POLITECNICO
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SCUOLA DI INGEGNERIA INDUSTRIALE
E DELL'INFORMAZIONE

EXECUTIVE SUMMARY OF THE THESIS

Connect Car & Mobility Startups: state-of-the-art and data valorization strategies

TESI MAGISTRALE IN MANAGEMENT ENGINEERING – INGEGNERIA GESTIONALE

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1. Introduction

The topics related to the Smart Mobility and the Smart Car have raised a significant interest in the last decade. Cities nowadays are becoming always more advanced and populated. Several projects related to the Smart City planning around the world have taken place and many others will come after. Smart mobility applications have a close relationship with this kind of projects. The mobility concept is something that affects the life of the people wherever. However, the expectations regarding the increasing urbanization trend say that approximately 70% of the world population will live in urban areas by 2050[1]. This will lead to face many challenges. The mobility will have a great impact in shaping the quality of life in the actual and future cities. In this way, Smart Mobility and consequently the Smart Car are playing and will play a fundamental role. According to Precedence Research the market size of the Smart Mobility is expected to grow in the following years. The following graph in figure 1 represents the expected trend of the market in the next years.

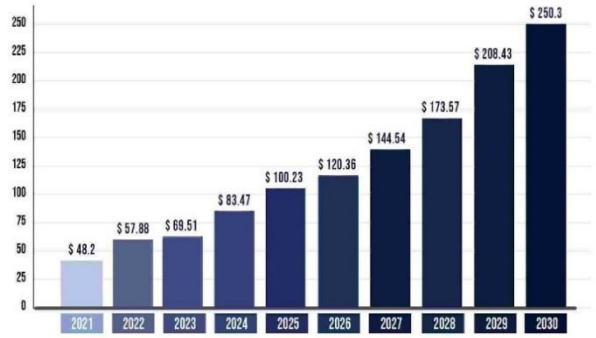


Figure 1: Smart Mobility Market Size Evolution from 2021 to 2030 by Precedence Research Website

Smart Mobility and Smart Car have an impact on different subjects. They affect the private sector composed by established firms and the new and younger players like startups in several aspects and functions of the mobility. They affect the public administrations as well and, last but not least, Smart Mobility and Smart Car functions, technologies, solutions affect the life of the citizens, especially in the urban areas. The fields of application of these two topics are many. Among them is possible to list: the electric mobility, the shared mobility, the autonomous driving, the traffic management, the driving safety, the public and private transportation, the logistic sector and many others. The new solutions and new technologies available are affecting different scopes of applications like the ones previously listed.

2. Objectives & Methodologies

After clearing up the relevance and the meaning and the description of the main topics addressed in the thesis, the goals of the research work have been set. The objectives of the thesis are expressed by two main research questions.

RQ1: Which is the current state of the art regarding Smart Mobility and Connected Car startups?

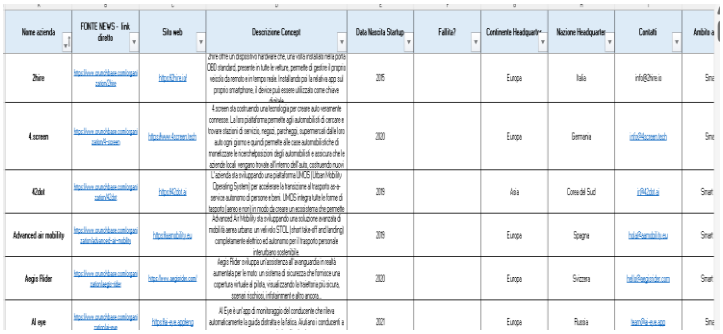
The first objective of the thesis is basically to understand what startups are doing in the two industries. This offers the opportunity to understand the main trends and evolution within Smart Mobility and Smart Car industries. In order to provide an answer, a census of startups has been done. The census is a huge sample of startups related to the Smart Mobility and Smart Car mainly obtained through a research on Crunchbase website. For each one of them the main data have been recorded like location, age, fundings, scope of application, functionality and other aspects. After that, a statistical analysis has been conducted to synthetize the results according to different perspectives, with the purpose to offer a good point of view on the state of the art of these players of the two industries.

RQ2: How much the data valorization strategies are affecting the startups business models?

Data valorization is referred to the users data. This means to understand how much each company is leveraging data from the user in order to develop their solution. The type of user data gathered and exploited could be of several typologies. In order to understand how much the user data valorization is affecting the business models of startups a qualitative framework composed by a two dimensions matrix has been created. The framework offers a classification of all the startups of the sample.

3. Smart Mobility & Connected Car Startup Analysis

The already mentioned census of startups has been initially provided by the Osservatorio of Connected Car&Mobility. The purpose of the work was to expand the analysis by adding new startups to the list. The research of new companies to add was mostly done through Crunchbase Website.



Nome azienda	FONTE NEWS - link diretto	Sito web	Descrizione Concept	Data Nascita Startup	Fallita?	Continente Headquarter	Nazione Headquarter	Contatti	Ambito a
2here	https://www.crunchbase.com/organization/2here	https://2here.it/	2here offre un dispositivo hardware che, una volta installato nella porta OBD standard, presente in tutte le vetture, permette di gestire il proprio veicolo da remoto e in tempo reale. Inoltre tramite la relativa app sul proprio smartphone, il device può essere utilizzato come chiave digitale.	2015		Europa	Italia	info@2here.it	Smar
4 screen	https://www.crunchbase.com/organization/4-screen	https://www.4screen.tech/	4 screen sta costruendo una tecnologia per creare auto veramente connesse. La loro piattaforma permette agli automobilisti di cercare e trovare stazioni di servizio, negozi, parcheggi, supermercati dalla loro auto ogni giorno e quindi permette alle case automobilistiche di monetizzare le ricerche/prenotazioni degli automobilisti e associare che le aziende locali vengano trovate all'interno dell'auto, costruendo nuovi	2020		Europa	Germania	info@4screen.tech	Smar
42dot	https://www.crunchbase.com/organization/42dot	https://42dot.ai	L'azienda sta sviluppando una piattaforma UMOS (Urban Mobility Operating System) per accelerare la transizione al trasporto as-a-service autonomo di persone e beni. UMOS integra tutte le forme di trasporto (aereo e non) in modo da creare un ecosistema che permette	2019		Asia	Corea del Sud	r&42dot.ai	Smar
Advanced air mobility	https://www.crunchbase.com/organization/advanced-air-mobility	https://aamobility.eu/	Advanced Air Mobility sta sviluppando una soluzione avanzata di mobilità aerea urbana: un veicolo STOL (short take-off and landing) completamente elettrico ed autonomo per il trasporto personale e/ed urbano sostenibile.	2019		Europa	Spagna	hola@aamobility.eu	Smar
Aegis Rider	https://www.crunchbase.com/organization/aegis-rider	https://www.aegisrider.com/	Aegis Rider sviluppa un'assistenza all'avanguardia in realtà aumentata per le moto: un sistema di sicurezza che fornisce una copertura virtuale a 360°, visualizzando in tempo reale gli ostacoli, i pericoli nascosti, i cambiamenti e altro ancora.	2020		Europa	Svizzera	hello@aegisrider.com	Smar
AI eye	https://www.crunchbase.com/organization/ai-eye	https://ai-eye.io/parking/	AI Eye è un'app di monitoraggio del conducente che rileva automaticamente la guida distratta e la fatica. Aiuta i conducenti a	2021		Europa	Russia	team@ai-eye.app	Smar

Figure 2: Database for the Census of Startups

Figure 2 represents a portion of the database of startups excel file. The database was

organized in the way to collect useful information about each one of the startups. The main data reported are about: company name, foundation date, useful links, concept description, country, continent, scope of application, functionality, fundings, relation with customers and typology of the offering. In this way is possible to have information regarding multiple aspects of the startup. In particular, it is possible to get useful insights about the general features and about the financial and the operative ones.

The next step was to synthetize all this information gathered. With the use of the Excel functions, several statistics with related graphs addressing different perspectives have been carried out.

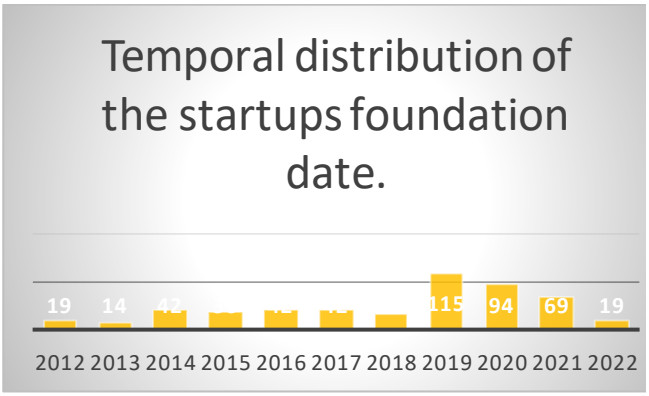


Figure 3: Temporal Distribution of the Database Startups Foundation Date

These statistical analyses offer good insights about the database content. They analyse startups different aspects like: the country distribution, temporal distribution, functionality distribution and others. The graph in figure 3, for example, is representing the number of startups founded in each year since 2012. There are also other graphs representing which are the countries or the continents more involved in the Smart Mobility and Smart Car industries. Other ones illustrate how many startups are involved in the different fields of application and so on.

A great relevance in this section is put on the financial perspective of the startups. In order to understand the main trends within the industries, a series of analyses have been done to highlight the funding evolution over the time. In particular, a great focus has been on the fundings related to the last three years (2020,2021,2022).

The graphs presented analyze different perspectives regarding the startups in the sample. The common element is the funding level raised by the companies. In this way is possible to know which are the countries and continents with higher financing, the total financing received in each year, the funding level in the different functionalities and so on.

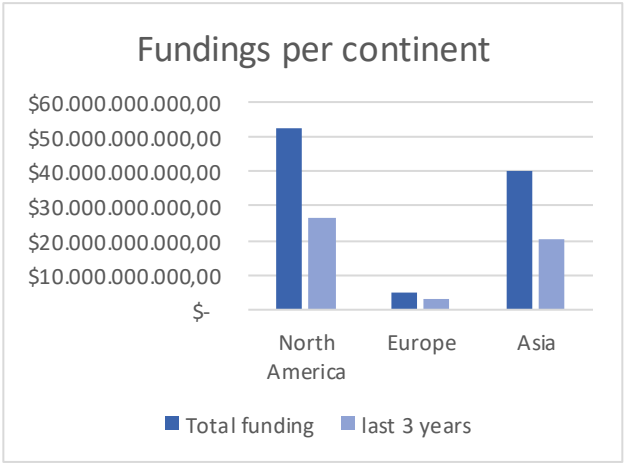


Figure 4: Total and Last Three Years funding amounts in the major Continents

For example, figure 4 represents the total funding amount in North-America, Europe and Asia.

The graph highlights also the funding amount of the last three years in order to have a temporal perspective. As it is possible to see, North-America and Asia have the leading roles while Europe is significantly behind. In order to complete the quantitative analysis on the database content and on the industrial trends a set of cases taken directly from the database have been presented. These examples are useful to improve the analysis also with a qualitative perspective.

4. Qualitative Framework: the User Data Valorization in the Startup Business Model matrix

The qualitative framework developed analyses the impact on the business model of the startups of the user data valorization strategies. The goal is to measure how much a company is extracting value from the data derived from the users of their solutions. The framework developed is a two dimensions matrix presented in figure 5. The vertical axis represents the value deliver and distinguishes the companies that are able to reach final users without involving other subjects and the ones which need to collaborate with other systems to deliver value to the user. The two approaches are in order: “Stand-Alone” and “Integrated” approach. The horizontal axis is referred to the extent of the user data valorization in the startup. It distinguishes companies that are leveraging user data in their business model from the ones in which the user data do not have a significant impact on the firm business.

User data valorization in each startup is distinguished in “High” and “Low”. The intersection of the two dimensions generated four different quadrants as it is possible to see from figure 5. The last step was to classify each one of the startups in the appropriate quadrant.

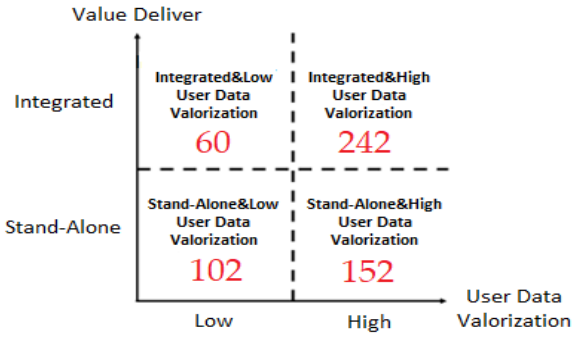


Figure 5: Qualitative Framework and Database Startups Classification.

The results provided are presented in figure 5. The majority of startups is leveraging user

data in their business model. The integrated approach is the most frequent in the case of high user data valorization involving the 44% of the database companies. Stand-Alone and high user data valorization combination is on the second place with the 27% of startups.

The qualitative framework highlights that the majority of the companies in the sample are leveraging data from the users in their business model. This imply that the majority of them is adopting a user centric approach in developing their solutions. On the basis of the results provided is possible to say that the user data valorization strategies are affecting consistently the startups business models of the database.

5. Conclusions

The purpose of the thesis was to answer to two research questions. The first one was referred to the current state of the art of the Smart Mobility and Connected Car startups. The study required to build a database containing a list of startups and for each one of them recording a series of different data. The tool used provides information on the startups of the sample collected in various perspectives. Afterwards, all these data were expressed through some statistics in order to have some graphical representations of the results. The analysis conducted reveals the main information on the state of the art regarding the startups in the Smart Mobility and Connected Car industries. The analysis adopted different points of view by exploring: temporal distribution, geographical distribution, functionalities, relation with customers and typology of the offering of the database companies. This information provided a clear view of the database composition. The further step was to understand the industrial trends by adopting a temporal and a financial perspective. The study focused on the level of fundings received by the startups according to different points of view referred to: temporal distribution, geographical distribution, different functionalities and so on. The analysis illustrates the funding level according to the perspective adopted and the funding level related to the last three years. In this way, for example, it is possible to gather information on the countries in which there is a higher level of financing or which functionalities are collecting more funds. Furthermore, it is possible to understand the trends by looking at the comparison between the total funding amount and the one related to the last three years.

The second research question was referred to the data valorization strategies of the companies. To answer that question, a qualitative framework has been created to analyze each one of the companies listed on the census. The framework developed was a matrix of two dimensions. The two dimensions identified were the value deliver and the extent of the user data valorization . The first one was needed to identify the approach of the company towards the user. The second one was needed, instead, to understand the impact of the users data valorization strategies on the companies business models. The matrix in the end was composed by four quadrants generated by the different intersections of the two axes. Afterwards, each one of the startups has been located inside of one of the quadrants, according to the matrix dimensions.

The results of this classification have shown that the majority of the companies of the sample are leveraging data from the users in order to develop their solution. According to this, it is possible to say that user's data valorization strategies are strongly affecting the startups business models.

6.Bibliography

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7.Sitography

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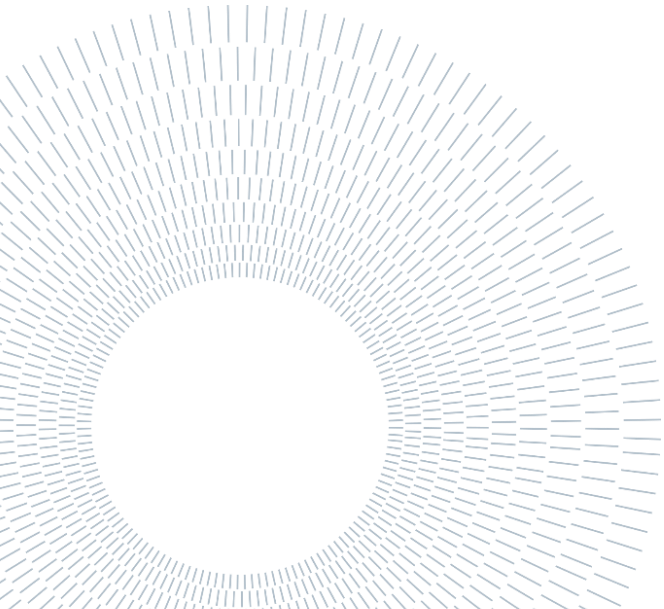
Academic Year: 2021-22

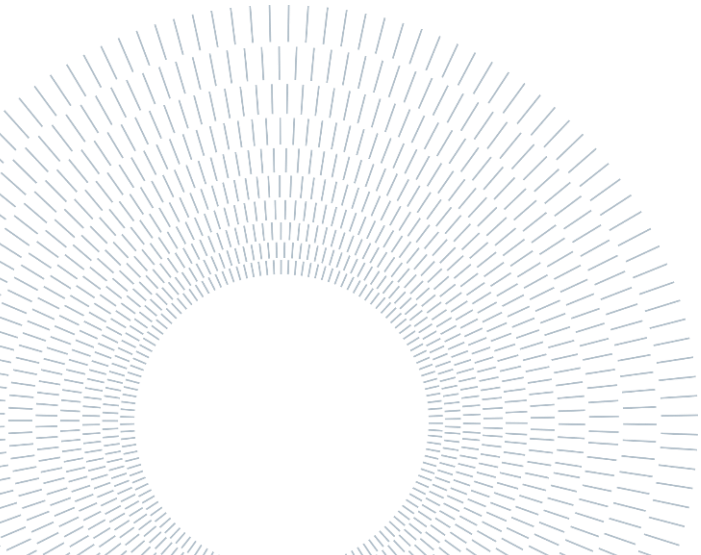
Abstract

The concept of mobility is something that affects the life of the people in several ways. Nowadays, the percentage of the population who live the urban areas is increasing in a consistent way. This phenomenon is presenting current and future challenges. The goal of achieving an higher quality of life within the urban areas has to consider the issues related to the mobility of the people. In this context, in the last decade concepts related to Smart Mobility and the Smart Cars started to develop in order to address these challenges in innovative ways. Smaller and younger players like startups typically are in possess this kind of approach. The object of this thesis, in fact, are the startups in the Smart Mobility and Smart Car industries. The first main goal of the work is to understand their current state of the art. In order to do that, a quantitative analysis has been conducted based on the data provided by a census of startups related to these two sectors. This analysis follows different perspectives providing useful insights. The second objective of this study is to understand the impact of the users on the businesses developed by this type of companies. The purpose is to measure how much these players are leveraging data from the users in the development of their solutions. The study conducted provides a qualitative framework that classify the startups from the census in order to give an appropriate answer to this second research question.



