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Effect of digitalization on the evolution of the automotive market strategy

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INTRODUCTION

The objective of the study conducted in this thesis was to provide an overview of how business has evolved in the automotive sector in recent years, following the COVID19 pandemic and the subsequent definitive establishment of the digitisation process.
Starting from an initial analysis, it was possible to grasp which innovative trends characterise and will characterise the cars currently on the market and those to be produced in the near future.
Since the beginning of the 20th century, every evolution and transformation of society has been reflected in a change and a metamorphosis of the automotive sector; in the past, the automotive has been the instrument and means through which society has expressed itself, and even today society tells, describes and depicts itself through it. It is no coincidence that Mussolini chose a car, and in particular first the Balilla and then the famous Topolino, as an instrument of Fascist propaganda in Italy; and his example was soon followed by Hitler, who chose Volkswagen, the people's car, to spread Nazi ideals among the Germans.
The car is the emblem of speed, of power, and it is not surprising that both dictators saw in the car a means by which the nation could symbolically acquire awareness of its own power, was considered to be the very symbol of extreme right-wing ideology and that, as a result, it was excluded from all infrastructure investment plans for years, years in which no roads were improved, no car parks were built and no modernisation or upgrading was carried out. It took years for life to return to normal and for the car to be freed from this negative image.
In Europe, however, this conflictual relationship with the car continued to remain dormant, only to explode again around the mid-1960s. And so, while at that time in America the car became an increasingly popular cult object as it had come to embody the ideal of freedom, the dream of independence, in Europe the image of the car was associated with the symbol of the struggle to be faced in social conflicts: hence the obvious parallelism between the images of the Florence flood of '66, with cars rolling in the mud, and those set on fire during the French May '68 in Paris.
These always very 'hard' associations and this conflictual relationship have aroused the interest of many researchers who have concentrated on investigating the reason for this relationship.
Some scholars, such as Tuminelli (2018), argue that it all stems from the fact that the car, understood as a private, personal means of transport, embodies the concept of consumerism and that the price we pay for the abundance of consumption is guilt: he argues that now the verb has become sharing, but that the scenario that politicians such as Merkel hope for, where autonomous vehicles will only be allowed with special permission, is unlikely to be realised.
In his opinion, man is not ready to accept this, as self-determination has been the main driving force

behind his evolution up to now, and property has come as a reward for this. Changing the rules of mobility would mean completely changing a system in which man has lived for 4500 years in a society based on movement, and it is difficult to imagine this system being wiped out in a single generation. The interpretation of some scholars such as Tuminelli would also seem to explain the fact that the automotive sector is always on the lookout for something better to add to its models so that they not only remain in step with the evolution of time and the technologies that accompany them, but also manage to precede them, if not actually lead them.

It is not for nothing that the entrepreneur Enzo Ferrari described the world of the automobile and everything else with his timeless verve in these words:

"The best car is the one that has yet to be built".

The aim of this thesis work is therefore to investigate the automotive sector in depth, starting with the elements that distinguish it and have characterised it since its origins, in order to try and analyse which of these can constitute a strategic element that the entire sector can use to meet the changes and challenges that will involve society and, more specifically, the sector itself over the next decade, together with the recent crisis brought about by the COVID-19 pandemic.

The first chapter of the study provides an overview of what we expect to be the trends that will characterise the automotive industry in the immediate future, namely those factors now universally grouped under the acronym ACES (Autonomous driving, Connectivity, Electrification, and Smart mobility), to which a large section is dedicated, detailing what has been achieved so far and what car manufacturers will be aiming at in the short term: very interesting topics such as autonomous driving, in which car manufacturers continue to invest and on which research continues to make giant strides, thanks in part to the collaborations and partnerships formed in recent years between the major car manufacturers and software houses specialising in the creation of automation systems, whose contribution has proved fundamental to the rapid realisation of the automated vehicle.

Connectivity was mentioned: COVID19 has now made remote connection a habit that cannot be done without, given the undoubted advantages it offers: considering how solidly structured society is now around the possibility of remote connection, it will be essential to equip vehicles with tools that enhance connectivity, even contextualising it in the driving experience. There is no doubt that the new products that will hit the roads will include systems that provide information to the driver, transforming the driving experience that we are traditionally attached to into something completely revolutionary that will increase transfer comfort and safety on the roads.

Alongside technological innovation, the theme of sustainability was also explored, another important driver to be considered in strategically guiding the evolution of the automotive sector, taking into account its pressing topicality and the importance it is increasingly assuming in the international debate. We talked about sustainability and international initiatives such as the 2030 Agenda, created with the aim of disseminating this concept in all its social, economic and environmental aspects. And

indeed, the environmental impact was analysed, both in terms of CO2 and PM10 pollution, and of alternatives to traditional internal combustion, electrification and saving natural resources.
But there was also talk of circularity, sharing, flexibility and a sustainable approach to mobility, especially in large cities. The presence of long and short-term rental companies would seem to have rewritten the rules of making competition even tighter: the sharing economy, car sharing, thanks to their high mobility and the economic advantage they offer, are really able to take over market shares that until a few years ago were a monopoly of dealers.
The central topic therefore revolves around the evolution of cars and the supply chain that surrounds them, with the ultimate aim of investigating what improvements dealers and sales networks can make in order to achieve commercial objectives and increase company turnover.
The second chapter focuses on the figure of the dealer and on what the future holds for the activities of dealers who, at the moment, are in a phase of transition and transition from the business concept linked to the role of the classic dealer to one based on e-commerce, virtualised and dematerialised business. In this context, attention has been focused on all the "core" issues of digital transition, Big Data, network and connectivity, especially following the effects of Covid-19.
According to the trend that has been emerging and establishing itself lately, the way forward would be that of independence: to evolve from simple resellers linked with the parent company by a franchising relationship, to independent activities, with their own image and brand, developing their own marketing and personal relationship with the customer.
This chapter tries to understand which changes will have to be used within the dealer business model and which are the necessary changes that dealers should promote in order to adapt to new market trends, to survive and to succeed.
The new needs linked to connected mobility, to the customer's need to find a variety of information through an online channel and to the new opportunities for purchasing through e-commerce are analysed, with a focus on the importance that these new remote purchasing formulas are acquiring.
In this respect, the effects of the COVID-19 epidemic on the automotive sector in all its spheres have undoubtedly been important: the shock caused by the lockdown in which the whole world has locked itself can be seen not only in the contingent fall in supply and demand but also in the consequences that have permanently changed the automotive business and made its impact similar to that of a prolonged recession.
It is not only a new phase of economic crisis that has opened up, but also consumer behaviour in the medium to long term, which does not appear to have been immune to the events that are still unfolding, thus changing everything that until before the pandemic had characterised the habits of the average customer: New challenges are now opening up to respond to the sudden change in needs dictated by a new context in which dematerialisation and remote connection are seen as a necessity for providing advice, assistance, information and support to people who prefer this type of iteration

to going to the dealership for fear of contagion.

The priority seems to have shifted from the study of market techniques in general to the analysis of a modus operandi that allows the capture and retention of customers, perhaps through commercial policies or product innovations, bearing in mind what are now the new fears, such as that of contagion, of those who must try a car of unknown origin.

Digital transformation is a great support in this period in which the future seems to be tending almost exclusively towards digital platforms, which allow the customer not only to book the company's range of cars, but also to receive concrete answers also in the field of financing.

In the third chapter, starting from research questions, hypotheses were elaborated on the basis of which an Empirical Model was proposed, which in turn formed the basis for an empirical investigation on the topic. The survey focused on analysing the answers to a specially designed questionnaire that was submitted to consultants and industry experts in order to understand what customers' needs and priorities are and what expectations they have of retailers.

The survey focused mainly on virtual dealers, in terms of how they intend to present themselves to users in a way that meets their needs and expectations, implementing technological innovation tools such as augmented reality and virtual reality, so as to recreate, if not improve, the experience that customers have when they come into contact with the physical dealer in person.

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CHAPTER I

1. Drivers of change in the automotive sector

1.1 The automotive sector, digitalization and change

The automotive sector is one of the most important trade sectors in the world and has been an important economic resource in Italy since the appearance of the first cars.
Due to the high costs of production and sales, the number of passenger car models was initially very limited, both in terms of the type of models and the quantity in circulation; on the contrary, nowadays they have become countless and capable of meeting the different needs of the consumer.
The wide range available has not only benefited from their size and technical characteristics, but also from the important technological equipment that supports them, which has quickly gone from being absolute novelties, introduced inside the machines themselves, to being accessories that are taken for granted.
The frenetic succession of innovations that has accompanied the automotive world in its development for over a century has contributed to creating a business that mobilises billions of Euros, transforming cars into a fundamental and indispensable tool for human life, a tool that mostpeople consider beyond its function purely as a means of transport, equating it to a *status symbol* and giving it such importance as to make it an object of social identification, an object of desire, one of the first objectives of purchase in adulthood, second only to housing.
And it is in this key that the concept of the car has evolved from a basic need that allowed, at first, faster travel than the means previously used, to that, in modern times, of a more than a need turned into a tool of trendiness and self-assertion. These concepts have slowly spread and become more and more deeply ingrained in the mind of modern man, so much so that today, however debatable it may be, one defines the type of person one is by the type of car one drives: this is why the car has become a fundamental descriptive part even of Maslow's pyramid[1].

[1] Abraham Harold Maslow (Brooklyn, 1908 - Menlo Park, 1970), American psychologist. Known for his 1954 theory on the classification of needs, also known as Maslow's pyramid, which made him one of the most influential and cited psychologists of the 20th century.
According to the book 'Motivation and Personality', human needs and motivation are hierarchically divided into a pyramid at the base of which are physiological needs (such as hunger and breathing), followed by needs for security (family, health, property), belonging (friendship, affection, intimacy), esteem (self-esteem, self-control, respect) and self-fulfilment (morality, problem solving).

Cars have become an object for which the consumer demands updates, variations and modernizations in both design and technology within a very short timeframe, to the point that most of the time the actual remaining life of the car is reduced to a very few years.
In order to properly introduce the automotive industry, it is necessary to specify that within it several specialties can be identified, such as design, production, distribution and service/repair (Volpato and Zirfoli, 2011).
The purpose of this paper revolves solely around the last point in the chain, the ultimate goal of any manufacturing company: distribution and service, which is the moment when contact is made with the end customer who will become, in the best of cases, the owner of the purchased car.
According to research carried out by UNRAE[2], as can be seen in Figure 1.1, the automotive sector is extremely important in Italy, so much so that it is the leading taxpayer, with an amount that amountsto 71.6 billion.

		Production	**Components**	**Distribution and repair**
Number of companies		810	2400	14200
Number of employees		95000	166000	160500
Turnover *[billion €]*		47.5	39.5	40.0
Total tax contribution *[bn €].*		71.6	**% of total tax revenue**	16.8

Table 1.1 - The centrality of the automotive sector in Italy. Source: http://www.unrae.it/files/importanza%20settore%20automotive_2_5655967d65153.pdf

Despite a hint of recovery in 2016, the global automotive industry is not in the best of health to date: to get an idea, one only has to consider that the 0.1% drop is worth 15 thousand fewer cars and that in 2018 over 71 million cars were produced, down 3.2% on 2017 volumes, with a further drop of almost 5% in 2019. The European market, which accounts for 20% of the world market, remains more or less stable, butit is significant to note that the top five European markets are all declining and that the major economic powers such as Germany and the United Kingdom are losing 0.2% and 6.8% respectively,while Italy is shrinking by 3.1% (Saglietto, 2019).
This general scenario has given rise to the need for change: it is necessary to react by trying to evolve as much as possible in order to meet the needs of an increasingly less compliant market, where competition is becoming increasingly fierce.
According to expert opinion (www.sap.com), the introduction of technologies and other solutions for the digital transformation of the global automotive and transport industry seems to be a must. The symbol of the fourth industrial revolution is the *Smart Factory, which* can be translated as *Factory*

[2] Unione Nazionale Rappresentanti Autoveicoli Esteri. This is the association of foreign car manufacturers operating in Italy in the marketing, distribution and technical assistance of vehicles for both private and public use and at industrial level (buses, caravans, trailers and semi-trailers). It is also the largest partner in our country in terms of the development of statistics and scenarios that support the Ministry and the competent bodies in the proper performance of their work.

4.0, and is characterized by an increasing integration of work performed by humans with elements of cyber-physical systems, intelligent machines and machines connected to the Internet.

The adoption of *Smart Factories by the* automotive sector could lead to an increase in investment of more than 60% by 2023, resulting in a productivity increase of more than $160 billion *(https://www.fabbricafuturo.it/automotive-4-0-la-rivoluzione-digitale-mette-al-centro-consumatore/).*

Digitalization has seen the introduction of automation during *manufacturing* processes: robotics, artificial intelligence and machine learning have been introduced into factories, all of which have helped companies become more competitive by reducing production times.

Flexibility is another keyword for automotive manufacturers, which is why companies have continuous improvement programs aimed at reducing set-up times in production.

While German car manufacturers have been leaders in combustion-based technologies in the past, the competition imposed by ever-increasing globalization has meant that the concept of 'industry leader' has all but disappeared, giving way to increasingly close collaborations between the former and external companies.

In fact, the necessary reduction in time requires the introduction of SMED technical solutions, which are very difficult to find, and which have given rise to special alliances that can save the car industry: whereas in the past it was possible to solve every need in-house, now, the need for new *software* and nano-technologies has made it excessively time-consuming and costly to develop what is required to keep up with the market.

SMED (*Single Minute Exchange of Die)* techniques were introduced by Japanese engineer Shigeo Shingō (Saga, 1909 - Saga, 1990) in 1950 in a Toyota factory and, as the acronym indicates, consist of being able to reduce the time required to carry out a set-up operation with a single *digit,* a time lapse of less than ten minutes.

Today, the landscape has changed radically in the field of e-mobility and digital transformation: start-ups[10] have become the real developers of vital technologies, which gives them a dominant position when negotiating with car manufacturers, who in turn are looking for new opportunities.

Furthermore, the shift to digitalization implies that car manufacturers make investments in new technologies and radical attitudinal changes, i.e. they should no longer see external partners as dependent suppliers, but rather as equal partners with whom value can be jointly created.

This shift will require different types of contracts, mindsets and time horizons.

Secondly, knowledge sharing is often more beneficial to the ecosystem than protecting it: an example of this was Tesla's decision to open up its patent portfolio for battery technologies in 2014, which allowed several start-ups to contribute to research, reducing time and costs for the car company.

These concepts bring us closer to the theory that, in the modern era, it is no longer convenient to compete with other companies, since sectors have become more labile and companies more open to novelty and change: the thin line dividing *competition* and *co-opetition* tends to blur in order to ensure

the survival of the entire sector.
The strategy just described is referred to as the "*win-win situation", which is* characterized by the presence of only winners, on both sides, in a given situation; by extension, anything that does not displease or harm any of the parties involved is considered *win-win*.
It is a negotiation at the end of which both parties satisfy their own interests, a departure from the situations that existed in the past, where one party came out the loser and the other the winner.

1.2 Autonomous driving, Connectivity, Electrification, and Smart mobility (ACES)

It is no coincidence that in films, when the aim is to make the viewer realize that a scene is set in the future, the most common method is to show roads swarming with futuristic cars. This is where the screenwriters' imagination finds the widest scope for expression: among vehicles that drive themselves, that run on the strangest fuels, that fly, that sometimes not only follow a route but even decide where to go and do so by exchanging witty banter with their passengers. Whether projected forward a few years or decades, our future is often represented through the future of the car and, through it, of mobility.
Man's development has always been linked to that of his means of transport, and for more than a century the car has been the means of transport par excellence in the collective imagination.
The future of the car is closely linked both to the future of the driver and to the future of the cities and territories in which the car is driven. So when we talk about the major trends affecting the car, we should do so in the knowledge that the shape they take will certainly not be neutral with respect to the dynamics that will affect tomorrow's society as a whole.
We are divided between acronyms and abbreviations: the acronym ACES derives from the words that make up the four most important *trends* of the moment: *"Autonomous driving, connectivity, electrification, and smart mobility"*, and which represent the features that will characterize the automotive world in the coming years. In the shared opinion of the major research institutes, these are the major trends that concern the future of the car, and to these could be added themes such as the use of hydrogen as an energy vector, which have not yet had an affirmation on a par with the others but could have one in the near future.
The problem is that if these are the trends the car is moving towards, the road to reach them is anything but obvious. And this is where the real game of our future lies.
As ACES trends are emerging simultaneously, it is crucial to include all four areas in one development, as they need to be developed and find their place in the market at the same time.
This interconnected perspective can help car manufacturers, suppliers and new entrants in the mobility market to create offers in line with customer needs.

Traditionally, vehicle technology trends have been renewing very slowly, success in this environment usually relies on a variety of seemingly unrelated *inputs* that are difficult to determine in advance: looking forward, it is necessary to understand how the industry will link connected, automated and electric vehicle technologies to drive the new vehicle paradigm.
In the rest of the chapter, these technological trends are analyzed one by one in order to highlight their characteristics and peculiarities, as well as to analyze their links and possible correlations.

1.3 Autonomous driving

The first component of the acronym, '*Autonomous Driving', is an* extremely interesting topic that intrigues manufacturers, software programmers and also customers, since car manufacturers, who previously focused their efforts exclusively on changing engines from combustion to electric, are now also dealing with this new transformation that would change the boundaries hitherto imagined by drivers.
A self-driving car would in fact correspond to a reduction in emotional tension due to the extreme concentration required for driving, the disappearance of the driver, a reduction in traffic, or rather, more regulation: it would be possible, for example, to respect speed limits and road signs, leading us towards a utopian world where even the police would be exempt from certain tasks.
These assumptions do not correspond to reality, let alone represent it in the near future, as is claimed by car manufacturers who, in addition to recognizing autonomous driving as a division into levels, make it clear that it is impossible to go beyond some of them (*Bundesanstalt für Straßenwesen,* German Federal Research Institute for Transport and Mobility).
In fact, the term *SAE refers to* a standard that classifies autonomous driving technologies into six levels, from level zero to level five; as far as limits are concerned, these are found in ADAS, i.e. *Advanced Driver Assistance Systems*, since all the systems available on production cars today are assisted driving technologies, not autonomous, and therefore do not exceed level three.
Level zero means that the car does not have any driving aids, while level five classifies cars that no longer have steering wheels and pedals, and are able to handle any situation that arises while driving autonomously.
Turning to the description of the ADAS, the first level is 'assisted driving', consisting essentially of two instruments: '*cruise control*', an electronic system that allows automatic regulation of a car's speed, or the more advanced '*Adaptive Cruise Control*', both of which are already available for sale.
The driver selects the desired speed and it is maintained, depending on the car's trim conditions.
The second can be considered as the implementation of the first, allowing in addition to the above functionality also the possibility of maintaining a constant distance from the car in front of our vehicle, adapting our cruising speed.

The next *step in* this classification is 'semi-autonomous driving', and consists of a series of devices through which the car is able to manage the steering, allowing the vehicle to stay within its lane thanks to a road sign reader, which can read the lines and markings that may be encountered on the road surface.
This level includes 'blind spot monitoring', which checks for the presence of vehicles close to the car but not visible to the driver, '*Forward Collision Warning*', which detects the danger of a collision with any obstacle and warns the driver with acoustic signals or by vibrating the steering wheel, 'Autonomous Emergency Braking' and finally 'Driver Fatigue Detector', which detects the driver's physical state and warns him of the need to stop.
The third level is referred to as 'highly automated driving' (*ADAS*): this is also present in some models on sale but, unlike the previous levels, it allows the vehicle to take control over acceleration, braking and steering for a given period of time or in specific situations, without the driver being required to constantly monitor the vehicle. (https://smartrider.ch/it/attualita/5-livelli-di-automazione-sae).
The fourth is 'fully automated driving' which, unlike the levels below, is still under study and will allow the car to drive autonomously most of the time, and not just occasionally. This step will allow the driver, who is always in the driving position, to take care of other things while navigating, but it should be specified that no car model is currently equipped with this option, mainly for legal reasons dictated by the legislation in most countries.
At the top of the list is 'full autonomous driving', in which vehicles with this feature do not need a steering wheel. These are highly intelligent cars that can move in all kinds of situations and conditions without any disturbance, so much so that the driver is no longer needed and only the passengers can drive.
This level illustrates a rather ambiguous scenario, allowing transport for people with reduced mobility, such as pensioners or children. In the opinion of Steve Wozniak, former partner of Steve Jobs, recognized as one of the fathers of the personal computer, a driverless car will never be part of our daily lives, except in the very distantfuture.
On the other hand, Carlos Tavares, former Chief Operating Officer at Renault, declares the impossibility of the autonomous car as a result of purely economic impropriety on the part of carmakers: costs would progressively increase out of proportion to value, leading to an inconvenience for both the customer and the manufacturer.
Despite these caveats, Ford has just increased its planned investments for 2023, making a commitment to launch a robo-taxi service in Miami, Washington and Austin by 2021.
Volkswagen has also invested in the future, creating '*Autonomy*', a company based in Wolfsburg and Munich, with the task of developing an autonomous driving system, in order to achieve the goal of reaching the market in the shortest possible time (Tavares, 2019).
Consultancy firm Deloitte has conducted a study on the car of the future, showing how global

consumer confidence in self-driving technology is slowing.

What has emerged from the studies is an unexpected percentage of those who still do not consider it safe to rely on autonomous driving, attributing this trend to the same media campaigns that had previously benefited the image of autonomous vehicles.

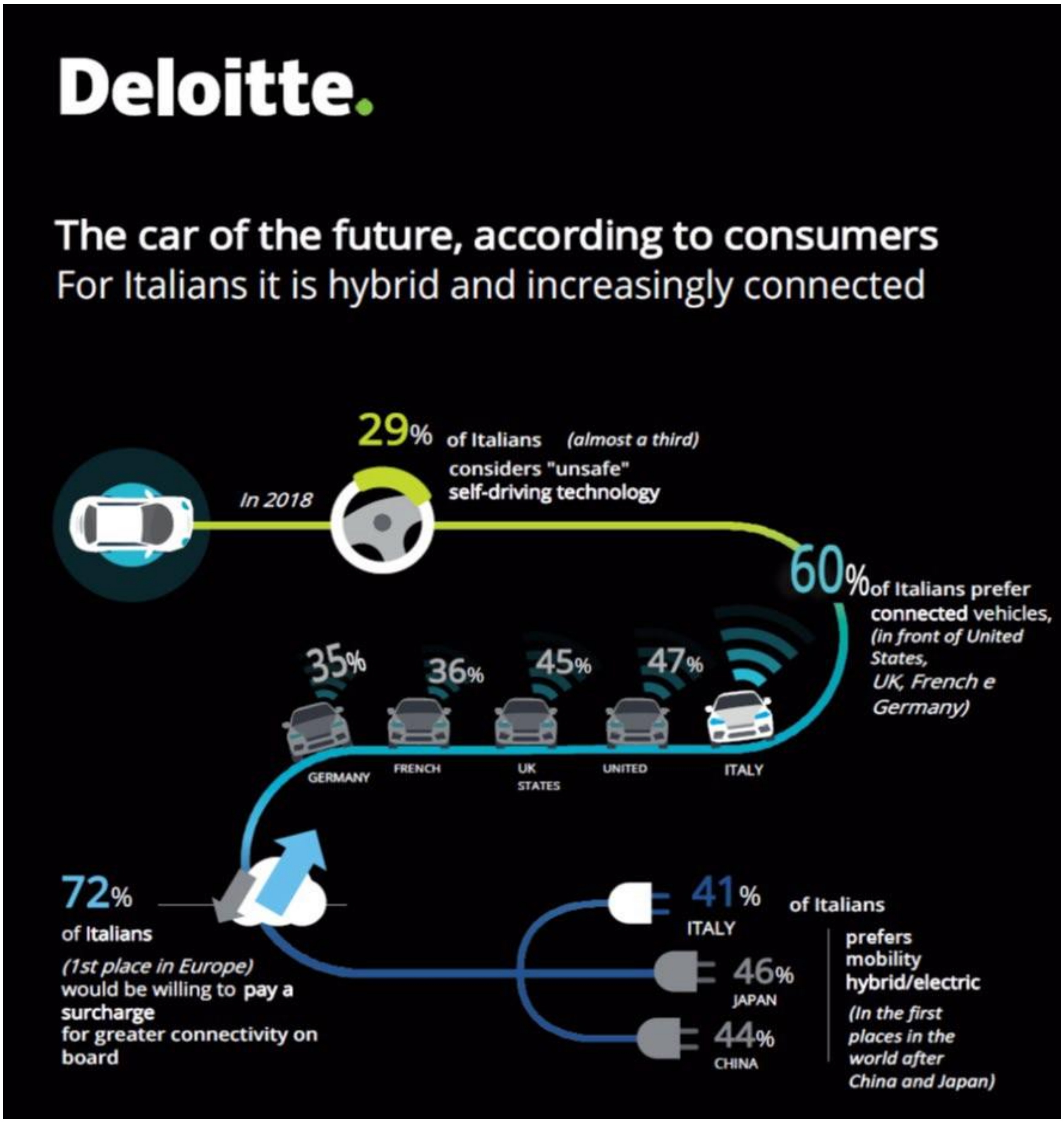

Figure 1.1 - Survey regarding the perception of the scarcity of autonomous driving. Sources: Barbieri, G., "The car of the future, according to consumers", in deloitte.it

Consumer interest in self-driving cars has slowed dramatically since estimates were made in 2018, but fears could be alleviated by regulations for which governments are expected to take a leadership role. The following image shows the percentage of consumers who believe that self-driving cars "will not be safe".

According to Deloitte's Survey, the most initially confident countries include Asia, which has always topped the charts for new technological breakthroughs and the confidence they place in them in

general terms, while the most sceptical are those in Europe.
Despite the level of safety initially attributed by well over 60% of the sample surveyed in 2017, it is easy to see, after the above incident and the slow pace of development of this extremely futuristic driving method, how drastically the general acceptance has dropped, from the initial average of 70% to 30% in the 2019 surveys.
To conclude, a further danger must be added: the possibility of hackers being able to attack self-driving cars, even though the risk of a breach is currently considered minimal since the systems are programmed not to be trusted. An experienced hacker, in fact, would have to be able to breach, and subsequently compromise, all the sensors at the same time, in order to gain access to the car's steering system, thus taking control of the central unit.
Also on this issue, manufacturers have set up divisions that deal with *cybersecurity* and conduct anti-hacker tests.

1.3.1. The history of autonomous driving

The history of autonomous driving dates back centuries, to 1925, when an American radio equipment company called Houdina Radio Control presented the first driverless vehicle: the Linrrican Wonder. The new functionality of this model was demonstrated on a demonstration tour through the streets of New York: what seemed like magic at the time was made possible by a radio antenna, capable of picking up impulses that were transmitted by an accompanying operator in another vehicle.
Almost fifteen years later, during the 1939 New York Expo, radio-controlled vehicles powered by an electromagnetic field were demonstrated by engineer Norman Bel Geddes.
In 1953, experiments were carried out by RCA Labs of New York, a major American electronics company founded as the Radio Corporation of America in 1919, which, in collaboration with General Motors, tested automated driving control through a number of circuits and sensors placed along the road, capable of controlling the car's accelerator and brakes, while also determining the presence and speed of other vehicles along the way.
Numerous studies were also conducted on European soil: in Germany in 1986, engineer Ernst Dickmanns, accompanied by his team from the University of Munich, designed a Mercedes-Benz van, also known as 'VaMoRs', capable of driving without a driver thanks to the processing of external data captured by cameras and sensors. However, it remained in the prototype stage: it was never commercialised or advanced to a higher state, but it undoubtedly inspired other car manufacturers to implement the technology with the ultimate aim of achieving automated driving.
In 1994, the twin robotic vehicles Vamp and Vita-2, designed by the same German engineer in collaboration with Mercedes-Benz, were presented: these two models were able to travel 1,000 kilometres along a three-lane Paris motorway in varying traffic conditions, reaching speeds of 130

km/h, experimenting with convoy guidance, lane changes and overtaking.
The scenario also opened up in Italy in the 1990s, thanks to the contribution of Professor Alberto Broggi of the University of Parma in collaboration with Lancia, who patented the famous Argo, a modified Lancia Thema that in 1998 covered almost two thousand kilometres in six days along the roads of northern Italy. Argo was able to operate 94% of the time in total autonomy, using a system to analyze data from the external environment, captured through the use of two cameras.

Figure 1.2 Lancia Thema Argo Source: Institute of Transportation Studies University of California, Berkeley, 'Road Vehicle Automation: History, Opportunities and Challenges'.

The same engineer carried out a further experiment, deemed highly successful, in 2010 with the start-up VisLab, managing to make a vehicle travel completely independently from Parma to Shanghai, covering 13,000 kilometres.
Since 2009, General Motors, Ford, Volkswagen, Mercedes-Benz, Audi, Toyota, Nissan, Volvo and Bmw have been extremely committed to the development of self-driving vehicles, accompanied by the more notorious and revolutionary Google and Tesla, which are playing a leading role in the testing and implementation of this technology.

1.3.2. Countries most active in the development of autonomous driving

2018 saw an acceleration of investment in technologies useful for autonomous driving by governments, as reported in the '*Autonomous Vehicles Readiness Index*', a dossier resulting from a thorough study by the consultancy firm KPMG.
The Autonomous Vehicle Readiness Index (AVRI) is a tool that helps measure the level of readiness of 25 countries for autonomous vehicles. It is a composite index that combines 25 individual measures (aggregated into 4 macro-areas: legislation, technology and innovation, infrastructure, consumer interest) with a range of sources into a single score.
The overall ranking for 2019 sees the Netherlands in first place; in a March 2018 speech, Dutch

Infrastructure Minister Cora van Nieuwenhuizen said the country would work with Germany and Belgium to succeed in introducing a "truck platoon" along the "tulip corridors" from Amsterdam to Antwerp and from Rotterdam to the Ruhr Valley, with the aim of allowing convoys of at least a hundred trucks and self-driving vehicles to travel overnight, adding that it would work to connect vehicles using 5G technology and install 1.200 smart traffic lights.

Index results

Rank		Country	2019 score
2019	2018		
1	1	The Netherlands	25.05
2	2	Singapore	24.32
3	n/a	Norway	23.75
4	3	United States	22.58
5	4	Sweden	22.48
6	n/a	Finland	22.28
7	5	United Kingdom	21.58
8	6	Germany	21.15
9	8	United Arab Emirates	20.69
10	11	Japan	20.53
11	9	New Zealand	19.87
12	7	Canada	19.80
13	10	South Korea	19.79
14	n/a	Israel	19.60
15	14	Australia	19.01
16	12	Austria	18.85
17	13	France	18.46
18	15	Spain	15.50
19	n/a	Czech Republic	14.46
20	16	China	14.41
21	n/a	Hungary	11.99
22	18	Russia	8.55
23	19	Mexico	7.73
24	20	India	6.87
25	17	Brazil	6.41

Figure 1.3 Index Result, 2019 Autonomous Vehicles Readiness Index ·Source: KPMG International 2019 Autonomous Vehicles ReadinessIndex: Assessing countries' readiness for autonomous vehicles:

Singapore confirms its second place as a powerhouse for technological innovation: in November 2017, it opened the Centre of Excellence for Autonomous Vehicle Testing and Research at Nanyang Technological University (CETRAN), which includes bus stops, traffic lights, skyscrapers, and realistic hills. The data collected from this facility has helped the government develop a set of national standards to promote the safe deployment of driverless vehicles in Singapore. It was also announced that driverless buses and shuttles for on-demand travel will run in three areas of the city itself, Punggol, Tengah and the Jurong Innovation District, from 2022.

In third place was Norway, which legalised AV testing on public roads in early 2018, counting 34 operators who decided to undertake small-scale autonomous bus services. In May of the same year, a transport service provider, called Stavanger, obtained the right to use driverless minibuses and, from June to December 2018, offered a free service in the district of Forus, in the city of Stavanger, Rogaland county.

1.3.3. European policy and legislation

In 2010, the European Union issued Directive No. 40 (so-called ITS) to provide a general framework for the deployment of intelligent transport systems in the road transport sector, according to which:

- the protection of consumers and pedestrians is guaranteed by the product liability rules("the provisions of the existing Community and national framework")
- protection for owners and drivers, on the other hand, will refer to the rules on trafficdamage and/or damage caused by dangerous activities.

In February 2017, the European Commission submitted a proposal for a directive to the European legislator, in which civil law rules were identified for member states to uniformly regulate aspects relating to the use and consequences arising from self-driving cars.

In particular, they focused on a risk management approach, which does not focus on the person who is individually responsible for the negligence of their actions, but on the person who, under certain circumstances, might be able to minimize the risks. It is precisely the latter who, if the chain of stakeholders (designer, producer, distributor) is retraced,will be held responsible and accused of having been able to manage the relevant risk in the best possible way. Moreover, if the distributor or manufacturer were to be held liable, the latter could thenmove up the chain by taking action against the former. In addition to a shift of responsibility, there is also a real responsibility gap, a highly debated issue, where the main actor is the creator of the processes that allow the machine to function and to collectand process data: in other words, the creator of the algorithm.

The companies supplying the algorithm, will be able to defend themselves with a punctual contractual regulation, and possibly by taking out an insurance policy to cover compensation claims, as indicated by the European Parliament itself, and it is here that a liability gap appears since the algorithm underlying the process is not easy to understand, especially if one does not have the tools of the analyzes that are exhaustive and can testify to the production defect (Montano, 2019).

To sum up, European laws on driving liability should make it clear who is responsible for any damage caused by a car and who should pay compensation for it, but numerous loopholes prevent the European Union from finding out who is responsible for any damage.

European standards are also expressed in other topics:

- on data protection in the field of automated transport: despite this, no specific measures have yet been drawn up to ensure cyber security and the protection of vehicles against cyber attacks.

- on ethical issues, which are an important topic in the field of automated mobility. Self-driving vehicles should respect human dignity and freedom of choice (two very difficult faculties to imagine in the interpretation of an AI machine), so much so that the European Union is drawing up guidelines for artificial intelligence on this issue.
- on the development of the technologies and infrastructures needed to support such a revolution: significant investment in both research and innovation will be essential for this implementation.

Wim van de Camp, a Dutch MEP from the European People's Party, wrote a report on autonomous driving, which was voted on in Parliament on 15 January 2018.

