalities in northern Italy: Comune di Como, Bergamo, Bollate, Busto Arsizio. The project wants to demonstrate that the shared car can be sustainable in medium or small municipalities from an economic and technological point of view (especially if zero-emission). In the municipality of Como electric cars are combined with hotels, thus offering a service dedicated to tourists, in Bergamo means of transport are shared between Municipality and citizens, in Busto Arsizio between commuters and neighbouring companies, in Bollate between workers of companies near the stations that have to reach industrial areas not served by public transport. The innovation represented can be defined as incremental because the model widespread in large cities is adapted to smaller realities while preserving original technology and functionality.
Source: https://www.lautomobile.aci.it/articoli/2019/09/17/como-sperimenta-il-car-sharing-elettrico.html

An example for parking management is Bosch Smart Parking, a pilot project developed in collaboration by Bosch, telecom and utilities companies (A2A Smart City, Cellnex, LGH) and public entities (Comune di Mantova, Aster and Università di Modena e Reggio Emilia). The objective is to monitor and communicate to drivers the availability, in real time, of parking spaces in the city centre, making traffic more fluid, reducing the time it takes to find an empty space and allowing greater transparency and precision in the payment of parking fees. The initiative is supported by Bosch sensors installed in the road surface. In the future, the driver can use an app to find the nearest free space in real time, make a reservation and receive information on how to reach it. This is an initiative in line with others in the sector, no radical innovation.
Source: https://www.formulapassion.it/automoto/tech/bosch-smart-parking-mantova-parcheggi-471679.html

In the same dial is Netherlands characterized by weak public-private partnerships and initiatives in areas with incremental innovations. In particular, the sample initiative is Traffic lights in 's-

Hertogenbosch and is part of the traffic management area. Sensors in the pavement are connected to traffic lights that are able to adjust the green according to traffic needs. The sensors are located on roads and bike lanes and data from them are added to the data from public transport. The initiative is implemented by the public administration and does not bring any disruption to the traffic management sector.
Source: https://www.alvolante.it/news/una-citta-olandese-installa-semafori-intelligenti-347482

The second quadrant to be analysed is the upper left and corresponds to an incremental innovation and a stronger collaboration between public and private. Finland and Germany are located in this area, both of them are characterized by a strong collaboration in areas where no radical innovations occur.

Thanks to the opening of data by the transport authorities, Finland, specifically Helsinki, has seen the development of apps integrating mobility services. Here the public administration has managed to work together with the many private providers to offer citizens a comprehensive solution that brings together all the transport offerings available in the city of Helsinki. Therefore, no technological progress but a strong collaborative effort. The best-known app is Whim, through which Helsinki travellers can plan and pay for trips by public transport, bike sharing, taxi and car sharing. There is no need to use the different apps and the underlying technologies are geolocation, GPS and app.
Source: https://www.citylab.com/perspective/2018/10/helsinkis-maas-app-whim-is-it-really-mobilitys-great-hope/573841/

In the case of Germany, the emblematic initiative is WATERKANT Berlin, a public project for the construction of a residential district that will reach the 2500 apartments built by 2024. They will be linked to a sharing electric mobility service and easy access to charging stations and columns. The solution does not foresee any technological novelty compared to classic sharing and charging. The collaboration between public and private (E.On & Etra, Malaga City Council, Novadays, VMZ, Ikem, Gewobag, Certh, Rise, City of Gothenburg - Consortium) aims to expand the fleet of electric vehicles.
Source: https://www.rinnovabili.it/mobilita/meister-piattaforme-smart-mobilita-elettrica/

U.S. and Canada are in the upper right quadrant, they are characterized by a stronger collaboration with private companies, but especially by initiatives in areas with radical innovations concerning last-

mile delivery and independent driving. The delivery sector could be disrupted by the use of drones in the last-mile, particularly deliveries of medical samples. In the case of the U.S., Global Smart Logistic Network is the initiative for drone shipping of medical samples by UPS Flight Forward Inc. in collaboration with Matternet, Federal Aviation Administration, Transport department of North Carolina. This project is part of the chapter opened by Prime Air in 2016 (an initiative of Amazon, a private company). It involves a strong collaboration and a radical innovation.
Source: https://www.economyup.it/retail/logistica-4-0/non-solo-amazon-come-ups-cambiera-la-consegna-pacchi-con-i-droni/

The case of Canada involves autonomous driving: the Driverless Shuttles project in Edmonton and Calgary made by Active Aurora, City of Calgary and City of Edmonton. The project involves autonomous driving shuttles accessible to the public supported by technology for connected vehicles. A strong collaboration which offer a disruptive service.
Source: https://www.thestar.com/edmonton/2018/06/07/in-a-canadian-first-people-in-edmonton-and-calgary-will-get-to-ride-driverless-shuttles-this-fall.html

Following the analysis of the three quadrants, a relationship emerges between the level of collaboration and the type of innovation generated. Indeed, no country (i.e. no database initiative) is located in the lower left quadrant where a weak collaboration is linked to a radical type of innovation. Therefore, no initiative that has been developed by public administrations or collaborations between public entities has generated a radical type of innovation.