Abstract in Italiano

Il concetto di mobilità influisce sulla vita delle persone in diversi ambiti. Oggigiorno, il numero di persone che vive e risiede in aree urbane sta crescendo enormemente. Questo fenomeno di urbanizzazione porta con sé delle sfide da affrontare. L' obiettivo di raggiungere una qualità della vita più alta all'interno delle città deve per forza considerare le problematiche relative alla mobilità delle persone. Nell'ultimo decennio concetti come quelli della Smart Mobility e Smart Car hanno cominciato a svilupparsi con il fine di affrontare queste sfide in maniera innovativa. Organizzazioni come le startup hanno nella loro costituzione questo tipo di approccio. L' oggetto di studio di questa tesi sono infatti proprio le startup nel campo della Smart Mobility e Smart Car. Il primo obiettivo di questo studio è quello di comprendere l'attuale stato dell'arte di queste iniziative. Per fare ciò, un'analisi di tipo quantitativo, su varie prospettive, è stata condotta sulla base di dati provenienti da un censimento di startup appartenenti a queste due industrie. Il secondo obiettivo dello studio è quello di capire che impatto ha l'utente sui modelli di business sviluppati da queste startup. L'idea è quella di misurare quanto queste attività stanno sfruttando i dati provenienti dai loro utenti nello sviluppo delle loro soluzioni. Per comprendere ciò, un modello qualitativo che classifica le diverse startup ottenute dal censimento è stato realizzato in modo da poter dare una risposta alla seconda domanda di questa ricerca.



Contents

1.Introduction

This introductory chapter has the main purpose to illustrate the concepts of smart mobility and connected car, which are the objects of this work of research. In particular, it will be presented a general description of them, their relevant characteristics, the supporting technologies and their scopes of application.

In the following sections there will be some references to the current literature about the two main arguments, in order to have an overall picture of them. In the second part of the thesis, instead, the focus will be more specific, by observing and analysing the results provided by a census of startups.

1.1. Smart Mobility

1.1.1. Concept

Smart mobility can be defined as a process. It can be defined as a process because it involves the reorganization of: the mobility needs, in the individual and in the collective perspective, and in the implementation of new infrastructures and solutions [1].

Smart mobility is a key component of the Smart Cities planning. A large proportion of the world's population live in urban areas, and this percentage is expected to grow till the 70% by 2050 (UN, 2012). This implies challenges in terms of growing concentration of people and associated flows of resources required to support economic prosperity and social wellbeing. A fundamental component of this "Urban metabolism" (Clift et al., 2015) is the mobility, that has great energy and emission implications (Lyons, 2018).

Smart Mobility involves the participation of: private firms, startups, cutting edge technologies, public authorities and citizens. The benefits are both related to public and private transportation. The aim is to have: a reduction of the costs associated to the mobility, more effective and improved ways of transportation and, of course, a reduction of the impact on the environment in terms of pollution (Biyik et al., 2021). Sustainability, therefore, is a key driver in this process. A sustainable urban mobility can be defined as "the ease, the convenience, affordability and accessibility of travelling to one destination with minimal impact on the environment and others" (Lam D.and Head P., 2012). Reducing the roads congestions and the urban pollution, improving the organization of transport in the cities and other aspects are the basis for the achievement of a greater quality of life in the urban areas. It is also crucial to highlight the importance of the cooperation between public

authorities and the private sector. Indeed, smart mobility is object of policymaking by governments and public institutions. As already said, the smart mobility is part of the Smart City projects development. National governments and local governments hold a significantly amount of data and with a proper use of big data technologies they can make the cooperation between citizens, public administrations, private businesses more efficient, improving the social welfare and many areas of the life (Zagyi, 2022).

Before moving ahead with the description of the main characteristics of the Smart mobility, the following picture, provided by Precedent Research, explains the relevance of this topic in terms of market size and its evolution in the future years.

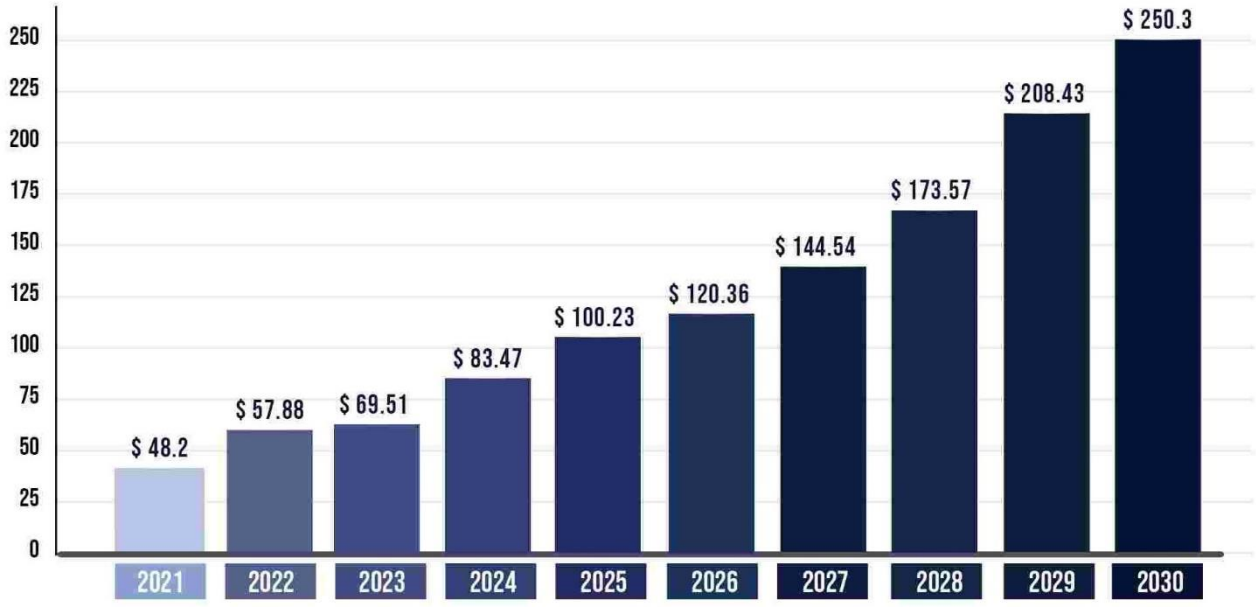


Figure 1: Smart Mobility Market Size Evolution from 2021 to 2030 by Precedence Research Website

The graph provided by Precedence Research Website presented in figure 1 shows a clear growth path in the future years. In 2030 the Smart Mobility market is expected to hit 250 billion USD. The annual growth rate (CAGR), from 2022 to 2030, is estimated to be 20,09% [2].

1.1.2 Main features and characteristics

A unique and complete definition of Smart Mobility is hard to find, researchers, in fact, are proposing different views on the argument. Anyway, it is possible to define which are the main elements and principles on which Smart Mobility is built on [3]:

- **Flexibility:** Multiple modes of transportation give the possibility to the user to identify and choose the best option to make its travel.
- **Efficiency:** Minimize the costs and the time associated to the travel.
- **Integration:** Organize and plan the travel in a door-to-door perspective, even if different transportation means are involved, in order to simplify the journey for the user.
- **Clean technology:** Moving from vehicles that cause pollution to environmental-friendly ones.
- **Safety:** Reduction of accidents and fatalities.

This section has also the purpose to make a list of the main applications of the smart mobility. These functionalities will be also explained and detailed better in the final chapters of the work, according to a classification provided by a database of startups. In the following sections, it will be described the main fields of application, in which, Smart Mobility is involved.

1.1.2.1 Electric Mobility

In the last years, the process of electrification of vehicles has been crucial in order to promote environmental sustainability and therefore enhancing the level of production of this kind of means of transportation. The focus nowadays is on the level of autonomy of the batteries and on the development of the infrastructure and systems for the charging, in order to solve EV owners' issues. The level of maturity in this field is elevated. (4)

1.1.2.2 Autonomous vehicles

The autonomous driving systems have been subject of great development during the last years, also in other fields like in the aerospace industry. The level of knowledge in robotics and artificial intelligence is growing very fast and various models of self-driving cars have been developed. Driver assistance technologies (ADAS) are already integrated in several recent vehicles sold in the market. Some examples are: electronic brake assist systems, engine management systems, parking

sensors and safety sensors for obstacles and dangerous situations. These technological tools are gradually reducing the responsibilities and the tasks of the driver. It is possible to classify the level of automation of the vehicle using the SAE (Society of Automotive Engineers) scale. This classification starts from the zero level in which there is none automation to the full level of automation (the fifth level) passing through intermediate modes in which the driving is more hybrid. The scale can be divided into two parts. In the first one the human monitors the driving environment (from zero to second level) while, in the second one, the automated system is in charge of that, reducing significantly human responsibilities.

Self-driving vehicles can bring several advantages like an increased level of safety on the road by preventing human mistakes that typically cause accidents. Parking operations can be performed better by increasing accuracy and also saving space. Insurance services will also be affected by reducing the risk of accidents. Maintenance is affected as well, these types of vehicles are endowed with hardware and software components that could perform system diagnosis and predictive maintenance.

The transportation of people and merchandise will also improve by performing in a more efficient way.
(4)

1.1.2.3 Connected vehicles

Thanks to recent technology development, cars are becoming always more “smart”. In this process the connectivity of the vehicle with: the environment, other vehicles and the road infrastructure is crucial. Car manufacturers and their suppliers have constantly introduced new devices in their latest products like: sensors, radars, cameras and etc. However, in order to improve driving experience, safety and performances the element of connectivity is fundamental to exploit to the fullest these new technologies on board. (4)

Since the Connected Car is a topic that has a great relevance in this work, it will be discussed better in the second main chapter of the introduction.

1.1.2.4 Shared Mobility

Shared Mobility is related to the possibility to give to the users the access to transportation services on demand by using different means of transportation. Among them, there are different services like the: car sharing, bike sharing, peer-to-peer ride sharing and others. In this section are described the main shared mobility services.

The car sharing is one of the most popular. Car sharing implies a short-term vehicle rental service that is typically offered within a specific geographic area, and the access to it is usually done through an app. A further classification can be done. Car sharing can be "station based" which means that the vehicles are only taken and then left in specific points after the use. It can also be classified as " free-floating" car sharing. In this case the vehicle can be picked up across the roads and then, it can be left everywhere within a specific area. Another possibility is the "peer-to-peer" sharing which is performed among individuals. In this case there is only an intermediator, typically an app used by the customers. In the other two first cases the service provider is offering its own cars. Another service related to shared mobility is the Ride Sharing. Ride sharing implies the sharing of the same vehicle for people who are going for the same travel. In order to have this, there is an intermediator who act as a platform in which people can met what they are looking for.

Another service is the Ride hailing. Ride hailing is very similar to the taxi service. It is basically used to request a car with a driver in order to carry out the travel. The main difference is that it is accessed through a platform. A famous example of ride hailing platform is Uber.

Then there are the scooter and bike sharing services. They are similar to the car sharing, but it involves the use of bike and scooters on demand in return for a payment on the basis of the duration of the use of the specific mean of transportation. The same classification of the Car sharing can be done. The "station based" system in which the user has to pick and then leave only in the stations. Typically, the customer unlocks the vehicles with an app or a QR code and leave them in the same way in certain specific points. Then there is the "Free-floating" and the "peer-to-peer" like in the car sharing case. Micro-mobility services are quite similar. They are sharing systems dealing with other types of means of transportation like: e-scooters, hoverboards and other small vehicles. The access to them is allowed trough specific apps of the service providers.

And finally, there is the DRT (Demand responsive transit) service that is done to provide private users with public means of transportation like buses, for a personal mobility purpose. (4)

1.1.2.5 Mobility-as-a-Service

Mobility-as-a-service (MaaS) is strictly influenced by the precedent main fields of application identified. The new transport services and technologies have been linked to "as-a-service" concept, defining a new paradigm in which mobility is not more consumed like an asset, intended as ownership of the vehicle, but rather accessed on demand. The mobility as service is often described like a one-stop travel management platform that digitally unifies trip creation, purchase and

delivery (Wong Yale Z. et al., 2020). The purpose is to reach the fullest level of integration of public and private transport. This means to have the possibility to manage the user's journey, which involves different transportation modes, in a unified way. The consequence is the reduction of the complexity in the organization of every travel. The user will be able to manage everything trough a single account of the service provider. The concept of car ownership is becoming always less relevant. It is interesting to look at the behaviour of younger people in order to understand the future trends regarding mobility demand (Kuhnimhof T. et al., 2012). Young people have shown a travel behaviour which differs from the one of the previous generations (Meng Zhou and Dongenn Wang, 2019). Indeed, younger people have shown a decrease in the use of the car and an increase in the use of multimodal transportation (Kuhnimhof T.,Buehler et. Al., 2012). In support of that, the percentage of young people who are in possess of driving license and car of property have declined (Metz, 2012), (Delbosc A. and Currie G., 2013), (Klein N.J and Smart M.J, 2017).

1.1.2.6 Parking Management, Fleet Management and Traffic Management

The research for parking spaces, especially in urban areas, has always been an issue for many drivers [5]. Empirical studies conducted in U.S have found out that the average time to find a curb side parking space are included in a range between 3.5 and 14 minutes (Giuffrè T. et al., 2012). Another study conducted, reveals that cruising for parking is responsible of an increase about 25%-40% of the traffic flow. The consequences are a waste of resources and a threat to the environmental issues (Jun Xiao et al., 2018). There are different approaches to address the different aspects of the problem. In the most advanced cars, there are systems that help or perform autonomously the parking. There are also systems which are used to interact with the parking infrastructure also enabling the possibility to manage payments and duration of the parking directly from the phone or any other devices.

Smart Mobility process is addressing also issues related to the fleet management of the private companies. Improving the management of the firms fleets leads to a general reduction of costs. It is possible to have better control of the use of the vehicles in order to: keep record of the level of consumption, fleet monitoring, insurances of vehicles and also to know when to perform maintenance [6]. Since the element of connectivity and the sharing of data from the vehicle is relevant, this scope of application is also strongly related to the Connected Car topic.

The Smart Mobility ecosystem is also involved in dealing with traffic issues within the urban areas. The focus on these issues is high since, as already said, the urbanization trend, that move people to establish in cities, will result in criticalities regarding traffic congestions. Roads Congestion, indeed, is the first challenge to face. According to a 2019 global traffic scorecard from INRIX, in U.S. there

was an average loss of 99 hours in that year for each driver. The consequence was a loss of USD 88 billion due to a decrease in productivity. Another consequence of the urbanization trend is the environmental impact, since transportation is one of the major causes[7]. The consequences are not just related to environment only, but also to the public health[7]. Congested traffic in urban areas results in high production of microscopic particulates. According to the World Health Organization, these particulates are a serious threat to people health. Another problem of the congestions is the public safety. Congested roadways are responsible for the majority of mortal accidents and nonfatal injuries[7].

1.2. Connected Car

1.2.1. Concept

The connected car is the second topic of great relevance in this work. Therefore, this chapter has the purpose to provide a clear description of the argument.

It is considered as a relevant component of the larger concept of Smart Mobility. Therefore, the two topics have an important relation. The fields of applications of the connected car are similar and sometimes the same of the Smart Mobility ones.

The "Connected Car" is a vehicle that is connected to the internet and endowed with IoT devices that allow the communication and connection with the surrounding environment [8].

Of course, there are many different definitions of the connected car, but, in this section, the purpose is to have a clear description. In order to define a vehicle as "connected", some conditions have to be respected (Coppola & Morisio, 2016). First of all, the vehicle must have the possibility to connect to internet. Secondly, it must be endowed with a set of modern applications and functions offering advanced infotainment functionalities for the driver and the passengers on board. Furthermore, the vehicle must be able to connect to the smart devices on the road infrastructure. This is possible thanks to the vehicle-to-road connection technologies. Another key characteristic of the connected car is the capability to interact with other vehicles thanks to the vehicle-to-vehicle communication technologies (Coppola & Morisio, 2016).

1.2.2. Main features and characteristics

The Connected Car is object of great interest for many subjects. First of all, industrial players like car manufacturers and big tech companies have a great role in the continuous development of new solutions. However, the analysis must also include the role of governments and local authorities, and especially the law authorities which have some relations with this topic [9]. Their main task is to understand the implications provided by these new technologies.

Furthermore, startups are key players in the process, by providing new technologies which supports the functionalities of the smart vehicles and by collaborating with the main incumbents in the industry.

The aim of this section is to deepen the concept of the connect car by describing: the main features, the relevant technologies and the main services offered.

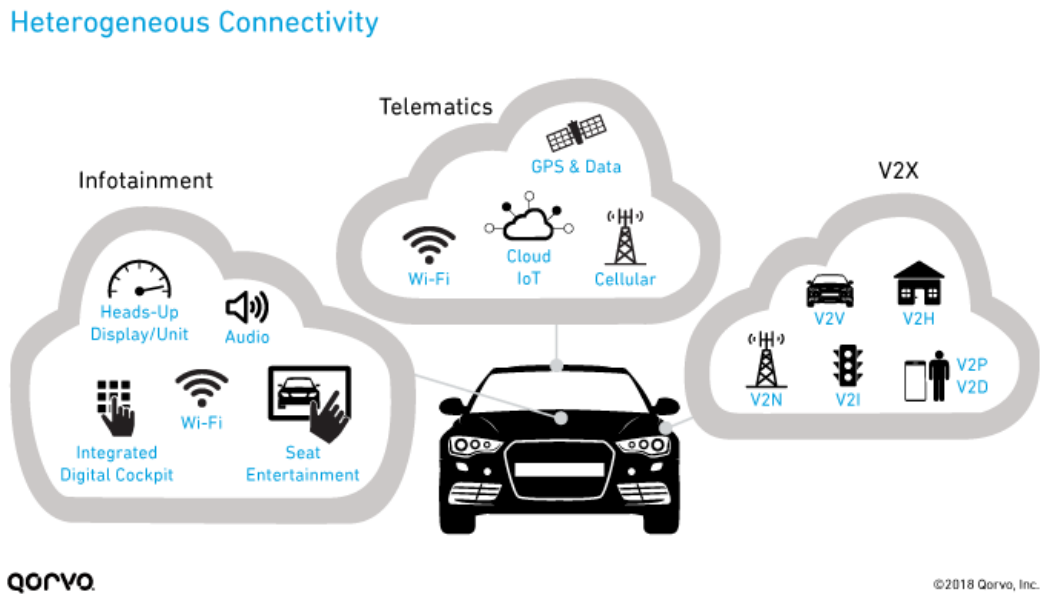


Figure 2: Main features of the connected car by Qorvo Website

In the above figure 2 provided by Qorvo website is possible to note the main features and characteristics of the connected vehicle.