In detail, the following:

- European policies and legislation on autonomous and related transport should cover all typesof transport, including short sea shipping, inland waterway vessels, freight drones and light rail transport.
- Standardisation efforts at international level need further coordination to ensure roadsafety and interoperability at global level.
- Electronic data recording devices (similar to black boxes) should be mandatory in autonomous vehicles to improve accident investigation and to adequately address liability issues.
- Specific rules for data protection and for addressing ethical issues in the field of automated transport should be created quickly in order to increase European citizens' confidence in unmanned vehicles.
- Special attention should be paid to the development of autonomous vehicles that are also accessible for people with disabilities or reduced mobility. (www.europarl.europa.eu).

As can be seen from the figure, the benefits that the EU believes autonomous driving shouldbring range from safety on the roads to economic growth that generates new jobs.

As mentioned in the previous chapter, there are countless moral and legal issues surrounding artificial intelligence vehicles. The automotive industry, telecommunications companies, and technology companies (one of which is NVIDIA, which works with the manufacturer Tesla) are more active than ever in developing systems and *software* to support autonomous driving.

This is supported by the number of patents registered between 2011 and 2017, which number more than 18,000 (https://www.autoactu.com/doc_new/ 451self_driving_vehicles _study_en.pdf).

This is what emerges from the study carried out by *EUCAR* (*European Council of Automotive ReD)* in collaboration with *Epo* (*European Patent Office*): the report shows an increase in patents of 330% over the above-mentioned time period.

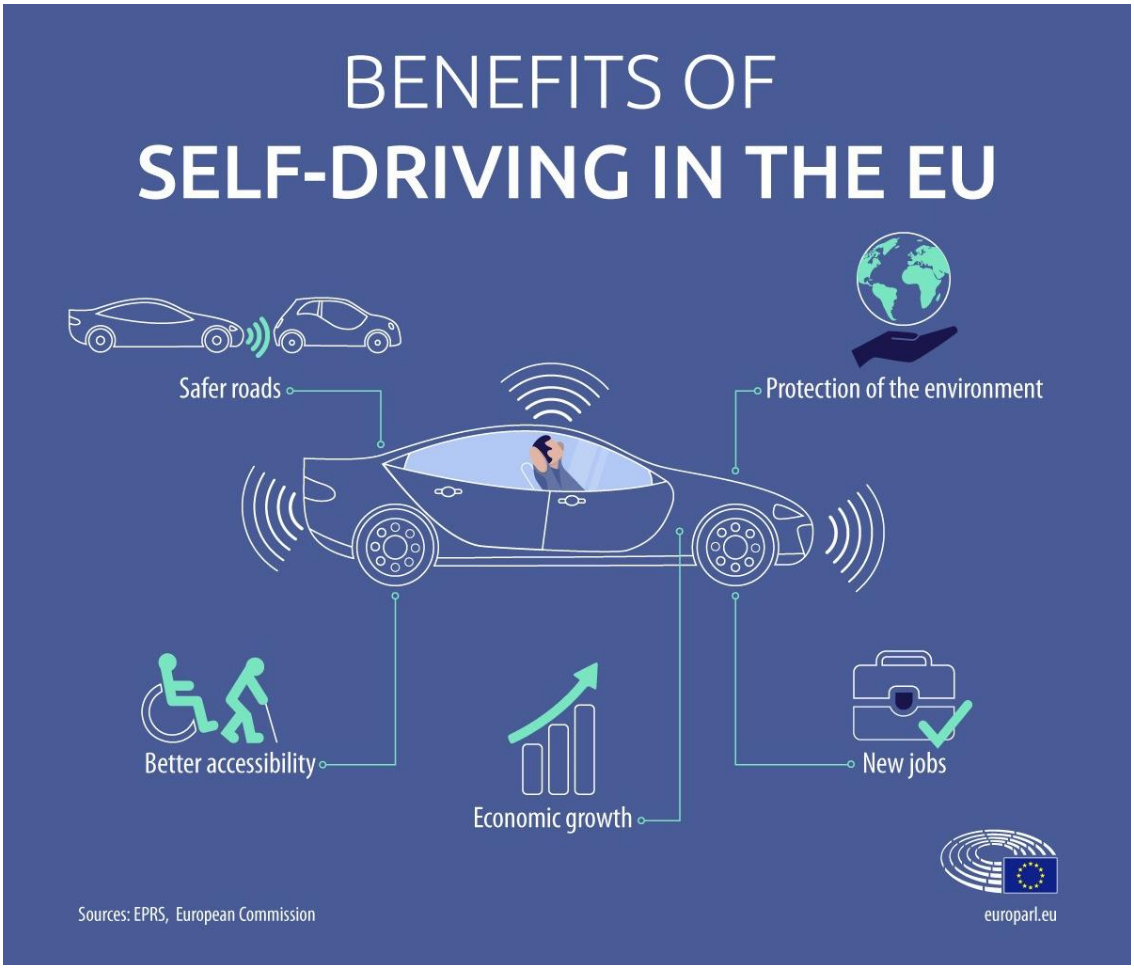

Figure 1.4 Patent legislation in Italy. Source: Europarl.Eu

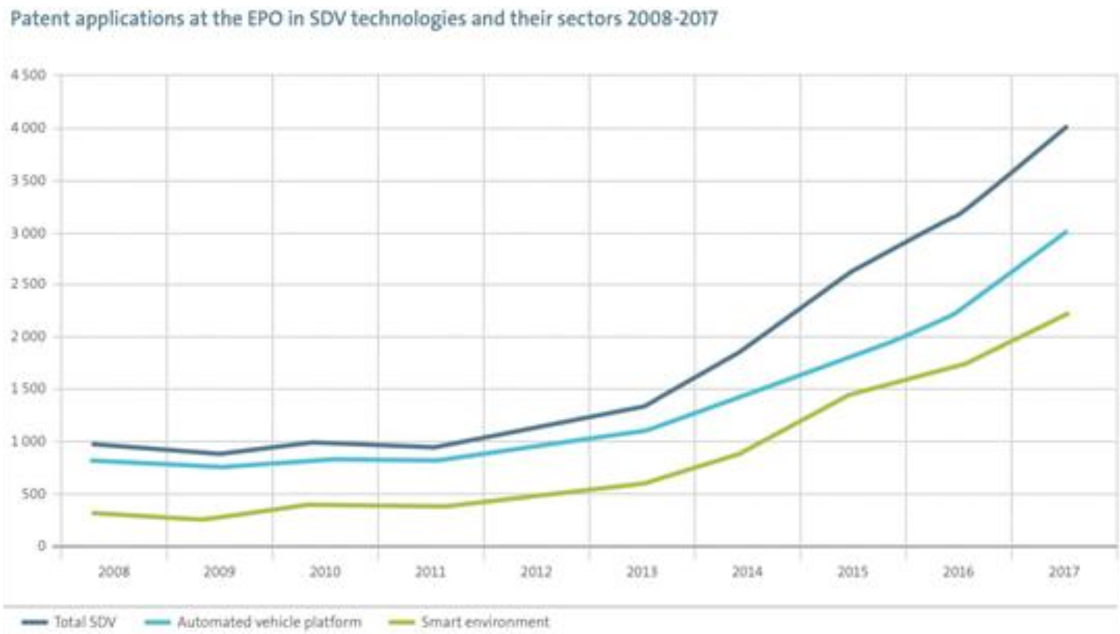

Figure 1.5 - EUCAR report - 'Patents and self-driving vehicles', EUCAR, November 2018.

The table shows the increase in patents over the time period shown on the x-axis, recording 4000 patents at the end of the year 2017.

Turning our attention to Italy, the Industrial Property Code lists in Articles 46-50 four fundamental requirements for the validity of the invention to ensure its patentability: industriality, novelty, originality and lawfulness. In particular, the invention possesses the requirement of *industriality* if it is capable of industrial application, i.e. if it proposes a technically attainable purpose, to be understood in a broad sense withreference to any field of technology, including agriculture.

This requirement is fully met, however, the industriality requirement is linked to the utilization requirement, which is dictated by the demand trend, i.e. how many people actually buy and use the product. With regard to the principle of lawfulness, described in Art 50: "*Inventions whose implementation is contraryto public order or morality shall not be patented*" (Industrial Property Code, Art 50.) A debate opens up onthe definition of public order, for which it is complicated to establish ethical-legal rules delineating its boundaries.

This is one of the first discussions that call into question Italian case law on the subject of the founding safety of autonomous driving technology, i.e. the patent: for this reason, it is no coincidence that Italy does not appear in the rankings of countries that implement the level of preparation of autonomous vehicles on the road. Looking at other countries, the situation is very different, so much so that there are no particular questions about applicability from a legal point of view; Singapore is one of the most active countries from this point of view, so much so that it tops the '*Autonomous Vehicles Readiness Index'* ranking *in the area called 'policy and legislation*'.

In this category they compete for the most:

- Countries that support this research the most financially.
- Countries that have regulations that support the use of AVs and place certain restrictions on when, where and how AV testing can occur.
- Countries spread the responsibility for *Autonomous Vehicles* over a large number of governmental entities.
- The countries with the largest market shares for electric vehicles, as most AV vehicles will be electric.

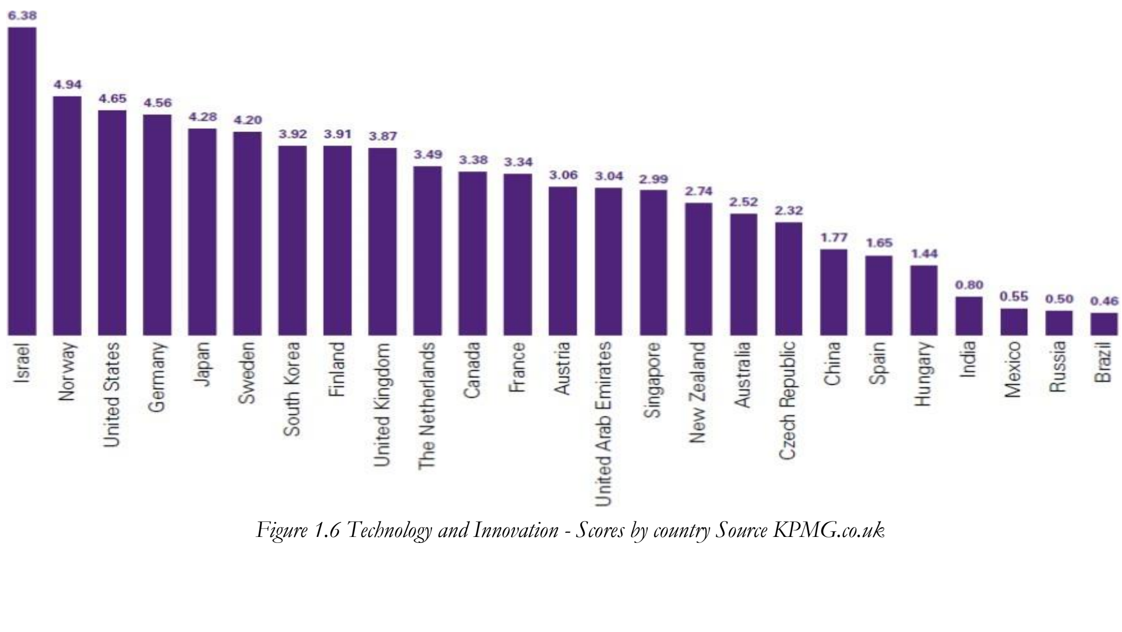

Figure 1.6 Technology and Innovation - Scores by country Source KPMG.co.uk

Pillar 2: (Technology and innovation) normalized indicator values by country

Country	Industry partnerships	AV tech firm HQ	AV-related patents	Investment in AV-related firms	WEF – Availability of the latest technology	WEF – Capacity for innovation	Market share of electric cars
Israel	1.000	1.000	0.045	1.000	0.946	0.968	0.000
Norway	0.917	0.126	0.009	0.155	0.971	0.662	1.000
United States	1.000	0.176	0.340	0.141	0.931	1.000	0.031
Germany	1.000	0.069	0.752	0.030	0.751	0.901	0.041
Japan	0.833	0.029	1.000	0.009	0.843	0.588	0.026
Sweden	0.750	0.179	0.214	0.124	0.937	0.904	0.161
South Korea	1.000	0.043	0.863	0.040	0.633	0.438	0.033
Finland	0.917	0.199	0.044	0.000	1.000	0.813	0.066
United Kingdom	0.833	0.130	0.246	0.123	0.855	0.778	0.043
The Netherlands	0.667	0.129	0.016	0.071	0.907	0.855	0.069
Canada	1.000	0.109	0.097	0.034	0.782	0.576	0.028
France	0.833	0.044	0.119	0.044	0.735	0.780	0.043
Austria	0.667	0.050	0.131	0.046	0.685	0.797	0.004
United Arab Emirates	0.833	0.000	0.000	0.000	0.787	0.713	0.028
Singapore	0.833	0.039	0.000	0.073	0.771	0.606	0.002
New Zealand	0.667	0.000	0.026	0.000	0.743	0.666	0.028
Australia	0.500	0.055	0.184	0.068	0.576	0.573	0.003
Czech Republic	0.750	0.000	0.000	0.000	0.543	0.509	0.000
China	0.750	0.005	0.062	0.005	0.023	0.310	0.056
Spain	0.500	0.009	0.029	0.017	0.462	0.257	0.010
Hungary	0.667	0.067	0.017	0.000	0.371	0.000	0.000
India	0.167	0.003	0.002	0.002	0.121	0.322	0.002
Mexico	0.000	0.000	0.008	0.000	0.269	0.146	0.001
Russia	0.167	0.002	0.036	0.003	0.000	0.180	0.000
Brazil	0.167	0.001	0.009	0.002	0.046	0.136	0.001

Figure 1.7 - Innovation indicators in the various countries. Source KPMG.it

1.4 Connectivity

Connectivity is the ability for different systems to interact through an exchange of information and, most of the time, humans are involved in this operation, such as when we open an *app* on our *smartphone* and buy a notification requesting location sharing or consent to receive notifications.
Accepting these requests seems obvious to us now that we have downloaded countless applications that we live with on a daily basis*, it* appears to us as an automatic process, we perform it with ease, yet it is exactly what connects our device with the servers that control it.
So described, it might have a negative connotation and might frighten users, who consider *privacy as* an important element to keep hidden the most intimate side of what concerns us, but the more we study these single events, the more we become aware of the fact that *privacy* is no longer something to be taken for granted, connectivity can simplify our daily life but it has its dangers and negative sides.
As shown in Figure 1.8, Italians nevertheless seem to be fascinated by the idea of an increasingly connected vehicle and are less concerned about the collection and use of personal data in the face of greater connectivity, with one survey showing that only one in three Italians is concerned about this issue, which is even lower than in China and Japan (42 per cent and 39 per cent).
What is of most concern is the idea that passenger biometric data could be stored and shared with third parties: a fear shared by more than half of customers in Austria (62%), Germany (60%) and the UK (57%).

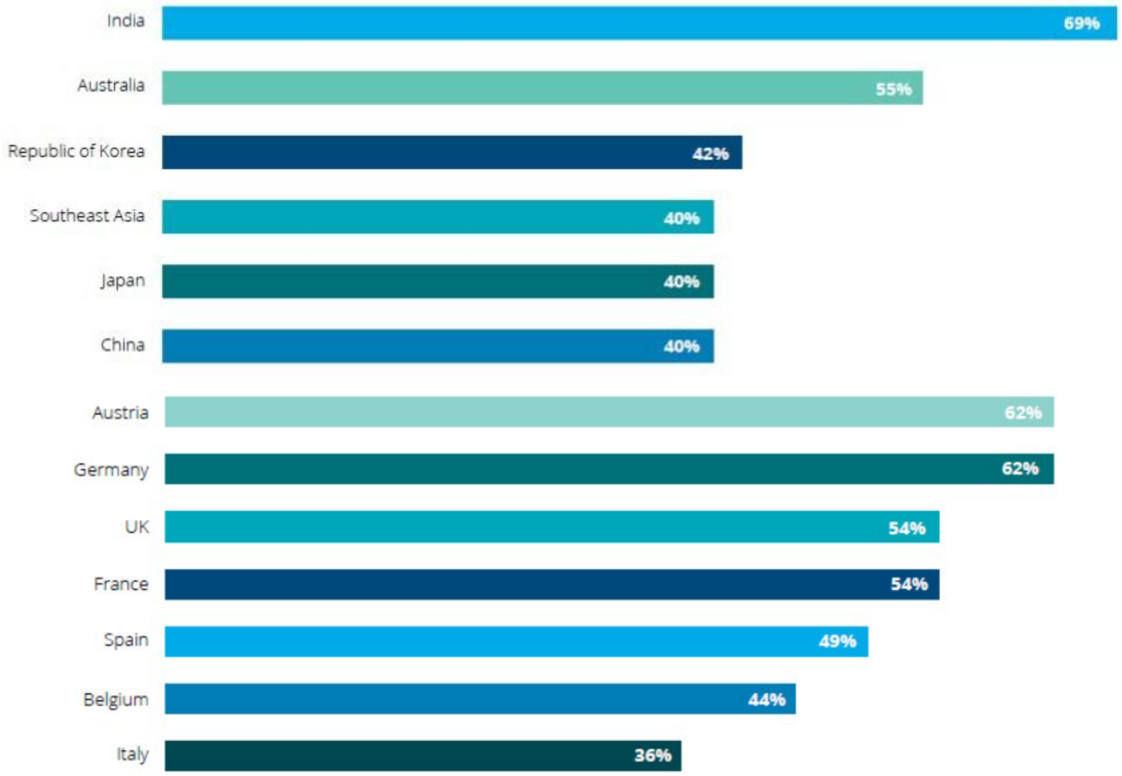

Figure 1.8 - Percentage of consumers who are somewhat/very concerned about the concept of biometric data being captured and shared with external parties. Source: Global Automotive Consumer Study 2020, "Is consumer interest in advanced automotive technologies on the move?", Deloitte.co.uk.

However, connectivity in the automotive sector is becoming an important feature for customers: the ability to communicate directly with the car through voice commands, the ability to view technical usage statistics, average consumption, range, tyre pressure, weather, song playback, store seat position or adjust temperature according to driver preferences.

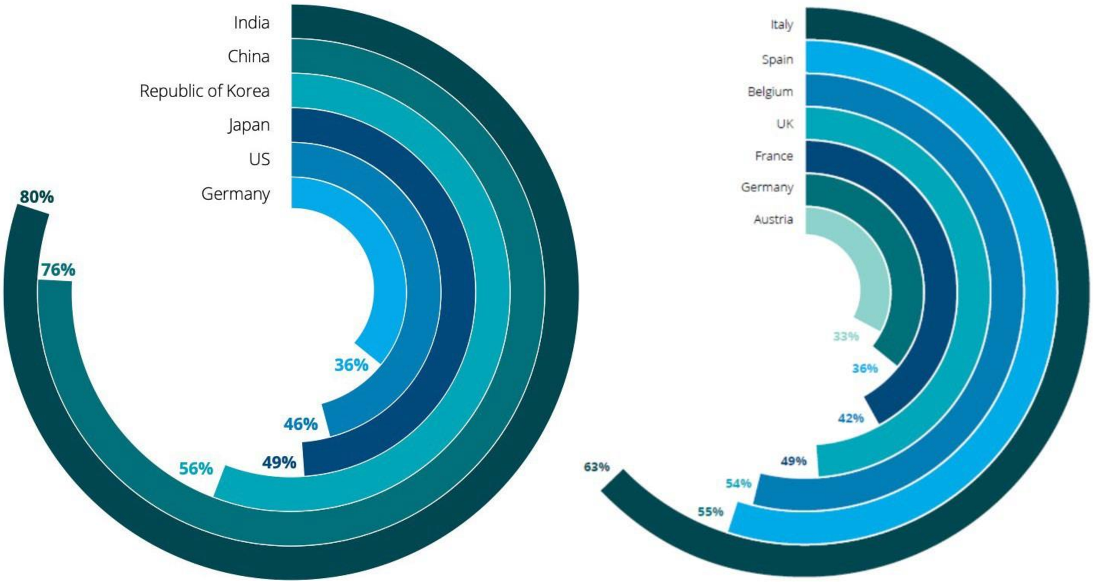

Figure 1.9 - How many consumers perceive vehicle connectivity as a benefit. Source Deloitte.co.uk.

From the graph in Figure 1.9, it is possible to see how consumers believe that connectivity in cars will bring benefits: the most convinced nations are India and China, with very high percentages of 80% and 76% respectively. Korea followed with 56% and Japan with half of the consumers, while the United States and Germany closed the list with 46% and 36%. Another survey conducted by Deloitte revealed which consumers are not willing to pay a premium for more connectivity on board: France and Germany lead the ranking (45% and 43% respectively), almost doubling the percentage in Italy (28%), expressing the lowest value among the main Western countries.

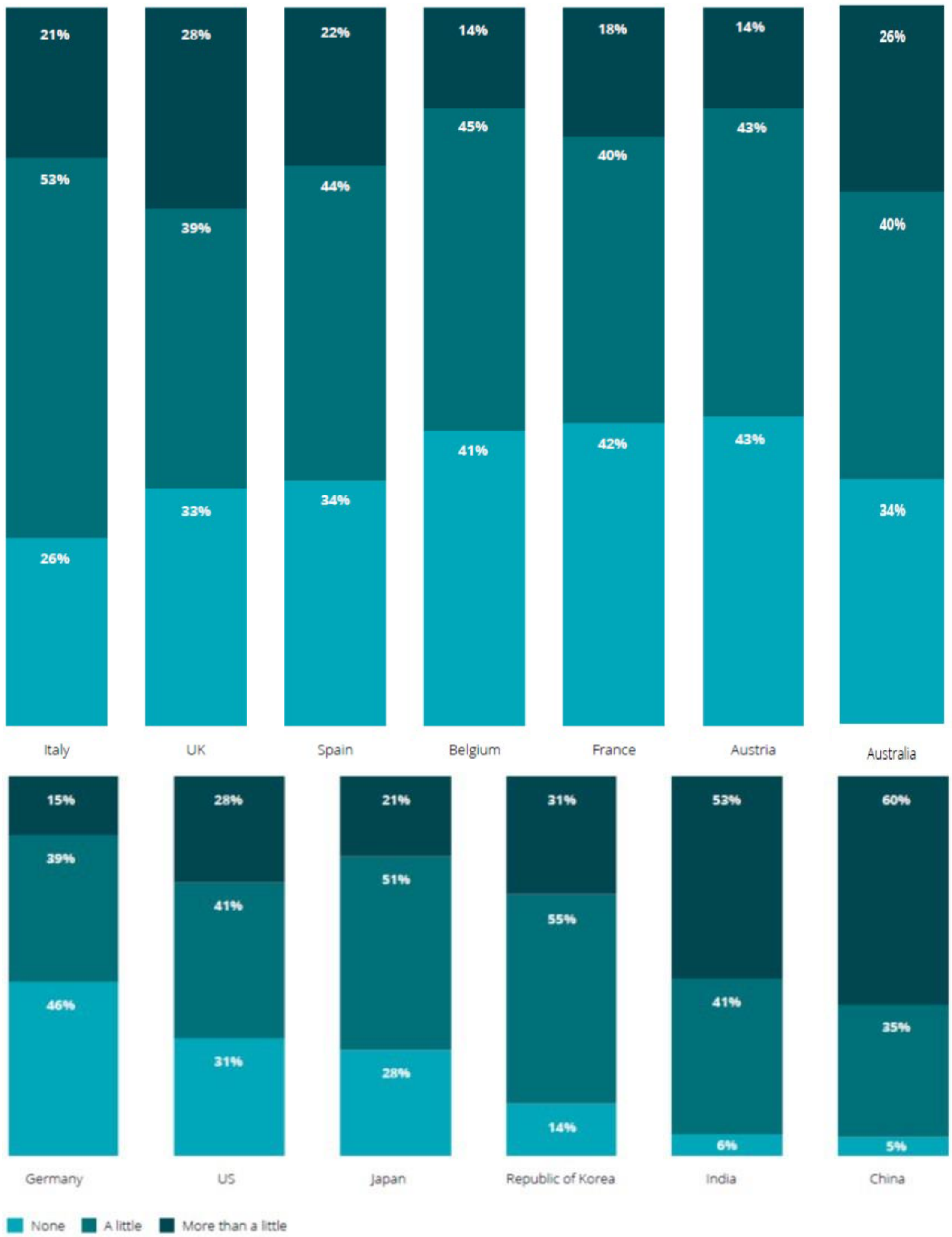

Figure 1.10 - Survey on increased car connectivity versus price increase Deloitte.co.uk.

In the past, the purchase of a car depended on the choice of vehicle size, category and segment, the size of the engine and the resulting fuel consumption, whereas today the arguments that lead a customer to choose one model over another are completely different.
One of these is the technology package with infotainment systems, such as navigation, which until a few years ago required the service centre to update, whereas today updates can be carried out remotely.
When we talk about *infotainment* systems, we are referring to the possibility of controlling the satellite navigation system, the radio and now also our *smartphone* from inside the car, creating a connection between our device and our car.
This step allows us to carry out various activities without taking our eyes off the road, i.e. without losing concentration, ensuring safety for the driver who can carry out other activities while driving.
Thanks to voice commands, you can dictate e-mails, messages, receive or make calls, and search the web, all without breaking the Highway Code.
This is why companies like Apple and Android have invested in the automotive market and, using their software know-how, have developed systems called 'Apple CarPlay' and 'Android Auto', thanks to which, once you have connected your smartphone to one of the two systems, you can display most of the *apps* installed on your phone on your car's *infotainment* screen via icons such as calls, Google Maps, Spotify and much more.
Car manufacturers are therefore not backing down, and are developing larger-than-life *infotainment* system screens with more detailed graphics that have access to real-time traffic news, roadworks or accidents.
A guiding example is Tesla's IVI *infotainment* system, which consists of a 15-inch touchscreen monitor in the middle of the car's dashboard and is the command centre for all the car's functions. There are no physical buttons at all, which might be disorienting at first, but their absence is made up for by a well-crafted voice command system and excellent *touchscreen feedback*.
Lastly, the new system called MBUX (Mercedes-Benz User eXperience), a new artificial intelligence interface developed by the German manufacturer Mercedes Benz, which guarantees a new man-machine communication aimed at revolutionising the relationship between the car and its occupants, starting with the driver.
With two simple words, "Hey Mercedes", the user enters the MBUX universe. Using the advanced artificial intelligence of the Voicetronic, the user is able to manage a wide range of topics, as MBUX is able to understand complex questions and answer them quickly: general culture, sport, calculations and stock market trends, or even switching lights and home security systems on and off (thanks to the collaboration with Amazon Echo (*mercedesbenz.it*).
The next step will be cars with C-V2X (*Cellular - Vehicle to everythings*), V2V (*Vehicle to Vehicle*), V2I (*Vehicle To Infrastructure*) and V2N (*Vehicle-to-Network*) connectivity.

All these systems will serve different purposes:

- Preventing fines with systems such as *Signal Phase and Timing* (SPaT) and *Red Violation Warning* which, via the central display, show the traffic light and indicate how long it will stay on, and will warn the driver if at the speed they are travelling they are in danger of running a red (California PATH Program Institute of Transportation Studies, '*Investigating the Potential Benefits of Broadcasted Signal Phase and Timing (SPaT) Data under IntelliDrive*', 2014).
- Saving more than 40 per cent of road fatalities, Vodafone Germany and Ford have used V2X technology to alert drivers of an accident, sending out the signal in advance to all cars approaching the crash site and alerting help promptly *(https://www.hdmotori.it/2019/07/02/ford-vodafone-auto-connessa-trovare-parcheggio/International, 2019).*
- Real-time high definition maps and traffic communication for the most critical T-junctions, allowing oncoming cars to know where other cars are and avoid accidents.

1.4.1. IoT, Internet of Things

Today, the use of electronics has become pervasive and the improvement of telecommunication technologies is making it easier and cheaper to integrate them into everything.
We talk about IoT when we have a real network of physical objects, including not only the classic devices such as smartphones, tablets and PCs through which we are accustomed to having access to the Internet, but all (or almost all) objects and services that we have every day.
The application domains of this current paradigm can be very diverse and the goal of engineers and infrastructures is to ensure good horizontal integration between them. Home automation is certainly one of the most iconic ones, but for example even public services such as schools and healthcare will enjoy great improvements thanks to such a widespread connection. There are also many possibilities in the productive sphere, whether in the primary sector with more advanced agriculture, in the secondary sector with much more efficient industries and factories, or in the tertiary sector where automatic or semi-automatic organisation of all the various management processes makes their services more effective.
What distinguishes a common object from an intelligent one is the ability of the latter to collect information about the world around it and to be able to exchange it, according to specific purposes, with objects of its own class and/or different classes.
In order to better understand the real meaning of IoT, it is appropriate to schematically illustrate the six main macro-elements that constitute the core of its functioning: identification, sensation, communication, processing, services and semantics.
It must be taken into account that the standards for implementing all the various building blocks are heterogeneous, so if the IoT is to become pervasive, all the various technologies used must be

interoperable with each other, either through the definition of single, precise standards or through the creation of appropriate supporting middleware.

1 Identification*:* the part of identification of objects and resources in the cloud is crucial, becauseit makes it possible to address them univocally by precisely selecting the desired services. Each object must have a precise Object ID and address; their distinction must be underlined, since the address identifies them univocally in the global network, while the ID is the name of the object within its particular context, so it is not globally unique (e.g., I address a particular temperature sensor as T1). An example of a structure for the public addresses of all objects could be the classic IPv4 or IPv6 (the latter is most likely necessary given the huge number of IP addresses required).

2 *Sensing:* in order to have the level of context-awareness needed to perform their functions, objects must be able to autonomously 'read' the outside world, in other words they must have real senses. Sensors are the devices that make this possible, absorbing signals from the real physical environment and translating them into digital signals that can be interpreted and processed by the integrated calculation unit. Thermometers, odometers, accelerometers, etc. are all examples of sensors. The information gathered in this way, which will then be analyzedand processed (Computation), will be stored in internal databases or on the network in the cloud.

3 *Communication:* the exchange of such data through interaction - both direct and indirect - with other objects is clearly fundamental in a co-operation perspective, because it allows access to collected data that are inaccessible to the sensors of the single object, but are necessary in the decision-making phase (Semantics). Some of the technologies that can meet this important requirement are WI-FI, Bluetooth or LTE network; NFC protocol is also suitable in many scenarios. In general, Radio-Frequency IDentification (RFID) technologies are particularly suitable for IoT and they also allow decentralised peer-to-peer communication, particularly suitable, as we will see, for the automotive sector.

4 *Computation:* this part is made possible by the advancement of consumer electronics, which has made it possible for microcontrollers and microprocessors to be cheaply integrated into objects, such as highly modular and adaptable products like Arduino or Raspberry Pi. Computational capacity is able to give a certain level of autonomy to things that possess it. Theuse of integrated computing units also makes it vital to use operating systems suited to the particular purpose. In the IoT context, so-called real-time operating systems (RTOS) are particularly suitable, as they are highly suitable for the critical and constant uses required in many situations (e.g. in the medical field). RTOS-based applications will therefore be developed. Examples of RTOS are Contiki, LiteOS, TinyOS or Android itself. Cloud platformsare also a very important part of computing. These allow smart-objects to share their (collectedand/or processed) data in a 'common ground', thus facilitating its real-time propagation, usefulfor both end-users and big

data. Two examples of existing cloud platforms designed for IoT are Nimbits and Hadoop.

5 Services: services represent the 'functions' of the IoT, i.e. the effects of this paradigm on the applications offered. They can be schematically grouped into four main abstract categories:

- *Identity-related Services*: these are the most basic services and are used in turn by other services; they allow physical objects to be uniquely mapped to their corresponding logicalvirtual objects, enabling various applications to interact with a physical object without misunderstanding. In other words, they give an identity to things.
- *Information Aggregation Services*: collect, group and summarise all the data from the sensorsembedded in the objects. By giving all 'raw' data a structure, the subsequent processing and exploitation of this information is made possible.
- *Collaborative-Aware* Services: These types of services take advantage of the data sorted by services of the previous type and use it to make decisions and react appropriately.
- *Ubiquitous Services*: here we are at the highest level, services of this type in turn coordinatethose of the previous type by intelligently determining how, where and when to use them.

The main applications are many. The so-called smart-home is a clear example of what we are talking about, but there is also fertile ground for this technology in the field of infrastructure, with smart-buildings (think of the management and coordination of an apartment block or a group of structures). The transport sector is another example of the application of the Internetof Things, with the *Intelligent Transportation System (ITS)* concept - discussed in the next chapter. In addition to the management of structures and vehicles, there may also be the management of industrial machines, where cooperation in factories between intelligent machines could have a major impact on the manufacturing sector. Another area, as already mentioned, is healthcare or even energy (smart-grids).

With proper horizontal integration between all these possible applications of the Internet of Things, we will have truly autonomous and intelligent cities (smart-cities), where the quality oflife could increase significantly.

6 Semantics: semantics is the IoT's ability to extract useful and targeted knowledge from the information produced by various devices. It can be seen as the brain of the IoT, it is that block that makes decisions by making the right requests, contacting the right resources, recognizing, analysing and interpreting the data in its possession and making sense of the decisions, thus providing the right services at the right time and in the most efficient way possible. This is supported by the use of semantic web technologies such as Resource Description Framework (RDF), Web Ontology Language (OWL) or Efficient XML Interchange (EXI).