To sum up, the generation of a radical innovation has a necessary condition: a strong collaboration with private companies (both established and start-ups).

In the future, Italy could benefit from the stronger collaboration with private companies (emerging from the survey) and experience the development and application of radical innovations. In this case Italy would move in the upper right quadrant reaching U.S. and Canada.

This trend is supported by:

- the survey data for the future, where percentages on radical innovation areas, in particular autonomous guide, are higher than before;

- the initiatives in the database, the first projects involving autonomous guide in Italy are collected (dated 2019, 2020, i.e. after the survey was compiled).

The dominant example is the municipality of Turin, which has already started several projects with its collaborations, including autonomous guidance, but also drones for deliveries. Tests have already been carried out in the city for self-guided cars which have paved the way for integration into public or sharing transport.

The first project presented concerns self-guided vans, electric and made with 3D printing. They are the Olli vans realized by Local Motors and Robotic Research that are tested at Itcilo, the United Nations campus in Torino thanks to the collaboration of the City of Torino, Reale Mutua and the University of Torino (a further partnership has been signed with IREN for energy). The buses used satisfy level 5 of autonomous driving: the highest level expected, which foresees the exclusive communication of the destination and the start-up of the system. Afterwards, the vans will be able to support the bus services currently available.
Source: https://www.ansa.it/canale_motori/notizie/eco_mobilita/2020/01/16/a-torino-il-minibus-autonomo-olli_4c0b283d-11ae-4bd7-a3d4-52c818ffff57.html

The second project concerns taxi-drones, the city of Turin has committed to carry out air mobility tests for the transport of 1 or 2 passengers inside drones and for the use of these aircraft for the rapid delivery of objects. The project is called Urban Air Mobility, it is a European project that sees the collaboration of the Department of Innovation and Smart Cities of the City of Turin and Airbus.
Source: https://www.economyup.it/mobilita/smart-mobility-a-torino-dopo-lestate-bus-a-guida-autonoma-aspettando-i-droni-taxi/

5.2 Final considerations

The aim of this thesis was to answer the following research questions:

RQ1: Which are the main trends in the Smart Mobility sector in Italy and the main similarities and differences with the rest of the world?

RQ2: What is the relationship between the level of public-private collaboration and the type of innovation generated and what influence can this relationship have on the future of Italian municipalities?

Following the research and analysis reported in the previous chapters, a summary of the conclusions drawn is presented below.

In response to the first part of RQ1, the Italian scenario outlined by the survey is described. Among the Italian municipalities the topic of Smart Mobility is very relevant, which is confirmed by the fact that most cities have launched and will launch initiatives in this field in the near future. The areas where the projects are already active or will be activated are mostly the same: electric mobility, sharing mobility and parking management and the projects are mostly executive. For active projects, the main actors are municipal companies, universities, research centres and other municipalities, for future initiatives collaborations with startups and sharing and delivery companies are expected. This is the picture of a country where the most traditional smart solutions are exploited, and also quite widespread in cities regardless of their size. When compared to the rest of the world (answering to the final part of RQ1), Italy is lagging behind in one of the most controversial areas of Smart Mobility, i.e. the use of solutions involving autonomous driving. In the world and especially in the U.S. autonomous driving projects are more widespread: they are the third application area for diffusion after sharing mobility and electric mobility. Their diffusion challenges the scepticism of Italian municipalities about the potential integration of autonomous driving in the near future. Even in the world most of the projects are executive but the autonomous guide makes the difference: many pilot projects and preliminary analyses are dedicated to it. Finally, established companies are responsible for the most part of the projects, once again they are linked to the numerous autonomous guide projects.

The creation and analysis of the framework respond to RQ2: the degree of public-private collaboration has an influence on the type of innovation generated. Close collaboration with private sector actors (established companies and start-ups) is the necessary but not sufficient condition for the generation of radical innovations. As a matter of fact, there are collaborations that do not generate radical innovations (see the cases of Finland and Germany) but there are no radical innovations that are the result of weak or absent collaboration (see empty quadrant in the matrix).