Some of the main characteristics have been described in the precedent section. In the following part, the focus will be on the main technologies supporting the connected vehicle.

The Connected Car is based on a communication system called "Vehicle-to-everything" (V2X). This system is a WLAN network or a mobile LTE network which allows the exchange of data from the vehicle to "everything" [8]. It is possible to define "everything" in a more precise way [10] :

- **Vehicle-to-Network(V2N)**
  In V2N, cars can use cellular networks to connect to the V2X management system and also dedicated short-range communications (DSRC) frequencies to interact with other vehicles and the road infrastructure. These technologies make the car a connected device like a smartphone. Vehicle-to-network connections have different implications: V2I,V2V,V2C and V2P communications.

- **Vehicle-to-Vehicle(V2V)**
  This connection among vehicles allows the sharing of data related to the: speed, direction, position and braking of each car when they are close to each other. Several dangerous situations can be prevented like reckless drivers or an ambulance running at high speed in

case of emergency. The main implication, therefore, is to improve the safety on the streets. This type of communication between vehicles is done through dedicated short-range communication (DSRC) frequencies.

- **Vehicle-to-Infrastructure(V2I)**

  This represents the possibility for the smart car to interact with different subjects. First of all, the connection with the local authorities that can provide useful information to the driver related to: traffic conditions, weather and any other issue that can affect the journey. Then, there is the interaction with the road infrastructure. There is an exchange of data coming from: other vehicles or data sensors installed in the streets like cameras or traffic lights for example. Also this type of communications is done trough DSRC frequencies and sometimes trough the cellular network.

- **Vehicle-to-Pedestrian(V2P)**

  Thanks to the modern and advanced systems of sensors on the smart car, pedestrians nearby are reported to the driver which is alerted, therefore preventing potential dangers for the others.

- **Vehicle-to-Cloud(V2C)**

  V2C operates through the cellular network in order to have an exchange of data between the vehicle and the cloud. This include functions like the update of the car's software, a further support to DSRC communications, remote vehicle diagnosis and communication with household appliances for example.

- **Vehicle-to-Device(V2D)**

  V2D involves typically the interaction between the car infotainment system and the smartphone for various functions. Apple CarPlay and Android Auto are an example of that.

- **Vehicle-to-Grid(V2G)**

  V2G is mainly linked with the electric vehicles and plug-in hybrid vehicles. It provides an exchange of data between this kind of vehicles and the smart grid. This is a supporting technology of the electrification process.

The introduction of the 5G network has a strong impact on the Connected Car industry and on the related communication technologies already mentioned. It will allow to improve existent functionalities and to implement new ones [11].

In the following sections, the main functionalities and applications of the connected car will be presented. Like in the case of the Smart Mobility, the functionalities of the Connected Car will be detailed more in depth in the final chapters of the work using the classification provided by a startups database.

The main services and functionalities provided by the Connected Car are grouped in different categories according to their main purpose.

1.2.2.1 DRIVING SAFETY

Smart Cars are dealing with issues related to the safety during the driving. There are different sources of potentially dangerous situations like accidents. The technology in the vehicle must be able to face different challenges.

First of all, the technologies in the car must be able to identify driving behaviors and conditions of the driver that could affect the safety. Driver's fatigue and drowsiness are the main sources of car accidents (Swan, 2015). Many sensors and computer vision applications can detect if the driver is tired or distracted by monitoring for example: the eye movement (Wan-Young et al., 2012), the time intervals of the eye closing (Ghimire et al., 2015), the eye rubbing and the yawning (Chandrakala et al., 2015). Furthermore, the level of stress can be estimated by using advanced seats which measure the heart rate variability [12] or by steering wheel speed sensors [13]. When a suspicious condition is detected, then the car must alert the driver.

After the driver conditions is crucial to understand potential dangers in the surrounding environment during the travels. This kind of functions make an analysis of the road by: spotting potential risks, obstacles and maintaining a correct trajectory. A set of components in the car like: radars, lasers and video sensors alert the driver of imminent crashes (Mobileye, 2015). Furthemore, some of these functions on board can act autonomously to prevent accidents by controlling the steering or the braking (Mobileye, 2015). In order to maintain a proper trajectory, there are also "line keeping" systems which help the driver and prevent accidental deviations (Doshi A. and Trivedi M., 2009).

In case of accidents, there are systems able to detect the crash and to send a notification to the road authorities and to ask for a quickly medical intervention (P-Dhole et al., 2015).

Then there are functions devoted to maintenance issues and assistance services. For example, the possibility to automatically communicate eventual problems or the malfunctioning of the car with the car-maker and, then, the possibility to perform a remote diagnosis (Coppola & Morisio, 2016). In case of thefts, some functions allow to block the car or to signal the situation to the authorities (Coppola & Morisio, 2016).

1.2.2.2 TRAFFIC MANAGEMENT

Connected vehicles are dealing with issues regarding traffic management. The element of the connectivity can be useful in different ways, especially for drivers during their travels. There are functions of these vehicles that are able to provide optimal route planning trough new systems of navigation.

The new generation of navigation devices helps users to plan better their routes. The main advantage is the real-time information which leads to optimal routes. This real-time information allows users to, for example, get information on fuel prices on the gas stations or to know where is possible to find available parking places (Coppola & Morisio, 2016).

The amount of data generated by connected vehicles has implication in the traffic management. The vehicle-to-infrastructure communications have a relevant role in avoiding traffic congestions situations. The information about position, speed, starting point and destination are shared anonymously to the infrastructure from each vehicle (Coppola & Morisio, 2016). This information could be very useful also to other vehicles by suggesting, for example, alternative routes in order to avoid congested roads (Coppola & Morisio, 2016).

Connected Cars can also share useful information about weather and road conditions to other users directly or through the intermediation of the road infrastructure. Automated stations on the edge of the road can gather useful information from the connected cars sensors and detect critical situations on the basis of that amount of data received (Coppola & Morisio, 2016). An example could be a situation where a road is blocked for some reason like an accident or the presence of an obstacle. This information is shared to authorities and other drivers in the same area quickly (Coppola & Morisio, 2016).

1.2.2.3 COST EFFICIENCY

Smart vehicles have an impact on the costs associated with the use of the vehicle. Thanks to the data provided and exchanged there could be some opportunities to save money for the driver.

The cost of the insurance is something that is affected for example. The Connected Car has an important relation with the insurance services. Trough the data exchanged like the: duration of trips, length of the travels, driving conditions of the area and driver ability and behavior, the price of the insurance service can be calculated in a more personalized and efficient way. This is called Usage based Insurance (UBI) (Coppola & Morisio, 2016). This kind of service is carried out through the data shared by smart vehicles thanks to some devices like black-boxes and also through the simple use of smartphones (Handel P. et al., 2014).

The implications are extended also towards the vehicle pricing. The information provided by this kind of vehicles could be very useful to evaluate the correct price of a used one. Having more information about it, rather than just know the number of kilometers of a car, helps the buyer to make a more informed decision about a vehicle purchase (Coppola & Morisio, 2016).

Connected vehicles are able to address energy consumption issues as well. Gathering information on the vehicle usage can help to reduce energy consumption. This concern is mainly for the electric cars, where the planning and managing of the recharge is crucial. In this perspective, the integration of the smart home and the electric connected vehicle is very useful. The connection among them allows to plan and schedule properly the charging, based on the data derived from the usage (Chunhua et al., 2013). There are also relevant implications for the companies fleet management. Being able to observe and receive data about the use of the company vehicles allows a better management and control of the fleet and a reduction in the consumption of fuel.

Another interesting application regards the relation of the Smart Car with the manufacturer. Information and data sent by the connected vehicles can be very useful to the manufacturers and their suppliers in order to understand criticalities and points of improvement (Coppola & Morisio, 2016).

1.2.2.4 OTHER SERVICES AND FUNCTIONALITIES

The connectivity of the smart vehicles has implications and benefits for car sharing service providers and their users. Connected Car networks offer a way for improving the existent car sharing services. Thanks to real-time information, users can have more easily knowledge about: position, movements and conditions, like for example the level of autonomy, of a specific vehicle (Coppola & Morisio, 2016).

As already mentioned, the connection of the vehicle with the smart home functionalities is interesting. Various functions are allowed to the user on the car in order to connect with the home by distance. The technology of these smart vehicles enables also to define driving profiles according to the different car users. This allows the possibility to personalize the configuration for each driver using the car, like climate settings or seats positioning. The profiles can be also exported to other cars (Coppola & Morisio, 2016). Smart vehicles are also bringing on board advanced features in terms of infotainment. These new features are more related to the improvement of the driving experience for drivers and also passengers. These functions are mostly involved in the delivering of entertainment services (Coppola & Morisio, 2016).

1.2.3. Emerging trends

The Connected Car technologies are in constant evolution and in the recent period new trends and applications have emerged.

Thanks to the relevant amount of data that connected vehicles produce, new solutions and services are going to be introduced. These new services have some specific characteristics. One of them is the pay-per-use pricing methodology and the other one is the possibility to purchase those services inside the car(In-Car purchase) (Salvadori et al., 2021). An example is the new possibility to purchase, temporary, some of the optional of the car just for the time in which they are used. Tesla has developed, for a model of electric SUV, the possibility to buy trough an app, after the purchase of the vehicle, a software update which increase the acceleration performance of the vehicle itself. The concept of car is evolving beyond just the additional improvement of some features and the introduction of new technologies. The new trends can suggest that the vehicle will be seen like a sales' channel (Salvadori et al., 2021). Future connected cars will be able to increase their performances like the engine power or the level of autonomy of the battery in return for a reasonable price only on demand and directly from the car itself.

2.Objectives and Methodologies

In this second chapter it will be explained which are the goals of the research and the methodologies used to reach them.

2.1. Objectives

The purpose of this thesis work is to provide an answer to two research questions.

RQ1: *Which is the current state of the art regarding Smart Mobility and Connected Car startups?*

This means to understand which are the main trends and evolution within the smart mobility industry and connected car industry. In particular, the focus will be on the startups which are playing a relevant role. A census of startups can offer a good point of view of the state of the art of these players in the two industries.

Looking at small players like the startups, instead of the major incumbents, is a good way to understand which are the most interesting innovative solutions. Typically, startups have innovative approaches, and they can offer technological solutions which are scalable and that could be integrated into existent products and services offered by the main automotive industry players. These new solutions could be also part of new services and technologies provided by other kind of actors within the mobility ecosystem like: sharing mobility platforms, public transport service providers, public authorities and many others.

RQ2: *How much the data valorization strategies are affecting the startups business models?*

The second research question of the thesis is related to the user data valorization. This means to understand how much a company is leveraging data provided by the users of their solutions. The valorization strategy could impact the business model in different ways. As already said, in the beginning chapter, Smart Mobility and Smart Car concepts involve the engagement of the citizens. The goal of the startups operating in this fields is to solve many of the issues related to the mobility by improving existing solutions in order to offer better products and services. It is crucial for them to be able to engage people in this process of modernization of the mobility through their developed solutions. The goal is to understand how much the companies are taking into account the information regarding the users and how they are using it.

2.2. Methodologies

After defining the research goals, in this section it will be explained the two methodologies used.

- **Database of startups**

  In order to answer the first research question about the current state of the art regarding the startups in the smart mobility and connected car industries, a database containing a significant sample of them has been created. The database is an Excel file containing a list of startups. For each one of them is available a description and the relevant data regarding it like the: foundation date, country of origin, level of fundings and many others information. After collecting a significant amount of data, the second step was to perform an analysis from a statistical point view in order to provide useful information about the key aspects. These statistical results help to understand which are the main scopes of application, which countries are more involved in the process, the level of fundings and their evolution during the time.

- **Qualitative framework**

  To give an answer to the second research question about the user data valorization strategies affecting the business models of the companies, a qualitative framework has been created. The framework is a matrix of two dimensions that has the final purpose of classifying the various startups of the database. The matrix considers two main aspects. The first one regards the approach towards the user by the firm. In particular, there is a distinction between companies engaging directly with the users and other ones which are involved in collaborations with other systems in order to deliver value for the user. The second dimension is related to the extent of the user data valorization. This dimension will be used to classify the startups according to how much they are getting value from user data in order to develop their solution. The framework will be explained in detail in the chapter 4.

3.Smart Mobility & Connected Cars Startup Analysis

In this chapter it will be illustrated the analysis of the database of Connected Car and Smart Mobility startups. In the first part there will be a description of the database used with its characteristics and structure. In the other part of the chapter the focus will be on the statistical analysis performed on the database and its main results, in order to understand the major industry trends.

3.1. Database structure

The already mentioned database is the starting point of the whole analysis. It contains a census of startup regarding the Connected Cars and the Smart Mobility industries. The initial version of the census was provided by the Osservatorio of Connected Car & Mobility, and the focus of the work was to further expand the analysis. After a first update of the data regarding the startups already listed, the work consisted, then, in a significant enlargement of the number of companies. The total amount in the end was 556. The research of new startups to add to the list was mainly performed using Crunchbase.

Each startup has its own line and in order to have a detailed picture of them, regarding different perspectives, several different items for the classification were used, each one with its own column. In the following part, there will be a description of each classification item, grouped into different clusters.

1)GENERAL INFORMATION

The general information about each one of the startups is referred to the first columns. Here it is possible to get knowledge of basic information about any company. In these columns there are reported: the name of the company, foundation date, links to the company websites, the concept description and geographical location.

- **Company name**
- **Links to company websites**
- **Concept description**

It consists of a brief description about the company. The main concern is to describe what the company does by looking at the business model. This allows to understand which is the value proposition in terms of products or services and what are the relevant characteristics of the company.

- **Foundation year**
  This information provides the year of birth of the company, in order to evaluate its age.

- **Operating status**
  It can be active of failed. It is useful to evaluate how many companies are still operating and which ones are not.

- **Headquarters continent**
  Continent in which company's headquarters are based. The continents considered are: Europe, North America, South America, Asia, Africa and Oceania.

- **Headquarters nation**
  The country in which the headquarters of the company are located.

2) TECHNICAL INFORMATION

In this cluster the focus is on the technical perspective by looking at what, each considered company, is doing and offering. Each startup, first, is classified in its scope of application. Afterwards, the company is classified according to its functionality. All the functionalities within the database are presented in this section.

- **Scope of application**
  The purpose of that is to distinguish startups according to their field of application. This means to separate them into the two main categories: Smart Mobility and Smart Car.

- **Functionality**
  After defining the scope of application, for each startup is possible to identify its main functionality. The functionalities which appear on the database are the following:

- *Fleet management*: technologies and solutions that helps companies to have a better use and control of their vehicles. The possibility to have more information on fuel consumption or how vehicles are used, give the possibility to reduce costs and simplify company tasks.

- *Cyber security*: In a modern context where digital devices have a relevant role in the car and in the mobility, the protection against phenomenon like hacking is crucial.

- *Autonomous driving*: New technologies that partially or totally reduce the tasks of the driver.

- *Sharing*: All the systems and services that provide the sharing mobility in its various ways.

- *Infotainment:* Set of functions available on the car for driver and passengers to enhance the driving experience and to provide useful information.

- *Private transport*: new ways to handle the personal mobility. This is done through new categories of means for private transportation or through new services supported by new technologies.

- *Safety*: Technologies and systems that help to improve the level of safety on the cars and on the streets. The aim is to reduce number of accidents and crashes by preventing potentially dangerous situations.

- *Driving style monitoring*: Functions that can detect eventual conditions of the driver that could affect driving capabilities or particular conditions in the road and in the surrounding environment.
- *Parking management*: Solutions and technologies that try to solve parking issues. Technologies that automatically perform the parking of the car or the ones that are able to spot where to park in the proximity. There are also systems that can manage the parking finding and payment automatically in the urban areas.

- *Public transport*: All the solutions that provide a better effectiveness of the public transport modalities. Enhancing public transport capabilities with the aim to increase the number of users of them is a way to reduce mobility issues especially in urban areas.

- *Smart insurance*: Devices on the vehicle that affect smart insurance services. Data provided by them are very useful to these services providers and for the car owners. In this way is possible to have tailor made insurance services for each driver and, eventually, to reduce the costs related to them.

- *Electric mobility*: Solutions that support the electrification process of the mobility. It is not just about production of electric vehicles, but also providing technologies and systems that support them. New system of charging which are faster or systems that manage the charging operations according to driver's needs and that connect also with other subjects like the energy suppliers.

- *Assistance service*: Services supported by some technologies that helps vehicle owners in different situations. There are services which address: the maintenance of the vehicle, fixing eventual problems, payment services, vehicle condition evaluations for selling purposes, etc.

- *Mobility-as-a-service (MaaS)*: The goal is to provide an integrated service to users that have to do a journey. The technologies, systems and software provided allow the user to manage the journey in more simplified way, especially in the case when the trip requires different transportation modes and to manage different payments in a single time.

- *Traffic management*: Technologies that support traffic monitoring and help to solve issues like traffic congestions or other critical situations that affect traffic viability.

- *Data analysis*: Tools that provide a relevant amount of useful data deriving from vehicles to various subjects like: manufacturers, other vehicles, public authorities,

public transport service providers and many others. All this information can be very useful, leading to better future products which are more personalized for the customers needs, better mobility services and a more effective management of traffic issues in urban areas for example.

- *Last mile delivery*: Solutions that deals with logistic issues. The focus is to solve the problems and enhance the level of services connected to the delivery of merchandise from the nearest company hub till the point of destination. This means to act on the last passage of the logistic network of the firms.

3)FINANCIAL INFORMATION

For each company belonging to the sample analyzed, several data have been collected about the financing raised. This information plays a relevant role in the analysis that will be explained in the next sections. The funding data have been collected in the following columns:

- **Total funding received**
  It is the overall amount of fundings obtained for each startup in all the years considered.

- **Funding per Year**
  It represents the funding received by the startup in a single year. This is done for all the years considered.

- **Last 3 years funding**
  It represents the total amount of fundings in the last three years: 2020, 2021 and 2022.

- **Typology of the last funding round**
  This is the classification of the last funding round received by the startup.

- **Main investor**
  The name of the principal investor is reported.
- **Revenues and Revenues range**
  These two columns illustrate the level of the revenues, and in which range they belong.

4) INFORMATION REGARDING EVENTUAL ACQUISITION

Some of the startups listed in the database may or may not be acquired by an external entity. If the answer is yes, then some other related information is reported in the following columns.

- **Acquired or not acquired?**
  This column gives information about the company regarding eventual acquisition. If the startup has been acquired, the following columns provide further data about the acquisition.

- **Year of acquisition**
  It is the year in which the company has been acquired by an external entity.

- **Name of the buyer**
  Reports the name of the company that acquired the startup.