1.4.2. From IoT to IoV: the Intelligent Transportation System concept

As can be easily imagined even by those who are not 'insiders', the Internet of Things is invading, and in the future it will inevitably do so more and more, the world of road mobility, involving not only devices connected to vehicles (such as tablets, smartphones, satellite navigation systems, etc.) but also the vehicles themselves and the entire road infrastructure we use every day to get around. Making this 'natural' evolutionary process orderly, efficient and safe is not a trivial objective, and the following questions need to be asked. The question arises whether the Internet of Things paradigm, as we conceive it today, is already fully suitable for the world of road mobility and whether it is already able to provide all the conceptual and technical tools necessary for the development of a satisfactory and safe road infrastructure.
The exponential technological development in the field of consumer electronics and telecommunications has opened the door to many fields of study; one of these is the Intelligent Transportation System (ITS), which is the integration of modern telecommunications engineering technologies with transport engineering [6]. This integration is a revolution for mobility, as it provides unprecedented tools for a much more refined management of numerous problemsconcerning road mobility.
Even after a very first fantasy, it is not difficult to imagine the potential positive consequences that techniques such as real-time simulation and monitoring of the global flow of vehicles, reactive and proactive communication between vehicles themselves (and with the road infrastructure) and real-time information sharing could have on traffic management. The effects of a better traffic management are not only limited to a (at least potential) decrease in average travel time, but also toa consequent energy saving, to a more effective planning of traffic and road interventions both in the short term and in the medium/long term, to a better safety of all road users, to a better management of emergencies, etc.; these are all aspects that we will see more specifically later on.
Such a scenario is not just desirable, it is even necessary given the current trend of monotonous population growth and ecological emergency. In addition to the benefits, it should be emphasised that ITS also poses all the open problems of computer security and privacy inherent in the network for vehicles.
We live in a historical moment in which so-called smart objects are a pervasive presence in our lives: when we talk about smart objects, we are talking about devices, appliances or other objects with the ability to communicate, but not only that, they are also equipped with sensors with which they are able to interpret, according to a certain language, the external environment, they are also equipped with integrated microprocessors, so they are also able to process this information and then share it with their "peers" and / or with appropriate middleware support.
In the context of road mobility, we can identify these intelligent objects in the vehicles themselves and in the objects that make up the road infrastructure, such as a traffic light or, more generally, a data centre used to process and propagate information to the vehicles, or a central server. In this

scenario, the field of study we are referring to is no longer simply the Internet of Things, but the Internet of Vehicles (IoV).

When it is possible to achieve something, it usually comes about sooner or later. The main areas of research that really constitute the raison d'être of this new mobility concept can be summarised as follows:

- ***Vehicle flow management***: until now, truly efficient traffic management has never really been possible, first and foremost because real-time detection of the flow of vehicles without current telecommunications technology is extremely difficult; some solutions have been (and sometimes still are) sensors on the road surface or video cameras positioned in strategic points, but these methods are of limited effectiveness and very costly. The main methods are illuminated signs, news bulletins, guidebooks or, at best, satellite navigation systems with mostly static information; with solutions of this kind there is the drawback that the same indications are forwarded to all vehicles, which simply moves a traffic jam from one side to the other, instead of distributing it.The aim is to achieve a situation where all vehicles can get a wide-ranging view, albeit always limited to their own geographical macro-area of interest, of the road situation and that each of them can be informed in real time of any new event of interest, so that they can independently decide the best way to move. An example of this could be the choice of the most convenient route at that moment to get from point A to point B; the routes could be multiple and the best way to choose is to do it dynamically, not statically, analysing the amount of traffic on one route rather than another, but to do this it is necessary to collect, process and share information on the flow in real time.
- ***Monitoring of road order***: proactive control of the road is currently very limited and always the responsibility of a few skilled players, so the key is for all vehicles to make their senses available in order to obtain both better quantitative and qualitative results. The key is therefore for all vehicles to make their senses available in order to obtain both quantitative and qualitative results. The coordinated exploitation of the many sensors with which vehicles and infrastructures are (and will increasingly be) equipped is very useful for this purpose.

  An example of a possible scenario could be that of the prevention of a criminal act or a terrorist attack; in the case of knowledge that certain vehicles or individuals are about to attack a certain location, vehicles randomly circulating around that area could be assigned the task of videotaping sequences, collecting metadata and sharing everything in a predetermined Cloud space. Video recordings would also be very useful, sometimes essential, in accident reconstruction investigations, but in this case it would be necessary for all vehicles to record and collect information constantly. Such massive data collection, however, raises significant privacy issues. It is important that such data are only exploited in cases of strict necessity (certainty of ongoing attacks or investigations after accidents). Until then, for example, the data could only be kept for a certain period of time (so old data would be deleted if unused) and remain appropriately encrypted offline on the mass memory of individual vehicles with appropriate (and possibly ephemeral) locally generated private encryption keys, In this way they would remain properly decentralized until a certified authority - perhaps decentralized in turn, distributing such power is important to prevent abuse - tells the vehicle to decrypt and deliver those relating to a given location at a given time. However, there may also be types of information that are not sensitive but useful for road monitoring, in which case it would be useful for such information to be efficiently shared in real time.

- ***Emergency management***: A concept like the IoV would also make the management and coordination of emergency situations much easier. An example could be the sudden unavailability of a portion of a road or the need to leave it free for the police, ambulances, fire brigade, etc. In the scenario we are aiming for, thanks to the orderly application of new technologies, an unexpected change in the situation becomes much less risky and much more coordinatable than now for road users.
- ***Driver assistance***: new generation cars are almost all equipped with a number of driving aids, making them in a sense semi-driven cars; this is therefore not really a new area of research but, with the increase of integrated sensors and the rapid refinement of new and suitable ad hoc communication protocols, it will soon become an increasingly complex and relevant issue. Influencing the vehicle in order to perfect the human driving style can have positive effects both on safety (preventing falls asleep, discouraging undisciplined driving, remedying distractions, etc.) and on pollution (optimal use of the gas, brake and above all the gearbox have a not inconsiderable impact on fuel consumption, vehicle wear and its longevity).

1.4.3. IoV, connectivity and automation

Connectivity is the fastest growing feature in the automotive market. Thanks to new shared mobility services based on the Internet-of-Vehicles (IoV), i.e. the connectivity of multiple vehicles via a communication network, this market is expected to generate around USD 1 trillion by the end of 2030 (McKinsey and Company, 2016), providing the driver with various options and benefits, such as, for example, infotainment or driver assistance services.

Autonomous cars also exploit connectivity and IoV to implement the proper functioning of their driving and mobility services. They use tools such as radar, lidar, GPS and computer vision to perceive the surrounding environment, while in-vehicle control systems integrate these sensory inputs with information from infrastructures or cars on the road, using the communication networkto extend the vehicles' 'line of sight'.

The current and near future market for autonomous cars can be declined according to the levels of automation standardised by the SAE (Society of Automotive Engineers). Specifically, Level 1 and Level 2 automated functionalities identify the market for so-called semi-autonomous cars, including assisted or partially-assisted driving services, such as parking assistance or lane-keeping.

Subsequent levels identify increasingly automated scenarios where connectivity plays a key role. We then move from Level 3, of so-called conditional automation, in which the autonomous driving system performs the driving tasks, but with the expectation that the human driver can respond appropriately to a possible request for intervention, to Levels 4 and 5, which identify fully autonomous cars, sometimes also called robo-cars, which are able to move without any intervention from the driver, even in heavy traffic situations.

While Level 4 and Level 5 fully autonomous vehicles are still being tested, there are already Level 2 and Level 3 cars on the market, for example using *Cooperative Cruise Control* and other technologies. And the trend is set to grow. According to PwC Autofacts, 40 per cent of the kilometres driven in Europe will be covered by autonomous vehicles in 2030. In addition, the global market for autonomous cars has been valued at around $24 billion in 2019 (Research and Market, 2020) and public authorities are focusing on its potential economic and social benefits. According to the EU Parliament, digital technologies can reduce traffic jams and accidents, reduce environmental impact, improve access to mobility and secure new jobs with profits of €620 billion for the automotive sector by 2025. Despite the recent slowdown caused by the Covid-19 pandemic, developments in Europe and the US are expected to continue at roughly the same pace. In China, on the other hand, given the investments on autonomous cars in the Chinese sector, the penetration of autonomous mobility could be faster than in the Western world (PWC global, 2018).

The key question to ask in this technological context is how to ensure that the transport of the future based on connected and autonomous vehicles is safe for all road users.

Mobile networks today provide an efficient and widely available communications infrastructure and,in the current scenario, 4G networks already support many of the services available in cars, enablingthe exchange of information with data transmission rates of up to 300 megabits per second and latencies of less than 200 milliseconds.

However, in order to improve road safety and make the autonomous and assisted driving systems of the near future more effective, it is necessary to imagine communication structures with even lower latency, i.e. making critical data exchanged in cyber space available 'immediately' to all road users, so as to avoid dangerous situations and prevent accidents between vehicles, pedestrians and motorcyclists.

The new 5G network can not only ensure faster data transfer and shorter waiting time between sending and receiving a signal, but can also handle many more connected devices at the same time, and can play a key role in the spread of autonomous cars and new IoV-based mobility services. Indeed, its bandwidth, with data transmission of up to 20 gigabits per second, allows latencies to be

reduced to below 10 milliseconds, while ensuring support for device densities of up to 100 devices/m2 and a reliable coverage area (5G PPP, European Commission Horizon 2020 collaborative research program).
This allows vehicles to be aware of the conditions of the environment in which they are moving in a shorter time and, consequently, to be able to make the right decisions autonomously and promptly, even in highly congested road contexts. In fact, this 'real time' information exchange will also enable new paradigms of collaborative mobility, allowing, for example, the formation of real platoons or convoys of vehicles that follow one another along the road maintaining very small inter-vehicular distances, thus reducing aerodynamic resistance, and therefore consumption, by up to 60% (platooning).
With this in mind, in addition to the pioneering demonstrations already carried out in this area by TIM thanks to its 5G network, a recent experimental campaign conducted by a team of researchers from the University of Naples Federico II and Chalmers University in Sweden at the AstaZero autonomous vehicle test track empirically showed how, by exploiting a 5G communication network, Level 5 vehicles can move around in an urban scenario, even crossing non-signalized road junctions. The experiments carried out in the AstaZero city area, characterized by small towns with roads of various widths and lanes, also tested the effectiveness of autonomous driving in mixed traffic conditions. Fully automated cars will gradually be introduced to the market and, as a result, will share the road with connected human-driven vehicles. Mixed traffic will therefore be the real challenge of the near future. Only by effectively exchanging information via the communication channel will automated cars be able to correctly sense the behaviour of human drivers and thus interact with other road users.

1.5 Electrification

"The automotive industry is in transition to an electrified future. It is focused on reducing carbon emissions related to its product offering, through more efficient internal combustion engines (ICEs) and, most importantly, hybrid and fully electric vehicles (EVs)." Comment by Daniel de Koning, Credit Analyst at Robeco.
The transition to electric vehicles requires significant investments by car manufacturers (OEMs) to finance research, development and the construction of production processes based on the new technologies. These investments are crucial to the ability of manufacturers to meet their ambitious targets, which in turn require a significant increase in sales of electric vehicles.
Increasingly stringent regulatory limits for CO_2 and NOx emissions are a key catalyst for the technology transition. Legislators around the world have set clear and strict emission limits for new vehicles. European legislators are setting an example globally, with regulations that include not only

strict emission targets, but also penalties for non-compliance should a car manufacturer breach these limits.

The ability of manufacturers to maintain profit margins varies considerably from one company to another. In general, the shift to selling electric vehicles will initially have a negative impact on margins, as electric vehicles do not yet have sufficient economies of scale and therefore generate lower margins than internal combustion vehicles. It is therefore vital for car companies to achieve significant scale in the production of electric vehicles as soon as possible in order to maintain overallprofitability.

The good news is that consumers are increasingly adopting electric vehicles. The production costs of combustion and electric vehicles should therefore reach parity in the next few years. The types of electric vehicles are increasing as products are further developed and charging infrastructures become more widespread.

Some developments triggered by the emergence of the Covid-19 pandemic in the early 2020s have been very beneficial for the electrification of the automotive industry. Governments and other national regulators have introduced attractive incentive schemes for consumers and subsidies for manufacturers to alleviate the financial impact of the pandemic on the automotive industry, mainly focused on electrified entry and mid-market models.

It is inevitable that the market for internal combustion vehicles will shrink as the penetration of electric vehicles increases. Depending on the pace of EV adoption, the traditional market could end up with significant excess production capacity, which in turn will squeeze profit margins and could result in asset write-downs and costly plant closures. Being too slow in moving away from fossil fuel vehicles may also mean unnecessarily allocating resources to a declining business, while the return on those resources could be much better if spent on electrification.

Since the transition to electrification could have a major impact on the development of a company's credit quality, it has become a key component of our fundamental analysis of automotive companies. An important element of this analysis is our assessment of EV product strategy. We have a preference for pure electric vehicles over hybrids, as they are able to reduce emissions more and benefit from the relative simplicity of their product; hybrids, on the other hand, still require two powertrains, i.e. both a combustion engine and an electric motor.

We also favour car manufacturers who apply a universal 'modular' platform that can be used for a multitude of different models, as this allows for greater economies of scale and thus higher margins. Another aspect we are looking at is the expected development of manufacturers' market share in electric vehicles.

Ideally, the manufacturer is an early adapter and has already incurred most of the R&D and capital expenditure. If not, we look at the extent of capex and R&D plans. For example, we assess whether the expenses are sufficient to achieve the objectives, and how the company would be able to finance these expenses.

1.5.1. The history of the electric car

We call it a revolution, and we look at it with attentive and curious eyes, but the first electric car dates back to 1832, when the Scotsman Robert Anderson created the first car powered by an electric motor, followed by Professor Sibrandus Stratingh of Groningen in 1835, and again by the French Gaston Plante in 1865 and Camille Faure in 1881, who perfected accumulators.

France and Great Britain were the first pioneers and spectators of the growing market for electric cars, which became the subject of constant experiments with the ultimate aim of perfecting the electric motor: one of the most famous was on 29 April 1899 by Camille Jenatzy in his 'missile-shaped' electric transport vehicle, the Jamais Contente, which reached a top speed of 105.88 km/h.

Figure 1.11 la Jamais Contente. Source: Mondial de l'Automobile de Paris 2014

It is even said that, for a while, they sold more electric cars than petrol-powered ones: the electric components were produced by the companies Anthony Electric, Baker Electric, Detroit Electric in the early 20th century.

However, the first technological limitations were already appearing, centred on the poor quality of the batteries, the inadequacy of charge control technology and traction problems, which prevented the cars from exceeding 32km/h. (Kirrsch, 2000).

1.5.2. Manufacturers' strategy

An interesting argument arises in knowing what the reasons are that have pushed car manufacturers towards the electric world: while on the one hand the biggest car manufacturers want to stand out with the designation of 'green company', it is also true that there are regulations that impose such a radical decision on them.

Ezio Spezza, Professor of Industrial Engineering at Turin Polytechnic, explains how: "*The European automotive industry is being forced to change by EU directives that envisage emissions of 95 gCO2/km for the average sales of each manufacturer in 2020, which will fall by 15% in 2025 and 37% in 2030. These levels can be reached in two main ways: by further improving internal combustion engines, which is complicated by the contrast between techniques for cutting pollutants and those for reducing CO2 emissions, and by electrifying cars*" (Codegoni, 2020).

Thus the major manufacturers, especially those boasting sporty ranges and high levels of gCO_2/km emissions, seem to favour the choice of electric rather than stopping the production of high-performance engines.

Once again, there is a flaw in the system, because according to Ezio Spezza: "*The CO_2 that counts in the EU limits is only that emitted at the tailpipe, not in the life cycle. If the CO emitted for battery construction and electricity production were also taken into account, the electric car would be less brilliant in this respect. However, since those are the rules, it is clear that car manufacturers will have to sell lots of electrically powered cars to lower average emissions*". (Codegoni, "*I rischi dell'industria dell'auto con l'arrivo dell'elettrico*", in qualenergia.it, January 2020).

*T&E'*s ranking of *the readiness of* 10 major OEMs in Europe examines carmakers' current and near-term EV sales as well as their broader industry strategies (battery supply chain, charging infrastructure, dedicated BEV platforms, etc.). T&E's ranking of the readiness of the top 10 OEMs in Europe to go electric by 2030 based on this index shows that there are big differences in the ambition and qualityof their plans. Volkswagen and Volvo Cars have aggressive and credible strategies. Others, such as Ford, have an ambitious phase-out target, but lack a solid plan to achieve it. Stellantis, Daimler, BMW,Jaguar Land Rover and Toyota rank worst with low sales of short term battery electrics (BEVs), no ambitious phase-out target, no clear industrial strategy and an over-reliance in the case of BMW, Daimler and Toyota on hybrids.

The report also reveals:

- Production of BEVs in the EU27 is expected to increase from around 1 million units in 2021 (7.4% of production), to 3.3 million units in 2025 (24.2%) and overtake sales of internal combustion engine (ICE) cars in 2030 with 6.7 million (50.2%).
- Carmakers' production plans show that plug-in hybrid vehicles (PHEVs) are expected to peak at 1.6 million units in 2026 (12% of total car production) and then stagnate throughout the second half of the decade.
- Ford has an ambitious commitment to go fully electric by 2030. But it seems that time is runningout. It is expected to produce only 13% BEVs by 2025.
- Toyota has not set a target for 2030 and plans to produce only 10% electric vehicles in 2025. Itis expected to rely on polluting hybrid technologies (44% of its EU production in 2030).

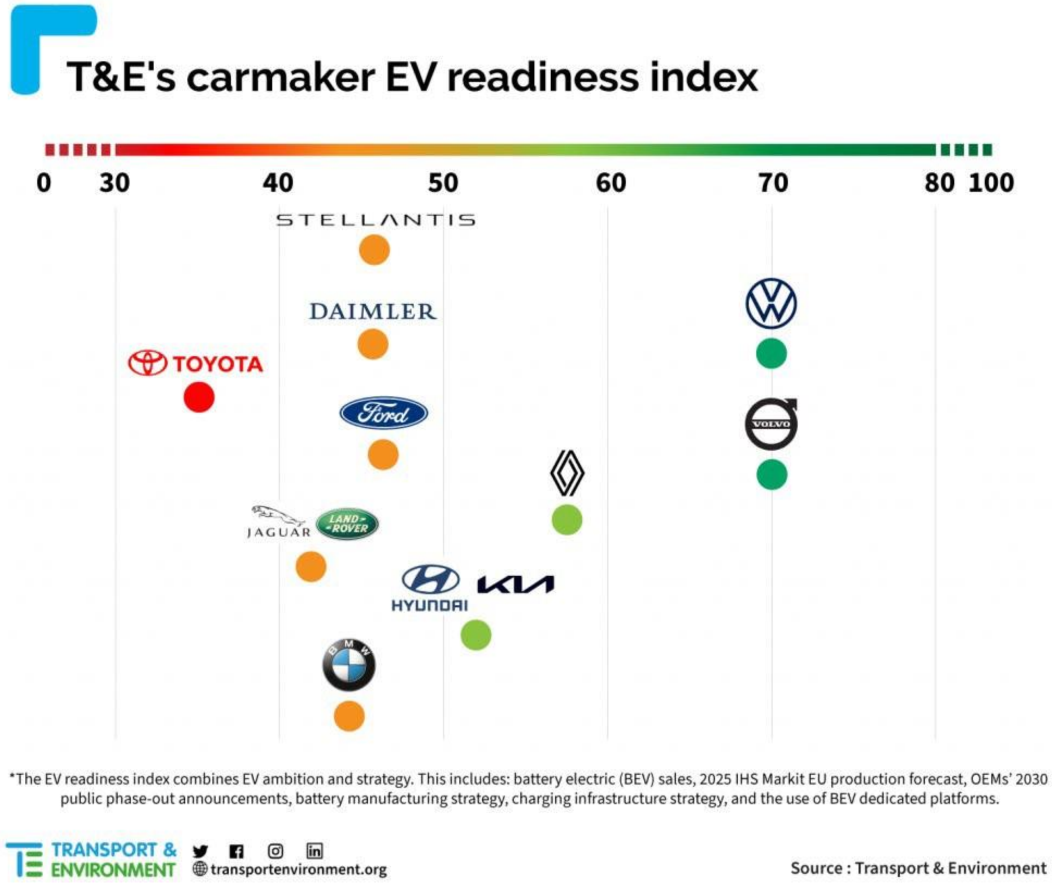

Figure 1.12 T&E's ranking of the readiness of 10 major OEMs in Europe. Source: IHS Markit Automotive

The report raises concerns about the reliance on voluntary commitments by carmakers, which are too low and not supported by a coherent industrial strategy.

T&E's previous analysis showed that in 2016, carmakers failed to meet their collective target of selling 3.6% of electric cars, achieving less than half of that.

But even if current promises are kept, European sales of battery electric vehicles (BEVs) are likely to be at least 10 percentage points lower than they should be in 2030. To ensure that carmakers increase production of affordable electric cars in time to decarbonise by mid-century, European regulators need to set binding CO2 targets for cars over the next decade, bringing two-thirds of new cars to be fully electric by 2030 and all new cars by 2035, says T&E.

1.5.3. The presence of electric vehicles in Europe

According to a report by *ACEA* (*European Automobile Manufacturers' Association*), more than 285,000 electric cars were sold in the European Union in 2019, marking a doubled number compared to 2018. Sales of hybrid cars were also up (+50%) with 465,026 units, and *plug-in* hybrids (+13.9%) with 174,103 units. As can be seen from the table, sales of electric vehicles in 2019 increased by 93.3%.

	Q4 2019	Q4 2018	% Change	Q1-Q4 2019	Q1-Q4 2018	% Change
AUSTRIA	1,864	2,278	-18.2	9,261	6,764	36.9
BELGIUM	2,099	1,235	70.0	8,837	3,648	142.2
BULGARIA	0	84	-100.0	181	194	-6.7
CZECH REPUBLIC	170	234	-27.4	756	703	7.5
DENMARK	1,609	617	160.8	5,532	1,745	217.0
ESTONIA	14	13	7.7	80	85	-5.9
FINLAND	321	235	36.6	1,897	776	144.5
FRANCE	12,397	10,839	14.4	42,827	31,095	37.7
GERMANY	15,436	11,538	33.8	63,491	36,216	75.3
GREECE	38	31	22.6	190	88	115.9
HUNGARY	481	433	11.1	1,833	1,300	41.0
IRELAND	470	59	696.6	3,444	1,233	179.3
ITALY	2,877	1,418	102.9	10,663	4,999	113.3
LATVIA	24	18	33.3	88	73	20.5
LITHUANIA	42	57	-26.3	162	143	13.3
NETHERLANDS	32,141	10,884	195.3	62,056	23,998	158.6
POLAND	301	209	44.0	1,490	620	140.3
PORTUGAL	1,461	1,268	15.2	6,883	4,073	69.0
ROMANIA	507	137	270.1	1,506	605	148.9
SLOVAKIA	43	71	-39.4	165	293	-43.7
SLOVENIA	162	119	36.1	515	467	10.3
SPAIN	2,582	2,590	-0.3	10,044	5,983	67.9
SWEDEN	3,444	3,100	11.1	15,596	7,083	120.2
UNITED KINGDOM	12,753	4,211	202.8	37,850	15,510	144.0
EUROPEAN UNION	**91,236**	**51,678**	**76.5**	**285,347**	**147,694**	**93.2**
EU15	89,492	50,303	77.9	278,571	143,211	94.5
EU (New Members)	1,744	1,375	26.8	6,776	4,483	51.1
ICELAND	*202*	*226*	*-10.6*	*914*	*687*	*33.0*
NORWAY	*10,862*	*14,737*	*-26.3*	*60,345*	*46,143*	*30.8*
SWITZERLAND	*4,338*	*1,635*	*165.3*	*13,190*	*5,138*	*156.7*
EFTA	*15,402*	*16,598*	*-7.2*	*74,449*	*51,968*	*43.3*
EU + EFTA	**106,638**	**68,276**	**56.2**	**359,796**	**199,662**	**80.2**
EU15 + EFTA	**104,894**	**66,901**	**56.8**	**353,020**	**195,179**	**80.9**

Figure 1.13 - Electric vehicles sold in EU+EFTA, ACEANew Passenger Car Registrations By Fuel Type In The European Union", ACEA, February, 2020.

First place is taken by Germany with 63,491 sales units, followed by the Netherlands with 62,056 units and, on the lowest step of the podium, France with 42,827 units. Although Italy in terms of volumes is still far from those of the countries competing for the top spots, it still marked an increase of 113% from 2019 to 2018, placing fourth with sales units of 10,663.

Taking a closer look, we realize that despite the significant progress in sales of electric vehicles, they represent a small niche in the market in which they operate: as can be seen from this pie chart representing the sectioning of the automotive market in Europe, fully electric vehicles (ECVs) represent only 4.4%, a figure that will probably have to be read and interpreted in a dynamic way in the coming years.

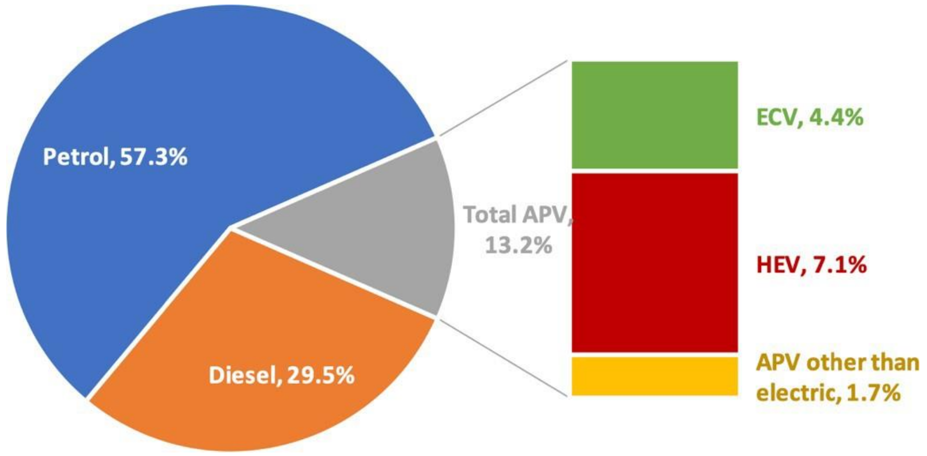

Figure 1.14 Pie chart market segmentation, ACEA

Sales of hybrid cars were also up (+50%) with 465,026 units, and *plug-in* hybrids (+13.9%) with 174,103 units. As can be seen from the table, sales of electric vehicles in 2019 increased by 93.3%. First place is taken by Germany with 63,491 sales units, followed by the Netherlands with 62,056 units and, on the lowest step of the podium, France with 42,827 units. Although Italy in terms of volumes is still far from those of the countries competing for the top spots, it still marked an increase of 113% from 2019 to 2018, placing fourth with sales units of 10,663.

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1.5.4. Climate Change and Electric Car Pollution

The issue of the environmental impact of vehicles frightens the population, as it is considered one of the main causes of climate change, mainly due to Green House Gas (GHG) emissions produced by engine combustion, and of atmospheric pollution, understood as the change in air composition through the emission of gases, fine dust and fumes, substances that can have serious consequences for human health.

The substances responsible for the climate-changing effect of emissions and those that are considered to be the most damaging sources of pollution from vehicles are mainly the following two:

1. CO2, primarily the result of the oxidation (combustion) of fossil fuels, which contributes to global warming and is unanimously considered by the entire international scientific communityas the gas responsible for the greenhouse effect.

2. PM10, the main sources of which are human activities: combustion processes (including thosein internal combustion engines, heating systems, many industrial activities, incinerators and thermal

power plants), tyre wear, brakes and asphalt, which pose an immediate danger to human health. With regard to the first source, it is logical to think that electric cars do not generate CO2 pollution, as their emissions are zero (however, this refers to the pollution linked to the production of the electricity that powers them: if it comes from fossil fuels, there is no benefit for the environment). With regard to the other categories, research by ADAC, one of Europe's largest automobile clubs, has shown that a new-generation diesel engine pollutes less than an equivalent petrol engine, while hybrid cars only pollute as much as a petrol car when used in the city, while on out-of-town routes they pollute as much as a petrol car as the electric motor is only called upon at low speeds, beyond which it is replaced by the heat engine. (ADAC, 2019)

As far as particulate matter is concerned, it is unavoidable how wear and tear on brakes, asphalt and tyres can result from the electric car as much as from other categories.

Speaking more generally about the effects on the ecosystem, a study conducted by the International Energy Agency (IEA) shows that the average life-cycle impact of electric or hybrid cars (BEVs and PHEVs), compared to petrol or diesel cars, is lower, and could generate considerable welfare for future generations, guaranteeing a reduction in PM10 of 40%-50% and a reduction in total primary energy of 15%-20%.

The estimation of the average environmental effects of BEVs and PHEVs substituting diesel and gasoline globally shows

- GHG-reduction: 25 % to 30 %
- PM reduction: 40 % to 50 %
- Acidification: 0 % to 5 %
- Ozone reduction: 50 % to 60 %
- Fossil primary energy reduction 25 % to 30 %
- Renewable primary energy increase 10 % to 15 %
- Nuclear primary energy increase 600 % to 800 %
- Total primary energy reduction 15 % to 20 %

Figure 1.15 Estimated impacts of electric or hybrid cars (BEVs and PHEVs) compared to petrol or diesel cars. Source: 'TechnologyCollaboration Programme on Hybrid and Electric Vehicles', IEA, 2018

Ultimately, there is the impact of electric mobility compared to traditional mobility in terms of pollution from the extraction of materials useful for the life of the batteries that power the vehicles, an example being the contamination of fresh water tables or the environmental impact attributable to their manufacture.

Almost all manufacturers use lithium-ion batteries for energy storage, and lithium is a metallic chemical substance, completely non-renewable and extracted by large multinational groups in a few, well-located mineral deposits.

Currently, the world's largest lithium producer is Australia, with 39.7% of world production, followed by Chile (33.3%), Argentina (15.8%), Bolivia and finally China.

Lithium deposits are therefore located in remote areas where legislative protection is often lacking;

in particular, this metal is extracted in large salt lakes, with the consequent contamination of the soil and groundwater, causing serious damage to the population living in those areas in the immediate future and to the world population in the medium to long term.
The second component widely used in lithium-ion batteries is cobalt, also a material with limited availability. More than half of its production, unlike lithium, is in the hands of a single country, the Democratic Republic of Congo. There are geopolitical and ethical problems in cobalt mining because the basic human rights of the workers are not respected in the mines, since a large number of indigenous workers, especially children, are employed, as their small bodies make it easier for them to enter tunnels and holes. To make up for these ethical issues, leading electric battery manufacturers, including Tesla supplier Panasonic, are developing a new generation of batteries that are free, or almost free, of cobalt, which will be replaced by a morally and technologically more promising solution: the use of large-capacity graphene electric capacitors, which would appear to need faster and more efficient charging processes, and would ensure electricity storage in smaller and lighter volumes. (Comini, 2019)
According to research conducted by the Swedish Environmental Research Institute in Stockholm, when the vehicle reaches its end of life, the battery remains at 80% of its initial capacity: this offers the opportunity to extend the life of the batteries by reusing them in a less demanding application, giving them a second life, and thus ensuring a longer use, which will mean less impact on production. Much of the battery capacity remains after use in the vehicles and this can and should be used to have a large fleet of electric vehicles in a sustainable way, or it could be used for many other applications, such as renewable energy grid storage, *backup* systems, small-scale electricity generation storage and probably many other applications.
The current problems are numerous; one is precisely the diagnosis of the batteries when they are removed from the car as to their condition, their safety and their remaining capacity.
Furthermore, considering that it is not always easy to guarantee the quality of old batteries, making their second life more complex and uncertain, these concerns will also be reflected in the market, leading to a situation where most customers prefer the safety and stability of new batteries, and for this reason it will be important for the market to direct the reuse of batteries into a safe business (Swedish Environmental Research Institute, 2017)

1.6 Smart Mobility

The world of cars is going through the most important transition in its history, the concept of mobility is changing radically, people are moving towards solutions that can be shared with other users and more environmentally friendly models continue to be developed.
Shared mobility does not represent a single sector, such as the automotive sector, but as a principle

it indicates and represents a concept: moving around by sharing the tools that enable you to get around. At the heart of this thinking lies the opportunity to avoid a purchase and to own the asset for a short period of time, i.e. the time needed to move from a point of departure to a point of arrival. Shared mobility is becoming one of the most important *trends* for metropolises, and represents a symbol of innovation and a glimpse into the future, although it is still difficult to imagine this phenomenon in a more peripheral context, characterized by long distances and more blurred borders that are difficult to administer.

According to George Atalla (EY Global Government & Public Sector Leader) and John Simlett (EY Global Future of Mobility Leader) urban mobility is being transformed by *trends* such as digitisation and urbanisation, but these improvements are not enough to meet demand, cities also need to develop and create mobility systems suitable for the years to come.

The mobility of the future is already ready from a technological and cultural point of view, but to achieve full development, adequate infrastructure and further cultural development are needed.

In their study, they outline methodologies through which cities can work to ensure mobility in the future, so as to overcome the forces shaping urban mobility:

- *Integrating mobility into broader urban policies.*
- *Improving access and experience for all*: cities need to enable mobility to develop properly so that itconsolidates as an added value for all citizens, and since digital technologies often reduce costs,this could also be the first value *driven*. To offer this, cities must offer citizens a menu of optionsthat can be fast, safe, sustainable and personalised. They must also widen access so that low- income, marginalised and elderly people can get to work, education and all kinds of other activities.
- Regulating *without hindering innovation*: modern urban mobility systems involve many different players, public and private. To make the most of the available options, cities need regulation that allows them to develop and pilot new business models and promising transport modes while also ensuring public safety. The first years of *ride-sharing* have brought out the need to develop regulation in a proactive, not reactive, way. This means providing regulatory "*sandboxes*", i.e. flexible rules that evolve over time, to help the development of new initiatives.
- *Working with the private sector to develop the next generation of mobility systems:* from connected buses to autonomous vehicles, new mobility options are constantly emerging, but no single entity, be it the government itself, a company or a transport service provider, will ever be able to deliver them alone, which is why close cooperation of all stakeholders will be necessary.

Finally, it is useful to analyze which forces speed up the process of cultural development towards the concept of mobility and, in this respect, a study conducted by the company Deloitte illustrates the four main factors:

1. The technological evolution of vehicles redefines the customer experience, initiating a gradual shift from the concept of the car as a means of transport and the consumer as the driver, to thevision of the former as a means of entertainment and the latter as a passenger.
2. The improvement in the efficiency of propulsion systems, i.e. the spread of electric vehicles, whose sales have been increasing considerably since 2016, partly due to the reduction in the costof batteries (-73% between 2010 and 2016);
3. The cultural change of the customer, linked to the shift from the logic of possession to that of use, and an evolution on the part of manufacturers to improve *customer engagement*.
4. Finally, the push comes from the institutions, in identifying the new forms of mobility as an opportunity to solve structural problems related to people's quality of life and environmental sustainability.