Therefore, Italian municipalities have the responsibility to exploit future collaborations with actors from the private sector in the most profitable direction (from the point of view of innovation). The City of Turin is already benefiting from these collaborations from 2019. It has already launched several projects aimed at radical innovation in their sector, such as the use of autonomous vans to be combined with public transport and the use of drones as taxis or for rapid deliveries.

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Annex

INDAGINE SUI PROGETTI SMART MOBILITY
SURVEY COMUNI ITALIANI

Obiettivo dell'indagine: **approfondire lo stato di diffusione in Italia dei progetti di Smart Mobility.**
L'espressione *Smart Mobility* racchiude in sé una concezione della mobilità urbana che integra molteplici modalità di trasporto al fine di garantire la massima efficienza di spostamento, flessibilità, sicurezza e convenienza. Tramite l'integrazione delle nuove tecnologie digitali con i trasporti pubblici, le infrastrutture urbane esistenti e le nuove modalità di sharing dei veicoli, le applicazioni di Smart Mobility mirano a ridurre il traffico e l'inquinamento, a creare flussi intelligenti e senza interruzioni, e a rafforzare le economie di scala per promuovere una mobilità accessibile a tutti. Inserita in un contesto più ampio di Smart City, la Smart Mobility contribuisce ad innalzare gli standard di sostenibilità, vivibilità e dinamismo economico delle città del futuro.

Guida alla compilazione del questionario: **la compilazione la impegnerà non più di 10 minuti. Non sono necessarie competenze tecnologiche specifiche per la compilazione del questionario.**
Eventuali chiarimenti in merito alla compilazione del questionario possono essere richiesti ad Elisa Vannini (elisa.vannini@osservatori.net – 02 2399 9560). Qualora preferisse è possibile rispondere alle domande del questionario tramite intervista telefonica.
Per visualizzare l'informativa privacy è possibile cliccare qui.

QUESTIONARIO

La preghiamo di inserire i suoi dati anagrafici:

Comune	
Nome e Cognome	
Ruolo professionale	
e-mail	
Contatto telefonico	
Disponibilità a intervista telefonica di approfondimento	☐ SI ☐ NO

Quanto è rilevante il tema Smart Mobility per il suo Comune?
Le chiediamo di indicare il livello di rilevanza nella tabella sottostante, in cui:
1= il tema non è rilevante
2= il tema è poco rilevante
3= il tema è molto rilevante
4= il tema è fondamentale
Selezionare una sola risposta

Livello di rilevanza	1 ☐	2 ☐	3 ☐	4 ☐

Note:

Il Comune di cui fa parte ha avviato progetti Smart Mobility in passato?
Selezionare una sola risposta

☐ SI, nel 2019
☐ SI, nel 2018
☐ SI, nel 2017
☐ SI, prima del 2017
☐ NO, non abbiamo mai avviato progetti di questo tipo

Note:

Se è stato indicato almeno un progetto nella domanda precedente, proseguire con la domanda 3 del questionario.
Se non è stato indicato alcun progetto nella domanda precedente, proseguire con la domanda 5 del questionario.

SEZIONE DEDICATA A CHI HA AVVIATO PROGETTI SMART MOBILITY NEL TRIENNIO 2017-19

A CHI HA INDICATO ALMENO UN PROGETTO NELLA DOMANDA 3

3) La preghiamo di indicare, per ciascun progetto Smart Mobility avviato dal suo Comune, lo stato di avanzamento (analisi preliminare, progetto pilota, progetto esecutivo).

Selezionare una o più alternative

AMBITI APPLICATIVI SMART MOBILITY	STATO DI AVANZAMENTO		
	Analisi preliminare	Progetto pilota	Progetto esecutivo
Gestione del Traffico (gestione da remoto di semafori, congestione stradale, infomobilità, etc.)	☐	☐	☐
Gestione dei Parcheggi (monitoraggio dello stato di occupazione del parcheggio, etc.)	☐	☐	☐
Trasporto Pubblico Locale (localizzazione mezzi pubblici, monitoraggio del tempo di attesa alle fermate, etc.)	☐	☐	☐
Mobilità Elettrica (installazione e gestione di stazioni di ricarica per veicoli elettrici, etc.)	☐	☐	☐
Sharing Mobility (servizi di sharing dei veicoli, quali auto, scooter, monopattini e bici, offerti da terze parti tramite App o sito web, etc.)	☐	☐	☐
Last Mile Delivery (monitoraggio consegna merce al domicilio dell'utente tramite App, etc.)	☐	☐	☐
Guida autonoma (sperimentazioni di veicoli a guida autonoma in specifiche aree urbane, etc.)	☐	☐	☐
Sistemi incentivanti per la mobilità sostenibile (App per monitorare mezzi di trasporto scelti dagli utenti e attivazione di scontistiche dedicate, etc.)	☐	☐	☐
Altro (specificare)	☐	☐	☐