- **Value of the acquisition**
  It represents the value of the transaction for the acquisition of the company.

5)RELATION WITH CUSTOMERS AND TYPOLOGY OF THE OFFER

The last two columns illustrate the target category of customers of each startup and the typology of the offering.

- **Relation with the customer**
  This represents what kind of relation is between the company and customers. It defines which type of customers the company have.

- **Typology of the offer**
  This last column identifies what company is offering to its clients. This is expressed in terms of hardware offering or software offering or service offering and the various combination of them.

3.2 Database Content

After defining the database structure, in this section there will be a detailed description of its content. The main features and characteristics will be highlighted. The purpose is to have a picture of the current state of the art and to understand the relevance of startups in the Smart Mobility and Connected Cars industries.

The total number of startups listed is 556. The startups added to the list of the database have to respect a criterion. This criterion consists of two conditions and at least one of them should be respected. First, the startup foundation date should be in the last four years, starting from 2019 included. The other condition, which also regards the companies which were not founded recently, is to have at least one funding round in the last four years.

This is done in order to have a clear picture of the current scenario.

The description of the database content in the following part will consider different perspectives: temporal distribution, geographical distribution, functionalities, relation with customers and typology of the offer.

Starting from a temporal perspective, it is interesting to look at the distribution of the foundation dates of the startups.

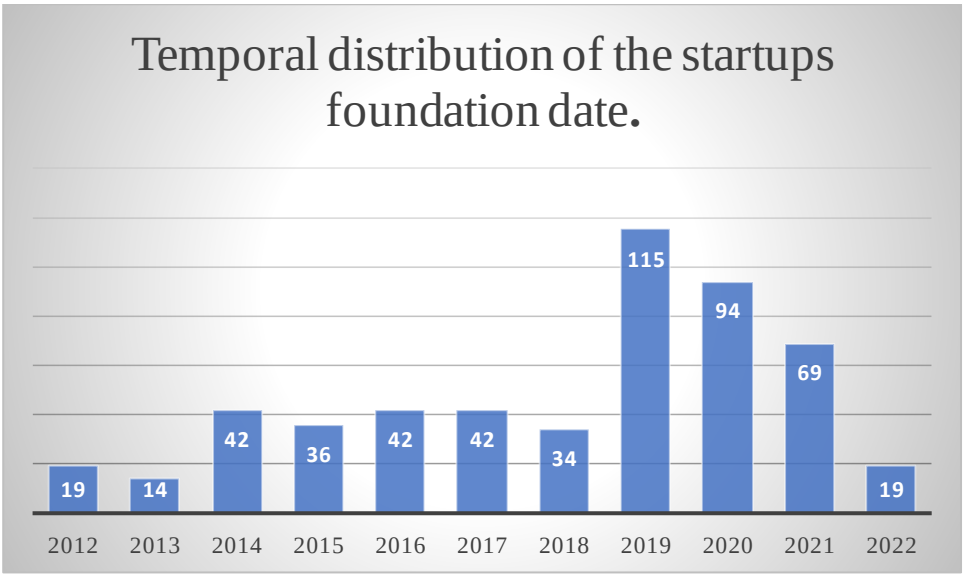


Figure 3: Temporal Distribution of the Database Startups Foundation Date

The proposed graph in figure 3 illustrates the number of startups founded for each year in the last decade. There are also startups founded earlier, but they represent a very small part of the total amount. This graph offers an idea of the evolution across the time.

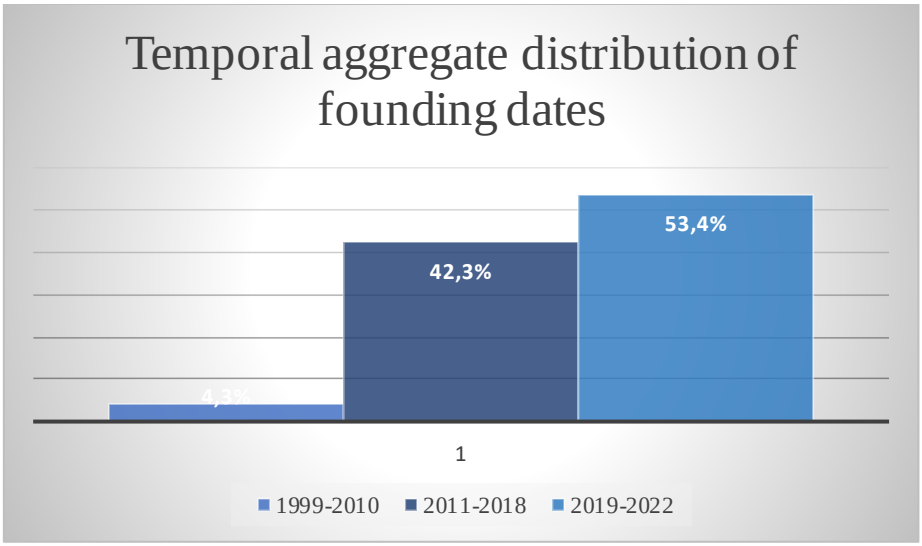


Figure 4: Temporal Clusters of Aggregation of the Foundation Dates regarding Database Startups

The evolution across the time is well explained trough the aggregate perspective in the above graph in figure 4. The majority of startups have been founded after 2010. Therefore, the last decade is very relevant and, in particular, the last four years: 2019,2020,2021 and 2022. This means that the maturity level in smart mobility and connected car industry is not so high. When the level of maturity is not complete, startups play a fundamental role by proposing innovative solutions which are going to set the future standards.

Another interesting point of view is to look at the geographical distribution of the startups on the list. First of all, is possible to see which continents are more involved.

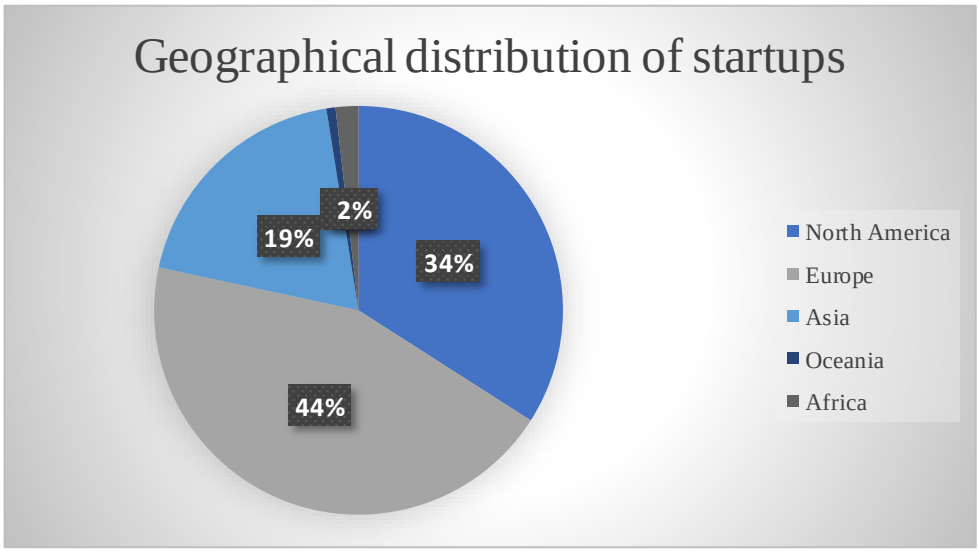


Figure 5: Startups Distribution among the different Continents

The graph in figure 5 underlines that the major percentage of the startups on the database are European and also located in the North America. There is also a significant percentage of them in Asia, while the other parts of the world are not so relevant. South America, for example, is not even on the graph.

Going more in depth, is useful to get a country perspective. The next graph in figure 6 provides information on the level of involvement in the different nations.

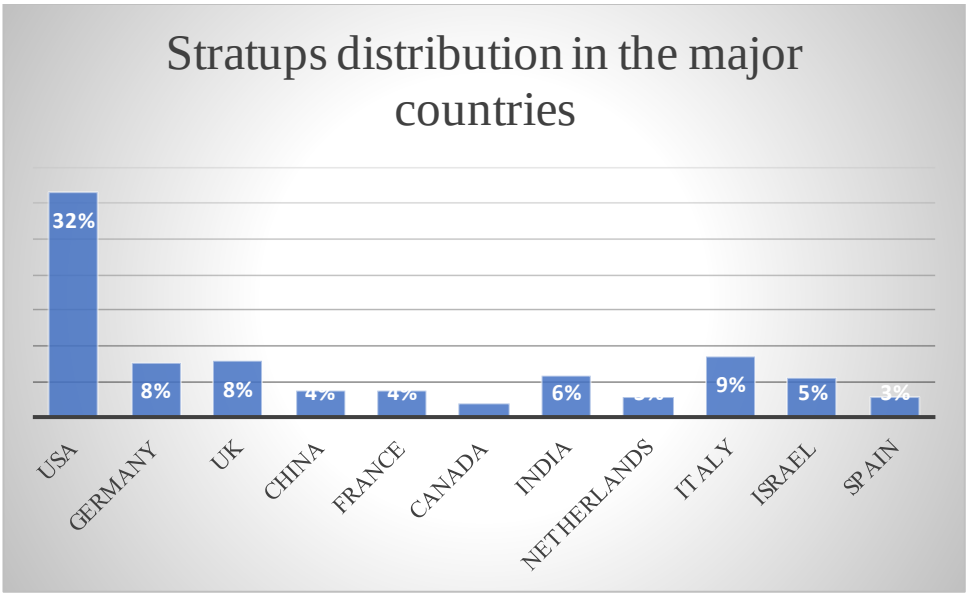


Figure 6: Startups Distribution among the Major Countries

USA is the country more involved in a significant way. This is not a surprise, since the U.S. always had a leading role in innovation, especially regarding the technological sectors. Smart cars and smart mobility sectors imply to deal with a sophisticated level of technology. In the United States is easier to find financing, infrastructures, expertise of the workers and institutions like the universities who supports the research in this kind of innovations [14]. Furthermore, the proximity to a large market is something to consider. This allows the possibility to test the new: products, services and technologies and get key insights from the customers.

Among the various successful USA startups there is the following example Motor Q.

MOTOR Q

Foundation date: 2016

HQ Location: Saratoga, California, USA

Website: https://motorq.com/

Description: Motor Q provides a software able to collect and analyze data from the connected vehicles. These data are then delivered to various subjects like: private companies with fleets of vehicles to manage, insurance companies and public administrations.

Scope of application: Smart Car

Functionality: Data analysis

Total funding amount: $49.000.000

Funding in the last 3 years: $47.000.000

Last funding round: $40.000.000

Year of the last funding round: 2022

Last funding round type: Series B

Revenues: $1M-$10M

Acquired: No

Target Customers: B2B

Typology of the offer: Software offering

However, USA is not the only one dealing in the industries of smart mobility and connected car. The graph shows also the relevant presence of startups in European and in Asian countries, especially in China and India.

Moving into a European perspective, it is interesting to look at the current scenario presented in the graph in figure 7.

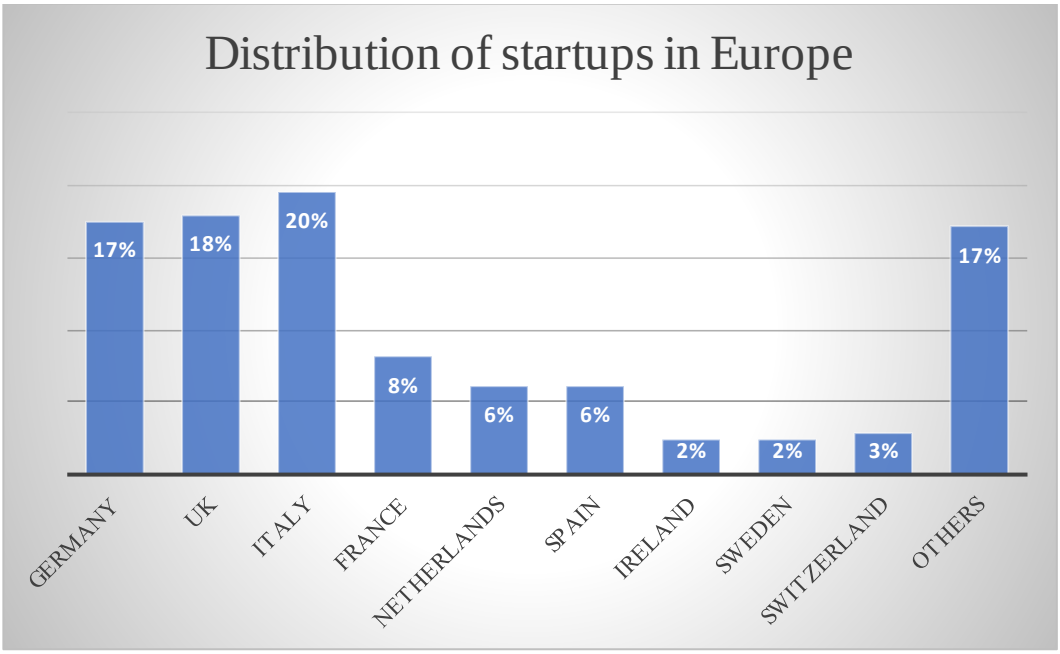


Figure 7: Distribution of Startups among the major European Countries

According to the data provided by the database: Germany, UK, France and Italy are the most involved. Italy has the highest percentage in Europe, but this result needs some explanation. Since this work of research is done by an Italian perspective, it is reasonable to expect a relevant focus on the startups within our country in order to understand the focus and the number of initiatives in Italy. It is also easier to gather information on the Italian startups operating in the smart Mobility and Smart Car ecosystem. The following example Reefilla is an interesting Italian startup which addresses one of the electric vehicles typical issues: the autonomy of the battery.

Reefilla

Foundation date: 2021

HQ Location: Turin, Italy

Website: https://www.reefilla.com/

Description: Reefilla provides a charging delivery service for electric vehicles. Through the use of app and a software the vehicle can automatically require a recharge whenever is needed. After the request, in a short time, a van endowed with a battery will arrive at the place and perform the recharge on the customer's vehicle.

Scope of application: Smart Car

Functionality: Electric Mobility

Total funding amount: $1.000.000

Funding in the last 3 years: $1.000.000

Last funding round: $1.000.000

Year of the last funding round: 2022

Last funding round type: Pre-Seed

Revenues: n.a.

Acquired: No

Target Customers: B2C

Typology of the offer: Software offering and Service Offering

Moving to a more technical perspective, the next graph gives a picture of the composition of the database according to the different functionalities. First of all, is relevant to show the composition in terms of scope of application. The database shows a majority of Smart Mobility startups (62%) respect the Smart car ones (38%). Anyway, as already mentioned in the introduction chapters, the functionalities can be the same for both, in some of the cases. Therefore, the composition of the database will be illustrated in terms functionalities without the distinction between "Smart Mobility" and "Smart Car".

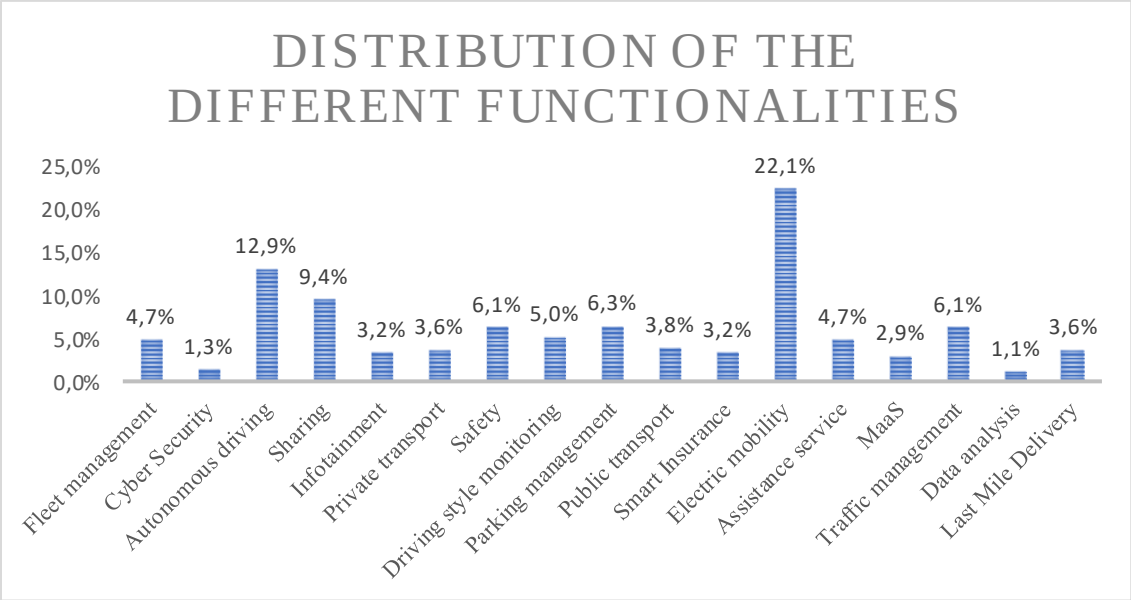


Figure 8: Distribution of the different Functionalities of the Database Startups

The above graph in figure 8 shows a major percentage of the functionality related to the "Electric mobility". During the last years, the transition towards an electrified mobility has become crucial for sustainability issues. Furthermore, the legal framework is now changing and, in the future, in many countries, the production of new vehicles will be restricted only to the electric ones. The sales of the electric vehicles have increased year after year. The biggest markets for them in the last years have been China and Europe [15]. The graph provided by the ICCT Website presented in figure 9 illustrates the amount of sales and their trend in the last decade.