In this context, different scenarios open up, which could be realized at the same time or could have different deadlines, each scenario being defined according to the degree of vehicle ownership and automation. The first scenario, *Incremental change*, represents a situation where vehicles are increasingly connected,allowing a more interactive driving experience and where the driver retains ownership of the asset. In 2016, there were 8 million connected vehicles, and the forecasts for 2020 are encouraging, also thanks to the push of the *eCall* legislation (about 16 million vehicles are expected, with a penetrationof 41% of the fleet).

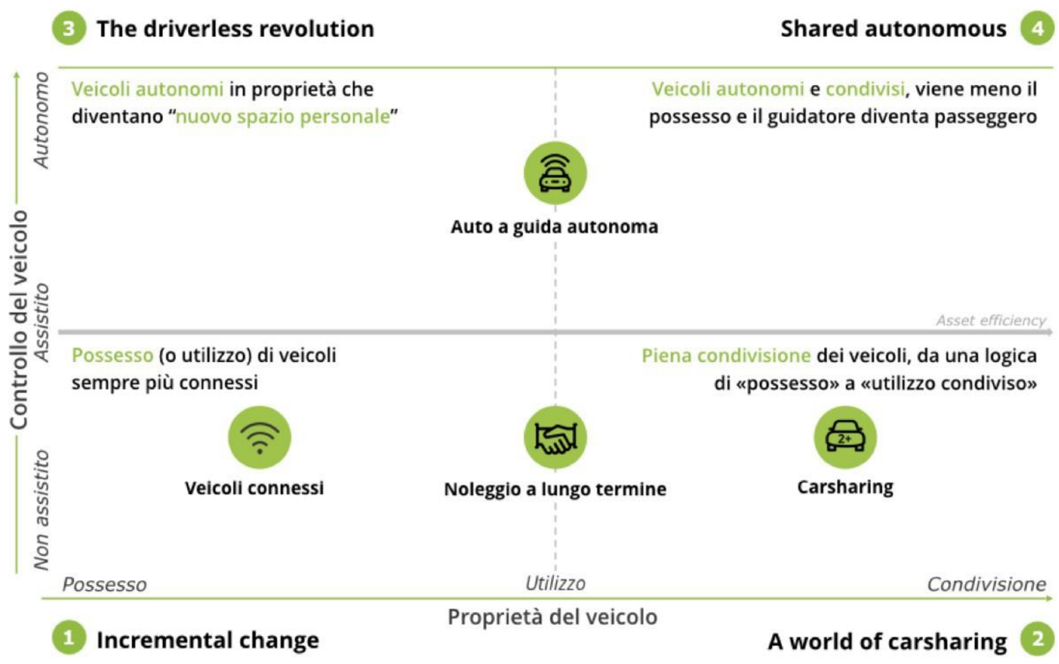


Figure 1.16 - Autonomous driving and long-term rental. Deloitte Monitor elaborations on BI Intelligence, UNRAE and PoliMi data.

The second, *A world of* carsharing, introduces the change in vehicle sharing. This hypothesis is supported by data showing a growth in the number of members, vehicles in the fleet and the average use of vehicles with the *carsharing* mode: the phenomenon affects just over 2.1% of the population,

but if it is translated into an urban context it reaches a penetration of about 14% (elaborations and estimates Monitor Deloitte on data from the National Observatory Sharing Mobility and Istat).
The third, *The driverless revolution, is* characterized by autonomous driving and the retention of vehicle ownership.
Finally, the fourth scenario, *The driverless revolution*, represents the phase in which autonomous drivingis considered safe, convenient and shared by customers.

1.6.1. Sharing economy - Carsharing

What we call the *sharing economy was* born in the United States in 2008. It was originally called '*collaborative consumption*' by the consultant Rachel Botsman, alluding to an economic system with a monetary and non-monetary exchange of goods as its focal point, which has continually developed to meet a real need dictated by the creation of a new demand, from which a new market would necessarily have to be created, driven by technology and increasingly savvy and digitally inclined users. Dr Bostman was not the only one to present a definition on this subject, several scholars defined it in different ways, the most important ones are shown in the table.

Benkler, 2004	"A non-reciprocal pro-social behaviour".
Botsman & Rogers, 2010	"An economic model based on the sharing, leasing, gifting, barter, exchange and lending of underused resources, from spaces to skills to goods, based on monetary or non-monetary exchanges".
Bardhi & Eckhardt, 2012	"We define access-based consumption as those transactions that can be mediated by the market, in which there are no transfers of ownership".
Belk, 2014	"Collaborative consumption consists of the acquisition and distribution of a resource for a fee or other compensation as long as this is not the gift or other form that involves a permanent transfer of ownership".
Frenken & Schor, 2017	"The sharing economy is a platform economy that is based on principles and models of economic, social and environmental impact".

Table 1.4 Sharing economy/car sharing Source: Maiolini, R., Petti, E., Rullani, F., 2018, Elaboration of the authors

As can be seen, the definitions reported present several distinctive elements of the phenomenon, allowing a complete view of the production and consumption models which, following Belk (2014), are identified in the interaction and transaction mechanisms between those who offer the service and those who receive it.
For example, it is possible to distinguish the *open sharing* and *demand sharing* models, which differ in the relationship between supplier and consumer. More specifically, *open sharing* models refer to relationships in which supplier and consumer share resources and their exchange is the result of familiarity between the subjects. On the contrary, *demand sharing* models are based on specific requests

for goods or services, so the relationship is based on the terms of the relationship between supply and demand, and is much less focused on familiarity between the actors.

The *sharing economy* would never have existed without technology, which plays a fundamental role in the growth of this *trend*, as it was necessary to create platforms that allow the dissemination of information in real time, using complex algorithms and schemes, introducing new techniques such as online payment, *crowdsource rating* and *reputational data* from users.

The initial project was to create a new market, based on the idea of sharing surplus goods that were not being used: houses, cars, boats and other durable goods, so that they could be exchanged through this new contractual formula for more limited periods of time than the existing contracts, allowing greater flexibility in the matter.

This initial thinking then evolved into the ability to serve more and more unknown users, expanding the market and creating an *omnichannel* [69]linking them to each other and, despite initial criticism from hoteliers, taxi drivers and goods sellers, the *sharing economy* has entered our lives, settling into the mindset of consumers. Omnichannel marketing involves the ability to direct the customer's interactions with the brand through a single directorate. Interactions are automated across all available contact channels: online and physical shops, direct marketing via social, email, text messages, apps.

The two major platforms that have provided the most visibility are Airbnb and Uber, the former is a platform for renting rooms, houses and villas for a period of time ranging from 1-2 days to several months, the latter is an innovative taxi service.

These two platforms, driving the *sharing economy,* have created a new trend on a global scale, activating entrepreneurs, programmers, start-ups and researchers to the extent that entire cities, such as Amsterdam, have embraced the idea of *sharing*, welcoming it into their daily lives as a symbol of innovation, change in lifestyle and in the way goods are used.

Many have recognized the potential of the *sharing economy* in the possibility of using idle resources, following the above examples, and thus placing an unused house on the Airbnb portal, or exploiting free time as a *driver* by using one's car as a taxi, so much so that platforms offering non-monetised exchanges (loans or donations) have even sprung up, such as Yerdle, Landshare or ShareSomeSugar (Wherry and Woodward, 2019).

The elements that make up the definition of the *sharing economy* are therefore:

- The logic of access via platforms.
- superior connectivity.
- the use of under-utilised resources.

This general concept gave rise to *car sharing, which* in March 2011 was described by "The Times" as one of the ten ideas that will transform the world: it is a new concept of car use which, thanks to the platform or *app on which* it is based, allows registered users to locate the nearest available cars and use the car for the journey they need to make.

These new platforms give rise to a new concept: man does not buy the machine but buys mobility, whereby the consumer does not derive value from ownership of the good but from access to its use. In this mode of consumption, the value lies in the possibility of using the car at the time and for the time needed, paying by credit card a fee that is calculated on the basis of the kilometres travelled and the minutes used for the service and, consequently, when the consumer's purpose has been achieved and the good is no longer needed, the relationship between the consumer and the product is interrupted, and will be reactivated in the future if necessary.
In Europe, different types of *carsharing are* widespread: not only free floating, i.e. without parking stations, but also other forms are entering the common vocabulary of car drivers.
Car sharing can be:

- *Station based*, i.e. with cars parked in dedicated car parks.
- *Free floating*, which allows you to reserve your car in place A and leave it in place B (as longas it is within the service area).
- *Peer2Peer*, i.e. car sharing between privately owned (or rented) vehicles.
- Community-based' car sharing means sharing cars within, for example, a block of flats or auniversity environment.
- *Ride* sharing, i.e. the sharing of a trip with other travellers by a private individual.

In Italy, the first two types are the most widely used, while the others, which are spreading in Europe, are slow to take root on the Peninsula, where the most important companies that have spread are: Enjoy, Car2Go and Sharengo, from which the joint venture ShareNow was born.
Enjoy was launched on 18 December 2013 in the city of Milan, and is the result of a series of partnerships between Eni and other companies on the Italian scene: Fiat, Trenitalia, RDS and Vodafone.
Eni is the first link in the chain, which has always been strongly oriented towards innovation, while Trenitalia is Enjoy's first *main* service *partner, which has* contributed to giving visibility to the project and above all has made it possible to develop interoperability between the services offered by the two companies with the construction of a complex service linking long-distance vehicles (trains) to short-distance vehicles (cars), guaranteeing rapid transport and greatly increasing the usability of the project by allocating dedicated Enjoy parking areas at stations.
Fiat supplied the cars, the basic product without which the project would not have been able to get off the ground, distributing the Fiat 500 model which, as a *city car, is* adapted to the traffic and parking requirements of the metropolis.
Finally, Vodafone provides '*welcome vouchers*' and dedicated discounts on the purchase of Vodafone-branded products for subscribers, while RDS, on the other hand, implements initiatives and competitions with Enjoy to attract the largest number of customers (*engagement*).

Car2go is another subsidiary of Daimler AG, and was developed by Daimler's *Innovation Division* which deals with *business exploration* and *business model development*, with the aim of identifying potential business areas that could be implemented to complement the *core business*.
Daimler is the first car manufacturer in the world to seize the opportunities offered by this new market by aiming to diversify its offer in order to meet the new demand created by *car sharing*.
From 21 January 2020, the ShareNow *joint venture* began operating in Italy, resulting from the merger between DriveNow, a *joint venture* between car manufacturer BMW and car rental company Sixt, and Car2go: this merger had been announced in March 2018 and, in two years, BMW and Daimler have completed the process that today brings them to be the pioneers of *car sharing* in Italy, boasting 700 thousand registered users and 3,000 vehicles available.
Keeping an eye on new products and the new difficulties that can affect this market sector, an example of this is the affair involving ShareNow, which had to announce in early 2020 the withdrawal of its fleet from cities such as Montreal, New York, Seattle, Washington, Vancouver, Florence, London and Brussels, stating that: "*The increasing complexity of the transport infrastructure in North America and the associated costs*" was the justifying cause for the decision to abandon North America (Eccheli, 2019).
Another frightening factor is new forms of mobility including, in particular, urban micro-mobility, which intercepts some *car-sharing* users (who blame this competition, which is reinforced by the progressive pedestrianisation of the most central urban areas), allowing them to move around city centres on scooters, bicycles or electric scooters, which allow them to access city centres more easily than cars and get to their destination without having to worry about parking.
A final negative sign comes from the budgets of the operators, who are called upon to incur considerable expenses to repair the damage caused by users who do not care about the service and the property made available to them, not to mention the theft of cars (Enjoy has withdrawn its fleet in Catania in 2019, https://www.ansa.it/canale_motori/notizie/attualita/2019/04/19/danni-e-furti-enjoy-lascia-catania_522c5b1d-b8ba- 420d-ac49-948641314748.html), vandalism or the low use of the service in some Italian cities, such as Florence.

1.6.2. The rental formula

The car is an asset that man has always considered essential in everyday life, it is a tool that initiates independence and accompanies us on every errand, it represents the start of a journey, a holiday, an adventure and the more we use it, the more we feel it is ours.
This phrase could have been the opening of an effective advertisement at the beginning of the 2000s when cars, unlike in the first half of the 20th century, were increasingly crowding city streets, representing an exclusive property that needed careful selection and analysis before purchase, and

once bought would accompany us in the years that followed.
Citizens had two choices for getting around their city, the concept of mobility was limited to public transport: trams, buses, coaches, subways, trains, or they travelled by car, which, even if it was not in the driver's name, undoubtedly belonged to a member of their family or the company for which it provided its service.
However, in other countries other realities existed: in Germany, where the first car rental company was founded back in 1912, as well as in Sweden and Norway, this approach to mobility was already widespread, and constituted an interesting alternative to private car ownership, with all the associated management costs. This was also the case in America, where the long-term rental market dates back to 1916, the year in which the Saunders System company was founded, later acquired in the first half of the 1950s by Avis.
These opportunities have spread over time in all countries of the world: unlike in the past, today there are even more ways to use cars without necessarily buying them.
Among the most popular are short-, medium- or long-term rentals, which allow the consumer to use the car for as long as he needs it, freeing him from all kinds of bureaucratic worries, additional taxes and concerns about the car's depreciation.
The rental market is a vibrant one, where all the different types of customers are growing:

- Corporate
- SME
- Sole proprietorships
- Craftsmen
- Freelancers
- Private

Short-term rental is an extremely interesting formula for those who need a car for a period ranging from just one day to a maximum of one month. It also provides for different rates that vary according to the duration of the rental and the kilometres driven: needless to say, the longer the last one is, the lower the first ones are.
A major advantage of short-term rental is the possibility of returning the car to a different location than the one where it was picked up, as long as it is from the same company from which the car in question was rented. In addition, another major safety feature is the legal services that are offered through short-term rental: they can include RCA insurance, full coverage in case of fire, theft and damage, *Kasko* insurance, road tax, both routine and extraordinary maintenance and even tyre replacement.
Medium-term rental is used by private individuals and businesses, and is to be distinguished from multi-month rental, which involves the use of the short-term rental formula, month by month,

replicated for a maximum number of months set by the contract. Medium-term rental varies from a minimum duration of 30 days up to a maximum of 24 months, although the minimum duration very often consists of 6 months, and is useful not only for companies that need flexibility, depending on the projects they follow and their duration, but also for private individuals: think of those who move to a new city for work or training in a limited period of time; those who see their family car used by another member on a temporary basis, or those who, for personal reasons, postpone the purchase of a car. The advantages deriving from this formula can be associated with that of the short term: management of the contract, maintenance of the car, the monthly fee envisaged which includes coverage of insurance costs, which includes a limit a maximum number of kilometres covered (usually on a monthly basis) but above all, the possibility of withdrawing, modifying or extending the rental contract with total flexibility.

Lastly, there is long-term car rental: a contractual formula whereby a vehicle is rented for a period of time ranging from a minimum of two years to a maximum of four, with payment of a monthly fee that varies according to the model, company and services included in the package selected. Long-term car rental was originally conceived as a contractual formula dedicated specifically to professionals with a VAT number and to companies, given the possibility enjoyed by these parties of deducting costs for IRPEF and VAT in the manner described in articles 164 and 19-bis 1 of the Consolidated Income Tax Act.

Long-term rental also provides for the car to be delivered after the contract period, and there is no possibility of buying the car by paying a large final instalment, as is the case with leasing. It follows from this last consideration that long-term car rental can be advantageous in some cases, given that a car with a high number of kilometres on the speedometer is returned that will have undergone significant depreciation, which the customer will not worry about.

When it comes to leasing, especially long-term leasing, there are new advantages, especially for companies that can, from the outset, select a *budget* that will be used exclusively for the use of vehicles by their managers and employees. A company, as is well known, before making any strategic decisions, draws up business plans, also known as "*business plans*", which make it possible to estimate and forecast the costs and revenues deriving from the choices made, and it is precisely because these are certainties and estimates that long-term rental is linked to them, since, for companies, the monthly rental fee may represent a fixed cost, which, unlike variable costs, symbolises guarantee and security, two characteristics that make it possible from the outset to estimate whether or not the plan is sustainable for the company in question.

In addition, large companies provide company cars to a huge number of employees, and the greater the number that makes up the fleet, the greater the management costs that depend on it: human resources, management of insurance, contingencies, maintenance and requests for replacement cars in the event of accidents.

With long-term leasing, these concerns are eliminated since, apart from the demobilisation of the human resources dedicated to the car fleet (which are certainly considerable), the purchase of mobility (a concept that will be developed in the following chapters) and the subcontracting of the aforementioned activities erase all thoughts related to the management of the cars given to employees, since they are managed entirely by the leasing company.

It is no coincidence that the first three major operators in the rental sector (*Leasys, ALD Automotiveand Arval*) have a strong participation of banking groups and financial companies that in turn belongto the largest car companies: Arval and ALD Automotive are controlled respectively by the BNP Paribas Group and Société Générale, while Leasys is controlled by FCA Bank, which is configured as an equal joint venture between the banking group Crèdit Agricole and FCA.

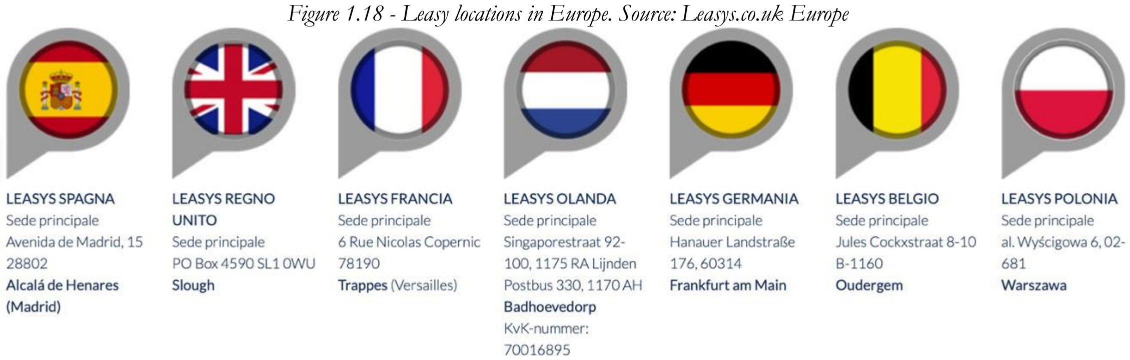
Figure 1.17 - FCA Bank . Source Leasys.it

Leasys in particular, is a company founded in 2001 in Italy, where its headquarters still reside, and over the years it has created the conditions for a European-wide growth plan, which took shape in 2017 with the ultimate goal of seizing in a timely manner the opportunities of a business that, as European trends show, was and still remains in rapid expansion, so much so that today it manages a fleet of around 300,000 units (cars and commercial vehicles) in 8 different countries.

One of the latest formulas offered by Leasys is called "*CarCloud*", aimed at private individuals and self-employed professionals, which is structured in four different options:

- CarCloud City (€199 per month)
- CarCloud Metropolis (€299 per month)
- CarCloud Renegade and Compass All Season (€379 per month)
- CarCloud Alfa Romeo (579 euros per month)

Figure 1.18 - Leasy locations in Europe. Source: Leasys.co.uk Europe



The novelty lies in the way this service is accessed, i.e. through the purchase of a subscription voucher on Amazon.it. The feature of CarCloud is flexibility: it is possible to choose the car and then change it with another model available in your package at no additional cost and you can enjoy such freedom as to allow you to decide on month-to-month renewal (minimum 30 days, maximum 12 months), thus eliminating any time-lag in the rental forms (Quattroruote.it).

2019 - Total Year			
#	NLT PC + LCV	REGISTRATIONS	MARKET SHARE
1	Leasys	79.233	24,5%
2	Arval	61.145	18,9%
3	ALD Automotive	41.898	13,0%
4	LeasePlan	37.190	11,5%
5	Volkswagen Leasing	32.507	10,1%
6	Alphabet	12.051	3,7%
7	Car Server	10.477	3,2%
8	ES Mobility	8.745	2,7%
9	Athlon	8.045	2,5%
10	Sifà	7.682	2,4%
11	Mercedes-Benz Charterway	6.793	2,1%
12	Free2Move Lease	5.935	1,8%
13	Rent2Go	2.074	0,6%
14	Program Autonoleggio	1.249	0,4%
15	PAN	304	0,1%
15	GFC	151	0,0%
-	NLT Altre	7.313	2,3%
TOTALE		322.792	100,0%

Figure 1.19 Ranking of companies according to registered units. https://www.dataforce.de/it/tutte-le-notizie/il-noleggio-a-lungo-e-breve-termine-a-dicembre-2019-leasys-a-gonfie- vele-arval-leader-in-lcv-decided-ald/

The long-term rental market closes 2019 with 8.99% growth on 2018, at 281,301 units, an increase of 23,217 units compared to 2018, including 6,299 in December alone.

As illustrated in the table, Leasys is in first position with a pool of 79,233 registered units, followed by the other two giants Arval and ALD Automotive, second and third with 61,145 and 41,898 units, followed by the other companies that register few numbers and from fifth position onwards have relatively negligible market shares.

1.6.3. The impact of Covid-19 on sharing and renting

The *year* 2020 was the *annus horribilis for* sharing: the industry and services in the tourism and national automotive sectors were among the hardest hit: dramatic figures were recorded for tourism in particular, with flows from other countries almost completely wiped out for several months. The pandemic-induced demand crisis spared no one. Vehicle rental has also been strongly affected. After seven years of continuous records in registrations and turnover, accounting for 25% of the market, the year 2020 saw a sharp decline.

It went from 525,000 registrations in 2019 (cars and commercial vehicles) to 350,000 last year, a vertical drop of 33%. The entire sector has been severely affected by this and has taken steps to overcome the difficulties by using what has always been the sector's trump card: the ability to adapt to the times and anticipate customers' needs, in terms of flexibility and professionalism in the offer. The short term, as anticipated, has been heavily penalised by the substantial disappearance of the travel business and in particular international tourism; domestic tourism has not been able to compensate for the very heavy losses.

A 52% drop in turnover and a 60% drop in the number of rentals compared to 2019 mirror the airport crisis, which saw a 72% reduction in traffic in 2020. Even with 8 million hours of redundancy payments behind them, companies have continued to offer services and operate the more than 1,100 rental outlets throughout the country.

Rental and sharing mobility is slowing down: short term and car sharing have collapsed, while the long term is holding up. In particular, short-term business was heavily penalised by the substantial disappearance of travel activities and in particular international tourism; domestic business, which was partially reactivated inthe short summer break, and the substantial resilience of commercial vehicle rentals (thanks to the boom in e-commerce and home deliveries) did not compensate for the heavy losses. The 52% dropin turnover and the number of rentals down 60% compared to 2019 mirror the airport crisis, whichsaw a 72% reduction in traffic. Rent-a-car operators estimate a return to pre-pandemic levels only in2023. Car sharing has also suffered a severe backlash. As a result of the sharp reduction in urban mobility and the substantial use of teleworking, car sharinghas seen rentals halved (from 13 million to 6 million), resulting in a 27% reduction in the available fleet.

Operators are reshaping the structure of the offer, responding effectively to customers' need for greater safety. The long-term rental sector, with its partially more stable business based mainly on multi-year contracts, did not immediately suffer significant repercussions on the revenue side (turnover: +2% in 2020), recording an increase in bad debts and a general trend towards extensions of existing contracts, which however caused a significant reduction in registrations of 25%. The fleet in circulation continued to grow, reaching 933,000 vehicles (65,000 of which are leased from private customers). In the first quarter of 2021, the report concludes, the trend of the three sectors was confirmed in line with 2020: the short term with over -60% of rentals (vs 2019), -67% of registrations and a fleet stopped at 73 thousand vehicles; the turnover of the long term grew compared to the pre- pandemic, with a fleet increased by 7% and registrations only slightly down (-1%); car sharing recorded a -50% of rentals compared to 2019.

Once the pandemic has passed, the use of pay-per-use mobility formulas in major urban centres is set to become even more ingrained in our daily lives. Short-term rental services will be used to strengthen proximity links and enable even those arriving from abroad to safely reach the 55 UNESCO World Heritage sites. However, we need a clear and effective political strategy on infrastructure and mobility that takes into account the complementary and intermodal role of the car.

The long-term rental sector, which is strong in terms of the stability of its business based mainly on multi-year contracts, has not suffered any significant repercussions in terms of revenues in the immediate future, but has recorded significant repercussions in the economic cycle, with an increase in bad debts on the credit side and a surge in early returns.

On the whole, operators have recorded a general tendency to extend existing contracts, which has caused a 25% reduction in registrations and has consequently slowed the speed of fleet renewal compared to previous years. The challenge of future corporate mobility was immediately taken up by the sector, which remodeled its services, making them even more flexible, almost in advance of demand, and expanding its offer of new generation vehicles.

Carsharing services, due to the strong reduction in urban mobility and the substantial use of teleworking even in big cities since last March, have reshaped the structure of their offer and responded effectively to the need for greater safety.

However, there is no doubt that the car-sharing business model has been challenged by the pandemic. If we really want to focus on this strategic mobility sector, which brings immediate benefits such as reducing congestion in city centers and polluting emissions, local and national institutions will have to implement concrete measures to support it. The Association strongly supports the need to align the VAT rate with the 10% rate currently in force for urban passenger transport, and the elimination of fees imposed by municipalities. According to a recent ANIASA analysis, in an articulated car sharing system, each shared car can replace up to 11 owned cars with immediate positive effects on direct emissions, with more sustainable and safer latest-generation shared vehicles, and on mobility fluidity, a key element of consumption efficiency and overall transport sustainability.

CHAPTER 2

2. The digitization of supply

2.1 The automotive sector and its recent evolution

"By 2025, 40 per cent of FMCG sales will be online," analysts from Edge by Ascential tell viewers at *CES 2021 - Insight into the most inspiring new technologies connecting brands with consumers*, which is the world's most important consumer electronics trade show, an event where they showcase the new technologies that will become part of everyday life in the near and far future.

In the world we have inherited and in the challenges we have experienced this year, the eCommerce sector is the one that has faced innovation in the most dynamic and rapid way possible. The customer journey has been overturned and accelerated, with the possibility of using new data sets and conversion paths to be interpreted and analysed according to new logic.

Carla Ballo, President and CEO of the *Center for Automotive Research*, described how the challengefor players has been disruptive, especially in those industries that are reinventing their approach to connectivity. In this direction, it is clear that mobility and the automotive world are evolving rapidly, with the vehicle becoming more social and more open to entertainment and technological innovation, as described in the previous chapter.

Similarly, different but strongly automotive-related worlds such as logistics are building innovative digital and technological processes, such as highly automated and intelligent door-to-door solutions or the use of augmented reality to discover and narrate products.

The Trend Sonar monitoring platform analyses the evolution of e-commerce in the automotive sector and how digital is virtually extending the concept of mobility.

Using its proprietary Trend Sonar trend monitoring platform, Reply conducted a study to examine how the e-commerce model, particularly in the automotive sector, has evolved over time, revolutionising it and consequently influencing customer expectations.

A digital approach and online presence have become indispensable in the automotive sector, especially since last year when the pandemic put digital on the fast track, rewarding those companies that were able to change their business model in favour of digitalisation.

Over the past year (April 2020-March 2021), the Trend Sonar monitoring platform, analysing the frequency of mention of millions of online sources within expert media articles, mass media, patentsand scientific publications, has in fact confirmed a 61% growth in Automotive E-Commerce relatedcontent compared to the previous 12 months.

In fact, this is an evolution that has been going on for a long time because, as already illustrated in Chapter 1, the automotive sector is no stranger to change: in the last 20 years it has been the protagonist of an unprecedented revolution and Reply's analysis shows that all the conditions are in place for us to find ourselves on the threshold of a new discontinuity.

The first online marketplaces for used cars date back to the year 2000, while a few years later the first online broker platforms became popular, directly linking authorised dealers and end consumers and providing online booking services, car configuration and digital brochures. Dealers have also strengthened their online presence.

In today's scenario, the boundaries between physical and digital are increasingly blurred, thanks to the Covid-19 pandemic which has greatly accelerated digitalisation: analytics systems, pricing tools and digitalised financing processes are now a necessary standard for increasing leads. Reply's study shows that we are currently at a crossroads between digital and traditional service offerings. In the near future, 3D showrooms, virtual test drives, advanced configuration tools and digital concierge services will be increasingly used, allowing consumers to test and configure products directly online. Digitally native car manufacturers are overturning the traditional model of car buying by opting for direct online sales to customers. The customer journey has also been affected by the revolution: digital processes for leasing, financing, choosing insurance and in some countries even registration, have digitised and automated the customer experience, shortening time and eliminating paperwork.

2.2 The importance of online sales

The future of mobility is increasingly virtual. Since services such as car sharing have entered the market, mobility has started to be perceived as a service built around digital. Several car manufacturers and suppliers are adopting an approach in which the car is a platform providing access to a wide digital ecosystem of data and app-based services. Indeed, cars, as well as a means of mobility will in the future increasingly be used to collect data on customers. Access to this information and the exchange and sharing of it are decisive for defining future dynamics and for offering customers more comprehensive and personalised services, also extending the role of dealerships.

The *switch of* investment from offline to digital stems from the realisation that consumers nowadays look for the most convenient product to buy, which in this case is the car purchased online.

Disruptive changes in the automotive sector are currently taking place on several fronts, with new business models related to online car sales being the order of the day for automotive companies, creating quite a few discussions and difficulties.

If there is one type of purchase that has been present for several years, it has experienced a real 'boom' in conjunction with the spread of the pandemic and lockdown, it is online trade. The trend towards digitalisation and e-commerce is growing steadily, both globally and nationally: in Italy, according to research by Google Italy, there are currently almost 27 million 'digital consumers' (e-shoppers) who are familiar with purchases made from their computer or any other device.

E-commerce has become the standard in retail, as all age groups are accessing the Internet with increasing frequency and in all sectors customers can purchase a wide range of products and services completely online. As a result, industries have also transformed their business models because they represent added value for customers, and companies that have been slow to act have been overtaken by new competitors.

Revolutionary innovators, such as Amazon, have completely changed customers' purchase expectations, followed more recently by companies such as AirBnB, Uber, Lyft and Didi, a Chinese mobility giant that recently acquired Uber China (CNBC, 2016). These last three players have disrupted the automotive industry by offering a new concept of mobility to city dwellers.

2.2.1. Types of e-commerce

E-commerce refers to any transaction that takes place online: the buying and selling of products, services and digital goods on the Internet all fall under the umbrella of e-commerce. The first online transaction took place more than ten years ago, and since then the way consumers shop has evolved enormously.

In the past, running an online shop was a competitive advantage; brands that set up an *e-commerce* channel were able to reach a new customer base and increase sales, resulting in growth in record time. The rise of online shopping and selling has created opportunities for millions of people and offers clear benefits to those who participate: increased profits, more customers and greater brand awareness are some of the fruits of *e-commerce*, but they are not the only ones. Opening an online shop removes many of the limitations associated with a physical retail location: it becomes possible to sell nationally and even worldwide if desired. This greatly increases the number of potential customers, as anyone with access to the Internet is able to search, find and buy products that would previously have been geographically restricted.

In order to define the main types of *e-commerce,* reference can be made to the parties carrying out the transaction and in this respect e-commerce can be divided into four types.The four main ones are:

- B2B (Business to Business): is a commercial transaction carried out between two companies in order to exchange real-time up-to-date information on products and price lists, order goodsand services and pay electronically. *Business-to-business* transactions are common in a typical supply chain, as companies purchase components and products as well as other raw materialsto be used in production processes. In the context of communication, *business-to-business* refersto methods by which employees of different companies can connect with each other, such asthrough social media. An example of B2B can be the relationship between Samsung, which isone of Apple's major suppliers in the production of the iPhone, and Apple, which also has B2B relationships with companies such as Intel, Panasonic and Micron Technology, manufacturers of semiconductors. B2B transactions are also the backbone of the automotivesector; in fact, many vehicle components are manufactured independently, and car manufacturers buy these parts to assemble cars. Tyres, batteries, electronics, hoses and door locks are generally produced by various companies and sold directly to car manufacturers.

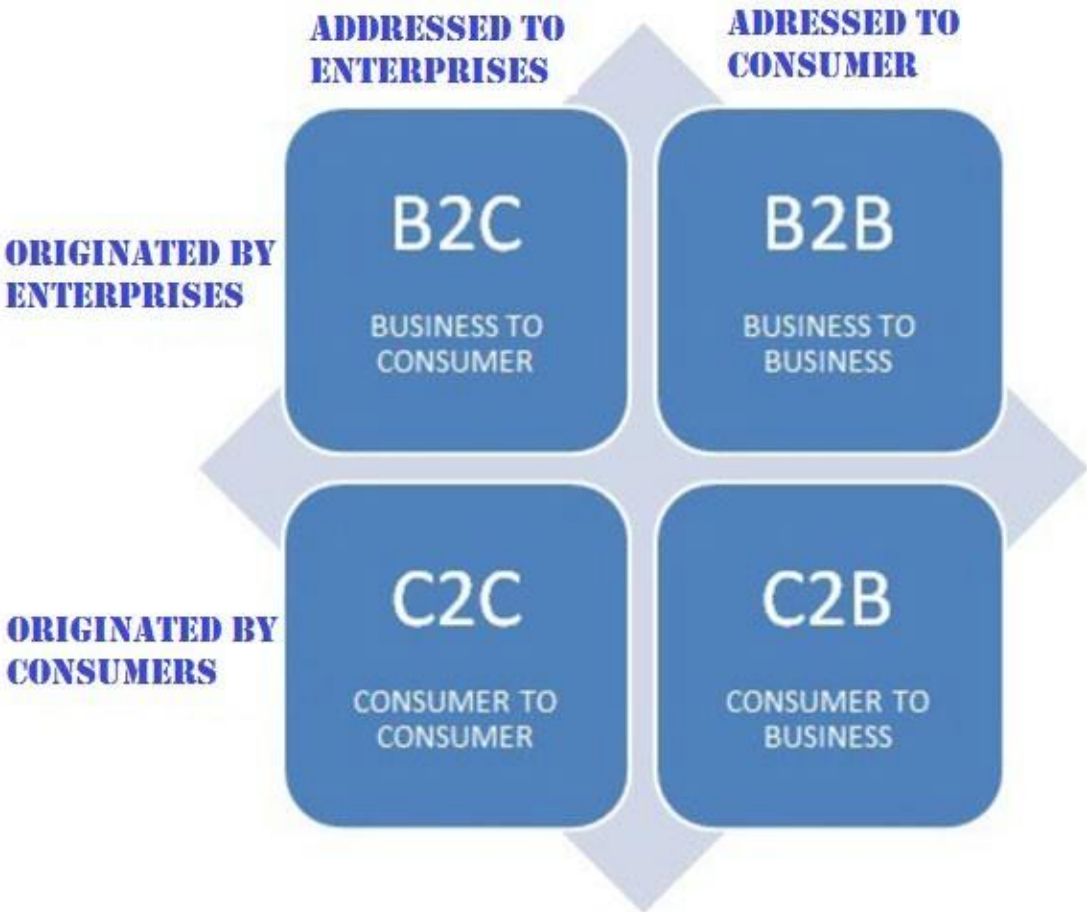


Figure 2.1 The main types of E-Commerce Source: Santacroce, B., Ficola, S, 2019

- B2C (Business to Consumer): represents a commercial transaction carried out between the company and the end customer, who is able to choose and compare, through multimedia andinteractive sites, catalogues and price lists accompanied by increasingly detailed and updated information. One of the most popular and well-known sales models, the idea of B2C was first used by Michael Aldrich in 1979, who used television as the main means of reaching consumers. From television then came the Internet, which created an entirely new B2C business channel in the form of e-commerce or the sale of goods and services over the Internet. Any company that relies on B2C sales must maintain good relationships with its customers to ensure that they return. Unlike business-to-business (B2B), whose marketing campaigns are geared towards demonstrating the value of a product or service, companies that rely on B2C must elicit an emotional response to their marketing from their customers.