Note:

4) I progetti Smart Mobility consentono di raccogliere grandi quantità di dati. Con riferimento ai progetti avviati dal suo Comune:

Selezionare una sola risposta

☐ I dati raccolti sono utilizzati dal Comune per finalità interne (es. per conoscere i flussi legati alla mobilità e prendere decisioni legate alla gestione del traffico)

☐ I dati raccolti sono utilizzati dal Comune per offrire servizi ai cittadini (es. per fornire indicazioni su quali aree della città presentano un miglior livello di qualità dell'aria, per rendere disponibili i dati in logica open data)

☐ I dati raccolti sono utilizzati sia dal Comune, sia da altre società pubbliche o private per erogare nuovi servizi

☐ I dati raccolti non sono attualmente utilizzati dal Comune ma è in programma un loro utilizzo in futuro

☐ I dati raccolti non sono attualmente utilizzati dal Comune e difficilmente saranno sfruttati in futuro

Note:

SEZIONE DEDICATA A TUTTI

5) Quali sono le barriere (interne ed esterne) che secondo lei rallentano o impediscono l'avvio di progetti Smart Mobility? Oppure che non consentono il passaggio da progetti pilota a iniziative su larga scala?
Selezionare una o più alternative (al massimo 3 risposte)

BARRIERE	MAX 3 RISPOSTE
Scarsa **conoscenza** delle tematiche relative alla Smart Mobility e/o mancanza di **competenze** interne in grado di gestire tali progetti	☐
Scarsa disponibilità di **risorse economiche**	☐
Difficoltà nell'**utilizzo** delle **risorse economiche**	☐
Complessità legate alla **burocrazia**	☐
Mancanza di **comprensione da parte dei cittadini** del reale **valore** delle soluzioni che si intendono implementare	☐
Cambi frequenti della Giunta comunale, che impediscono di portare a termine i progetti avviati	☐
Difficoltà di **coordinamento dei diversi attori** (pubblici e/o privati) coinvolti nei progetti	☐
Difficoltà di **integrazione** di nuovo e vecchio hardware e software	☐
Resistenze da parte di organizzazioni esterne o di altri attori esterni al processo	☐
Resistenze interne (es. da parte dei dipendenti comunali)	☐
Problemi di **privacy**	☐
Altro (specificare)	☐

Note:

6) Il Comune di cui fa parte ha in programma di avviare progetti Smart Mobility in futuro? Nel caso si intendano avviare progetti, specificare gli ambiti applicativi di interesse ed il periodo temporale entro quando saranno realizzati.
Selezionare una o più alternative

AMBITI APPLICATIVI SMART MOBILITY	NEI PROSSIMI 12 MESI	NEI PROSSIMI 2-3 ANNI
Non avvieremo progetti Smart Mobility in futuro	☐	
Gestione del Traffico (gestione da remoto di semafori, congestione stradale, infomobilità, etc.)	☐	☐
Gestione dei Parcheggi (monitoraggio dello stato di occupazione del parcheggio, etc.)	☐	☐
Trasporto Pubblico Locale (localizzazione mezzi pubblici, monitoraggio del tempo di attesa alle fermate, etc.)	☐	☐
Mobilità Elettrica (installazione e gestione di stazioni di ricarica per veicoli elettrici, etc.)	☐	☐

Sharing Mobility (servizi di sharing dei veicoli, quali auto, scooter, monopattini e bici, offerti da terze parti tramite App o sito web)	☐	☐
Last Mile Delivery (monitoraggio consegna merce al domicilio dell'utente tramite App, etc.)	☐	☐
Guida autonoma (sperimentazioni di veicoli a guida autonoma in specifiche aree urbane, etc.)	☐	☐
Sistemi incentivanti per la mobilità sostenibile (App per monitorare mezzi di trasporto scelti dagli utenti e attivazione di scontistiche dedicate, etc.)	☐	☐
Altro (specificare)	☐	☐

Note:

7) Quali obiettivi vorrebbe perseguire l'Amministrazione tramite (l'eventuale) avvio di progetti Smart Mobility in futuro?
Selezionare una o più alternative (al massimo 3 risposte)

OBIETTIVI	MAX 3 RISPOSTE
Miglioramento dell'**immagine** del Comune	☐
Maggiori **introiti** per il Comune	☐
Riduzione dei **costi** del Comune	☐
Miglioramento dei servizi attualmente offerti ai cittadini	☐
Introduzione di **nuovi servizi** per i cittadini	☐
Creazione di un **database** ricco di informazioni rese disponibili dai progetti Smart Mobility (es. reale utilizzo dei mezzi pubblici, aree con maggior traffico)	☐
Miglioramento della **sostenibilità ambientale** (es. riduzione CO_2, efficienza energetica)	☐
Sviluppo delle **imprese** del territorio	☐
Maggiore **sicurezza** stradale (es. riduzione della probabilità di incidenti, fluidificazione del traffico)	☐
Adeguamento rispetto a **vincoli di legge** e/o obblighi normativi	☐
Volontà di **sperimentare soluzioni innovative**	☐
Necessità di **allineamento** rispetto a quanto presente in altri Comuni	☐
Maggiore **inclusione sociale** (es. abbattimento barriere architettoniche) e servizi sociali ai cittadini	☐
Altro (specificare)	☐

Note:

8) Quali attori potrebbero essere coinvolti (o sono già stati coinvolti) dal suo Comune per lo sviluppo dei progetti Smart Mobility?

Selezionare una o più alternative

ATTORI SMART MOBILITY	COLLABORAZIONE GIA' AVVIATA	VORREI COLLABORARE IN FUTURO
Aziende municipalizzate	☐	☐
Altri Comuni	☐	☐
Utility	☐	☐
Operatori Telco	☐	☐
Tower company / operatori di rete	☐	☐
Aziende private che consegnano prodotti di vario tipo a casa dei cittadini (es. Amazon, Glovo)	☐	☐
Aziende private che offrono servizi di sharing (es. Uber, Car2Go, Enjoy)	☐	☐
Concessionari auto	☐	☐
Polizia / Carabinieri / Aziende private che offrono servizi di sicurezza	☐	☐
Produttori di hardware / software	☐	☐
System Integrator	☐	☐
Banche e assicurazioni	☐	☐
Fornitori di servizi	☐	☐
Università e centri di ricerca	☐	☐
Startup innovative	☐	☐
Intermediari che operano attraverso la raccolta pubblicitaria	☐	☐
Altro (specificare)	☐	☐

Note:

9) Qual è a suo avviso la più grande sfida da affrontare per sviluppare un progetto Smart Mobility di successo?

Selezionare una sola risposta

☐ Sviluppo di un modello di business vincente

☐ Attiva partecipazione da parte dei cittadini

☐ Proficua collaborazione tra attori pubblici e privati

☐ Capacità di passare dal progetto pilota all'implementazione estesa su tutta la città

☐ Sviluppo di una tecnologia radicalmente innovativa

Note:

10) In futuro, quali sono i servizi di integrazione tra l'auto smart e la città che potrebbero risultare maggiormente utili per la mobilità urbana all'interno del suo Comune?
Selezionare una o più alternative (al massimo 2 risposte)

☐ Connessione tra l'auto e i parcheggi (es. segnalazione parcheggi liberi, pagamento direttamente dall'auto)

☐ Connessione tra l'auto e i semafori in modo da ottimizzare il flusso del traffico (es. per dare priorità alle ambulanze)

☐ Connessione tra l'auto e i guardrail (es. il guardrail avvisa automaticamente i soccorsi in caso di incidente)

☐ Connessione tra l'auto e gli altri veicoli (es. per segnalare incidenti, code)

☐ Connessione tra l'auto e la segnaletica verticale (es. per segnalare un limite di velocità)

☐ Connessione tra l'auto e le colonnine di ricarica elettrica (es. per monitorare lo stato della ricarica da remoto)

☐ Connessione tra l'auto e le stazioni di servizio (es. per pagare il carburante direttamente dall'auto)

☐ Non ritengo utile nessuno di questi servizi

☐ Altro (specificare)

Note:

11) Crede che nei prossimi 10 anni la guida autonoma possa diventare realtà anche nel suo Comune?
Selezionare una sola risposta

☐ Sì

☐ No

☐ Non lo so

Note:

Il questionario è concluso, la ringraziamo per la collaborazione. Qualora volesse, può aggiungere ulteriori commenti sul tema.