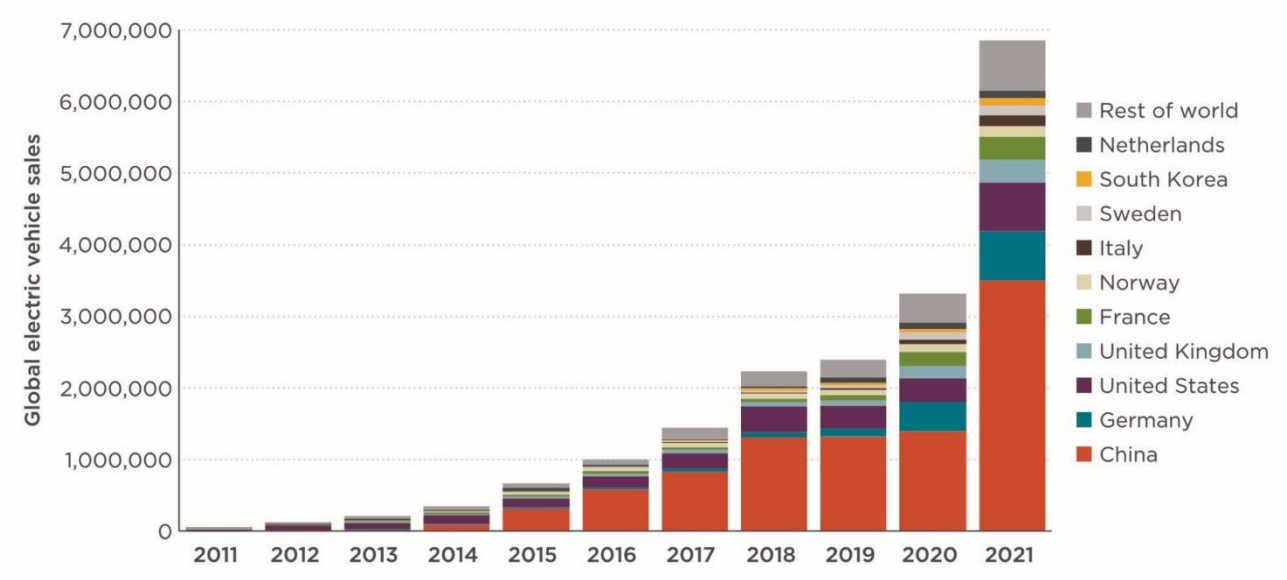


Figure 9: Global Electric Vehicle Sales Evolution from 2011 to 2021 by The International Council on Clean Transportation Website

Therefore, this relevant presence of startups related to the electric mobility is not a surprise. Some of them are directly involved in the manufacturing of electric vehicles, other ones in the development of more efficient batteries or in the development of the recharging infrastructures. Furthermore, in recent years, according to the database sample, some new initiatives are linking the connectivity potential with electrification purposes, in order to simplify the adoption of this kind of vehicles.

Autonomous driving is also object of great interest. The driving technology in the cars, nowadays, is gradually reducing the responsibility of the driver on board. Therefore, the direction is to move to new vehicles able to perform everything autonomously. The shared mobility is the third relevant voice. Shared mobility platforms are already widely spread in the urban areas. Several startups are offering the service itself, while other ones are helping these providers to improve their services.

The startups involved in the other functionalities are less, but still relevant. They will be discussed better in the next chapter by looking also at the data related to the fundings.

The next step is then to understand the composition of the database in terms of the relation between each startup and its clients. The classification identifies the typology of customer addressed by the offering of the company.

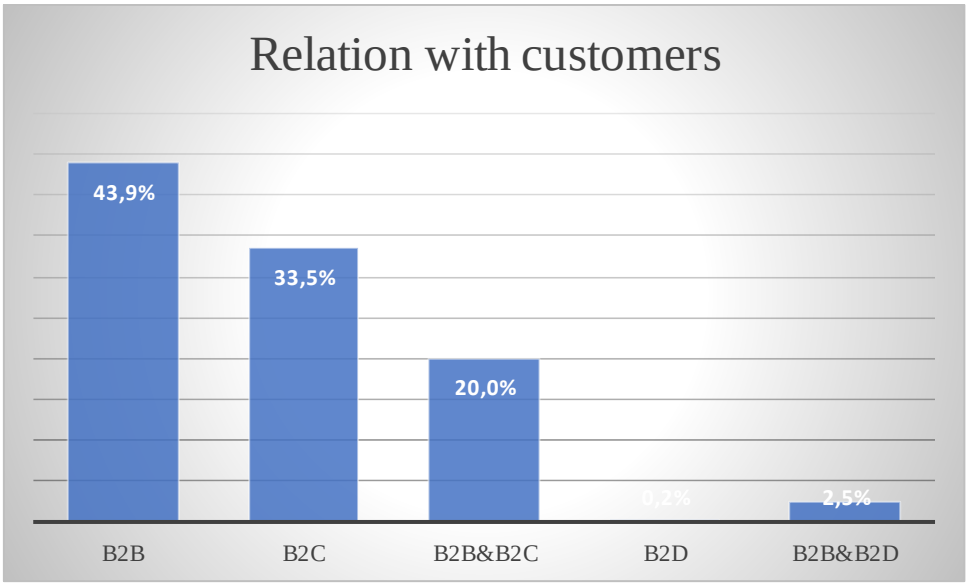


Figure 10: Distribution of Database Startups according to the Customer Target

The graph in figure 10 shows that the majority of the startups on the list are addressing business clients. The focus of these companies is mainly to operate with other businesses like established players of the automotive or for example the public administrations. Typically, these kinds of startups offer technological solutions or services to improve products realized by other players or to help to improve services offered to the final customers.

There is also a significant percentage of B2C companies which directly serve final customers. They are typically firms that provide a complete product or a service by addressing directly final customers needs. B2B&B2C relations are also significant. There are companies that can serve both private customers and both business ones. The others kind of relations are less relevant in the composition of the database.

The following example Netradyne is a B2B startup.

Netradyne

Year of foundation: 2015

HQ Location: San Diego, California, USA.

Website: https://www.netradyne.com/

Description: Netradyne provides an hardware device based on AI algorithms which is able to identify and understand the driving style of the driver and, therefore, can prevent potential dangerous situations and accidents.

Scope of application: Smart Car

Functionality: Safety

Total funding amount: $197.500.000

Funding in the last 3 years: $150.000.000

Last funding round: $150.000.000

Year of the last funding round: 2020

Last funding round type: Series C

Revenues: $50M - $100M

Acquired: No

Target Customers: B2B

Typology of the offer: HW offering, SW offering and Service Offering

An example of a company, instead, that is dealing with private and business customers is the following:

Charge4Go

Foundation date: 2020

HQ Location: Sweden

Website: https://www.charge4go.com

Description: Charge4Go has developed an app which manages the recharge of electric vehicles, dealing with different operators. During a trip is possible to find all the charging stations in the path. The app offers the possibility to the users to look at the different offers at the recharging stations by comparing, for example, the prices of the electric energy among the different operators.

Scope of application: Smart Mobility

Functionality: Electric Mobility

Total funding amount: n.a.

Funding in the last 3 years: n.a.

Last funding round: n.a

Year of the last funding round: n.a

Last funding round type: n.a

Revenues: No

Target Customers: B2B&B2C

Typology of the offer: Software Offering

The last graph of this chapter in figure 11 provides information on the composition in terms of typology of the offer.

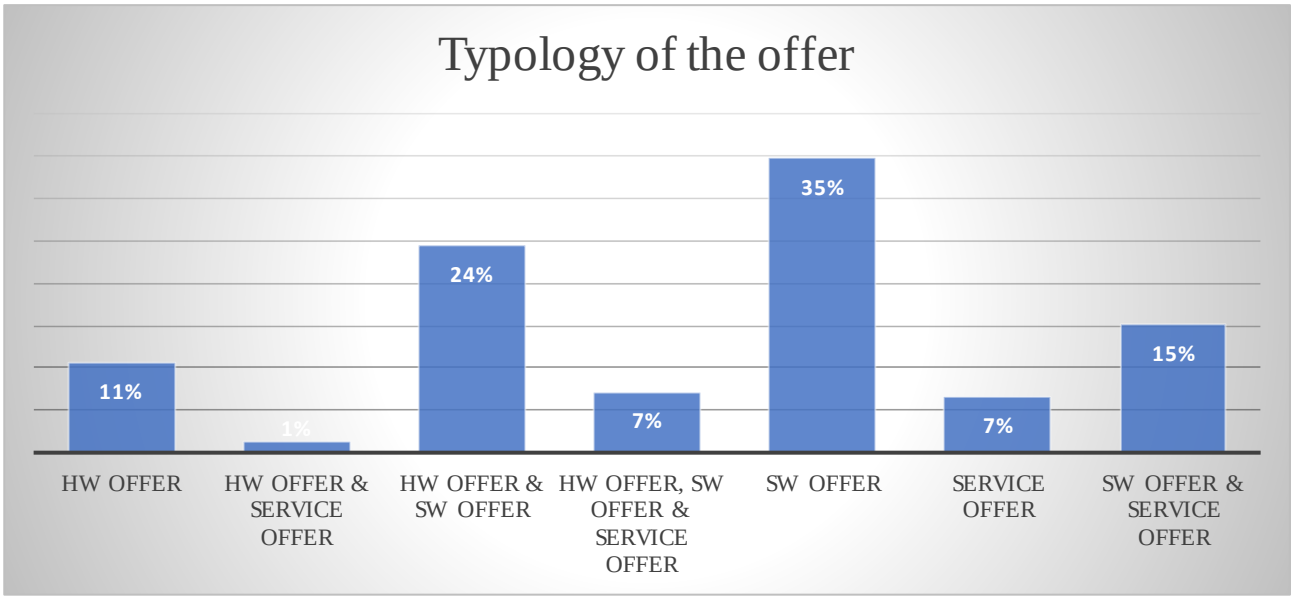


Figure 11: Distribution of Database Startups according to the Typology of the Offering

It is easy to see a prevalence of startups providing purely software (SW) products. There are also companies with a more composed offering like both software and a related service or both software and hardware together. The relevant presence of the software component in the offering is due to the great necessity to collect useful data in order to develop algorithms which are the basis of the new services and new technological solutions.

An useful example is a startup like No traffic, which provides an hardware and software offering.

No Traffic

Foundation year: 2017

HQ Location: Tel Aviv, Israel

Website: https://www.notraffic.tech/

Description: No Traffic has developed an artificial intelligence platform for the traffic management. In particular, this platform optimizes the traffic lights functioning thanks to several sensors. The AI platform is able to identify and track all the vehicles or pedestrians around. Thanks to this information the system is able to manage the colour shifting of the traffic lights. The results are a traffic optimization and also the preventing of dangerous situations.

Scope of application: Smart Mobility

Functionality: Traffic management

Total funding amount: $25.650.000

Funding in the last 3 years: $17.500.000

Last funding round: $17.500.000

Year of the last funding round: 2021

Last funding round type: Series A

Revenues: $1M - $10M

Acquired: No

Target Customers: B2B&B2D

Typology of the offer: Software Offering and Hardware Offering

3.3 Industrial trends

This section is dedicated to deepen the analysis on the database content by adopting a financial and a temporal perspective.

The fundings received by the startups are the main object of the analysis and, also, their evolution across the time. This kind of analysis helps to understand which are the main trends within the industry. Like in the previous chapter there will be illustrated some graphs and examples picked from the database in order to explain better the analysis done.

The starting point is the funding across the time. It will help to quantify the role of startups in the Smart Mobility and Smart Car industries in the last years.

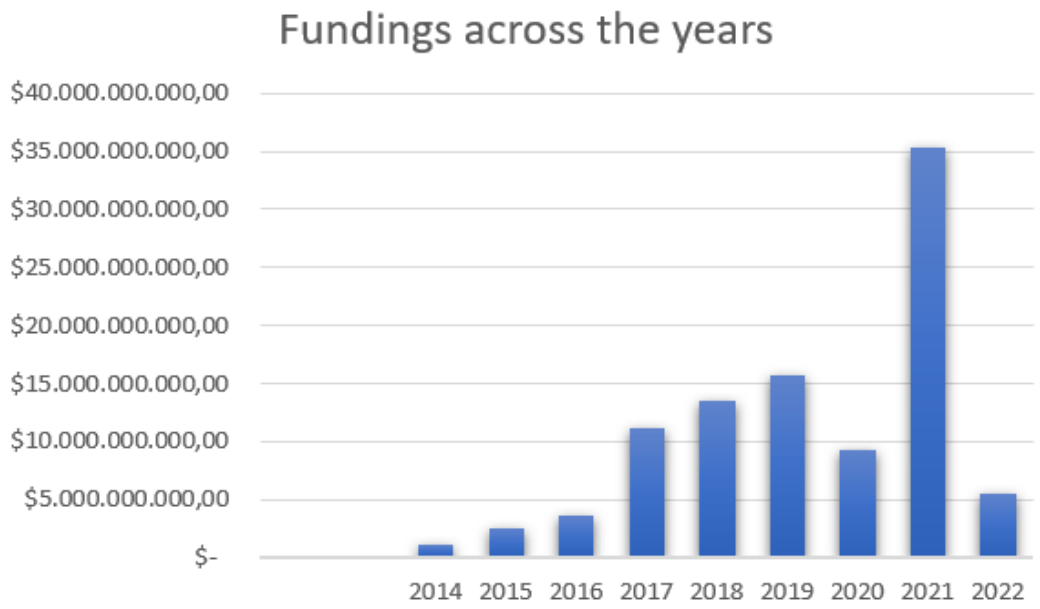


Figure 12: Evolution of the Startup Fundings across the year

The above graph in figure 12 shows a clear growth path across the years regarding the level of fundings raised by the startups, reaching the top in 2021. The relatively low value of 2022 can be explained by the fact that the database building was done mainly in the middle of 2022 and therefore, it may not have considered all the months, so there could be some missing funding rounds. The results of 2020 need also to be clarified. Startups during the Covid-19 pandemic had to face significant challenges as they were more vulnerable to the risks connected to the Corona Virus outbreak than mature incumbents. Smaller organizations like startups are strongly relying on external financing. In that period the access to financing was more constrained. Furthermore, the economic and political uncertainty reduced in many sectors the revenue streams. All these

conditions brought startups into a fragile financial position in meeting their short-term liquidity needs [16].

Moving back to the graph of figure 12, the growth in the amount of fundings represents an increased level of interest and trust by the investors. The funds received in the last three years (2020-2022) are the half of the total funds raised in all the years considered in the above graph. This is related also to the growth trend of the number of startups founded across the years, presented in the previous chapter in figure 4, which highlighted an increasing trend in the last four years. New startups founded means, of course, an increase in the total funding amount.

Moving into a geographical perspective, the next graph in figure 13 describes the level of fundings in the different continents.

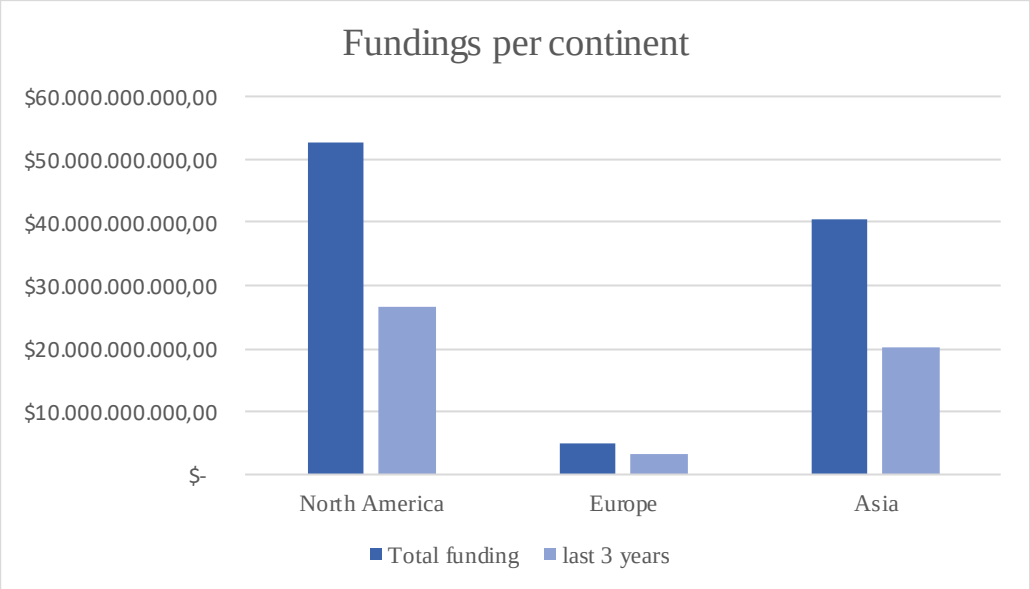


Figure 13: Total amount and Last Three Years amount of fundings in the major Continents

In the graph in figure 13 are just reported the three main continents involved. Africa and Oceania do not have a significant amount of fundings. The graph illustrates also that approximately half of the fundings have been raised in the last three years.

North America and Asia have the highest funding level, even if Europe, as mentioned in the previous chapter, has the highest number of startups. In order to have a better comparison among the different continents it is useful to see which are the level of average fundings by dividing the total funds received with the number of startups of each continent.

The next graph in figure 14 presents the average funding in each continent and the average funding in the last three years.

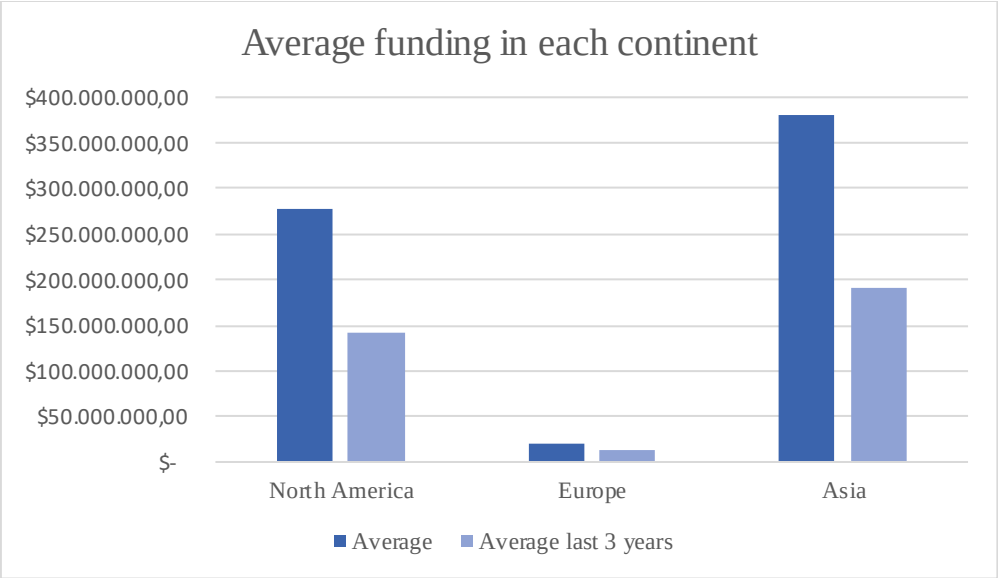


Figure 14: Average funding and Average Last Three Years funding in each Continent

The situation in figure 14 has changed respect the previous graph of figure 13. Asia is the first in the average funding perspective. The Asian startups listed in the database have typically an high financing and in some cases it is really high. Asian countries are always more engaged in the development of smart city projects. The urbanisation trend is moving fast, especially in Asia. Therefore, the need to improve the quality of life in the big urban areas is becoming a priority. China, India and South-East Asian countries like Singapore are already developing their major cities. Shanghai and Singapore, for example, are already cutting-edge projects. In this context, improving the mobility within urban areas as part of the process of cities modernization is crucial. Furthermore, governments and public authorities are strongly financing these projects which are really expensive [17].