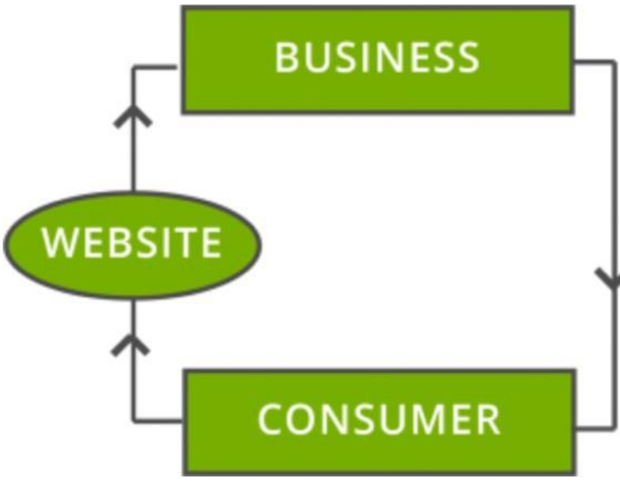


Figure 2.2 - Business to consumer system

There are generally five types of B2C business models that most companies use online to target consumers:

1. Direct sellers, where people buy goods from online retailers.
2. Online intermediaries, platforms that allow buyers and sellers to meet quickly (Expedia, Trivago).
3. Advertising-based B2C, which uses free content to attract visitors to a website, who in turn encounter digital or online ads.
4. Community-based, such as Facebook, which creates online communities based on shared interests, helping marketers and advertisers to promote their products directly to consumers.
5. Paying, such as Netflix, are platforms that charge a fee so that consumers can access theircontent.

- C2C (Consumer to Consumer): represents a market environment in which a customer buys goods from another customer using a third-party company or platform to facilitate the transaction. C2C companies are a new type of model that emerged with e-commerce technology and the sharing economy, in fact two implementations of C2C marketplaces were auctions and classified advertisements. Some examples of this type are eBay and Etsy, the latter allowing business owners to create their own customised website on which to market their products, offering assistance and tools with price variations depending on the stage of development of a business. A C2C business, also called an online marketplace, connects consumers by allowing them to exchange goods and services, and typically derives its income from charging commissions on transactions or listings.

In the early days of the Internet, online companies such as Craigslist and eBay pioneered this model. C2C businesses expand passively by satisfying buyers and sellers, but face challenges in quality control and technology maintenance.

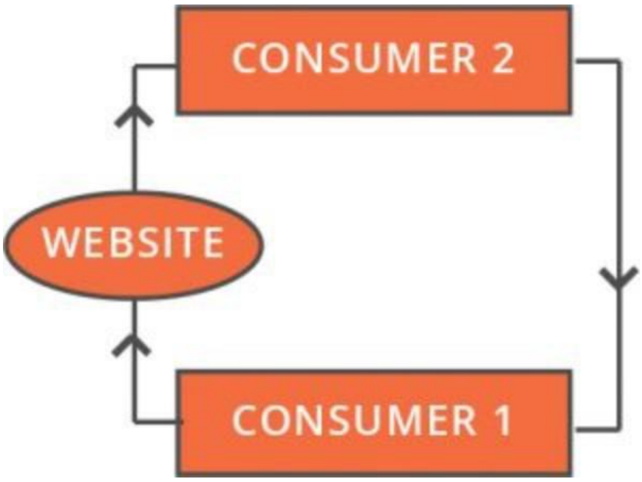


Figure 2.3 - Consumer to consumer system operation

- C2B (Consumer to Business): In this particular form of e-commerce, it is the consumers who set the price they are willing to pay for a product or service and then the business will decide whether to accept or reject the offer. C2B companies allow people to sell products and servicesto companies. In this model of e-commerce, a site might allow consumers to post the work they want done and allow companies to propose themselves. Affiliate marketing services are also considered C2B. By helping companies hire freelance professionals, Elance (now Upwork)was one of the first innovators of this model. The competitive advantage of the C2B e- commerce model lies in the price of goods and services. This approach allows consumers to settheir own price or directly compete with companies to meet their needs. Recently, innovators have creatively exploited this model to connect companies with influencers on social media andlet them market their products.

B2B, B2C, C2C and C2B are the main types of e-commerce, but two other less well-known and widespread categories can be added: B2A (Business to Administration), which concerns all transactions between businesses and the Public Administration, and C2A (Consumer to Administration), which concerns transactions between citizens and the Public Administration.

In particular, if the business model refers to the automobile, then the literature identifies a number of methods for offering added value through innovative e-commerce; the interesting aspect lies in the margin of advantage that can be generated over the competition, creating an e-commerce company capable of convincing the consumer of the validity of its offer and the high level of innovation of its proposal.

Below are some of the most popular approaches adopted by industry leaders and companies considered to be market innovators.

1. D2C: Direct to consumer: is a type of model that cuts out the middleman. It identifies a new

generation of consumer brands that have managed to build a loyal following of customers, growing rapidly through a network using tools such as wom or e-wom to get their name out there. In this respect, online retailers such as Warby Parker and Casper have set the standard torevolutionise the industry, while brands such as Glossier, through their commercial success, aredemonstrating how the D2C model can continue to be an area of innovation and growth.

2. White label and private label: "white label" refers to a generic product purchased from a distributor to which you can apply your name and brand. Private labeling, on the other hand, iswhen a retailer contracts with a manufacturer to create a custom, unique, Taylor-made productfor exclusive sale. By taking advantage of these two methods, you can continue to minimise investment in design and production and focus instead on technology and marketing.
3. Wholesale: In the wholesale approach, a retailer offers a discount on the sale of its products inbulk or in large quantities. Wholesale is traditionally a B2B practice, but many retailers offer it to wallet-conscious consumers in a B2C context.
4. Dropshipping: One of the fastest growing methods in e-commerce is dropshipping. Usually, dropshippers market and sell items produced by a third-party supplier, such as AliExpress or Printful. Dropshippers act as intermediaries, connecting buyers with manufacturers. BigCommerce offers easy-to-use tools that allow users to place products from suppliers all overthe world in their inventory and shop window.
5. Subscription services: as early as the 1600s, English publishers used subscription models to deliver books to their loyal customers. With e-commerce, companies can go well beyond periodicals and best sellers of the month and today almost every industry offers subscription services to offer customers convenience and savings.

2.2.2. E-commerce success factors

E-commerce encompasses advantages that physical commerce cannot achieve: setting up an online platform allows two main advantages:

- a temporal advantage, as there are no opening and closing times, and therefore the consumer can buythe product whenever he/she wants, carving out a moment during the day. In fact, an e-commerce site is active 24 hours a day, 7 days a week, so a consumer can make purchases at any time during theday without worrying about whether the shop is open or closed;
- secondly, a geographic advantage: by creating an *omnichannel,* it is possible to reach the demand of anyconsumer from the most diverse parts of the world; in fact, through an e-commerce site you can sellyour product or service even at enormous distances from the

place where your company is physicallylocated.

Using e-commerce to sell your own products, given the results achieved by e-commerce and estimatesfor the future may seem like a good way to go, even if, according to an article by Neil Patel, about 80% of all e-commerce activities fail. According to Neil Patel, the reasons for these failures are mainlydue to the fact that customers do not know how to use the site, the product value is not clear and navigation is difficult; He also says that for 80 per cent of Americans, price and shipping speed are two key factors, stating that when shipping is free, shoppers are more likely to make purchases.

Neil Patel, best known for his work in digital marketing and for co-founding the analysis company KISSmetrics, identifies the 5 success factors for a satisfying and productive *ecommerce:*

1. The Brand Identity: The brand identity is the collection of all the elements that a company creates to represent the right image to its consumer.

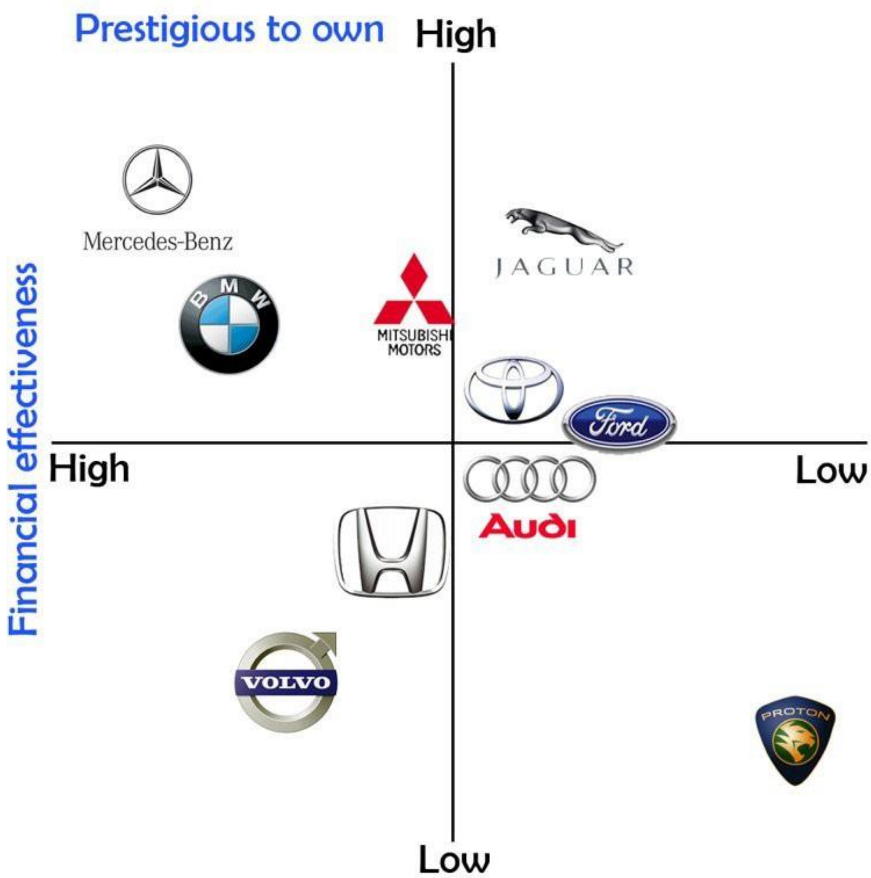


Figure 2 4- the importance of brand identity

A company must create an identity in its brand, which encapsulates its core values. The brand becomes the fulcrum: the e- commerce activity that a company starts has a brand at the centre of its identity and this brand encapsulates the core values of the company.

The importance of the brand lies in the fact that people interacting with the company will make assumptions about the identity of the brand, the first impression is fundamental; in fact, if thanks to the brand consumers remember the company, they are more likely to return for future purchases, to leave positive reviews, which will attract new customers.

2. SEO (*Search Engine Optimisation*): this encompasses all the activities that have the ultimate aimof increasing visibility on the web and in search engines, so as to bring to your portal all thepeople interested in the goods you are marketing. It is necessary to ensure that one's own website is among the first results and on the first pages when a hypothetical buyer does a search, for example on Google, which in fact increases the probability that this customer enters the site and eventually makes a purchase, which is why SEO activities are important.
3. User experience: it consists of all the features that make up the pages of the website, ensuringclarity and simplicity of use by the consumer, and also allowing access via apps or other devices. people who use an e-commerce website want to find what they are looking for quickly, otherwise there is a risk that they will leave. The website must clarify what the site does to those who are using it, the graphics of the site are important, very important is alsothe positioning of the cart that must be easy to locate, another procedure that must be simpleis the checkout procedure, also if relevant interactive content helps to improve the site. It isalso increasingly important to optimise the user experience for mobile devices such as mobilephones and tablets, which are increasingly being used as tools by users to enjoy e-commerceexperiences.
4. Transparency creates trust: the possibility to find contacts easily and immediately increases the level of trust in the product offered online, as well as the detailed description or the possibility to view the product in numerous pictures or videos that describe it comprehensively. one of the ways to achieve maximum transparency is to make the contactinformation visible on the website; therefore, it must be easy to find the e-mail address, telephone number, so that customers can contact the seller. Unlike physical shops, online shops do not offer the possibility of trying out a product; therefore, the information that customers are able to obtain through descriptions, pictures, etc. is very important. Another important factor is the price, which has to be competitive; an overpriced product might be considered not in line with its usefulness, while if the price is underpriced the product might seem less valuable than similar but more expensive products.
5. Increase engagement: a very simple methodology is to use social media, or create a blog on the industry and product lines where information is shared for customers, create a space in the portal dedicated to direct chat between salespeople and customers, so that the customerfeels understood and accompanied during the purchase. Once you have a strong

brand, a great user experience, relevant content and transparency with the customer you can also startinvesting in advertising budget.

2.2.3. E-commerce in the automotive sector

The sales and distribution model in the automotive sector has been essentially the same since the 1980s, with little change taking place: although technology has revolutionised other sectors, the automotive industry as a whole has not adapted to the shift to online as quickly as many had predicted, probably due to the importance that consumers place on buying a car.
In fact, one in two consumers in Europe say they are ready to buy a car remotely, but only if the purchase is sufficiently supported by photos and videos to make up for the actual visit (93% of consumers believe that images are an important element in determining the car, and 17% believe that an illustrative video is also important). In Europe, the phenomenon of online sales of new cars is still non-existent; however, Tesla had already announced in March 2019 the new revolution conceived and implemented by leader Elon Musk who, like a true revolutionary, decided to close all of the electric brand's physical shops, giving customers the option of online purchase only.
Underlying this choice was the need to reduce costs (estimated at 5-6%), make electric cars more affordable and fuel the company's profits, ignoring the loss of around 3000 jobs.
"*You can buy a Tesla with your mobile phone in about 1 minute, drive it for hundreds of miles and then return it forfree*", with these words Musk explained his new revolution, adding that it is "*a difficult decision, but it is the right one for the future*".
As far as the new market is concerned, it is impossible to find data to prove the small amount of cars sold online; however, as far as the secondary (second-hand) market is concerned, the e-commerce channel is widely used.
Market research and analysis was carried out by a young company called Brumbrum (a direct online car dealer, first in Italy, operating on the website www.brumbrum.it) using its own Observatory for online statistical surveys and investigations in the automotive field, in which the most sold used cars online in Italy were ranked.
According to this data, small cars are the most popular cars purchased through the online channel, with an average of 40% in the different regions, followed by sedans with 17% and family cars with around 10%. The popular Italian car is in first place among the best-selling used cars in Italy, with a good margin over the competition. It dominates the overall ranking, is in first place in several regions11, but above all is on the podium in all the others, except in Veneto and Sardinia where it is fourth. In second place in the overall ranking is the Fiat 500, for an all-Italian double. The small city car is the best-selling car in Lombardy and Veneto. Volkswagen Golf, the first foreigner in our top ten, closes the podium. The German sedan is in third place thanks to excellent results in Calabria,

Friuli-Venezia Giulia, Marche and Trentino-Alto Adige. Fourth and fifth overall were two other Italians: Jeep Renegade and Lancia Ypsilon. The small B-segment SUV won in Molise and went on the podium in six other regions, while the Ypsilon was second in Basilicata. An excellent sixth place for Mercedes A Class, very popular in Abruzzo and Emilia-Romagna. Volkswagen Polo came seventh, on the podium in Sardinia and well placed in almost all Italian regions. Only eighth was the Smart Fortwo, which triumphed in Lazio thanks to great results in Rome and its province but struggled in the rest of Italy. Nissan Qashqai and Audi A3 Sportback closed the top ten.

Figure 2. 5- Ranking for tyop ten cars sold online

A cursory glance at the industry's sales results in 2021 in a broader sense, without analysing them,suggests that the industry is in excellent health: the new market recorded +20.9% in the first nine months of the year compared to the same period in 2020, +24% for used cars, +23% for online usedcars. However, it is almost impossible to compare the figures for March, April and early May 2021 with those for the same months of the previous year, when the health emergency began and the firstlockdown took place, leading to an almost total paralysis of the automotive world.

Taking into consideration only the quarter just ended, the situation of the Italian automotive industrybecomes catastrophic. New cars are down 27% compared to 2019, but they are also paying the pricefor the very bad 2020: -26%. The same goes for used cars online, which closes the third quarter with -10% compared to the same period last year.

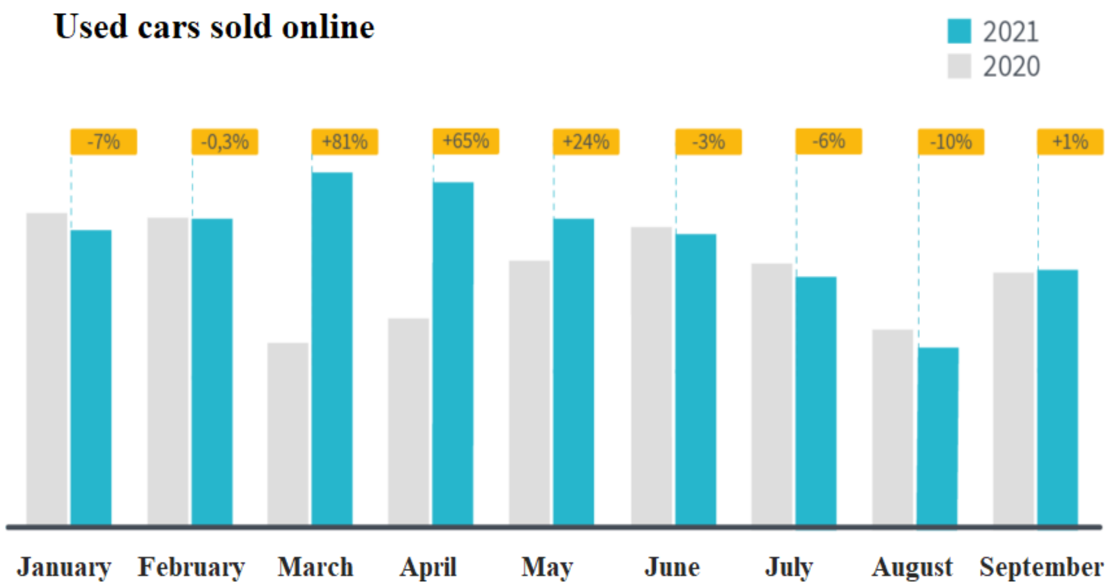


Figure 2.6 - Online used car performance 2021 vs 2020 - Source: brumbrum.it

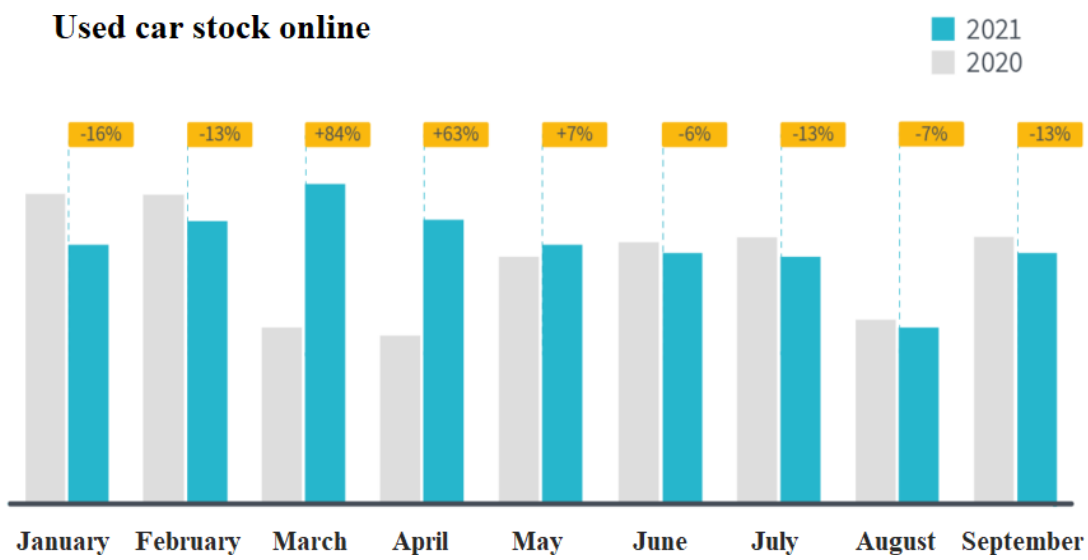


Figure 2. 7 Market analysis carried out by Brumbrum

The trend of the last period is quite worrying: the third quarter ended negatively even compared to the unfortunate 2020, precisely by 10%. The sector is paying for a very difficult summer: while last year saw a recovery of the industry after a spring that was practically nil due to the lockdown, the summer of 2021 saw a contraction in sales, which reached its peak in August with -10% compared to the same period in 2020.

The only positive news is that there was a slight turnaround in September. In fact, the month closed with +1% compared to the same period in 2020. But overall, the trend in the sector is negative and these last three months of the year are likely to be even more complicated, given the good sales results recorded both in 2020 and the previous year.

2.3 The importance of data management in e-commerce

Taking into account what has been said above about e-commerce already accounting for a significant proportion of total purchases in Italy, fashion continues to be the sector that registers the most activity and accounts for 48% of online purchases made.

The overwhelming majority of purchases fall to millennials, with more than 57% admitting to making such purchases via the Internet.

The following sales rankings are occupied by the beauty and technology sectors with 38% and 36% of total online purchases in Italy respectively. The report highlights the emergence of online purchasing of fresh food and beverages in the top 10, accounting for 18% of total national sales; in addition, 14% of Italians who buy online acknowledge that they buy food online at least once a month.

Knowing the opinion of online shoppers is a key factor for success if you want to get into e-commerce: a simple and secure purchase will have a positive impact on the consolidation of more business conducted on the Internet as the satisfied customer will repeat the experience and recommend it to their friends and family. This is demonstrated by the same study, which shows that 85% of shoppers felt that their online purchase was easy and 75% were very satisfied with the experience.

2.3.1 E-commerce metrics and KPIs

Having metrics is crucial, in virtually every business, whether you teach high school maths or work as a digital marketer, metrics are how everyone monitors performance and based on which decisions are made. This is all the more so in e-commerce, which, compared to other marketing efforts, offers much more visibility into behaviours and actions: after all, you can't count how many people see a billboard on the street, but you can see how many people access a website, just as you can't tell how many people went to a restaurant after seeing an ad for it in the community newspaper, but you can measure how many people arrived at a site by clicking on a banner ad.

But before we get to the metrics that can improve the performance of e-commerce activities, the question arises as to what metrics are of value and how they relate to performance measurements such as KPIs.

KPI stands for 'key performance indicator', i.e. measurable data that monitors the progress of an activity to see if it is achieving its goals. As a first step, it is important to understand just that: what isthe main objective behind your strategy, to have a clear and, above all, measurable purpose and to beclear about what information is really relevant.

An ecommerce metric is any quantifiable and consistently defined measure of website performance:

examples of relevant ecommerce metrics range from conversion rate to average order value, from shopping cart abandonment rate to traffic sources. Google Analytics, social media, online stores, product pages, home pages, checkout and shopping carts: all these are rich sources of data that capture quantifiable data, ripe for interpretation and measurement of trends over time. Metrics measure the process and provide the data by which KPIs can measure the performance of these processes. The use of specific tools, such as Google Analytics or Facebook Manager, allows you to monitor the KPIs of your interest, divided into different areas: indicators related to the performance of a company on social networks, the performance of the website, the effectiveness of SEO. In short, there are KPIs for everything, although only some of them will be of value for an e-commerce business: all the others will fall into the so-called 'vanity metrics', i.e. those metrics that are not really useful, except to satisfy a form of self-satisfaction. If not aligned with objectives, the number of followers, likes, reactions and hearts on posts are often vanity metrics: many of the followers are often off-target and may fill the shopping cart, but do not finalise the purchase, so you need to focus on other information, the value metrics.

Value metrics are the data that really matter to ecommerce practitioners and, although they vary depending on the analysis platform they are using, they are characterised by general elements that are simple and can be summarised in a few steps.

A value metric must aim to gather information in order to quantify a good KPI, and therefore it must:

- Encourage the achievement of an objective through measurable and objective evidence of theprogress being made, or not made, for the brand;
- Provide all those indispensable aspects that serve to understand the direction taken during thedecision-making process in the briefing;
- Monitoring the effectiveness and efficiency of an action undertaken;
- Measuring fluctuations in performance over a defined period of time.

This last point is really important: comparing several pieces of data collected over time is fundamental to comparing the different information, highlighting trends and patterns. Individual data, as an end in itself, often only gives an idea of the success or failure of a social campaign, without providing a comprehensive picture of how your business is performing.

The frequency with which ecommerce metrics should be monitored is highly variable: some metrics should be checked weekly to ensure the status of a business is healthy. Examples might include website traffic, social media engagement and impressions. Zooming out from weekly metrics, bi-weekly metrics are best suited to a larger sample size, less affected by any variations that may occur within a given week: metrics of this type could include *Average Order Value* (*AOV*), *Cost Per Acquisition* (*CPA*) and *Cart Abandonment*.

Monthly metrics require a longer data window due to traffic patterns or marketing models and could include email open rate, multi-channel engagement, coverage and cart addition abandonment (or

other micro-conversions).
Quarterly metrics are the most strategic, at least as defined by these time periods, as they allow monitoring of long tail activity and could include email click-through, customer lifetime value and subscription rate.
The six crucial KPIs for e-commerce activities:

- Cart abandonment rate;
- Conversion rate;
- Cost of customer acquisition;
- Lifetime customer value;
- Average order value;
- Gross profit margin.

These KPIs can provide extremely valuable information about the inner workings of a company and help to identify potential harms to be avoided and the best opportunities to be exploited.
For example, the shopping *Cart Abandonment Rate* is a term used in e-commerce to refer to visitors who place items in their shopping cart, but then leave the site without completing the purchase; it is a very common occurrence, so much so that, according to the Baymard Institute, the average shopping cart abandonment rate for e-commerce sites is almost 70% if not more in some cases. The reasons why people abandon their shopping carts are varied and include unforeseen additional costs, website errors, complex check-out procedures, a declined card or simply that visitors are not ready or convinced to buy.
Or one can ask how *Effective Landing Pages* and *Calls To Action* (CTAs) are: in that case the conversion rate will reveal the truth.
The *Conversion Rate* refers to the percentage of visitors who take an action on a website; this action can be anything, such as signing up for an email newsletter or making a purchase. Therefore, the conversion rate tells how effective a web page is in encouraging visitors to take an action; the average conversion rate for online shoppers is between 2.89 and 3.31 per cent. This means that out of every visitor100, two or three will convert.
The *Cost of Customer Acquisition*, also known as the *CAC*, is the amount of money it takes to "buy"a customer. Knowing the CAC is critical because if you want to plan how many customers you wantto acquire in each period of time, you can allocate your marketing budget appropriately. Furthermore, when you understand the variables and metrics behind the cost of customer acquisition,you can take steps to reduce it. To calculate the cost of customer acquisition, simply divide the totalamount of money spent on marketing and sales by the total number of customers provided by thoseactivities.
Average order value (*AOV*), is an e-commerce metric that refers to the average amount of money spent by customers per order. Increasing *AOV* can be one of the easiest ways to increase your revenue. Also, by receiving more money from each customer, you can absorb more customer acquisition costs

while still maintaining profits. To calculate the average order value over a given timeinterval, you need to divide your total revenue by the total number of orders.

Customer Lifetime Value, often referred to as *CLV*, *CLTV* or *LTV*, is the average amount of net profit each customer is expected to contribute to a business over the lifetime of the relationship and also helps to understand how well a company retains customers. It also helps to understand how well a company retains customers. This metric helps to understand return on investment (ROI) and is extremely useful for strategising future goals; a 5% increase in customer retention can increase company profits by 25-95%, and acquiring new customers is 5-25 times more expensive than retaining repeat customers, not to mention the fact that repeat customers spend 67% more than new customers.

2.3.2 Big Data

What we have described about the importance of metrics and KPIs shows how important data collection is for an e-commerce company. Often, when doing e-commerce, especially for large companies, the amount of data to be processed becomes huge: we then talk about "big data". In the field of statistics and computer science, big data is generically defined as *"a collection of information data that is so extensive in terms of volume, velocity, and variety as to require specific technologies and analytical methods for value or knowledge extraction" (Bellini, 2019).*

Generally speaking, we talk about Big Data when the set of data is so large and complex that it requires the definition of new tools and methodologies to extract, manage and process information within a reasonable timeframe.

Described in less complex words, Big Data represents data that is defined as unstructured, i.e. not having a well-defined structure and organisation, which results in irregularities and ambiguities that make it difficult to understand them and prevent traditional programs from deciphering them.

Data in general is an essential element of modern business. It is used to measure and manage processes and to make short and long-term forecasts. The advent of the digital age has led to a sharp increase in their importance in the business world: every interaction with consumers and businesses generates a flow of information that can be collected and analysed.

Data knowledge can be used to implement services, to conduct predictive analyses regarding changes in consumer customs and habits, or to identify new variables to improve the *customer experience*.

Data comes from countless sources: the closer people's habits and customs become to a digital everyday life, the more the devices they use send *big data* to companies and intermediaries who analyse, decipher and disseminate it as a source of information.

One of the main reservoirs is represented by consumers who share, during the iteration process, data in response to a certain value offered to them: this category includes, and above all is highly appreciated by, *lead* users, i.e. the most active users, who are most responsive to offers and who, often, review, comment and post opinions and advice from which companies can derive very valuable information.

Another source from which information is gathered are public *data-sets*, in which a large amount of unstructured data is freely accessible, so much so that many governments are in fact deciding to open up access to the huge databases they have. Setting up a Big Data strategy means creating a high-level project to oversee and improve the way in which data is acquired, stored, managed, shared and used, both inside and outside the organisation: this is fundamental to the success of all those companies that have to deal with huge volumes of data.

When developing a strategy it is important to consider existing and future business and technology objectives and initiatives: this requires treating Big Data as an important business *asset* and not as a by-product of applications.

However, it is not always easy to translate this data into immediately usable information. This is why companies need modern IT systems that allow the speed, power and flexibility needed to quickly access large amounts and types of Big Data.

In addition to reliable access, companies also need methods to integrate data, ensure *data quality*, provide *governance*, archive and *prepare data* for analysis (*data preparation*). Some of this data may be stored locally in a traditional *data warehouse* (a collection or aggregation of data from internal or external operations), but there are also flexible and low-cost options for storing and managing big data through faster and more innovative solutions such as the *Cloud,* but also *Hadoop*, a system created by Doug Cutting in 2006, is a *framework* that supports distributed applications with high data access, allowing applications to work with thousands of data nodes. *In* addition, *Data Lakes are becoming more* and more popular. They represent a new method of using data that, in this case, comes from diversified and inhomogeneous sources in its native format, or in an almost exact copy of the native format, as opposed to warehouse systems in which data is first structured according to the schema of the basin that must accommodate it and then restored to its original form when it is to be used. This makes data storage, management and analysis easier and more capable.

With high-performance technologies such as *grid computing* or *in-memory analytics*, companies can choose to submit all their big data to analysis or, in another approach, they can determine in advance which data is really relevant before analysing it: either way, this process is how companies get value and new ideas from raw data.

Well-managed and reliable data leads to concrete conclusions and therefore to reliable decisions. To remain competitive, companies must extract the true value of big data and operate in a *Data-Driven* manner: that means making business decisions based on the concrete evidence offered by results rather than on instinct. The benefits in being *Data-Driven* are clear: companies perform better, are more operationally effective and are more profitable. (AIDEA 2019).

When we talk about big data, we also call upon *Customer Relationship Management, in* fact, dealing more specifically with automotive companies, improving *customer service* and managing investments more accurately are two *Touchpoits* of a winning strategy: automating the relationship between potential customers and car salespeople, based on the customer's wishes and resources, can improve the sales process. These business rules-based applications go beyond decision-making algorithms to provide information and options more quickly and confidently as part of the sales conversation, based on customer analysis via social media, email, and internet platforms, through which customers can be divided into segments based on their actions.

Customer trends can be extracted from Big Data and used to predict what customers see as needs, in order to target product development and promotional efforts.

They allow in these cases to create specific customer segments and to tailor products and services according to their needs. This is a great benefit especially for an industry like Automotive: companies are starting to use big data techniques to create promotions and advertisements tailored to different consumer groups, also called *Clusters*.