The next graphs will take a country perspective in order to deepen the geographical analysis.

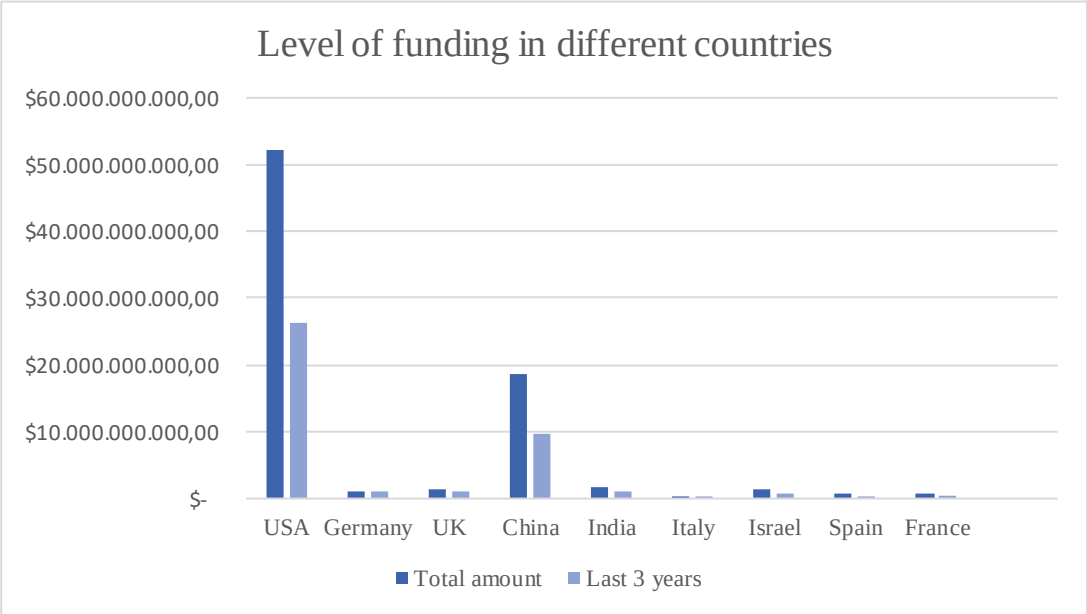


Figure 15: Total Funding amount and Last Three Years amount in the major Countries

The countries listed in the above graph of figure 15 are the ones which have a significant presence of startups inside of them. It is easy to see that in USA and China the total level of startups funding is significantly higher than the ones of other countries. These results are clearly linked to the previous ones presented in the graphs with a geographical continent perspective.

The evolution of the funding rounds across the time reflects an increasing trend in the financing in the last three years.

European startups are significantly behind North America and Asian countries. In particular, Italy has a very low level of financing despite a significant number of Italian startups inside the database. However, in the last years something has become to change. According to the Italian Venture Capital Observatory, in the last two years there was an increase of 48% in the financing towards Italian startups. The report of the observatory also declares that behind this growth there is an increase in the amount of foreign fundings. The sector most financed is the one related to the smart city in which the smart mobility and connected car industries play a fundamental role [18].

Therefore, in the future is possible to expect a positive trend regarding the Italian startups financing.

The European country which is performing better is the United Kingdom. In the database there is a huge presence of UK startups, and their total amount of financing is the higher in this geographical region. There are some reasons behind this placement. Despite some crucial events like Brexit and

the Covid pandemic, UK is still an excellent startup hub and the best tech ecosystem in Europe. The level of deals and related amount of money has grown in the last years reaching £19.1 billion in 2021 respect the £8.56 billion of 2020. In London, especially, startups can benefit from leading venture capital funds and very active angel investors [19].

Moving back to a more general point of view, the next graph in figure 16 is related to the average level of funding in the different countries.

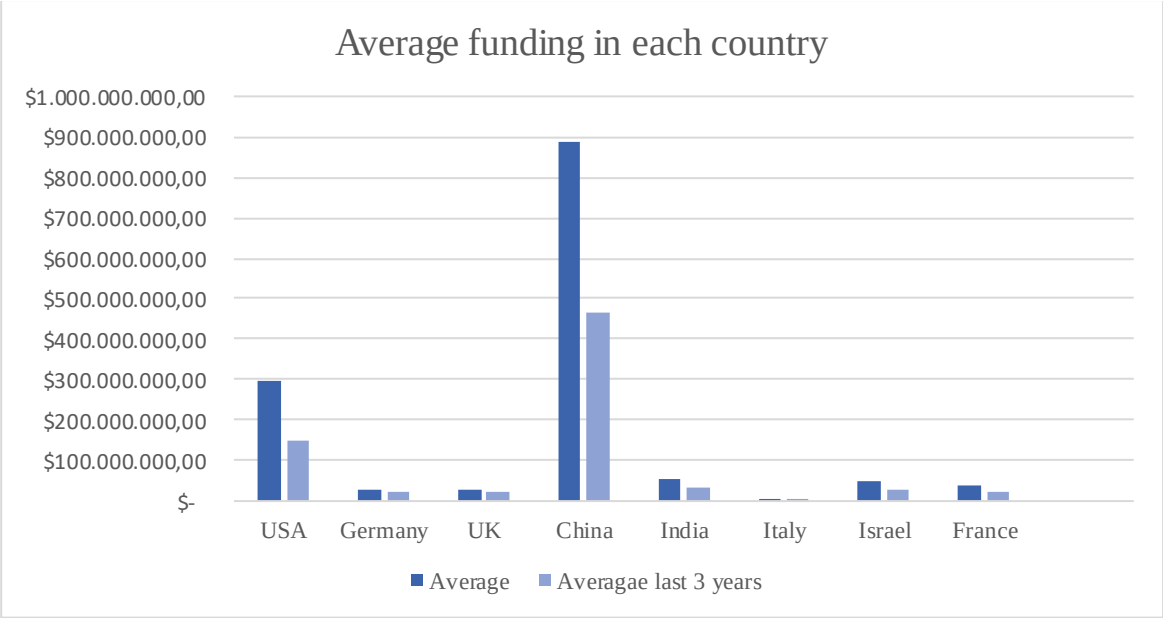


Figure 16: Average funding and Average Funding in the Last Three Years in the major Countries

Like in the previous case, related to the continent's perspective, there is a shift between USA and China. The latter has an higher level of average funding.

In order to describe better the situation in the East, the next graph in figure 17 is exclusively related to Asian countries by including also other nations with a lower number of startups in the database but with significant funding amount.

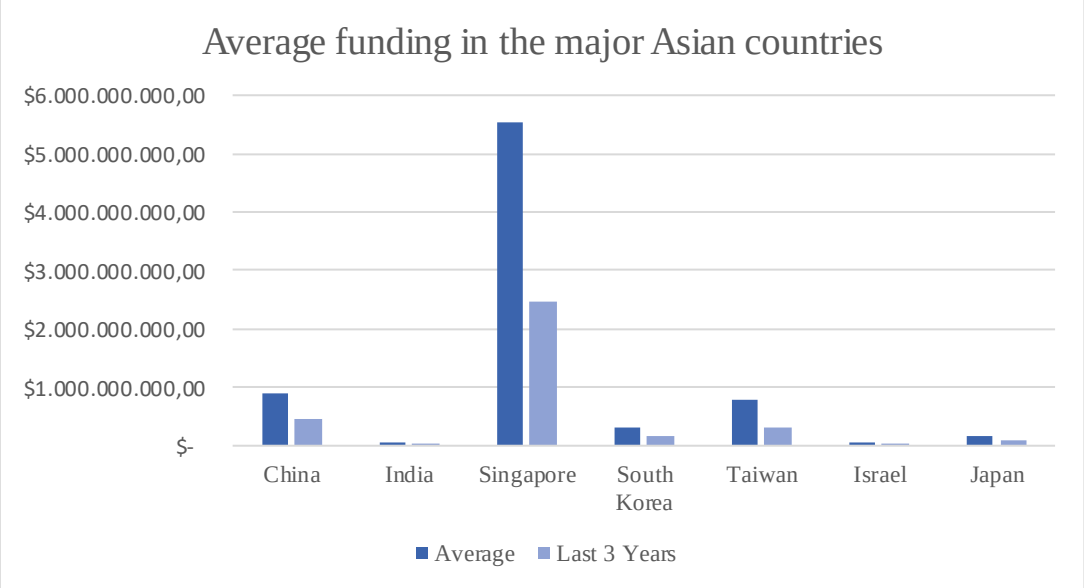


Figure 17: Average Funding and Last Three Years Average Funding in the major Asian Countries

The 42% of the Asian companies listed on the database have more than twenty million U.S. dollars of funding each.

The above graph in figure 17 shows a great amount of average funding in Singapore. As already mentioned, this country is strongly involved in the development of smart cities and, therefore, in the development of topics linked to this research. There is also to highlight the high level of average funding in Taiwan and South Korea. Like in the case of Singapore, these south-east Asian countries are putting a great effort, thanks also to the local governments, in the Smart Mobility and Connected Car sectors.

The next point is related to the functionalities and the related fundings received.

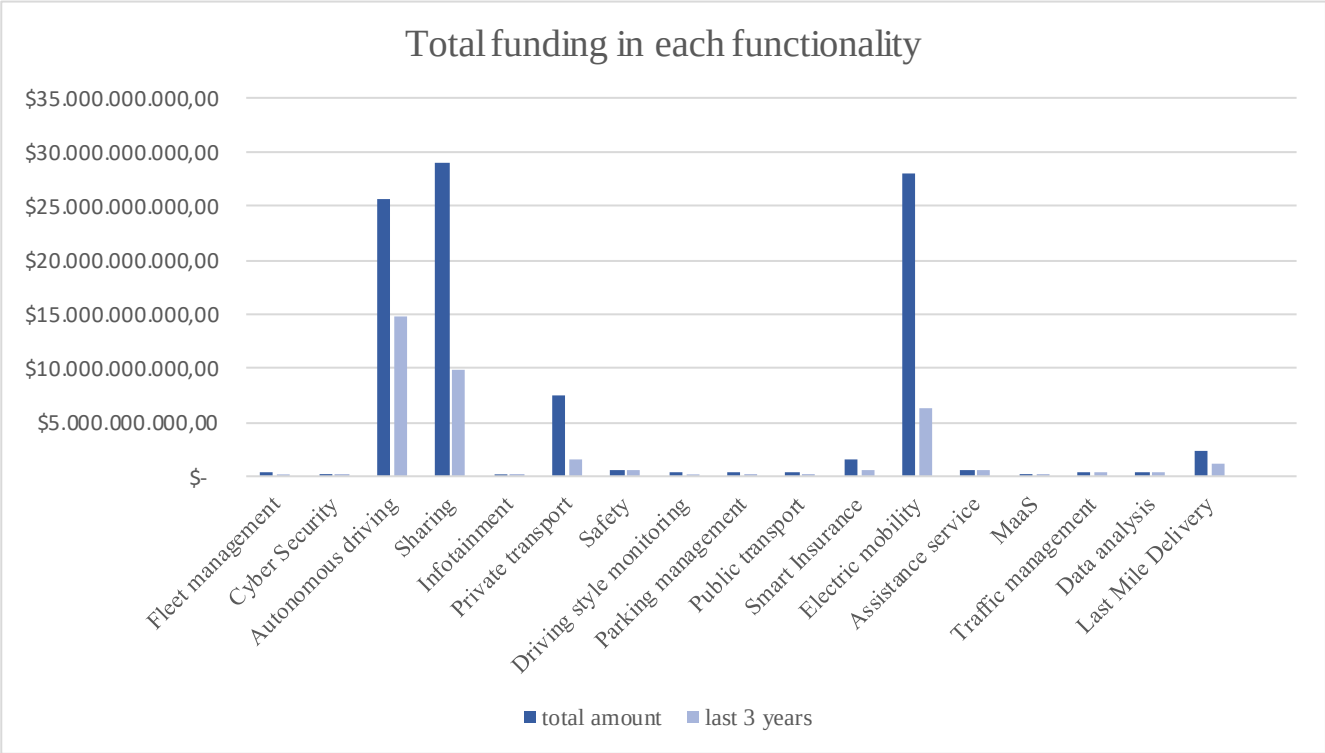


Figure 18: Total funding and Last Three Years Funding in each one of the startups Functionalities

Coherently with the results of the previous chapter, the: “Electric Mobility”,” Sharing” and ”Autonomous Driving” are the most financed as it is possible to see from the graph in figure 18. This is related to the great number of startups on the database related to these functionalities. It is possible to observe that a large amount of fundings has been received before the last three years. Looking at the “Electric mobility” and “Sharing” functionalities for example, a large proportion of their funds collected is not referred to the last years. The trend towards a more sustainable mobility is very marked due to recent updates in the legal framework related to the pollution, pushing automotive players to reduce and then, in the future, completely eliminate the production of fossil fuel cars in favour of the one of electric vehicles. The European parliament, for example, had already taken the decision to ban the selling of fossil fuel vehicles by 2035 for cars and light commercial vehicles [20]. Therefore, it is not a surprise that a lot of investment has been done already in order to move in this direction.

The Sharing mobility platforms are already a concrete reality in most of the urban areas, therefore the high financing already received is reasonable to understand. Anyway, it is expected a continuous growth in the future. The ownership of the vehicle is becoming less relevant and not efficient. Indeed, some studies highlighted that the percentage of time in which private vehicles are

unused is really high. This represents a great opportunity for the shared mobility market since a lot of people is expected to choose this kind of services for their travels [21] .

The field of the autonomous driving, as well, had great relevance in the recent years as it is possible to see in the above graph in figure 18. The trend illustrated is a clear growth in the level of investment in this kind of startups.

The next graph proposed in figure 19 illustrates the average funding in the different functionalities.

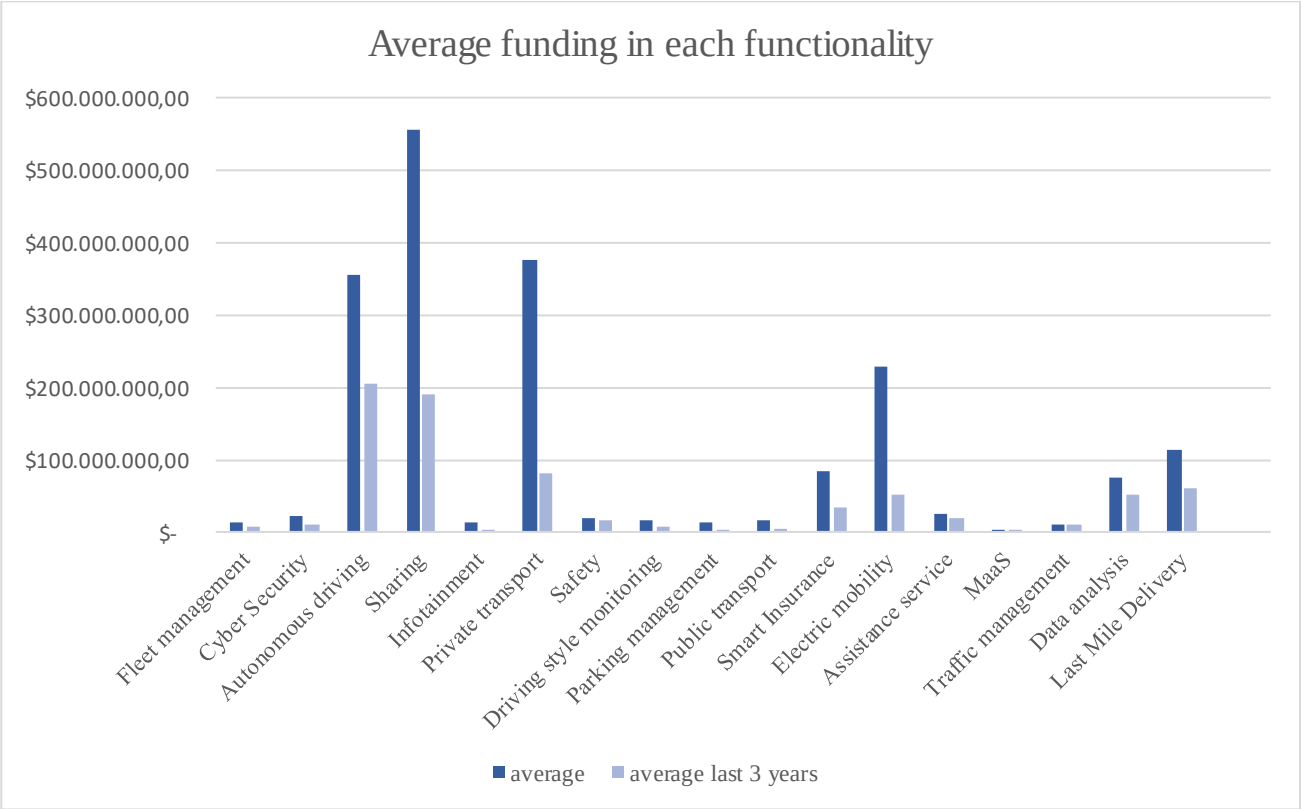


Figure 19: Average funding and Last Three Years Average Funding in each one of the Startups Functionalities

The above graph in figure 19 helps to have a better look also of the other functionalities in terms of funding. The functionalities with highest average financing are the highest ones illustrated also in the previous graph of figure 18. The difference is the lower position in the case of the “Electric Mobility”. The number of startups linked to this category is the highest one and the total amount of funding is close to the highest level. However, in the average funding perspective it has not the leading role. Another significant change is in the functionality related to the “Private Transport”. In this case, the change is in a positive way by showing a great amount of average funding level. This kind of startups are proposing new solutions for the private mobility by leveraging on new technologies to create innovative means of transportation. Among these solutions, there are

companies that are developing vehicles designed for the urban air-mobility. The following example Eve Air Mobility is one of those firms.

Eve Air Mobility

Foundation date: 2020

HQ Location: Fort Lauderdale, Florida, United States.

Website: https://eveairmobility.com/

Description: Eve Air Mobility are developing various solutions for the urban air mobility ecosystem. They are developing an electric vertical take-off and landing(VTOL) vehicle and an air traffic management solution. Their goal is to realize a safe and sustainable air transportation within urban areas.

Scope of application: Smart Mobility

Functionality: Private Transportation

Total funding amount: $372.000.000

Funding in the last 3 years: $372.000.000

Last funding round: $372.000.000

Year of the last funding round: 2022

Last funding round type: Post-IPO equity

Revenues: n.a.

Acquired: No

Target Customers: B2B

Typology of the offer: Hardware Offering, Software Offering and Service Offering

Moving to the other categories is possible to note from figure 19 a good level of average financing towards “Smart Insurance”, “Last Mile Delivery” and “Data Analysis” startups. The first two have collected a large proportion of their fundings before the last three years, while the startups connected to the data analysis are characterized by a growth trend in the latest years. The relevance of startups which collect and analyse great amounts of data, especially for third parties, is increasing. The rest of the functionalities have a lower amount of fundings. However, is possible to note some trends. The categories related to the “Traffic Management”, “Safety”, “Assistance Service”, “MaaS” and “Fleet Management” have a very positive growth trend in the financing received in the last three years. In particular, Mobility-as-a-service(MaaS) startups have raised most of their financing recently. This is related to the fact that most of them were effectively founded after the year 2019. The point is to overcome the concept of ownership of the vehicle by transforming completely the mobility in a service. The service should be an app through which the

user is able to organize the travel in different ways, in an integrated mode. This trend is affecting major cities in the world because of the many benefits that could challenge the current problems. Among them, there is the reduction of the vehicles in transit in the urban areas, therefore reducing traffic congestion and pollution derived from it. MaaS market is expected to grow rapidly in the next years and it will play a fundamental role in the future of the mobility [22].

An example of MaaS startup from the database is Mileus.

Mileus

Foundation date: 2019

HQ Location: London, England, United Kingdom.

Website: https://mileus.com/

Description: Mileus technology helps to improve the transportation effectiveness within the cities. The urban transportation apps which are integrated with Mileus platform are able to offer a full planification of the trip that the user needs to do. The advantage is that their technology is able to integrate different transportation modes like : public means, taxis, shared vehicles and etc. In this way, the user manages the trip in a single time, and he/she is able to evaluate different alternatives for the travel with a full information on the prices of them. The goal of the company is to become the reference platform for urban residents in all their movements.

Scope of application: Smart Mobility

Functionality: MaaS

Total funding amount: $556.600

Funding in the last 3 years: $556.600

Last funding round: $113.000

Year of the last funding round: 2021

Last funding round type: Pre-Seed

Revenues: n.a.

Acquired: No

Target Customers: B2B&B2C

Typology of the offer: Software Offering

Looking at the other functionalities in graph 19, some of them had a more steady growth across the time, like for example startups related to : “Cyber Security”, “Driving Style Monitoring”, “Public Transport”. The funds received in these cases are more balanced across the time.

The functionalities which are showing, according to the database, a slowdown in the level of financing in the last years are the ones connected to: “Parking Management” and “Infotainment”.

The next point is on the level of the funds received by startups according to their target customers.

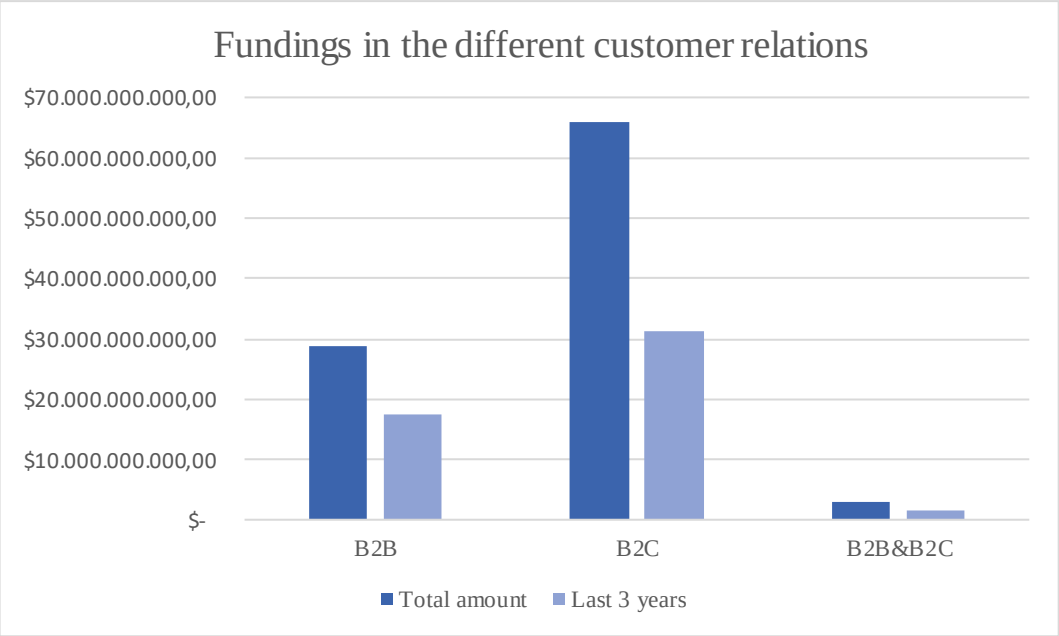


Figure 20: Total funding and Last Three Years funding according to the Customer Relation

According to the above graph in figure 20 is possible to note that the majority of funds are received by B2C startups. Despite B2B companies are more, in the database, than the B2C ones, this last category is raising more funds. Firms that are serving both private customers and both business ones have significantly lower funds. The other categories like for example B2B&B2D and B2D have little presence in the database and also very little level of financing.

Furthermore, is possible to observe a good level of financing in the last period. Half of the total funds, approximately, are related to the last three years in all the different customer relations.

The last point of the analysis related to the industrial trends is focused on the funding level in the different typologies of offering proposed by the various startups in the database.

According to the graph of figure 21, the category most financed is the one related to startups with an hardware offering. On the second place, service offering is relevant as well. This is interesting, since these two categories are represented by a limited number of startups(the first has the 11% and the second has the 7% of the total) respect the other ones. This means that the level of financing in the average perspective for each one of those firms is high.

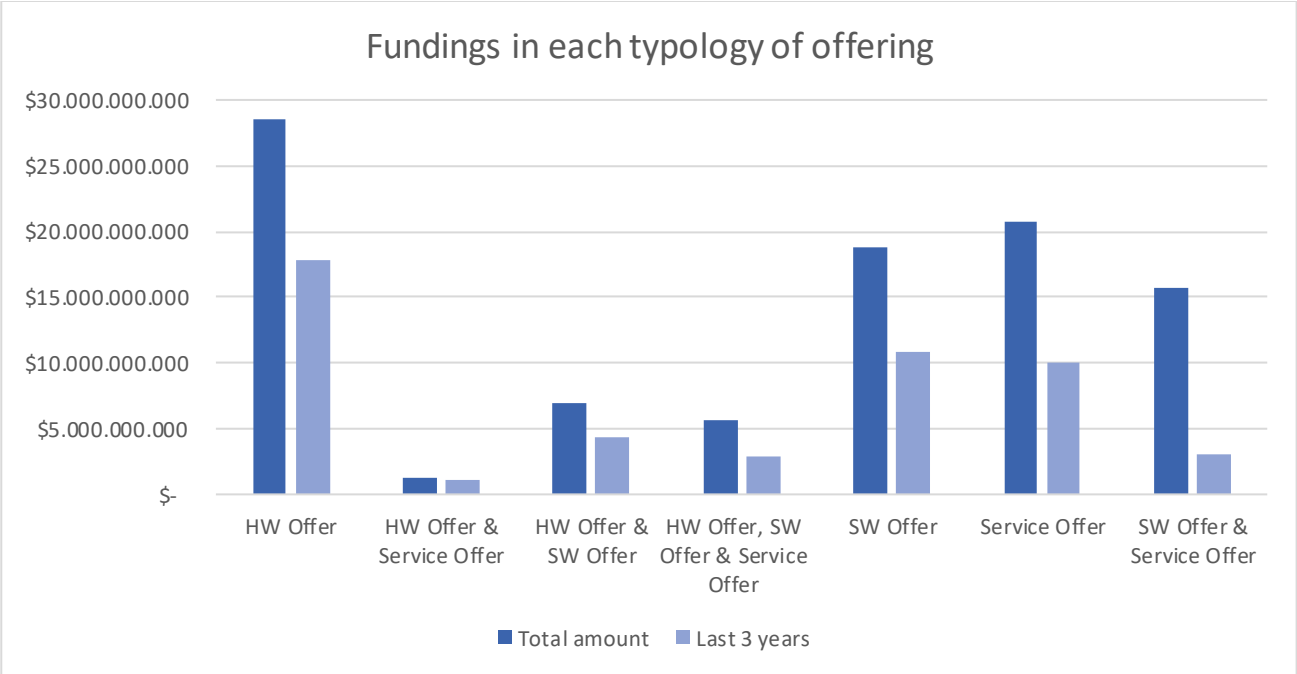


Figure 21: Total funding and Last Three Years Funding according to the Typology of The Offering

Always referring to the graph in figure 21, it is possible to note a significant level of funds raised by software offering firms. This is related to the fact that a great number of startups on the database list are proposing this kind of offer. It is also remarkable the financing received by the startups with an hybrid offer composed by both service and software offering.

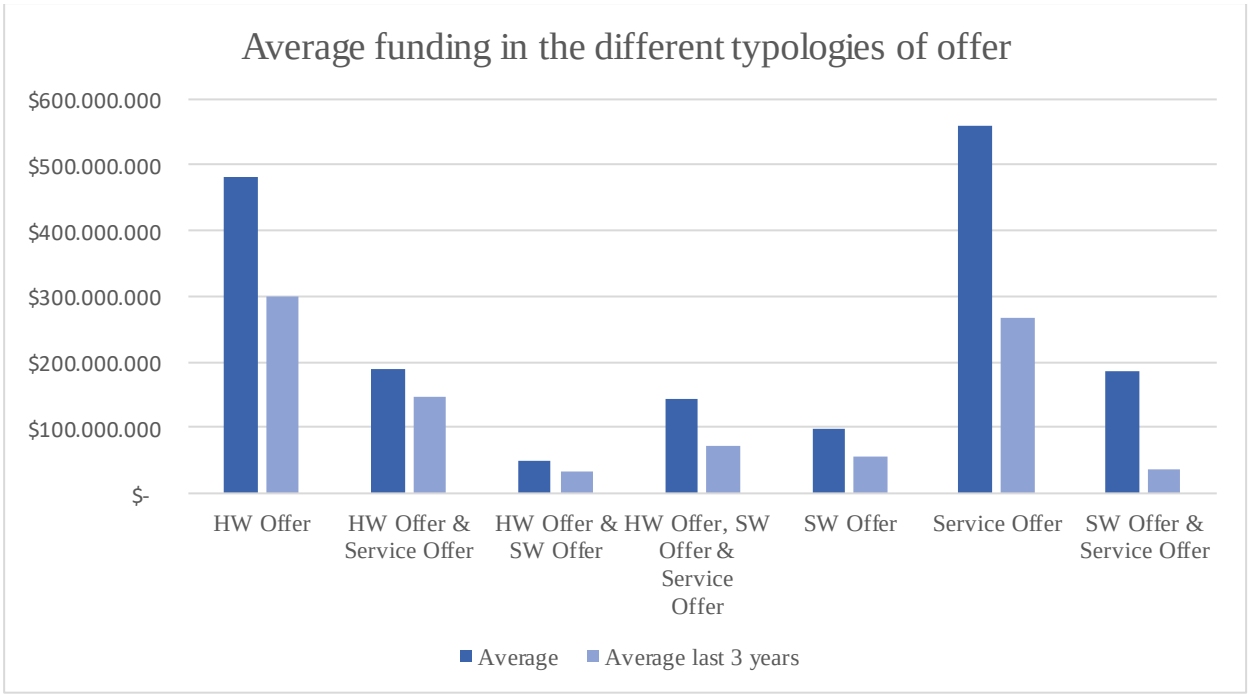


Figure 22: Average Funding and Last Three Years Average Funding according to the Typology of Offering

This second graph in figure 22 focused on the average financing is useful to deepen the observations done previously. The high average financing in hardware offering, and in service offering mentioned before is now visible clearly on the above graph, while the one related to the software offering is significantly reduced. The following case Metawave is a startup picked from the database with an hardware offering.

Metawave

Foundation date: 2017

HQ Location: Palo Alto, California, USA

Website: http://www.metawave.co/

Description: Metawave is developing advanced and complex radars in order to support the autonomous driving. These devices are able to perform 3D imaging and vehicle-to-vehicle communications. The goal of this technology is to make autonomous cars safer and more connected with the surrounding environment.

Scope of application: Smart Car

Functionality: Autonomous Driving

Total funding amount: $43.000.000

Funding in the last 3 years: $26.000.000

Last funding round: : $26.000.000

Year of the last funding round: 2022

Last funding round type: Debt financing

Revenues: $1M-$10M

Acquired: No

Target Customers: B2B

Typology of the offer: Hardware Offering

Another change is represented in the hardware offering and service offering combined, in the average financing, in a positive way.

Looking at the temporal perspective is possible to note a positive trend in the last three years in approximately all the categories listed in the above graph in figure 21. The majority of funds have been collected in these recent years. The category who presents a slowdown in the last years is related to the software offering and service offering combined which has raised most of its financing in the previous years.

4. Qualitative Framework: The User Data Valorization in the Startup Business Model Matrix

In the previous chapters the startups available on the database were analysed in different perspectives using an approach mostly quantitative. In this section the aim, is to deepen the analysis done by adopting a qualitative approach. In the following parts it will be illustrated a qualitative framework developed using a matrix composed by two dimensions.

The framework used has the final goal to classify the different companies according to some relevant characteristics of their business model. The results provided in the end will be able to answer to the second research question related to this thesis about the user data valorization strategies of the startups analysed.

The two dimensions chosen to build the matrix were selected in order to be suitable to all the startups listed. The number of companies and their functionalities are many, even if their main field of application is the same. Startups operating in the same field could be classified in different ways within the matrix developed. The framework is able to offer a valuable comparison among the different initiatives by managing a wide heterogeneity.

4.1 The Framework

The purpose of the framework is to provide a classification of the different approaches used by the different startups. In order to do that, a matrix obtained by the combination of two dimensions has been created. The first dimension considered is presented in the vertical axis and it is a defined as “Value Deliver”. The second one, on the horizontal axis, is the “User Data Valorization”.

For each dimension, there are two possibilities that will be detailed in the next two sections. The figure 23 shows the graphical representation of the matrix.

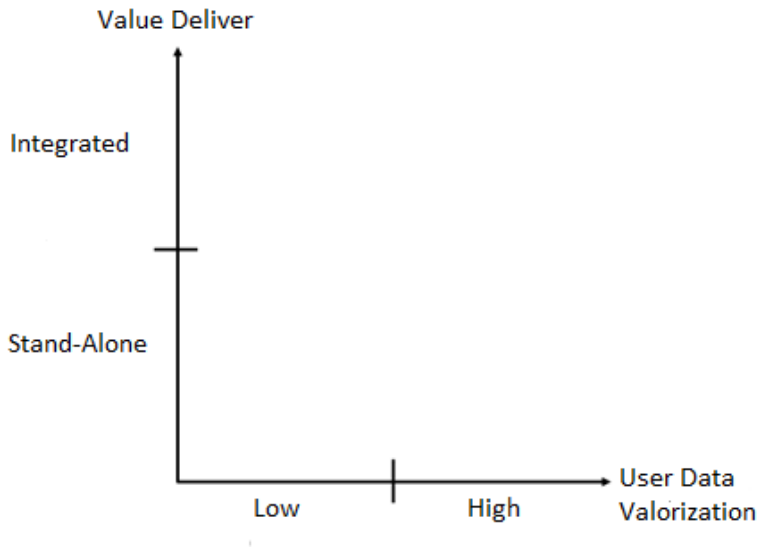


Figure 23: User Data Valorization in the Startup Business Model Framework

The result of the combinations between these two dimensions are four different quadrants. Every startup contained in the database will be assigned to one of those quadrants according to the criterion defined by the two matrix dimensions.

4.1.1 Value Deliver

The first dimension considered is the "Value Deliver". This is referred to how the startup is able to generate and deliver value to the user. There are two different ways to do that. The first approach is the "Stand-Alone" one. This means that the company solution is able to: create and deliver the value to the final user on its own. The solution proposed can be considered as a sort of closed system. Looking at the database, the startups with this approach are offering a product or a service directly to the user, without the collaboration with other systems.

The second approach is, instead, the "Integrated" one. In this case the firm solution needs to interact and collaborate with other subjects in order to reach the user. This kind of solutions are valuable for the user if only they are combined with other existing systems. In the following sections there will be some examples to explain better the implications of this dimension.

4.1.2 User Data Valorization

The second dimension, the one in the horizontal axis, is related to the "User Data Valorization". This term refers to the measurement of how much the firm is extracting value from the data derived from the user. The intent is to understand if the company considered is leveraging data from the users in order to develop the solution offered. In the matrix, the horizontal axis presents two possibilities: low user data valorization and high user data valorization.The first one is mostly related to the startups providing solutions in which the user data have little or none presence in the company strategy. In this sense, these startups are not leveraging information from their users in the development and delivery of their solution. There are, instead, startups in which the valorization of data from the users is crucial in their business model. The exploiting of these data is a necessary component of the solution. There are cases of startups dealing exclusively with user data by managing and analysing them. Their role is just to act as pure data management companies. They create revenue streams directly from the selling of this information to other subjects. An example are the startups which functionality was classified in the database as "Data analysis". The following example Continual is one of them.

Continual

Foundation date: 2010

HQ Location: Caesarea, Hefa, Israel

Website: https://continualexperience.com/

Description: Continual is gathering data from the connected smart vehicles. The focus of the company is to analyse the amount of information obtained on behalf of the connected vehicles manufacturers. The information which is then provided to them is valuable because it helps manufacturers to understand better final customer needs. Once they have knowledge of it, they may be able to offer products and services which are more suitable for their users.

Scope of application: Smart Car

Functionality: Data analysis

Total funding amount: $5.800.000

Funding in the last 3 years: n.a.

Last funding round: n.a.

Year of the last funding round: 2019

Last funding round type: Series B

Revenues: n.a.

Acquired: No

Target Customers: B2B

Typology of the offer: Software Offering

The company is a good example of taking advantage of the users data. There are also cases in which the valorization of these data does not create and immediate revenue stream. The strategies to take advantage from the user data are more “indirect”. The user data are valuable to create and develop the solution. There are products or services which have a strong link with the user data. Therefore, the role of the startup is to be able to leverage them in order to develop and improve their solution. In the following sections there will be some examples to explain better this type of cases.

4.2 Matrix Classification

Once defining the two dimensions of the matrix the next step is to present which are the four combinations generated by their intersections. Each quadrant obtained is one of the combinations. The next four sections will present and describe each one of them. There will be also some cases picked from the database in order to offer a more practical view of each quadrant. The figure 24 illustrates the results of the combinations of the two axes.