Figure 2.8- The components of Big Data. Source https://www.velocitybroadband.co.zw/big-data/

Companies can also exploit Big Data to create new products and services: many companies are using data on the use of current products to improve the development of future models and to develop innovative after-sales services; the real-time availability of location data is leading to the development

of new services based solely on the results of analysis.
Still citing an example from the automotive sector, non-life insurance based on where and how people drive their cars, i.e. based on usage, is becoming more widespread.
Recent digital innovations such as self-driving cars, connectivity, big data and social networking are major trends that have radically revolutionised the automotive industry.
In addition, the transition phase that the industry itself is facing, moving from traditional production to a high-tech industry in which vehicles are manufactured with more electronic and digital components, in which the amount of data on vehicles and drivers is expected to increase.
The industry has also been flooded with technology and data systems because vehicles will no longer be limited to being simple means of transport but will themselves generate data in the near future. In this respect, as already mentioned, valuable knowledge could be acquired, which will lead to the creation of value-added offers such as predictive maintenance, remote control of driving habits, exchange of information on road conditions and traffic situations or remote diagnostics.
Emerging challenges aligned with the *Digital Transformation of the* automotive industry can compete with an expanding range of new non-industrial rivals and competitors. This term refers to the set of technological, cultural, organisational, social and managerial changes associated with the new and ongoing application of digital technology to all aspects of society.
Sectoral boundaries become blurred and the difference between *Competition* and *Coopetition* tends to disappear, giving many companies the opportunity to collaborate with other companies representing a different industry sector and yet find common interests to form a *partnership*.
By building new collaborations between the different players in the ecosystem, information flows and exchanges between partners in the business system to create new digital value.
In addition, the rapid digital advancements of automotive manufacturers force the automotive aftermarket to increase their digital presence in order to remain relevant in their business environment and keep customer satisfaction at a high level and ensure long-term profitability.
By additionally considering the application of statistical models to a mass of historical data from a variety of sources, it is possible to identify the impact of fixed and variable marketing investments, and to support car manufacturers with a more precise and effective approach to the amount and composition of marketing expenditure.
Predictive analytics is becoming a powerful tool to generate a huge boost in predicting efficiency, operations and performance.
A final usefulness of big data is found in the field of *supply chain,* revealing which links in the chain are weak and which might be weakened, thus allowing predictive and timely measures to be taken before problems arise. But a specific section is devoted to this topic in the following pages of this paper.

2.3.3 The customer experience

CRM or *Customer Relationship Management* is a business strategy for managing all the relationships and interactions that a company establishes with both potential and existing customers. A CRM system helps companies to stay in touch with their customers, simplify their mostly informational processes and improve profitability: it is therefore a very useful tool for optimising and managing contacts, sales and ongoing relationships with customers and consumers.

CRM can be interpreted as a technological product in its own right, i.e. a *cloud-based* configuration that business teams use to store, analyse and report on all the data arising from the above-mentioned interactions and to obtain, as an ultimate goal, reports that help understand the positives, to be encouraged, and negatives, to be improved, in the relationship between businesses and users.

It can also be seen as a strategy, or rather as a business philosophy, concerning how relationships with existing and potential customers should be managed.

Finally, *Customer Relationship Management* can also be fundamental in business processes as a system adopted by a company to consolidate and manage relationships.

Unfortunately, many companies have not yet realised the importance of this strategy, which was created to deepen relationships with customers, *customer service users*, colleagues, partners and suppliers. Creating lasting relationships and monitoring all kinds of customers, from potential to existing ones, is fundamental to customer acquisition and retention, which is the core function of a CRM.

There are also tools that make it easy to control: a customisable dashboard, or control panel, that can show a customer's history with the company, the status of their orders, any outstanding customer service issues and much more (www.salesforce.com).

The call to shape up with these new management practices has also reached the automotive sector, which needs to sharpen its relationship with the digital world of *customer service*.

As already indicated, CRM is a fundamental tool for the growth of long-term sustained profits for a company through the development of customer satisfaction and, in addition to this, this *software* is also a system that enables a company to provide services that are truly effective, as shown in Figure 2.9.

Recently, several studies have been conducted on CRM in the automotive field, one of which was carried out by the "NEOMA Business School" in Reims and the "Hanken School of Economics", Helsinki (Eber et al., 2019).

The research examined the impact of customer relationship management on key suppliers as a strategic tool, in order to quantify the benefits of supply chain management and risk reduction, through specific interviews with five car manufacturers and five original equipment manufacturers or first-tier suppliers.

Figure 2.9 - Services deemed effective for customers. Source: Ngangi and Santoso, 2019

The study noted the great interest of companies in focusing on industrial evolution, constantly monitoring, and with even greater interest, the costs, quality and capabilities of suppliers, together with monitoring issues concerning new and smaller supply chain actors, sudden process or production changes affecting suppliers, lack of communication of car manufacturers and information sharing. Suggestions for tackling these inhibitors include greater collaborative involvement between car manufacturers and the original equipment manufacturers they work with in a key approach to supplier relationship management.

When dealing with the topic of CRM, however, reference is also made to a number of component factors, such as trust, the sales experience at the dealership, *co-creation and* empowerment or customer *brand loyalty*.

With reference to the latter, in America there is a car brand that has set record figures for the increase of brand loyalty, representing an example for all the other car manufacturers that are still trying to approach this practice. It's Subaru that among the many CRM initiatives has launched the campaign "Dear" Subaru that can be considered a real hymn to brand loyalty: a collection of letters from real fans, technically the *lead users*, that highlight special moments or reasons why they love Subaru.

These letters have even been used as the basis for some of the most popular commercials, based on customers' emotions, which back up the demonstration of how long-lived their cars are: by creating a direct connection with their consumers and showing them how important the brand is in their daily lives, they manage to reach and engage future buyers, simply by presenting the benefits they could gain by choosing their brand.

Using these media techniques, the company has become a true excellence in this respect, boasting one of the highest loyalty growth rates in the last decade, rising from 45% in 2007 to 61% in (2017James, 2018)

Car buyers say that the sales experience at the dealership is the most important factor influencing consumer loyalty and retention, making it another important element on which to base CRM.

However, with visits to dealerships declining, from an average of five in 2005 to an average of two in 2017, car brands have fewer opportunities to engage and inform customers in person, leaving the field open to online searches, through which people satisfy their curiosity and need for insight before interfacing with a live salesperson.

It can be said that around 95% of vehicle buyers use digital as a source of information: while these statistics may be a warning to the role of the salesperson, who has always been recognised as the ultimate expert on the product he or she is marketing, they also represent a huge opportunity for brands and retailers to influence customers before they arrive at the shop. In other words, if customers are to be so satisfied with the product that they become loyal and active marketers through word-of-mouth marketing in their community of friends, colleagues and family, they need to be captivated from the outset by the information they find on the web.

This would be described by mathematicians as a 'necessary but not sufficient condition': after the sales, maintenance and service experience of a customer has been ranked second in influencing car brand loyalty. In fact, customers who receive after-sales service from the same dealership they went to when they purchased their vehicle are more likely to remain loyal to the brand than those who went elsewhere, yet one in three owners say they have serviced their car elsewhere.

It is important to remember that while at best a customer becomes a regular buyer, more often than not he/she considers more than one brand before changing cars, or buying *from scratch*: data reveals that 90% of that category consider another car brand.

Among the factors that are assessed for purchase are:

- Price is intuitively the first factor that customers consider.
- life events, such as the need for more cargo space as a result of an enlarged family.

As an automotive manufacturer or retailer, CRM has the task of keeping up with the evolution, making sure that messaging matches, and grows in step with, changing customer needs.

One way to implement this is to interact with viewers who might experience important life events such as a graduation, a recent marriage or a new baby. All these remedies will be the backbone of thispaper and will be developed in the following chapters: it is necessary to become aware of how the above mentioned management practices are becoming important in a rapidly changing scenario thatneeds to be followed, or even better, preceded.

2.4 Supply Chain

A final usefulness of big data is found in the field of *supply chain,* revealing which links in the chain are weak and which might be weakened, thus allowing predictive and timely measures to be taken before problems arise. But a specific section is devoted to this topic in the following pages of this paper. Globalising operations to take advantage of fast-growing markets, driving innovative operational strategies that aim to optimise the manufacturing process and managing regulatory environments around the world are just some of the forces that are putting enormous pressure on *supply chain* management capabilities. If these scenarios are not managed correctly, automakers can quickly find themselves in challenging scenarios ranging from parts shortages, government scrutiny or lost growth opportunities.

The good news is that in the midst of these intense and complex challenges, vast amounts of data areaccumulated that can help carmakers crack the code on global *supply chain* risk management.

A proactive management model can help carmakers in their ability to continuously detect and respond as the industry changes around them.

In addition, advanced *supply chain* insights can help automotive manufacturers analyse ever-larger data sets using proven analytical and mathematical techniques, including regression analysis, stochastic modelling and linear and non-linear optimisation.

The ability to fuse discrete data sources and use powerful big data tools to help obtain actionable intelligence has improved significantly in recent years.

An example of this in its simplest form is the possibility of using product configuration on web portals, enabling car manufacturers to obtain early information of emerging trends, such as switching from an automatic to a manual gearbox, or a particularly fashionable colour in a given time period. These methods and tools can enable parent companies to identify patterns and correlations that were less visible in the past.

Advanced supply chain analytics offer more and more opportunities for the global automotive industry to move from information that used to be collected over long periods of time, to accessing data in real time.

The focus will shift to data sharing for greater coordination and shared understanding of data flows across value chain partners.

Individual silos within the supply chain, suppliers, purchasing, operations, sales and consumers will be broken down.

Instead, a more visible and wider supply chain will emerge, more connected and better prepared to detect, react to changes through proactively managing by reducing *supply chain* risks and introducing new effective responses (Deloitte.co.uk, 2019).

2.3.1 BlockChain technology

Blockchain technology is a fully *distributed* system for cryptographically storing a consistent, immutable and linear event log of transactions between actors belonging to the same network (Risus and Sphorer 2017). Blockchain technology is derived from the well-known and popular digital currency Bitcoin, which is precisely based on it (Morabito 2017 p. 5). Bitcoin's blockchain system aims to eliminate centralised control by providing the ability by any entity, to write to the blockchain behaving similarly as a network system of computer-generated databases (Morabito 2017 p. 7). Iansiti and Lakhani (2017) list distributed database, peer-to-peer transmission, transparency, irreversibility of records and computational logic as five core principles of blockchain technology:

1. ***Distributed database***: No single entity controls the data on the blockchain, but each network participant has access to the entire blockchain database and its complete history. Verification of transaction records does not require a trusted third party.
2. ***Peer-to-peer transmission:*** communication takes place directly between peers without the central node.
3. ***Transparency:*** all actions and values relating to the nodes in the network are visible to anyone with access to the network. Each node, or participant, is digitally identified by a specific 30-character alphanumeric address.
4. ***Irreversibility:*** means that the transaction cannot be altered after it has been entered into the database, as this transaction is linked to every transaction that has taken place previously.
5. ***Computational logic:*** stands for the fact that all transactions on blockchain can be scheduled, network participants can create rules and algorithms that automatically trigger transactions between participants. (Iansiti and Lakhani 2017)

According to the most simplified definition of Lewis (2015) blockchain is a set of data coupled in a logical order that creates a structure. Table 1.1 shows a brief comparison between the Bitcoin approach and traditional methods according to an interpretation adopted by Lewis (2015).

The innovation behind cryptocurrencies, such as bitcoins, is not in the currency itself, but in the system on which they are based and which makes them enforceable; thus the blockchain, on which bitcoin is based, is the real innovation, as it constitutes a new, digital payment system that is based on cryptographic proof instead of trust, and that allows two consenting parties to conduct a transaction directly with each other instead of using a trusted centralised intermediary, such as a bank or government institution. (Nakamoto, 2008).

Category	Traditional methods	Bitcoin's approach
Consensus mechanism	Trusted node or super node (No need for trusted networks)	Rule of the longest chain
Updating mechanism	Centralised update, contractual obligations	Rules change via; PIF (for writing rules) Vote for hashing power (for implementing rules)
Data storage	A database	Data should be stored via the blockchain
Data distribution	Hierarchical, Client-server	Distribution of new data should be in a peer-to-peer format
Participation criteria	Trusted and pre-accredited participants	Sending, reading and authenticating transactions are anonymous and open
Defence mechanism	Not necessary in trusted networks	Proof-of-work
Incentive	Contractual obligations or third-party financing	Reward for Bitcoin Block Mining

Table2 .1 - Comparison between the Bitcoin approach and the traditional approach

In essence, the blockchain is a public ledger that contains information about every transaction conducted within a P2P system. (Nakamoto, 2008; Arias et al., 2013; Kosba et al., 2015; Kapil, 2014; Swan, 2015; Pilkington, 2015).

Swan (2015) refers to blockchain as a giant global spreadsheet that accounts for transactions and records both tangible and intangible assets such as currency, physical property or documents. In addition, the technology can be used to track and monitor assets, communication and information sharing, and the execution of long-term and conditional contracts. The essence of blockchain is a distributed ledger that verifies valuable information.

The establishment and introduction of blockchain technology has solved the **problem of double spending** that has long been associated with the implementation of digital currency. The use of cryptocurrencies within a decentralised system could be dangerous as a consequence of not having a trusted third party to ensure, by maintaining a ledger, that the digital currency used for one transaction has not already been spent on another transaction, the double-spending problem. (Naknamoto, 2008; Arias et al., 2013; Swan, 2015; Pilkington, 2015). To counter this problem and enable secure digital transactions, (Nakamoto 2008), the Blockchain resorts to the use of a **peer-to-peer distribution** server where timestamps are used to record and confirm transactions in chronological order. These occurrences are validated by a system based on a consensus mechanism (see Back, 2002) that needs to be implemented and is achieved through the use of hashing (Nakamoto, 2008; Swan, 2015). A hash is created by processing the original data (input) in a mathematical algorithm, and the results (output) represent the hash, which is inserted into the blockchain. When the input converts to output there is no possibility to reverse the process due to the cryptographic function of a hash. (Pilkington, 2015).

The realisation of a transaction through a blockchain (illustrated in Figure 1.1 with cryptocurrencies as entities) begins with an identity, known as participant A, informing the network of its agreement with another identity, participant B. Then B announces his acceptance, using his public key, to the network and simultaneously asks peers within the network to determine the authenticity of the transaction. The validation of a transaction is established by the consensus of peers.

The verification is conducted with the use of miners (computer computing powers). The miners extract the information from the block, in which it was stored after the acceptance of B, and transform it into a hash by applying a conversion that can be seen as a kind of mathematical formula (Kiviat, 2015; Pilkington, 2015). The validity of the hash is then processed within a proof-of-work system to safeguard the transaction from double charges. Once the validity is confirmed, a timestamp is added and the hash is placed, in chronological order, on a platform as a link in the chain that constitutes the blockchain.

The hashes are built on each other, which guarantees the legitimacy of each block that is created later along the chain. (Kiviat, 2015; CoinDesk, 2016) Indeed, tampering with a block would alert the entire network because the alterations would contradict the proof-of-work applied in previous blocks. The only procedural mode that could topple a blockchain is if the culprit confers 51% of the network's processing power. Essentially, transactions that have been proven to be solid will be recorded in the public ledger, making it irreversible due to the awareness of sedation networks. When a block is admitted in a chain, the transaction is considered completed. (Nakamoto, 2008; Swan, 2015; Pilkington, 2015).

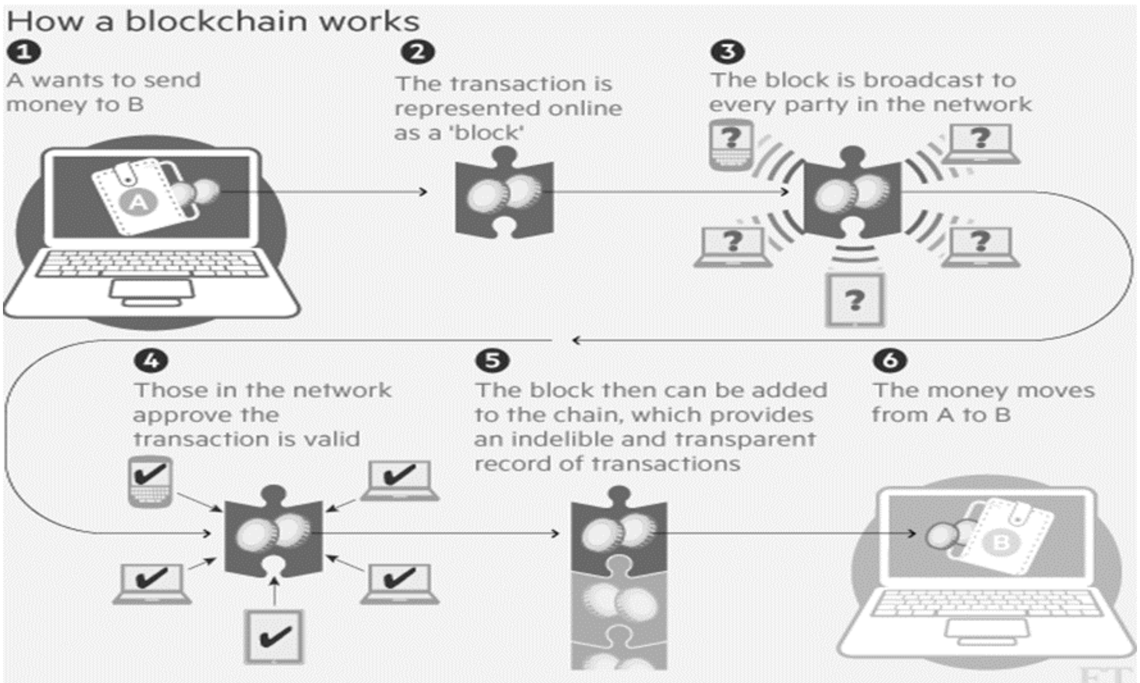


Figure2.10 . Stages of a transaction using a blockchain, the example is based on currency transfer. (Financial Times, 2015)

The system notifies the public that a transaction is taking place (Back, 2002). However, it does not reveal the parties to the transaction, it only states the size of the exchange, a bit like information about a stock exchange. A further length of precaution is to use a new set of keys for each transaction in the notion of hiding one's identity from being linked to several transactions. Anonymity can be difficult to ensure with multi-input transactions because the inputs show indications of being from the same owner. Exposing the ownership of a key may lead to the discovery of multiple transactions through linkage (Nakamoto, 2008).

2.5 The new generation of Digital Commerce

Never before has the search for a digital strategy and the ability to implement it in the shortest possible time been so relevant. Now, in the post-pandemic phase, the digital *customer journey* plays a key role. A new economy based on social distancing requires companies to use technological expertiseto minimise real-world risks, to invent unique experiences that maximise sales and, above all, to increase the value perceived by customers.

Experts say that reinventing the *customer journey* is, and will increasingly become, an essential element of digital commerce. In this respect, when it comes to digital commerce, the first elements that would probably come to mind would be online shops, shopping carts, product recommendations and personalisation systems, but this is not actually the case, or at least this is not the whole story. Emerging technologies and techniques, such as Artificial Intelligence (AI), Machine Learning (ML), Augmented and Virtual Reality (AR/VR), Internet of Things (IoT), Robotic Process Automation (RPA), Natural Language Processing (NLP) and data-driven processes are able to breathe new life into digital commerce, and enhance its potential by transforming shopping applications into emotional shopping experiences.

This is why there has been a big effort lately by industry professionals, in constantly studying how toanticipate trends and explore new possible strategies. In this regard, in 2019-2020 Reply Practice interviewed 15 industry experts and conducted digital surveys with the support of 13 different Groupcompanies, as well as organised Bootcamps with more than 40 clients in the Automotive, Manufacturing, Retail (Home Appliances, Fashion, Furniture), Energy and Insurance sectors, and from this activity it emerged that it is common thought that technology is a key factor and that unleashing creativity and making the most of technology are the real challenges of the future.

According to interviews and surveys, there are many trends and solutions related to the *Customer Journey*. If organised into quadrants, it is possible to identify different phases of their use: *Experimental* (prominent activity in the market), *Transformational* (disruptive potential in the market), *Early Bird* (conceptual with limited market penetration) and *Commodity* (widespread and generally accepted).

Figure 2.11 shows the locations of the activities according to the phases of use listed above.

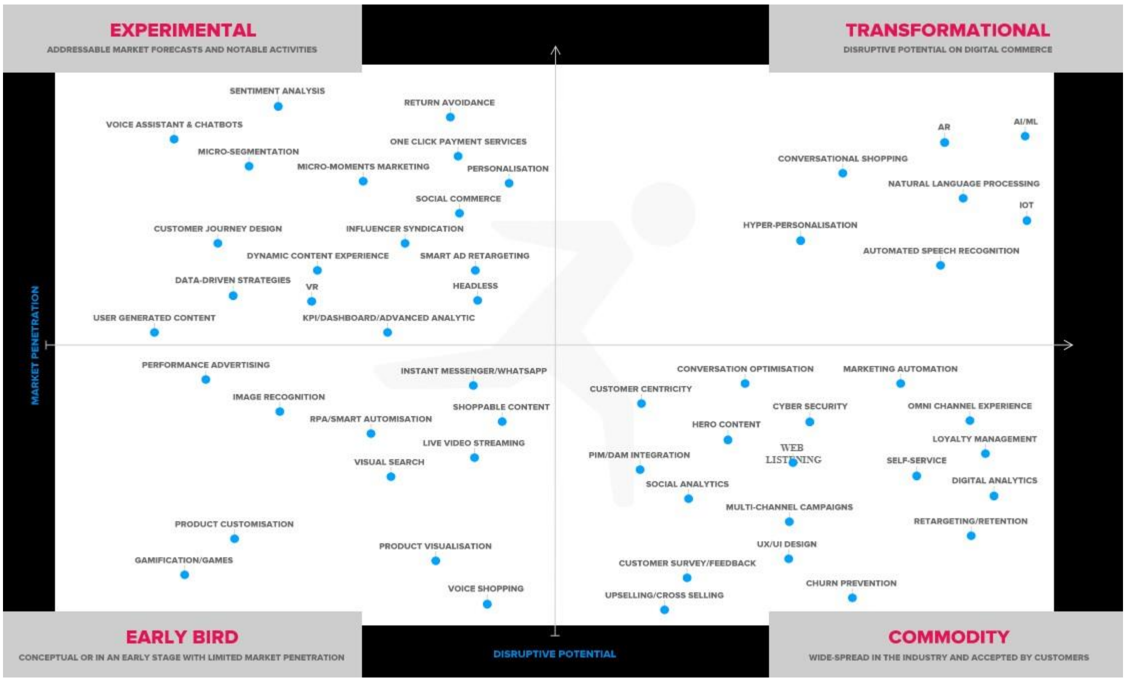


Figure 2.11 - Areas found to be of relevance in digital commerce over the next three years by the survey. Source: Reply study on digital commerce:

In relation to the *Customer Journey,* on which digital commerce is now entirely focused, six areas were found to be the most highly rated. Reply asked industry experts to rank from 1 to 5 the importance of technological capabilities over the next three years. In particular, as shown in figure 2.12, it was found that the most relevant are those aimed at meeting the needs of full personalisation, contextual content, continuous shop optimisation and innovation to overcome interruptions in the *Customer Journey*.

To enhance digital commerce, revolutionary new shopping formats are being developed, such as voice commerce, Digital Shopping Assistants, Digital Twins, Social Commerce, Data-Driven Ecommerce, Interactive Shopping Windows and so on. Combined with hyper-personalisation, it will be possible to create shopping experiences, dedicated to individual customers, that are revolutionary and will exceed current limits. Everything and everyone is destined to be represented digitally. A one-size-fits-all approach will not be enough to stand out. To attract attention, eShops will have to be unique and creative. the ultimate challenge will be to balance customer expectations and business complexity.

A company can only offer its consumers a unique shopping experience by recognising customers as individuals within micro-moments, managing large amounts of micro-data and processing them to generate useful insights and using them to respond to consumers in a beneficial way. advantages.

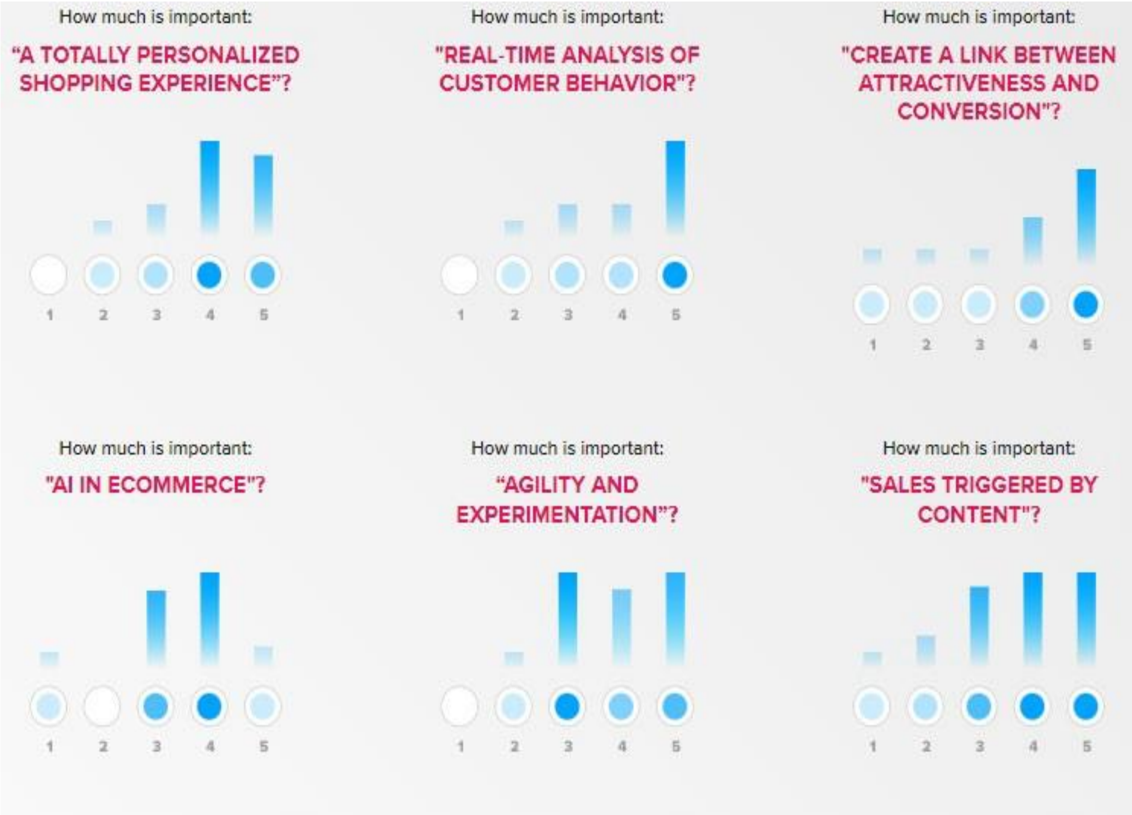


Figure 2.12 - Areas found to be of relevance in digital commerce over the next three years by the survey. Source: Reply study on digital commerce:

In recent years, there has been an increasing number of companies that have structured their e-commerce to include highly technological elements such as Virtual Reality and Augmented Reality: This trend stems on the one hand from the need, on the part of companies that base their business largely on e-commerce, to convey to their customers an image of their products that is as realistic as possible and as close to reality as possible, in order to make their offer more credible and convincing, and on the other hand from the desire to make concrete use of the high level of experience gained in the use of the main Virtual Reality and Augmented Reality platforms in various sectors, including inthat sector in which, perhaps more than others, it seems to find a natural place and could succeed inproviding a more consistent added value. Therefore, the use of such technologically advanced resources is designed to meet the needs of both companies and customers, as it creates interactive navigation products with images and videos that can be totally customised, in an efficient and innovative manner.

These technologies allow for a dynamic and personalised approach to those who want, in turn, to offer a 360° immersive experience to their customers. The possibility of customising the VR or AR interface is complete, the level of customisation is very high, and it is designed to offer the customera tailor-made product that is as much in line with their needs as possible.

2.5.1 Virtual and Augmented Reality

Many people think that virtual reality is synonymous with augmented reality, but this is not the case. Virtual reality allows the user of the experience to be totally immersed in a different environment, from a sensory (visual and auditory) point of view. With it it is possible to create true immersive experiences where customers have the freedom to move around in space: this could be a flat that is still under construction, or the inside of a car, or even the square of a city in Roman times, for example.

Augmented reality, on the other hand, leads to the vision of one's own environment enriched with virtual elements, which always recall the real world; it enriches human sensory perception through information, manipulated and conveyed electronically, which cannot be grasped through the five senses.

The idea of being able to 'augment reality' was born in 1957, when Morton Helig built a machine, called Sensorama, which, when used, allows one to see, hear, and even smell a short film, but interest in it has only re-exploded in recent years, supported by the rapid spread and evolution of smartphones, the mobile devices that, thanks to the simultaneous presence of a camera, GPS, compass and network connection, represent the ideal tool for developing applications based on this type of technology. It is precisely the devices used for them that are perhaps the biggest difference between AR and VR technologies, since the latter requires a special tool, the visor.

Virtual and augmented reality, if wisely used, has no real limits.

Their use can change the way information is accessed and, therefore, where there is data, can play a fundamental role. Our clients can revolutionise the way they interface with the users of their portals: they can finally offer those who visit their portal a complete, all-embracing, totally immersive experience. Alongside information on their business, they can offer 3D reconstructions of buildings, places and landscapes, they can bring experiences to life, recreate moments of history, and make short films of significant events that have marked their evolution along a path.

Tools such as the virtual tour within search engines such as Google, represent a digital shop window open to the world. In the year of the Coronavirus health emergency, when many businesses had to adopt new strategies and digital tools to stay in touch with their audience and resist, the value and potential of tools like this came to the fore.

To be really effective, virtual experiences should be of very high quality, and should be characterised by a light navigation, which does not weigh down the website. Another outstanding feature that virtual tours should have is compatibility and accessibility with all devices, which is often achieved by developing a responsive and mobile-friendly version of the virtual interface. This allows users to digitally visit the interior or exterior of a location, with a very strong emotional involvement.

As mentioned above, one of the sectors affected by the crisis is undoubtedly the automotive sector. In order to maintain direct contact with its customers (or potential customers) even in digital mode, sophisticated equipment has begun to be used, such as the Oculus visor, for the use of information and 'extra' content, designed ad hoc. The virtual tour can be linked to print via QR Code, for the creation of a multilingual version to be prepared for the Oculus visor.

Virtual reality can be used to enhance and add extra-sensory contributions and environments, which in sectors such as the automotive industry can provide high added value. For example, it is possible to create a smart room in which, by manipulating the sounds, humidity and temperature of the environment, or by placing particular elements on the ground (urban path, dirt road, sand, grass, etc.), it is possible to offer a complete and flexible service that can show images of different routes, selecting various driving scenarios, from the most common to the most extreme.By manipulating sounds, humidity and temperature, or by placing particular elements on the ground (urban route, dirt road, sand, grass, etc.), it is possible to offer a complete and flexible service that is able to show images of different routes, selecting various driving scenarios, from the most common to the most extreme. Through these tools, dealers and retailers can offer as a service to the customer that of anticipating the experience of travelling to a certain destination with the car of interest, to be tested first virtually, and to be able to compare it with other cars in order to make an informed choice of car. Visiting the dealership in smart version allows those who are perhaps comfortably seated to carry out real Test Drives in environments rendered in 3D and to give, therefore, the possibility for the user to interact with information and/or other content.

In addition to virtual tours and virtual reality services, filters can be conceived, designed and implemented for Instagram and Facebook to increase the online visibility of companies that choose us. Filters are highly engaging information content for users. Having your own filter not only allows you to engage your audience with interactive content, but it also makes it easy to share your brand through Stories; your audience of followers can in turn view the filter with that logo or idea.

Virtual catalogues, Show-Rooms, Virtual Showcases, Photo Booths, immersive for events or trade fairs, projections in both VR and AR can be realised.

As far as VR is concerned, two main types of content are available on the market:

a) in-app downloads
b) projects to implement content on portals

The in-app downloads are virtual reality apps produced expressly for the customer and containing information relating to the brand's business presented through the Virtual Reality system so that theuser can fully experience them remotely, an experience that is vividly close to that which the customerwould have when using its products or services.

As far as augmented reality is concerned, there are mainly two different categories of systems availabletoday:

- Geo-based projects, in which reality is 'augmented' by exploiting the user's position. The system must therefore be equipped with a global positioning system (GPS) and a magnetometer, whichacts as a compass. The device locates the point where the user is and, through this information, offers the service user the possibility of viewing additional content.

- Tag-based projects, in which the presence of graphic 'labels' is exploited. To be able to create anew level of reality, the system must therefore be equipped with a camera that, by exploiting therecognition of these graphic markers, adds further levels of information.

This differentiation resembles the one generally applied in this period, which differs from the one used in the past, which was based on the type of electronic device used. Today, given the rapid evolution of smartphones and the considerable increase in their processing power, this distinction isobsolete. The offer, also in this case, focuses mainly on two types of content:

a) in-app downloads
b) projects to implement content on portals

The in-app downloads are AR apps produced expressly for the client and comprising content relatingto the brand's business imaginatively revisited through the Augmented Reality system so that the userexperiences them in a way that is completely unexpected and makes him appreciate the originality ofan absolutely unique and surprising experience.

Projects, on the other hand, are content that is published on the portal or implemented in special ARworkstations at the client's premises, which are modelled according to the client's specific requirements. The content can be as varied and disparate as you wish:

- filters;
- virtual catalogues;
- Showrooms and virtual showcases;
- Photo Booth;
- immersive for events;
- projections in AR.

The main benefits of products based on VR and AR technologies are the so-called "3I's":

- Diving
- Interaction
- Innovation

These benefits, appropriately integrated and developed according to a certain approach, guarantee atype of experience that is difficult to forget for the user who uses them, an experience that satisfies the user's needs, finds the solution to their requests through paradigms that are very different from the traditional ones, managing, in many cases, to perfectly meet the needs of a wide target audience. First of all, however, we will have to go into the possibilities and functionalities that the user will haveat his disposal in the use of the portal, through the 3 "I "s.

- *Immersion:* this component is probably one of the most innovative of the project, as it can only be guaranteed through technologies that have only recently been developed, in particular"virtual reality" and the new "360 degree cameras". Virtual reality, in its strictest sense,can be considered as the new technology that allows users to be 'convinced' that they have entered a different reality from the one they are actually in. This is possible through the use of particular devices, called Head-Mounted Displays (in Italian 'Visori'), which, once worn, allow the user to disconnect from the reality thatsurrounds him and project him into another created by third parties. 360° cameras, on the other hand, are new devices that allow the production of spherical videos and, as such, are able to offer the user all possible perspectives from a given point of view.Therefore, by connecting these two technologies, it is possible to create a context in which the user can feel as if he were inside the landscape and see what he is interestedin.