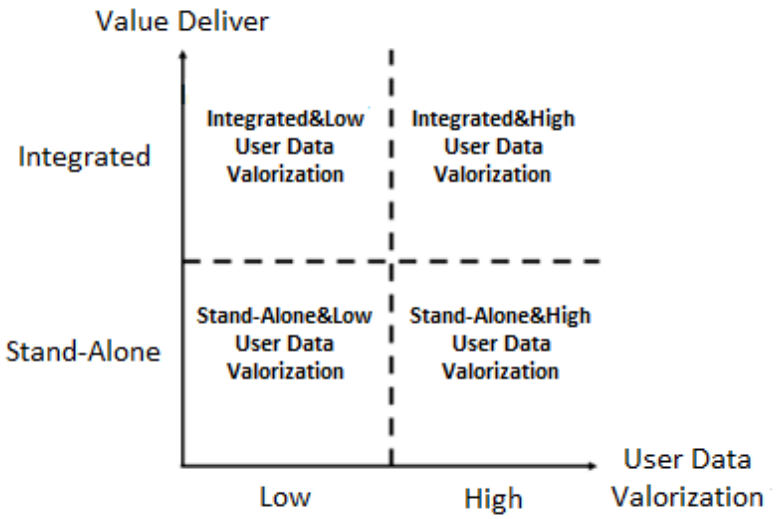


Figure 24: User Data Valorization in the Startup Business Model Matrix

4.2.1 Stand-Alone and Low User Data Valorization

The quadrant considered is the lower left one. The startups operating in this area are providing their own solutions without the involvement of other systems. Furthermore, startups of this quadrant are not pursuing user data valorization strategies. This is the case of firms that are offering a product or a service by focusing more on other aspects. By the observations done in the database the focus of these companies is typically on the technological side.

A significant percentage of startups whose function is “Electric Mobility” are in this quadrant. These companies are the ones dealing with the recharging systems for electric vehicles or the manufacturing of this kind of vehicles. An example of startup dealing with systems for the recharging of the electric bikes is the following.

Tiler

Foundation date: 2019

HQ Location: Delft, Zuid-Holland, The Netherlands

Website: http://tilercharge.com/

Description: Tiler is offering a wireless recharge system for e-bikes. The use of this solution is very simple. The customer needs only to place its e-bike on the charging spot. The system is able to inductively charge the bike trough the kickstand of it.

Scope of application: Smart Mobility

Functionality: Electric Mobility

Total funding amount: $1.600.000

Funding in the last 3 years: $1.000.000

Last funding round: $750.000

Year of the last funding round: 2022

Last funding round type: Seed

Revenues: $1M - $10M

Acquired: No

Target Customers: B2B&B2C

Typology of the offer: Hardware Offering

The startup focus is on the development of a wireless charging system. User data valorization in this situation is low since the company just provides an innovative technological solution without the need of gathering and exploit the user data in its strategy.

Other functionalities located in this quadrant are “Private transportation” and “Last Mile Delivery”. The same considerations can be done also for these functionalities. The focus is more on technical issues rather than collecting data from users to get an advantage.

4.2.2 Integrated and Low User Data Valorization

The quadrant considered is the upper left one. Startups belonging to this area are creating and delivering value to the user in a integrated mode. This involves the participation of other entities. Looking at the other dimension of the matrix, the user data valorization in this quadrant is low. The quadrant considered is mainly populated by startups belonging to the autonomous driving functionality. These companies often operate as partner or suppliers of other firms by developing some particular technologies that need to be integrated with other systems. An example picked from the database is BlackShark.ai.

BlackShark.ai

Foundation date: 2020

HQ Location: Graz, Steiermark, Austria.

Website: https://blackshark.ai/

Description: The company is involved in the development of a 3D mapping of all the earth surface. Their system "SYNTH3D" gathers images about the surface from 2D satellites. After that, all this information is elaborated by their artificial intelligence-based platform and then reconstructed in three dimensions. The solution is able to map everything and then visualize. Buildings, fields and many other objects are captured and reconstructed. This technology has a great application in the field of the autonomous driving, in order to make autonomous vehicles able to visualize in 3D the surrounding environment.

Scope of application: Smart Car

Functionality: Autonomous driving

Total funding amount: $20.000.000

Funding in the last 3 years: $20.000.000

Last funding round: $20.000.000

Year of the last funding round: 2021

Last funding round type: Venture-Series Unknown

Revenues: $10M - $50M

Acquired: No

Target Customers: B2B

Typology of the offer: Service Offer

BlackShark.ai uses an integrated approach since its technology alone is not valuable for the users, but it needs to be exploited with other systems. Their solution can help others subjects to develop

autonomous vehicles. The user data valorization is low in this case. The technology implemented is dependent on other kind of data like satellites images.

4.2.3 Integrated and High User Data Valorization

The upper right quadrant refers to the startups whose business model relies on other partners in order to deliver value to the user, like in the precedent case. However, the difference here is in the other axis of the matrix. User data valorization is high in the companies located in this third quadrant. Firms are exploiting data from users in their business model.

Within this category are present many different functionalities. Looking at the database is possible to note a huge presence of functionalities like: Mobility-as-a-Service, traffic management, fleet management, public transport, driving style monitoring, parking management, autonomous driving, data analysis and safety.

Startups dealing with these functionalities typically adopt an integrated approach with other subjects in order to reach the user. Furthermore, they are also dealing in gathering users data. Mobility-as-a-Service startups are collaborating with the different transport providers and, at the same time they have to understand users behaviour by leveraging their data through their service app. Startups related to the public transport are quite similar. They gather data on the users of these services and analyze them in order to help public transport providers to enhance their services by meeting properly their customer needs. The main difference is that MaaS solutions involve different ways of transport, also considering the private ones, while in the public transport the subject is more specific. The following example CitySwift is picked from the category “Public Transport” in the database.

CitySwift

Foundation date: 2016

HQ Location: Galway, Ireland.

Website: https://cityswift.com/

Description: CitySwift has developed a data driven platform for the scheduling and planning for bus networks in urban areas. The platform uses artificial intelligence and machine learning to understand users behaviour in the bus networks, in order to predict accurately journey times and users demand. On the basis of that, the schedulers can plan in a optimal way the timetables that consider other factors like: traffic conditions, events and etc. The results are a better performance of the network and a higher customer satisfaction.

Scope of application: Smart Mobility

Functionality: Public Transport

Total funding amount: $7.200.000

Funding in the last 3 years: $7.200.000

Last funding round: $5.000.000

Year of the last funding round: 2022

Last funding round type: Series A

Revenues: < $1M

Acquired: No

Target Customers: B2B

Typology of the offer: Software Offering

The case of CitySwift describe the typical approach of the companies belonging to this quadrant. The user data are at the heart of the business model of the company. By leveraging all these data they are able to support public transport providers in improving their services addressing better the needs of their customers. The approach is oriented to the integration. The value for the user is created by the collaboration of the startup with other entities.

Looking at the other functionalities within this quadrant, Traffic Management field typically involves the participation of other subjects like public authorities, connected vehicles and road infrastructures. Startups in this area analyze data gathered from third parts about the users and support the development of a better traffic planning in urban areas. Parking management is similar. Startups deal with drivers and with parking services in order to solve the issues regarding the parking in the urban areas.

Data analysis startups also are dealing with the data regarding users. They can manage and analyze great quantity of them with the purpose to give valuable information to: vehicle manufacturers, public authorities and insurance companies. These data are provided by smart connected vehicles usually.

In the field of the driving monitoring style, the relevance of gather and elaborate data from the driver is a core element of the solution system provided by this kind of companies. The same considerations can be done to the other functionalities within this quadrant. Startups in this field are present also in the quadrant related to the combination “Stand-Alone and High User Data Valorization”. The difference depends mostly on the necessity to be integrated or not with other systems.

4.2.4 Stand-Alone and High User Data Valorization

This is the last quadrant obtained by the intersection of the two dimensions and it is positioned in the lower right part of the matrix. The companies contained are creating and delivering their offering to the user without involving other subjects. They also are leveraging data from the users in their business model in order to develop their solution.

The more frequent functionalities of the startups belonging to this quadrant are: Electric Mobility, Smart Insurance, Parking Management, Autonomous Driving and Driving Style Monitoring.

Firms dealing with the electrification of vehicles were also present in the other quadrant characterized by stand-alone approaches and low user data valorization. The difference is that in this last quadrant, startups are also dealing with the user data. The electric mobility startups of this zone are often offering charging systems directly to the user and accompanied by a software for the recharge management of their cars. This imply that in the solution developed users data are a key component. These type of software gathers data about the use of the car by the driver and organize consequently the charging plan more appropriately. These solutions relieve drivers from any stress regarding the managing of the recharge of their vehicles. Trough an app the user is able to see all the information needed.

Smart insurance startups have a significant presence in this quadrant. They leverage user data about their driving behaviour and vehicle usage and offer accordingly a proper insurance contract to them. The data are often gathered via smartphone without the need of integration with other systems. An example of Smart Insurance company taken from the database is Cuvva.

Cuvva

Foundation date: 2014

HQ Location: London, England, United Kingdom

Website: https://cuvva.com/

Description: Cuvva is offering flexible smart insurance services. Through their app is possible to get data regarding the drivers. Thanks to the information collected, the company is able to offer a price for their service tailor made for the customer. Therefore, good behaving drivers will be rewarded by having a discount on the price. They also provide insurance services on a pay-per-use basis, targeting especially low frequency drivers.

Scope of application: Smart Mobility

Functionality: Smart Insurance

Total funding amount: $22.100.000

Funding in the last 3 years: $19.500.000

Last funding round: $19.500.000

Year of the last funding round: 2020

Last funding round type: Series A

Revenues: n.a.

Acquired: No

Target Customers: B2C

Typology of the offer: Software Offering and Service Offering

The case of Cuvva reflects a stand-alone approach because the company is able to get value to the user on its own by providing the insurance service. The user data valorization is evidently high in order to develop their offer in a highly personalized way.

The parking management startups in this quadrant are usually acting as a marketplace platform for the sharing of private parking spaces. In this way, a driver who needs to find a parking space is matched with people who are renting their private ones. All of this happens within a closed system, without the need to interact with other systems. Furthermore, as a platform business, the users data are relevant. They leverage them in order to realize a revenue stream by acting as intermediaries.

There is also a huge presence of sharing mobility platforms. They directly provide the service to the users. Users data plays a fundamental role in this kind of services.

The startups dealing with the driving style monitoring often are able to deliver their offer in autonomy, typically via app or through an easy installable hardware. Their solutions act, usually, as detectors towards potentially dangerous driving behaviours and driver conditions. Therefore, these data provided by the users are a core element of their solution.

The startup dealing with autonomous driving in this zone are typically the manufacturers of this kind of vehicles. The collecting of user data is more related to future improvements of their solutions.

4.3 Database Startups & Matrix Classification

This last section has the aim to illustrate the results obtained with the already explained qualitative framework. The last step was, indeed, to classify each one of the startups available in the database according to the two dimensions of the matrix: Value Deliver and User Data Valorization. Each startup, therefore, is placed in one of the four quadrants identified. The results are illustrated in figure 30.

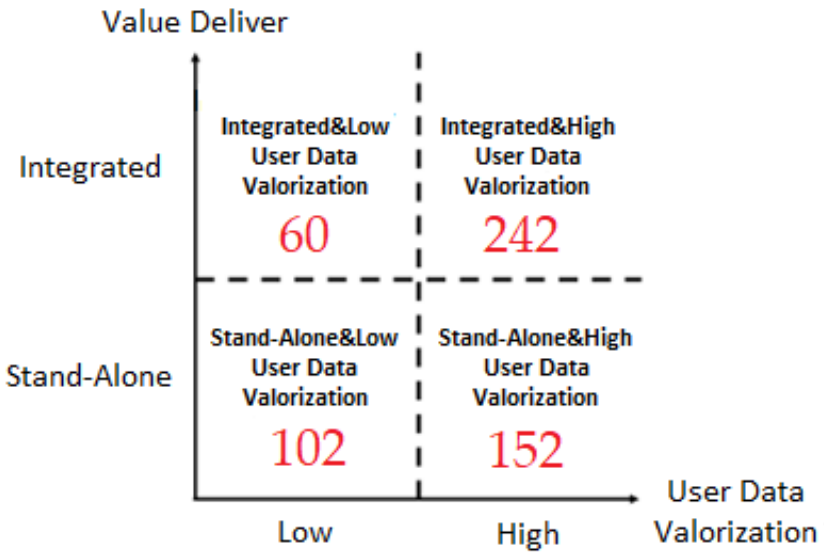


Figure 25: Results of the Qualitative Framework

The figure 25 shows a clear majority of startups belonging to the upper right quadrant. This is the quadrant identified by the combination of integrated approach and high user data valorization. The 44% of the companies are here. Even if startups here are partnering with other existent systems or organizations to address the user, the exploitation of data about it is relevant. In the cases already seen, this aspect of their business is creating real advantages for them and related partners. The second one is the lower right quadrant, the one characterized by stand-alone and high user data valorization combination. The percentage of the startups in this area is the 27%. The sum of the two percentages in the right part of the matrix is 71%. The majority of companies within the database are leveraging user data in their business model. The valorization of data regarding user has an active role in these company activities. Looking at the other quadrants, Stand-alone approach and low user data valorization and integrated approach and low data valorization percentages are respectively: 18% and 11%.

The second research question about the user data valorization in the business models of the companies finds an answer in this framework. According to the results, it is possible to say that in the startups business models the user data valorization is high. Many of the firms are leveraging users data in order to develop their business. At the same time, thanks to the observations done about the other axis of the matrix, regarding the approach towards the user, is possible to say that this depends mainly on the type of business and on the firm own strategy. Therefore, it is not possible to affirm with certainty that one approach is better than the other. The higher percentage of integrated approaches is due to the fact that operating in the mobility sector, especially in certain fields, often implies to deal with different subjects and already existent systems.

5.Conclusions

In this last part of the study the purpose is to resume the main findings of the research. Previously, there were defined the objectives of the research and the methodologies to pursue them. The objectives of the thesis were basically to provide an answer for each one of the two main research questions.

RQ1: *Which is the current state of the art regarding Smart Mobility and Connected Car startups?*

The methodology to provide an answer to that question was based on a database containing a significant sample of startups operating in the fields of Smart Mobility and Connected Car. The number of startups listed was 556. For each one of them the main relevant data were recorded. Afterwards, a quantitative analysis on those data was performed in order to provide results from a statistical point of view. The analysis performed addresses the topics of the research in different perspectives. The main results obtained are reported here. In the temporal perspective, the study reported that a huge number of startups have been founded in the last four years. The funding across the time also highlights a growing path. The financing received by the startups in the last three years: 2020, 2021 and 2022 is a huge percentage of the total received. This suggest that in industries like the smart mobility and smart car ones the level of maturity is still far. As already mentioned, in fact, the market for smart mobility and smart car are expected to grow significantly in the next years. From a geographical point of view the results say that the majority of the startups of the sample are located in Europe. But, the continents with the companies that are collecting a significantly higher financing are North-America and Asia. The countries with a significant number of startups and with an higher level of financing are USA and China. These two countries are extremely far from the other ones in these terms. Europe countries are significantly behind, despite the huge number of initiatives. Taking an average perspective on the level of funds raised is possible to note that the average financing, for each startup, is higher in Asia. Asian cities are always more involved in projects of development of smart cities, often strongly financed by governments. The mobility is something that is part of that topic. Therefore, Smart Mobility and Connected Car industries will get advantages from this environment. Moving into a more technical perspective, an analysis has been conducted also from the point of view of the functionalities and fields of application of the startups in the database. The sample contains high numbers of startups related to: electric mobility, autonomous driving, sharing, traffic management and parking management. Most of them are also on the top level of financing received. Anyway, there are also other segments which have shown an interesting trend especially in the last years. Looking at the

average financing received is possible to get some interesting insights. Autonomous driving and sharing have a leading role and they are expected to continue to grow in the future. There are also functions like: private transport, smart insurance, data analysis and last mile delivery which are performing well in the average funding perspective. Generally, looking at most of the functionalities is possible to note positive trends in the funds received in last three years. Mobility-as-a-Service startups, in this perspective, are quite interesting. The overall level of financing is not so high compared to others. Nevertheless, it has shown a relevant increase in the last years. In the future they are expected to have a great impact in the mobility ecosystem by overcoming the concept of vehicle ownership. The last two points of the quantitative analysis regarding the state of the art were focused on understanding the relation with customers and the typology of the offering proposed by the startups. The companies in the sample are mainly addressing business clients. On the second place, a significant number of them are also addressing private customers. There are also companies that operates with both businesses and final customers. The other relation types are not so relevant. Looking to financial data, instead, B2C companies have the leading role in raising funds, even if they are less than B2B ones. Moving to the typology of the offer, the analysis showed that the majority of startups are delivering in order: software offering, hardware and software offering, software and service offering and hardware offering. In the financing the situation changes by showing the highest level of funds raised in the hardware offering startups, especially in the last period. They are followed, in order, by companies with a: service offering, software offering and software and service offering combined. They also have a good level of financing in the last three years. Some of them raised half of their funds in this period.

RQ2: *How much the data valorization strategies are affecting the startups business models?*

The answer was provided by developing a qualitative framework represented by a two dimensions matrix. The first dimension "Value deliver" represents the company approach towards the user which is distinguished in "Stand-Alone" and "Integrated" approaches. On the horizontal axis it is represented the "User Data Valorization". This dimension distinguishes companies in which the user data valorization is high from the ones in which it is low. The combination of the two axes generated four different quadrants. The startups of the sample were then classified according to this framework. The results provided have shown that the majority of startups are adopting users data valorization strategies in order to develop their solutions. Therefore, is possible to say that the data valorization strategies are affecting heavily the business models of the companies of the sample analyzed. Furthermore, the matrix has highlighted that the approach more frequent is the integrated

one in the case of startups with high user data valorization respect the stand-alone one. The situation is inverted in the cases of low user data valorization. Here the companies are more often adopting a stand-alone approach in order to get value to the user.

The high impact of the user data valorization strategies on the business models of the startups reveals that in these industries understanding the behaviors and needs of the user is crucial. In this way, considering all this information helps companies to develop solutions which are able to engage people. The mobility ecosystem involves the participation of citizens. The companies operating in this environment must be able to offer solutions that are not just "new" but also: useful, flexible, suitable, easy to access and efficient for their customers. According to the study done, startups are acting in this direction, with an approach always more user-centric. Revolutionizing the mobility is not an easy task. The point is to increase people awareness about the argument, in order to make them understand the advantages that these new solutions can bring respect the existing and past ones.

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List of Figures

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