- *Interaction:* The aim is to give the user the possibility of not having to make do with the usual classic static way of using content, but to make the experience dynamic, alive, allowinghim to choose between different sources, which will represent various paths of interest, thus giving him the possibility of finding the type of content he prefers. Theuser can thus choose the route he prefers to take, acting on the basis of the types of information (culture, cuisine, history, main characters, etc.) he can find on the variousroutes. He can interact, in a virtual but vividly realistic way, with local people, who thus become a tool for disseminating information on beauty, history, cuisine, customsand anything else of interest concerning the element in question, so as to recreate a real visit to the place, enriched with content and information. In the post-viewing phase of the contents, the user will also have the opportunity to save favourite routes and act on the saved contents, taking photos of the most interesting places, with the possibility of sharing their creations on social networks.
- *Innovation:* The content that the seller wants to communicate to its users can be conveyed in a completely innovative way through the presence of markers (signposts) in augmentedreality that will contain written information and through the fictitious interaction itselfwith the people of the place. The user has the opportunity to enter a different context,in which objects of various kinds are superimposed on the content being viewed, enriching it and making it unforgettable.

All this, if well integrated and amalgamated, can lead to an experience that is not intended to replace the actual visit experience, but to give the user the possibility of living an experience that goes beyond the documentary style and is reinterpreted in a new format.

According to the unanimous estimates of the most influential magazines in the entertainment industry, Virtual and Augmented Reality technologies will find application in more and more areas over the next decades and will have an increasing impact on our business and private lives.

Already next year, the market for these technologies is estimated at around $120 billion, of which

$17billion for the European market alone will be up 74% on the previous year.
The augmented reality market consists of hardware and software; from products for the business market to products for the end market.
The market for Augmented Reality and Virtual Reality solutions was expected to register a slight contraction in overall sales volumes during 2020: this was the estimate obtained in the market analysispublished by Strategy Analytics.
This estimate of the 2020 figure was linked to the effects of the global COVID-19 pandemic, which has almost naturally slowed down market expansion in new areas such as virtual and augmented reality devices.
The real figure, which is also confirmed by leading market researcher *International Data Corporation* (*IDC*), states instead that worldwide spending on Augmented Reality and Virtual Reality (AR/VR) for 2020 will be around $18.8 billion, an increase of 78.5% compared to 2019 (source IDC).
But from 2021, according to estimates, the market is expected to take a strong positive leap: by 2025, combined sales of VR and AR devices are expected to increase sixfold, according to Strategy Analytics' forecasts, and driving these volumes will be the spread of visors developed by Samsung and the start-up Nreal, products offered to the mid- and entry-level segment of the market that are connected to a smartphone. The growing availability of smartphones compatible with the new 5G networks will lead to an increase in the supply of smartphone-connected virtual reality products thatcan benefit from the lower latency offered by 5G connectivity.
With the spread of 5G, one can in fact imagine experiencing virtual reality on the move and thus in very large environments (in a hotel or at a trade fair), being able to make the most of the possibility of moving with one's body in increasingly large and complete virtual environments. At the same time,new gadgets similar to treadmills allow one to move with great freedom even in restricted environments (but it is difficult to imagine them in places other than amusement arcades that VR could bring back to life).
But marketing developments are really the most interesting and promising of all: digital marketers arefacing new challenges and seizing new opportunities. All the more so today given the ongoing pandemic and the acceleration in the changes in people's buying and search processes.
Virtual Reality (VR), Augmented Reality (AR), Mixed Reality (MR), are all terms with which CEOs, Marketers and Sales Managers will be increasingly forced to become familiar.
Speaking of numbers, here are some thought-provoking statistics:

1) Virtual reality is estimated to generate $1.8 billion in retail and marketing segments by 2022. (ABI Research). Digital marketing, the e-commerce world and the retail segment have already changed the way many companies do business. ABI Research's Virtual Reality Market Report shows that AR and VR are likely to take shopping and advertising to the next level. As customers demand more interactive shopping experiences, the list of

companies using virtualreality grows every day. The possibilities are almost endless: virtual tours of holiday destinations, luxury car test drives, furniture testing, clothes testing and all kinds of viewing aids. Experts claim that the ROI of such activity will be significant and achieved in a 'tight' timeframe.

2) More than 60% of people discover AR and VR trends through social media. (Perkins Coie). According to recent research by Perkins Coie, social media plays an important role in learning about facts and trends in virtual reality. Trade association publications and dedicated websitesare the main source of information for 69% of respondents, but social media is fast approaching 64%. This is another statistic that shows that the social aspect of virtual reality isone of the key elements that the industry must pay attention to in the future.

3) 78% of Americans are familiar with VR technology (Greenlight Insights). According to a Greenlight Insights report, this number has increased dramatically over time, starting at 45% in 2015, showing that people are becoming more comfortable with virtual reality. The survey'svirtual reality statistics show that 55% of Gen Z respondents who say they are familiar with virtual reality have also tried it. In the 55+ age group, that figure drops to 19%. Young peopleare clearly driving the growth of the VR market.

4) 44% of people interested in buying VR devices are aged between 18 and 35. (Yulio Technologies). The demographics of virtual reality are definitely skewed towards the younger generation. This number corresponds to previous research by Nielsen, which reported in 2017that millennials (aged 18-34) account for 44% of those interested in purchasing VR devices.

   When we consider that the current VR revolution started with Oculus Rift on Kickstarter, it makes sense that the tech-savvy younger generation would be at the forefront.

5) Nearly 80 per cent of virtual reality users seek greater social engagement. (Greenlight Insights).According to a Greenlight Insights survey of 4,217 consumers, 77% say they seek social interaction when using their VR devices. The huge popularity of VR games is another factor contributing to the increased demand for social interaction in the virtual world.

6) An estimated 100 million consumers will use AR and VR technologies to shop by 2020. (Gartner). This is a huge and growing market. Virtual reality statistics from Gartner's survey confirm the strong link between shopping and altered reality platforms.

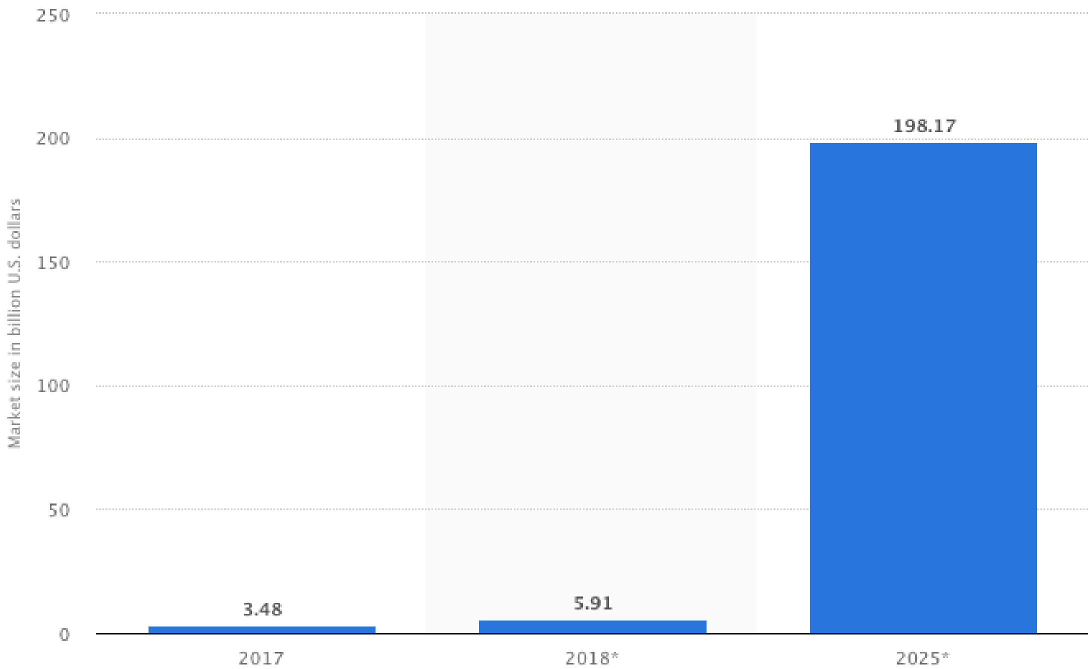


Figure 2.13 – Trend for Market Size for AR. Source: Statista

In any case, augmented reality products and devices will achieve the highest sales volumes in the coming years, reversing the trend that has seen virtual reality devices dominate in recent years. In the latter case, the fields of engineering, automotive and architecture are expected to benefit most from these technological innovations.

The infographic from Statista in fig. 2.13shows the size of the global augmented reality market in 2017, 2018and 2025. It is estimated that the market will reach more than USD 198 billion in the next few years.The following tables 2.14, also by Statista, allow you to check a little more how the market is moving: the first one shows, confirming the boom of this technology, the growth of the aggregated AR and VR (virtual reality) markets.

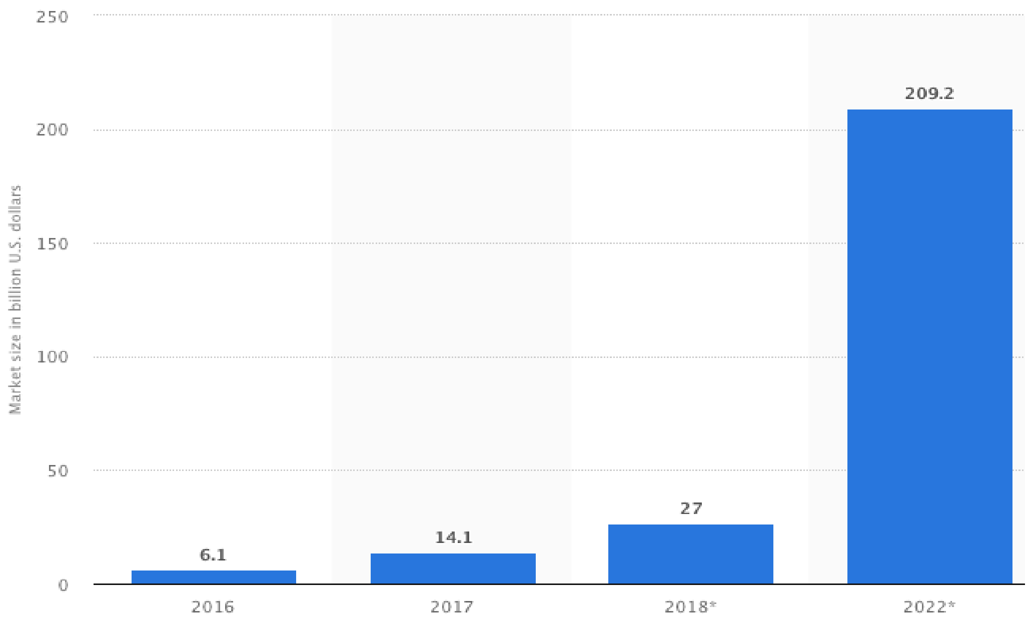


Figure 2.14 – Trend for Market Size for VR and AR. Source: Statista

The following chart in fig. 2.15 shows the growth of AR + VR (virtual reality) within the different industries, asyou can see video gaming seems to be the industry with the largest market, but growth rates are higherin other sectors especially healthcare. In this industry, the market value is expected to reach $1.5 billion by 2020 (source: PlugandPlay Tech Center), with growth rates ranging from 20 to 30-35% depending on the source. Right behind this are the sectors closest to our interest, namely Live events,Video Entertainment and Retail, which have very promising growth margins.

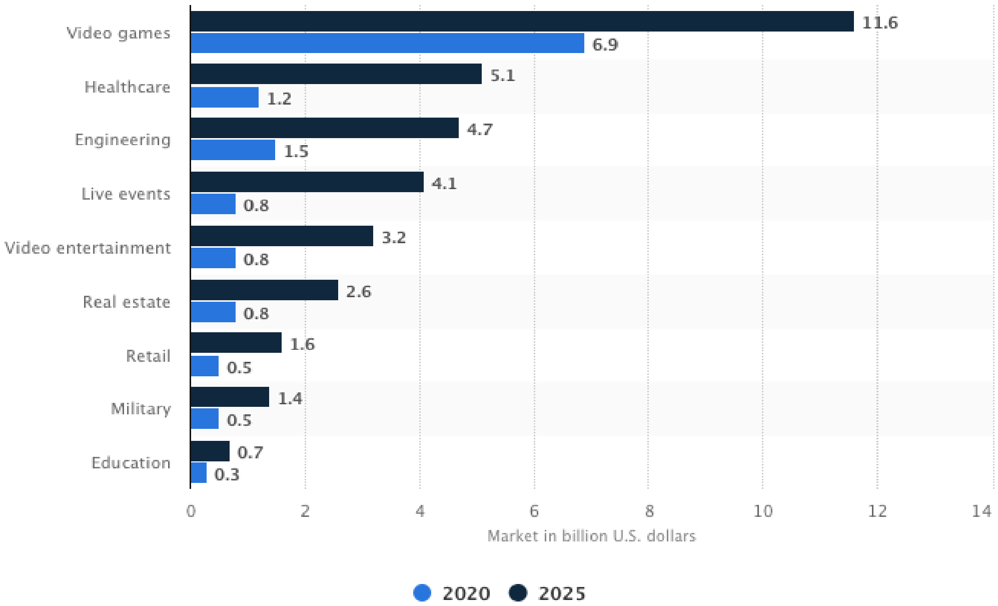


Figure 2.15 – Trend for the growth of AR + VR within the different industries. Source: Statista

This other graph in fig. 2.16 is interesting because it shows the boom in sales of 'headsets' for AR and VR, i.e. visors and smart glasses: the growth is very evident for augmented reality, which is actually the one that, especially in the consumer field, requires less hardware.

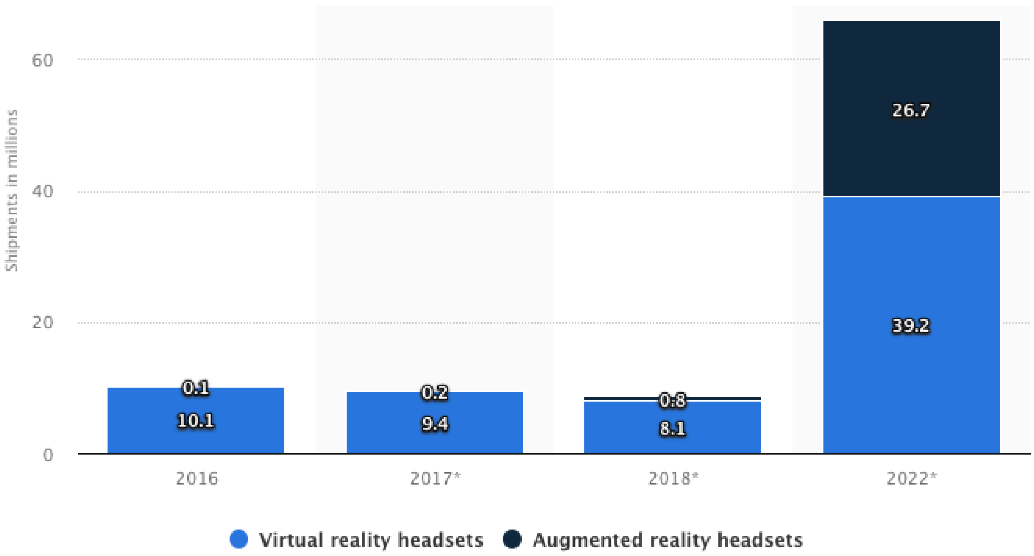


Figure 2.16 – Trend for sales of 'headsets' for AR and VR, i.e. visors and smart glasses. Source: Statista

2.6 A concrete example of a response: Stellantis

Stellantis welcomes the debut in Italy of an entirely digital platform common to the brands that make up the 'orbit' of the new big player created by the merger between *FCA* and *PSA* (Abarth, Alfa Romeo,Citroen, DS Automobiles, Fiat, Jeep, Lancia, Opel, Peugeot among the others, as in Fig 2.17), and capable of integrating online and offline channels, to follow every stage of the sale of the cars that make up the respective Stellantisline-ups, and to guarantee - a press note specifies - 'the special features of each brand in the customerjourney'.

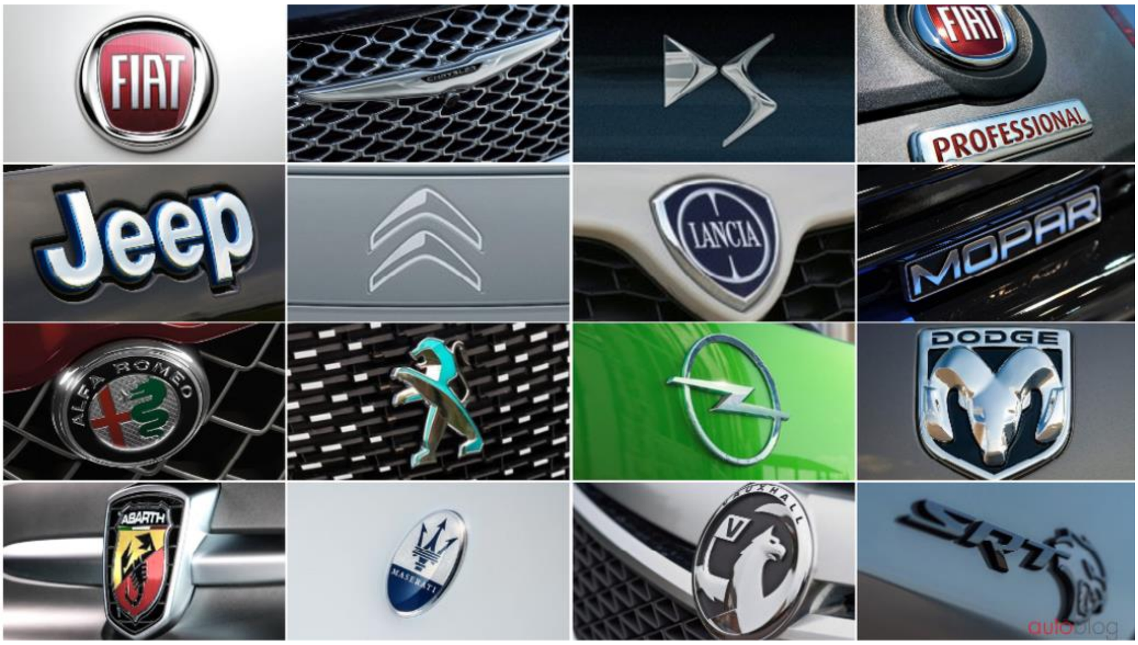


Figure 2.17 – Brands that are included in Stellantis. Source: Google Analysis

This latter indication is fundamental with reference to the Google analysis mentioned at the beginning and is further motivated by a 4 percentage point increase in the propensity to purchase anew vehicle online compared to the pre-Covid period, as well as - continues Stellantis - in the more than 6,000 registrations to the Stellantis e-commerce platforms, with over 2,500 customers having purchased a new Group vehicle. What's more, to highlight the affinity between innovation in the sales channel and the development of fuel technologies, 80% of purchases involved electrified models: from mild-hybrid vehicles to plug-in hybrids and all-electric models.

Every order placed online, Stellantis illustrates, has no strings attached and gives the user the option of withdrawing from the order free of charge and receiving an immediate refund of the deposit. If delivery has already taken place, there are fourteen days to cancel. Other benefits include specific prices and promotions. For example: for the online purchase of a Jeep Compass, the purchaser receives a free 500 euro voucher that can be used in Mopar products and services.

The objective declared by Stellantis in developing the new e-commerce service goes beyond the simple concept of a "market place": it is, the Group's Italian management points out, a real start-up that focuses on a broader experience, albeit one that is consistent with traditional purchasing formulas. This is a strategy whose importance is now beyond doubt, as recently emerged from a studypresented at the Automotive Dealer Day held in mid-September at Veronafiere.

The initiative, organised by Quintegia and dedicated to the world of dealerships, has highlighted a figure that says a lot about the preferences of Italian consumers when it comes to buying a new car: 43% of respondents said they were ready to rely on e-commerce channels, rather than a "physical" dealer, precisely because of the values of convenience, savings and speed in the choice of a new vehicle through the Web, which has had a further "boost" during the dramatic months of lockdown. Among the most "popular" methods, highlighted the analysis by Quintegia's Automotive Customer Study, the first place goes to the official dealership's corporate online portal (which received 88% ofpreferences), followed by the manufacturer's official website (identified by 23% of consumers surveyed), the websites of independent multi-brand car dealers (16%), the online portals of car rentalcompanies (6%) and, lastly (3%) the websites of the "big players" in e-commerce such as Amazon (and it should be borne in mind that the latter has, in the recent past, already proposed a sales channelfor the purchase of cars).

Buying online, however, in the 'new gen' sense of the process, corresponds not only to the mere actof concluding a contract (i.e.: the potential customer browses through the offers online, identifies what he or she thinks best meets his or her needs, and formalises the purchase by going to the checkout and providing his or her details for sending the item to his or her home). This may be truefor several products, but in the case of a car, the choice is carefully weighed against any offers proposed by the manufacturer and the sales branch. And there is, very often, the need to "touch withone's hands" what one is going to buy. The Quintegia survey itself represents this aspect very well: for 90% of the consumers interviewed, the opportunity to see the vehicle they are interested in "live",and perhaps try it out with a test drive before concluding the purchase, is "Very important" or "Fairlyimportant". In the same way... human contact: almost all those who took part in the survey (96%) declared that they always wanted to discuss and compare notes with a person (a "reference figure", therefore) in order to be listened to and receive advice and suggestions on the most suitable versionand equipment. Indeed, for 55% of consumers, the dealership remains the preferred channel for theconclusion of a purchase initiated online, while - confirming the above - for 37% of consumers interviewed by Quintegia, the exclusion of the online purchase of a new car is motivated, in first place, by the lack of support from an expert; followed, at 21%, by the fact of not being able to physically see the desired car, and - at 20% - by the difficulties that can arise in the face of various problems.

A 'happy coexistence' between e-commerce and a 'tangible' point of sale is born here: it is the 'phygital' concept, in which online sales are complementary - in the case of cars - to showrooms.

CHAPTER 3

3. Model formulation and empirical analysis

3.1 Research Questions

In the previous paragraphs we have described the radical changes that have been taking place in the automotive industry for some years now with the arrival of new digital technologies and companies hitherto unconnected with the automotive world that, on the other hand, have the right IT knowledge in their hands and make competition increasingly tough and challenging.
For this reason, within the ACES strategy, IT specialists, software developers in the areas of artificial intelligence, machine learning and data analytics converge towards a flexible use of the tools made available to them by companies in the sector so as to be able to integrate different working methodologies and support the creativity, flexibility, efficiency and autonomy of developers. In line with the ACES philosophy, it conscientiously charts the course for the autonomous driving of tomorrow in the following steps.
Increasing levels of assisted driving will increasingly characterise the cars of the future, which will be autonomous, connected, electrified and shared. The acronym ACES - Autonomous vehicles, Connected cars, Electrification and Shared mobility - has been coined to describe this 'revolution', and 2030 is the date that will mark the watershed between two eras of the automotive industry. In the new era of the connected car and autonomous driving, which has already begun but will be in full swing in a decade's time, the automotive industry will increasingly shift its focus to the car's technology stack, i.e. the whole ecosystem of car software and hardware that underpins the digital car, increasingly integrating IT and tech suppliers into the value chain.
Already today, car ADAS need to collect a huge amount of data through sensors, radars and car cameras in order to function. As autonomous driving functions are implemented, the amount of data will grow exponentially and need to be managed securely and reliably. Intel has estimated that a self-driving car generates more than 4 terabytes of data per day. An enormity, unimaginable just a few years ago. As McKinsey points out, the number of sensors inside the vehicle has grown exponentially and is set to increase further.
The next two to three generations of cars with ADAS, which will be mandatory from 2022, will in fact be equipped with sensors with similar functionality to ensure functional safety through redundancy. McKinsey also highlights the continuing trend towards integrating car functions and related electronic control units (ECUs) into a central domain controller, driving the technology push

towards more integrated and connected infotainment systems.

McKinsey assumes there will be a multitude of connected devices along the road, including cameras to monitor traffic, sensors to measure temperature and driving conditions, temporary roadworks signs and so on. Telecom operators will play a key role in building networks with wide coverage and low energy requirements based on narrowband Internet of Things, Cat M1 and soon New Radio (NR). Our roads are therefore set to change their face, becoming smart roads, and this will require a synergy between various players to build and share basic infrastructure such as fibre networks.

Regardless of the type of communication, 'total' connectivity is the key to facilitating autonomous driving between cars on the road. Direct communication facilitates the transmission of coordinates between connected cars as they communicate with their surroundings, for example to adjust travel speeds. Network-based communication, on the other hand, facilitates large-scale autonomy by providing cars with up-to-date information on driving conditions and high-definition map data. Advanced network partitioning functionalities, such as network slicing, will also enable a more dynamic allocation of capacity in the network and full-scale sensor communication.

The huge flow of data generated by cars and sensors on the road needs to be aggregated in a secure pipeline, and then analysed and processed by cloud-based computers. Many automotive players, as McKinsey points out, are looking to build common car software and platforms to create an ecosystem of connected vehicles and related services (e.g. location-based marketing, intelligent driving and implementation of maps with real-time data). There is also an increased use of cloud capabilities to combine in-vehicle data with environmental data. In addition, data that is neither security nor personal will increasingly pass through cloud-based processing to derive additional information.

As high-tech companies enter the automotive market, the incumbents form new partnerships; what is certain is that new technologies related to connected cars and autonomous driving will generate enormous value, but no one can yet say exactly where the economic profit will flow. To remain dominant in the ACES world, manufacturers need to re-evaluate their role in the whole ecosystem, understand what levers to move and decide what slice of the pie they will be willing to give up to create a virtuous innovation network.

For global technology giants, the ACES car represents a great opportunity to enter and revolutionise the automotive industry. A number of cars already use infotainment platforms from these giants, and there are numerous projects underway to create new applications and services. Smaller technology start-ups are also trying to make inroads. All these technology players will be the first to benefit from the increasing amount of valuable data generated by cars. Both tech giants and start-ups are well placed to support carmakers in their transition to a technology-driven business model - a transition that McKinsey says will need to be made.

In conclusion, ACES trends represent a new wave of innovation that connects the car with its environment in new, more efficient and effective ways. All this, as McKinsey analysts point out, opens

up complex challenges and attracts many new players that many incumbents may not be readyto embrace.
New technologies are forcing changes in habits and everyday life, and the car market is no exception. According to estimates by MotorK, one of the most important digital automotive companies, in four years' time 18% of Europeans will buy their cars online, while 79% will opt for a hybrid approach using the internet at certain stages of the buying process and a visit to the showroom to settle the deal. The Covid-19 pandemic has given a further boost to private car use and e-commerce: 34% more Italians have searched online for information on the four wheels, while 50% of motorists say they are considering buying a car on the internet.
These are the basis on which a sample survey was developed in order to analyse what emerges from the concrete opinions of the respondents on the subject of virtual dealerships.
Based on what has been described, there seems to be a close link between the propensity to use virtual dealerships and some of the elements highlighted so far.
In particular, the aim of the analysis conducted was to analyse which elements could be important for the success of a new business model in the automotive sector that increasingly sees the dematerialisation of dealerships for the establishment of a type of virtual dealership.
In the hypotheses that seem reasonable on the basis of what has been analysed so far, the question arises as to whether elements such as attitude towards ACES factors or sustainability can have an influence on users' propensity towards virtual dealerships.
These reflections led to the following Research Questions.Therefore, the first *Research Question is as* follows:

RQ1.: *Is it conceivable that users who show an aptitude for technology aimed at advanced driving automation, andtherefore a strong interest in autonomous driving, are more likely to prefer virtual dealerships?*

If the results of this RQ confirm the predictive power of the attitude towards autonomous driving towards the propensity towards the dematerialisation of dealerships, this power could be used to identify a lever on which to act in order to influence the affirmation of the new model of car sales that foresees the use of virtual dealerships. Confirmation of this result could provide useful recommendations to managers of automotive companies to foster the affirmation of this new business model that seems to be so promising.
From the same motivations come the other research questions: the question is whether, in addition to the attitude towards autonomous driving, the attitude towards the other ACES factors detailed in Chapter 1 can also influence the propensity of users to use virtual dealerships.
Therefore, the following Research Questions were formulated.Starting with the connectivity factor:

RQ2.: *Is it possible to assume that users who are attracted to the enhanced connectivity aspects of in-car driving are more likely to use virtual dealerships when buying or leasing a vehicle?*

As far as the Electrification factor is concerned:

RQ3.: *Is it reasonable to assume that users who view the use of electricity as a powertrain in motoring positively, and therefore welcome the spread of electric or hybrid cars, are more likely to use virtual dealerships to buy or lease a car?*

Regarding the last remaining ACES factor, the Smart-Mobility factor:

RQ4.: *Can it be assumed that users who view the use of vehicle sharing for locomotion positively, and who are therefore supporters of Smart-Mobility, are more likely to turn to virtual dealerships for the possible purchase or leasing of a car?*

Finally, the question arises as to whether, in this context, a more general interest in sustainability issues could have any influence.
Hence the fifth and final Research Question:

RQ5.: *Is it possible to assume that users who are sensitive to sustainability issues in general, and therefore to environmental, economic and social issues, are more likely to use virtual dealerships to buy or lease a vehicle?*

If the results of this RQ confirm the statistical relevance of these statements, managers and those involved in analysing strategic aspects within companies involved in the automotive sector may derive useful indications to direct their efforts towards facilitating the transition to the new business model outlined above.

3.1.1 Research hypotheses

Once the research questions to be answered in this thesis have been formulated, the research hypotheses that serve as the basis for the empirical model can be established.
Starting from the first Research Question, the first research hypothesis is as follows:

H1: The intention to use a virtual dealership to buy or rent a car depends on the user's attitude towards advanced automation technologies, including the development of a framework for autonomous car driving.

In this hypothesis the concept of attitude towards an advanced level of technology recurs with explicit reference to those who feel involved and interested in technological innovations related to autonomous driving. From a statistical point of view, this condition can be obtained by asking a specific question on the subject, taking into account the level of attitude towards products with a high degree of technological innovation declared by the user. If this hypothesis is confirmed, the predictive power of the attitude towards autonomous driving could be used to identify levers to increase the propensity of users to turn to a virtual dealership, for example.
The second research question gives rise to the second research hypothesis, which can be expressed

as follows:

H2: The propensity to turn to a virtual dealership to buy or rent a car depends on the user's attitude to appreciate connectivity to different types of devices and the network during the driving experience.

In this case, it refers to the ability of the potential customer to appreciate the presence in the car of devices and functionalities that allow him to stay connected to the network, social networks, smartphones, and other tools that he uses for both work and personal activities. If the results of this RQ confirm the importance of connectivity, it could provide useful indications for managers of car manufacturers to understand how to act on these levers to encourage potential customers to use the online dealership for a service related to the purchase or rental of a car.

Starting from the same premises formulated in Chapter 1, the third research question also arises: in fact, it has been pointed out that the drive towards electrification, both total and supplementary in hybrid cars, could, in particular, be an additional motivation for potential customers to opt for dematerialised dealerships.

This leads to the formulation of the third *Research Question* as follows.

H3: The propensity to turn to a virtual dealership to buy or rent a car depends on the customer's attitude to prefer mobile cars in which electrification as power supply is not negligible, either in total form as in electric cars, or in partial form as in hybrid cars.

The fourth ACES factor, Smart-Mobility, on the other hand, is the protagonist of the fourth hypothesis, so it arises from the fourth research question and can be posed in the following terms:

H4: The propensity to use a virtual dealership to buy or rent a car depends on the customer's attitude towards intelligent modes of transport, e.g. sharing, car pooling, leasing etc.

Such a hypothesis, if tested, would allow a better interpretation of the tastes and inclinations of potential future users of virtual dealerships.

The last hypothesis to be tested, on the other hand, departs from the ACES model and relates more generally to the approach to sustainability and circularity issues that dealership users may have.

In the light of this, the fifth hypothesis is as follows.

H5: The propensity to use a virtual dealership to buy or rent a car depends on the proximity of the user, potential customer, to sustainability issues in general, both from a social and environmental point of view.

3.2 Conceptual model and overview of the study

The Conceptual Model presented in fig. 3.1 is formulated on the basis of what emerges from the literature review that has been made concerning the actual perception of citizens to the topic of the thesis reported in the previous chapters. On this Conceptual Model the empirical analysis that is reported below was conducted.

To summarise briefly, the above-mentioned model presents the following as independent variables (the name used to name the variable in the statistical processing software used is indicated in brackets).

1. *Autonomous drive (auto_drive)*: this variable records the subject's interest in autonomous driving issues;
2. *Connectivity*: this variable measures the subject's interest in the car's connectivity while driving;
3. *Electrification (electric): a* variable that quantifies the attitude of the subject towards the use of electric propulsion of the vehicle, either in a partial sense (hybrid cars) or in a total sense (electric cars).
4. *Smart-Mobility (smart): a* variable used to assess a user's readiness to use *smart* means of transport for mobility. It therefore measures a person's willingness to choose to use sharing, carpooling and other shared modes of transport.
5. *Sustainability: a* variable that quantifies the respondent's closeness to sustainable issues in a general sense, which are therefore characterised by elements of social and/or environmental and/or economic sustainability. It therefore measures the respondent's attitude to support *Triple Bottom Line* sustainability models.
6. *Technical Innovations (tech_innovations):* variable quantifying the subject's preference for technologically innovative applications, which in the specific case can be represented by Virtual Reality and Augmented Reality.

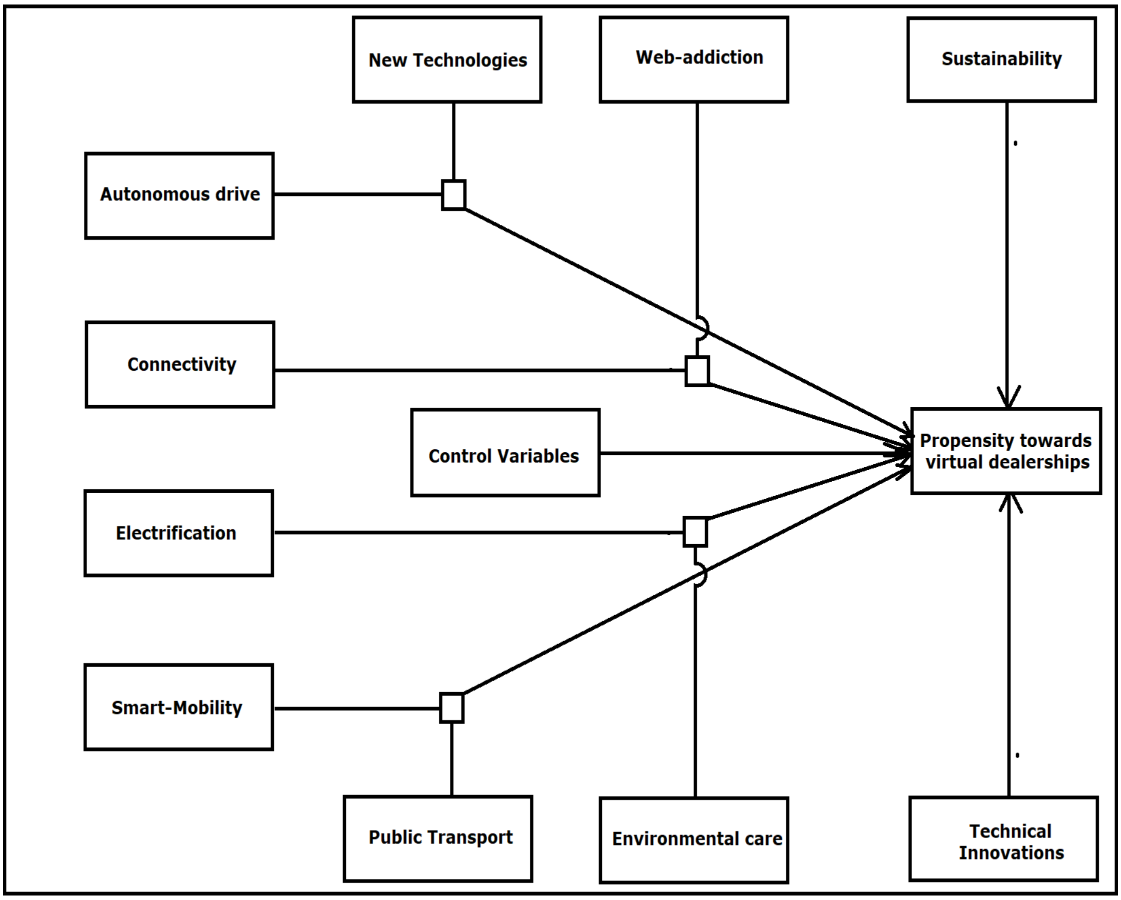


Figure 3.1 - Empirical Model

Alongside these independent variables, a key role in the model is certainly represented by the co-variates used as moderators, and therefore used as variables with which the newly introduced independents are made to interact in order to be correlated with the dependent variable. In this model, a moderating variable was identified for each of the independent variables that are derived from the ACES model according to the scheme below.

1. *New Technologies (new_technologies):* variable measuring the extent to which the subject declares himself to be inclined towards and in favour of the use of innovative technologies. This variable was used as a moderator of the *Autonomous Drive* variable.
2. *Web-addiction (web_addicted):* variable quantifying how much the respondent claims to be addicted to everything related to the world of the web, including the use of forums, blogs and especially social networks. This variable was used as moderator of the *connectivity* variable.
3. *Environmental Care (environment_care): this* variable was used to express the respondent's closeness to environmental issues and the application of eco-sustainability principles in their daily life practices. This variable was used to measure the respondent's attitude towards putting ecological principles into practice, such as attention to waste production, energy efficiency and pollution reduction. This variable was used as a moderator for the variable *Electrification*.

4. *Public Transport (public_transport):* variable used to measure the respondent's willingness to use public transport for travel instead of private vehicles. This variable was used to moderate the smart Mobility variable.

Alongside these independent variables, a key role in the model is played by co-variates and control variables, which can be subdivided as follows:

A. Personal variables: the personal variables considered in the model are age and gender;
B. Socio-demographic variables: as socio-demographic variables were considered the economic condition, the level of education, the attitude to the use of internet and social networks;
C. Ideological variables: this variable is used to express how firm the subject is on his ideological positions and how ready he is to support the principles he believes in by applying them to his lifestyle.

Finally, the subject's propensity towards virtual dealerships is used as a dependent variable, understood as the possibility that the subject might use this type of dealership for the purchase and rental of his vehicles (propensity) or would be predisposed to use this mode of interaction with the seller, preferring it to traditional dealerships (Willingness to buy).

Variable name	Question	Type	Stairs
autonomous1	What do you think about the introduction of 'Autonomous Driving' in the automotive sector? - I appreciate this solution, I would be very thrilled if my car had it.	Discrete quantity	Likert scale from 1 to 7
autonomous2	What do you think about the introduction of 'Autonomous Driving' in the automotive sector? - I find this solution very useful, in the future it will be necessary for my car to have it.	Discrete quantity	Likert scale from 1 to 7
autonomous3	What do you think about the introduction of 'Autonomous Driving' in the automotive sector? - I think this solution is very interesting, I would benefit a lot if my car had it.	Discrete quantity	Likert scale from 1 to 7
auto_sector1	What do you think about the introduction of 'Autonomous Driving' in the automotive sector? - The introduction of this solution contributes greatly to the improvement of the automotive sector.	Discrete quantity	Likert scale from 1 to 7
auto_sector2	What do you think about the introduction of 'Autonomous Driving' in the automotive sector? - This solution is perfectly suited to the dynamic and evolving image of the automotive industry.	Discrete quantity	Likert scale from 1 to 7
auto_sector3	What do you think about the introduction of 'Autonomous Driving' in the automotive sector? - This solution will enable the automotive sector to remain competitive, up-to-date and forward-looking.	Discrete quantity	Likert scale from 1 to 7
connectivity1	What do you think about the role of 'Connectivity' in the automotive sector? - I appreciate an high level of connectivity, I would be very thrilled if my car had it.	Discrete quantity	Likert scale from 1 to 7
connectivity2	What do you think about the role of 'Connectivity' in the automotive sector? - I find connectivity very useful, in the future it will be necessary for my car to have it.	Discrete quantity	Likert scale from 1 to 7
connectivity3	What do you think about the role of 'Connectivity' in the automotive sector? - I think a high level of connectivity is very interesting, I would benefit a lot if my car had it.	Discrete quantity	Likert scale from 1 to 7
connect_sector1	What do you think about the role of 'Connectivity' in the automotive sector? - The introduction of solutions with high connectivity level contributes greatly to the improvement of the automotive sector.	Discrete quantity	Likert scale from 1 to 7
connect_sector2	What do you think about the role of 'Connectivity' in the automotive sector? - The concept of connectivity is perfectly suited to the dynamic and evolving image of the automotive industry.	Discrete quantity	Likert scale from 1 to 7
connect_sector3	What do you think about the role of 'Connectivity' in the automotive sector? - This 'Connectivity' will enable the automotive sector to remain competitive, up-to-date and forward-looking.	Discrete quantity	Likert scale from 1 to 7
electrification1	What do you think about the 'Electrification' in the automotive industry? - I appreciate this electrification, I would be very thrilled if my car had it.	Discrete quantity	Likert scale from 1 to 7
electrification2	What do you think about the 'Electrification' in the automotive industry? - I find 'Electrification' very useful, in the future it will be necessary for my car to have it.	Discrete quantity	Likert scale from 1 to 7
electrification3	What do you think about the 'Electrification' in the automotive industry? - I think 'Electrification' is very interesting, I would benefit a lot if my car had it.	Discrete quantity	Likert scale from 1 to 7
electr_sector1	What do you think about the 'Electrification' in the automotive industry? - The spread of electric cars contributes greatly to the improvement of the automotive sector.	Discrete quantity	Likert scale from 1 to 7
electr_sector2	What do you think about the 'Electrification' in the automotive industry? - The 'Electrification' is perfectly suited to the dynamic and evolving image of the automotive industry.	Discrete quantity	Likert scale from 1 to 7

Variable name	Question	Type	Stairs
electr_sector3	What do you think about the 'Electrification' in the automotive industry? - The 'Electrification' will enable the automotive sector to remain competitive, up-to-date and forward-looking.	Discrete quantity	Likert scale from 1 to 7
smart_mobility1	What do you think about the affirmation of the 'Smart mobility' concept in the automotive sector? - I appreciate this concept, I would be very thrilled to share my asset for short periods.	Discrete quantity	Likert scale from 1 to 7
smart_mobility2	What do you think about the affirmation of the 'Smart mobility' concept in the automotive? - I find 'Smart Mobility' very useful, in the future it will be necessary for me.	Discrete quantity	Likert scale from 1 to 7
smart_mobility3	What do you think about the affirmation of the 'Smart mobility' concept in the automotive sector? - I think 'Smart Mobility' concept is very interesting, I would benefit a lot if it became more widely spread.	Discrete quantity	Likert scale from 1 to 7
smart_sector1	What do you think about the affirmation of the 'Smart mobility' concept in the automotive sector? - The spread of Smart Mobility contributes greatly to the improvement of the automotive sector.	Discrete quantity	Likert scale from 1 to 7
smart_sector2	What do you think about the affirmation of the 'Smart mobility' concept in the automotive industry? - The 'Smart Mobility' is perfectly suited to the dynamic and evolving image of the automotive industry.	Discrete quantity	Likert scale from 1 to 7
smart_sector3	What do you think about the affirmation of the 'Smart mobility' concept in the automotive? - The 'Smart Mobility' will enable the automotive sector to remain competitive, up-to-date and forward-looking.	Discrete quantity	Likert scale from 1 to 7
virtual_reality1	Clients can also experience a virtual test drive without leaving the dealer. - I appreciate virtual reality, I would be very thrilled to use it to buy my car.	Discrete quantity	Likert scale from 1 to 7
virtual_reality2	Clients can also experience a virtual test drive without leaving the dealer. - I find 'Virtual Reality' very useful, in the future it will be necessary for my choices about cars.	Discrete quantity	Likert scale from 1 to 7
virtual_reality3	Clients can also experience a virtual test drive without leaving the dealer. - I think 'Virtual reality' concept is very interesting, I would benefit a lot if it became more widely spread in the automotive sector.	Discrete quantity	Likert scale from 1 to 7
virtual_sector1	Clients can also experience a virtual test drive without leaving the dealer. - The diffusion of 'Virtual Reality' contributes greatly to the improvement in the automotive sector.	Discrete quantity	Likert scale from 1 to 7
virtual_sector2	Clients can also experience a virtual test drive without leaving the dealer. - The 'Virtual Reality' is perfectly suited to the dynamic and evolving image of the automotive industry.	Discrete quantity	Likert scale from 1 to 7
virtual_sector3	Clients can also experience a virtual test drive without leaving the dealer. - The 'Virtual Reaility' will enable the automotive sector to remain competitive, up-to-date and forward-looking.	Discrete quantity	Likert scale from 1 to 7
augmented_reality1	What do you think about the application of the 'Augmented Reality' for virtual dealerships? - I appreciate augmented reality, I would be very thrilled to use it to choose my car.	Discrete quantity	Likert scale from 1 to 7
augmented_reality2	What do you think about the application of the 'Augmented Reality' for virtual dealership? - I find 'Augmented Reality' very useful, in the future it will be necessary for my choices abuot cars.	Discrete quantity	Likert scale from 1 to 7
augmented_reality3	What do you think about the application of the 'Augmented Reality' for virtual dealership? - I think 'Augmented reality' concept is very interesting, I would benefit a lot if it became more widely spread in the automotive sector.	Discrete quantity	Likert scale from 1 to 7
augmented_sector1	What do you think about the application of the 'Augmented Reality' for virtual dealerships? - The diffusion of 'Augmented Reality' contributes greatly to the improvements in the automotive sector.	Discrete quantity	Likert scale from 1 to 7
augmented_sector2	What do you think about the application of the 'Augmented Reality' for virtual dealership? - The 'Augmented Reality' is perfectly suited to the dynamic and evolving image of the automotive industry.	Discrete quantity	Likert scale from 1 to 7
augmented_sector3	What do you think about the application of the 'Augmented Reality' for virtual dealership? - The 'Augmented Reaility' will enable the automotive sector to remain competitive, up-to-date and forward-looking.	Discrete quantity	Likert scale from 1 to 7
wtb1	How much do you agree with the following statements? - I appreciate the concept of a Virtual car Dealer, I would be very thrilled to use it to choose my car.	Discrete quantity	Likert scale from 1 to 7
wtb2	How much do you agree with the following statements? - I find the 'Virtual car Dealer' very useful, in the future it will be necessary for my choices abuot cars.	Discrete quantity	Likert scale from 1 to 7
wtb3	How much do you agree with the following statements? - I believe 'Virtual car Dealer' concept is very interesting, I would benefit a lot if it became more widely spread in the automotive sector.	Discrete quantity	Likert scale from 1 to 7
propensity1	How much do you agree with the following statements? - I would definitely use a Virtual Dealer to buy my car if it were available.	Discrete quantity	Likert scale from 1 to 7
propensity2	How much do you agree with the following statements? - I am interested to buy a car through a virtual dealership and I guess it will be a key strength for the development of the sector.	Discrete quantity	Likert scale from 1 to 7
propensity3	How much do you agree with the following statements? - If I had the choice I would prefer to use a Virtual Dealer over a physical dealer.	Discrete quantity	Likert scale from 1 to 7
supply_chain	What do you think is the most important factor or what aspects about the virtual dealer most appeals to you? Sort the options below from the most attractive to the least attractive. Draw the pictures up or down according to your preferences. - Advanced Supply Chain (Block Chain, etc.)	Discrete quantity	Likert scale from 1 to 7
data_analysis	What do you think is the most important factor or what aspects about the virtual dealer most appeals to you? Sort the options below from the most attractive to the least attractive. Draw the pictures up or down according to your preferences. - Enhanced Data Analysis	Discrete quantity	Likert scale from 1 to 7
customer_care	What do you think is the most important factor or what aspects about the virtual dealer most appeals to you? Sort the options below from the most attractive to the least attractive. Draw the pictures up or down according to your preferences. - Advanced Customer Care	Discrete quantity	Likert scale from 1 to 7

Variable name	Question	Type	Stairs
virtual_reality_driver	What do you think is the most important factor or what aspects about the virtual dealer most appeals to you? Sort the options below from the most attractive to the least attractive. Draw the pictures up or down according to your preferences. - Virtual Reality	Discrete quantity	Likert scale from 1 to 7
augmented_reality_driver	What do you think is the most important factor or what aspects about the virtual dealer most appeals to you? Sort the options below from the most attractive to the least attractive. Draw the pictures up or down according to your preferences. - Augmented Reality	Discrete quantity	Likert scale from 1 to 7
environment	What do you think is the most important factor or what aspects about the virtual dealer most appeals to you? Sort the options below from the most attractive to the least attractive. Draw the pictures up or down according to your preferences. - Environmentally sustainability	Discrete quantity	Likert scale from 1 to 7
climate_change	Which of these factors are you interested in or actively involved in? (1= Minimum; 7= Maximum) - Climate Protection and Climate Change	Discrete quantity	Likert scale from 1 to 7
pollution	Which of these factors are you interested in or actively involved in? (1= Minimum; 7= Maximum) - Protection from pollution (pollution from non-biodegradable waste, landfills, marine pollution)	Discrete quantity	Likert scale from 1 to 7
animal	Which of these factors are you interested in or actively involved in? (1= Minimum; 7= Maximum) - Respect for the life of animals (no abandonment, intensive farming, mistreatment etc.)	Discrete quantity	Likert scale from 1 to 7
social_sustainability	Which of these factors are you interested in or actively involved in? (1= Minimum; 7= Maximum) - Social sustainability (respect for people and cultures, health conditions and malnutrition, waste of resources in the western world)	Discrete quantity	Likert scale from 1 to 7
new_technologies	How much do you agree with the following statements (0 = Not at all agree, 10 = Perfectlyagree) - I am always open to new technologies, I think they make life easier and I have no problem applying them in my daily life.	Discrete quantity	Likert scale from 1 to 7
environment_sustainability	How much do you agree with the following statements (0 = Not at all agree, 10 = Perfectlyagree) - I don't mind paying more for products with low environmental impact or greater sustainability	Discrete quantity	Likert scale from 1 to 7
energy_efficiency	How much do you agree with the following statements (0 = Not at all agree, 10 = Perfectly agree) - I pay attention to energy efficiency and I am carefully applying it in my daily life. For example, I always make sure I turn off the lights when I leave a room.	Discrete quantity	Likert scale from 1 to 7
public_transport	How much do you agree with the following statements (0 = Not at all agree, 10 = Perfectly agree) - I avoid taking the car for short distances, preferring public transport or cycling or sharing.	Discrete quantity	Likert scale from 1 to 7
ideologies	How much do you agree with the following statements (0 = Not at all agree, 10 = Perfectlyagree) - I strongly believe in my ideologies and gladly volunteer my time for good causes.	Discrete quantity	Likert scale from 1 to 7
gender	You are: Male or Female?	Dichotomous quan.	Male/Female
age	What age group do you belong to?	Discrete quantity	Intervals
web_addicted	How familiar are you with the internet and social apps? - (1= Minimum; 7= Maximum)	Discrete quantity	Likert scale 1-7
occupation	What is your occupation?	Discrete quantity	Unambiguous choice
wealth	What economic status do you feel you belong to?	Discrete quantity	Unambiguous choice
education	What is your level of education?	Discrete quantity	Unambiguous choice

The research was carried out by presenting to a sample consisting of a homogeneously selected groupof "insiders", i.e. consultants who are often involved in working relationships with companies in the automotive sector, a survey consisting of 4 phases:

Fase 1. Quantification of the ACES variables. Thanks to the information obtained in this phase, evaluations can be carried out to attribute a level of attitude on the part of the respondentto each of the independent variables considered;

Fase 2. Respondents were asked to express their opinions on virtual dealerships and what they consider to be the most important elements in stimulating the use of this mode of car purchase/rental advice.

Fase 3. Section dedicated to mediating variables. Within it, ideological and practical behavioural data related to the issues of sustainability and circularity are collected.

Fase 4. Section dedicated to control variables. This section collects personal and socio-demographic data such as age, gender, level of education, economic status etc.

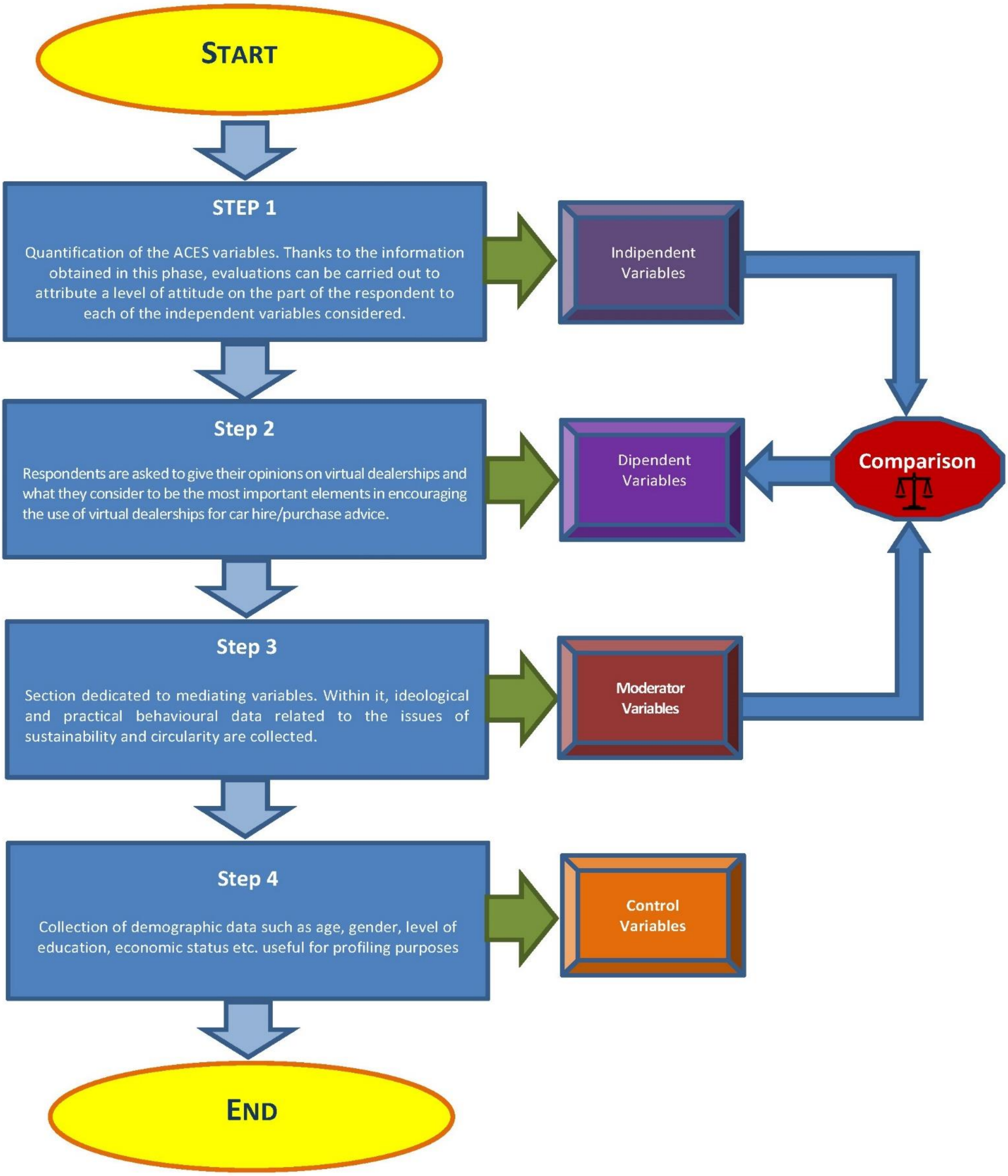


Figure 3.2 – Survey Flow Chart

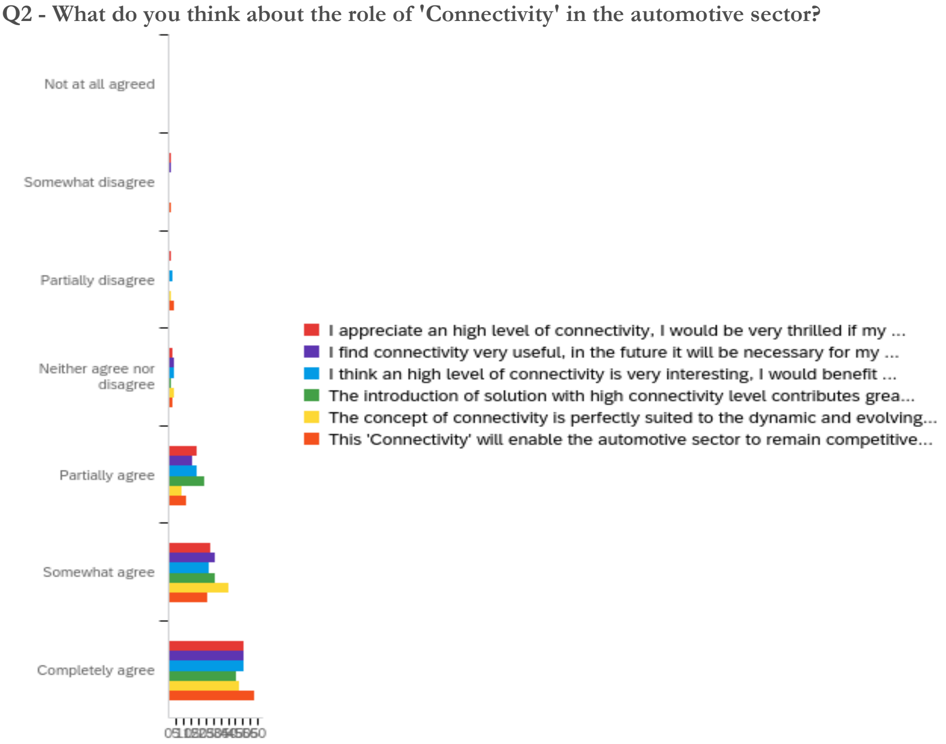
3.3 Survey results

Q1 - What do you think about the introduction of 'Autonomous Driving' in the automotive sector?

#	Question	Not at all agreed	Somewhat disagree	Partially disagree	Neither agree nor disagree	Partially agree	Somewhat agree	Completely agree	Total
1	I appreciate this solution, I would be very thrilled if my car had it.	1.87%	3.74%	14.02%	3.74%	28.97%	25.23%	22.43%	107
2	I find this solution very useful, in the future it will be necessary for my car to have it.	2.80%	3.74%	12.15%	5.61%	24.30%	33.64%	17.76%	107
3	I think this solution is very interesting, I would benefit a lot if my car had it.	0.93%	6.54%	14.02%	4.67%	21.50%	29.91%	22.43%	107
4	The introduction of this solution contributes greatly to the improvement of the automotive sector	0.93%	0.93%	2.80%	2.80%	23.36%	35.51%	33.64%	107
5	This solution is perfectly suited to the dynamic and evolving image of the automotive industry	0.00%	3.74%	0.93%	5.61%	23.36%	34.58%	31.78%	107
6	This solution will enable the automotive sector to remain competitive, up-to-date and forward-looking.	0.00%	1.87%	2.80%	6.54%	18.69%	31.78%	38.32%	107

#	Field	Min	Max	Mean	Std. Dev.	Variance	Count
1	I appreciate this solution, I would be very thrilled if my car had it.	1.00	7.00	5.20	1.53	2.34	107
2	I find this solution very useful, in the future it will be necessary for my car to have it.	1.00	7.00	5.17	1.53	2.35	107
3	I think this solution is very interesting, I would benefit a lot if my car had it.	1.00	7.00	5.19	1.58	2.51	107
4	The introduction of this solution contributes greatly to the improvement of the automotive sector	1.00	7.00	5.88	1.14	1.30	107
5	This solution is perfectly suited to the dynamic and evolving image of the automotive industry	2.00	7.00	5.79	1.19	1.42	107
6	This solution will enable the automotive sector to remain competitive, up-to-date and forward-looking.	2.00	7.00	5.91	1.17	1.37	107

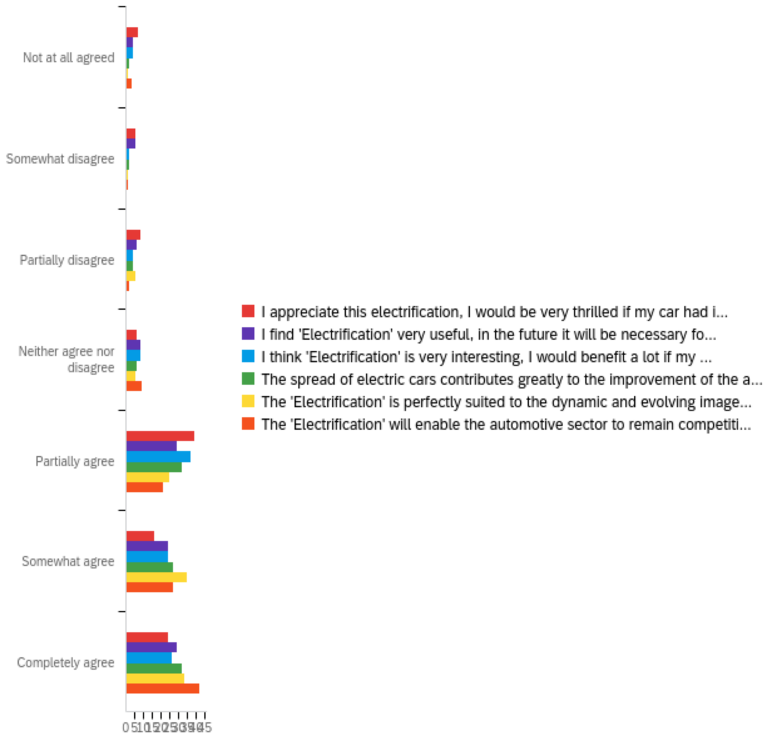
Q2 - What do you think about the role of 'Connectivity' in the automotive sector?



#	Field	Min	Max	Mean	Std. Dev.	Variance	Count
1	I appreciate an high level of connectivity, I would be very thrilled if my car had it.	2.00	7.00	6.11	1.12	1.24	105
2	I find connectivity very useful, in the future it will be necessary for my car to have it.	2.00	7.00	6.15	1.08	1.16	105
3	I think an high level of connectivity is very interesting, I would benefit a lot if my car had it.	2.00	7.00	6.10	1.10	1.22	105
4	The introduction of solution with high connectivity level contributes greatly to the improvement of the automotive sector	2.00	7.00	6.10	0.98	0.97	105
5	The concept of connectivity is perfectly suited to the dynamic and evolving image of the automotive industry	1.00	7.00	6.15	1.11	1.23	105
6	This 'Connectivity' will enable the automotive sector to remain competitive, up-to-date and forward-looking.	2.00	7.00	6.19	1.18	1.39	105

#	Question	Not at all agreed	Somewhat disagree	Partially disagree	Neither agree nor disagree	Partially agree	Somewhat agree	Completely agree	Total
1	I appreciate an high level of connectivity, I would be very thrilled if my car had it.	0.00%	1.90%	1.90%	2.86%	18.10%	26.67%	48.57%	105
2	I find connectivity very useful, in the future it will be necessary for my car to have it.	0.00%	1.90%	0.95%	3.81%	15.24%	29.52%	48.57%	105
3	I think an high level of connectivity is very interesting, I would benefit a lot if my car had it.	0.00%	0.95%	2.86%	3.81%	18.10%	25.71%	48.57%	105
4	The introduction of solution with high connectivity level contributes greatly to the improvement of the automotive sector	0.00%	0.95%	0.95%	1.90%	22.86%	29.52%	43.81%	105
5	The concept of connectivity is perfectly suited to the dynamic and evolving image of the automotive industry	0.95%	0.95%	1.90%	3.81%	8.57%	38.10%	45.71%	105
6	This 'Connectivity' will enable the automotive sector to remain competitive, up-to-date and forward-looking.	0.00%	1.90%	3.81%	2.86%	11.43%	24.76%	55.24%	105

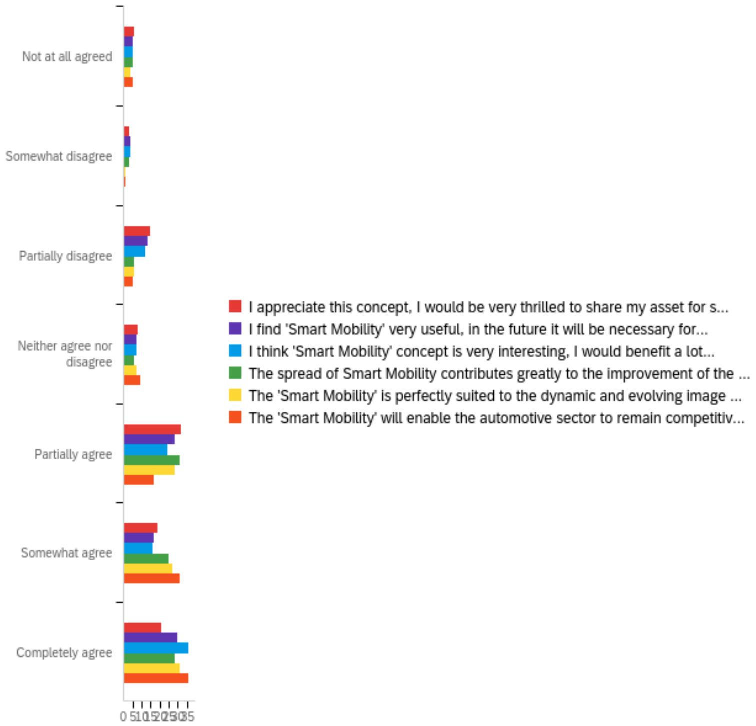
Q3 - What do you think about the 'Electrification' in the automotive industry?



#	Field	Min	Max	Mean	Std. Dev.	Variance	Count
1	I appreciate this electrification, I would be very thrilled if my car had it.	1.00	7.00	4.99	1.71	2.92	105
2	I find 'Electrification' very useful, in the future it will be necessary for my car to have it.	1.00	7.00	5.30	1.61	2.59	105
3	I think 'Electrification' is very interesting, I would benefit a lot if my car had it.	1.00	7.00	5.36	1.45	2.10	105
4	The spread of electric cars contributes greatly to the improvement of the automotive sector	1.00	7.00	5.60	1.34	1.80	105
5	The 'Electrification' is perfectly suited to the dynamic and evolving image of the automotive industry	1.00	7.00	5.75	1.22	1.50	105
6	The 'Electrification' will enable the automotive sector to remain competitive, up-to-date and forward-looking.	1.00	7.00	5.79	1.39	1.94	105

#	Question	Not at all agreed	Somewhat disagree	Partially disagree	Neither agree nor disagree	Partially agree	Somewhat agree	Completely agree	Total
1	I appreciate this electrification, I would be very thrilled if my car had it.	6.67%	4.76%	7.62%	5.71%	37.14%	15.24%	22.86%	105
2	I find 'Electrification' very useful, in the future it will be necessary for my car to have it.	3.81%	4.76%	5.71%	7.62%	27.62%	22.86%	27.62%	105
3	I think 'Electrification' is very interesting, I would benefit a lot if my car had it.	3.81%	1.90%	3.81%	7.62%	35.24%	22.86%	24.76%	105
4	The spread of electric cars contributes greatly to the improvement of the automotive sector	1.90%	1.90%	3.81%	5.71%	30.48%	25.71%	30.48%	105
5	The 'Electrification' is perfectly suited to the dynamic and evolving image of the automotive industry	0.95%	0.95%	4.76%	4.76%	23.81%	33.33%	31.43%	105
6	The 'Electrification' will enable the automotive sector to remain competitive, up-to-date and forward-looking.	2.86%	0.95%	1.90%	8.57%	20.00%	25.71%	40.00%	105

Q4 - What do you think about the affirmation of the 'Smart mobility' concept in the automotive?



#	Field	Min	Max	Mean	Std.Dev.	Variance	Count
1	I appreciate this, I would be very thrilled to share my asset for short periods.	1.00	7.00	4.90	1.68	2.82	104
2	I find 'Smart Mobility' very useful, in the future it will be necessary for me.	1.00	7.00	5.12	1.73	2.99	104
3	I think 'Smart Mobility' concept is very interesting, I would benefit a lot if it became more widely spread.	1.00	7.00	5.24	1.77	3.12	104
4	The spread of Smart Mobility contributes greatly to the improvement of the automotive sector	1.00	7.00	5.33	1.59	2.53	104
5	The 'Smart Mobility' is perfectly suited to the dynamic and evolving image of the automotive industry	1.00	7.00	5.49	1.49	2.21	104
6	The 'Smart Mobility' will enable the automotive sector to remain competitive, up-to-date and forward-looking.	1.00	7.00	5.59	1.57	2.47	104

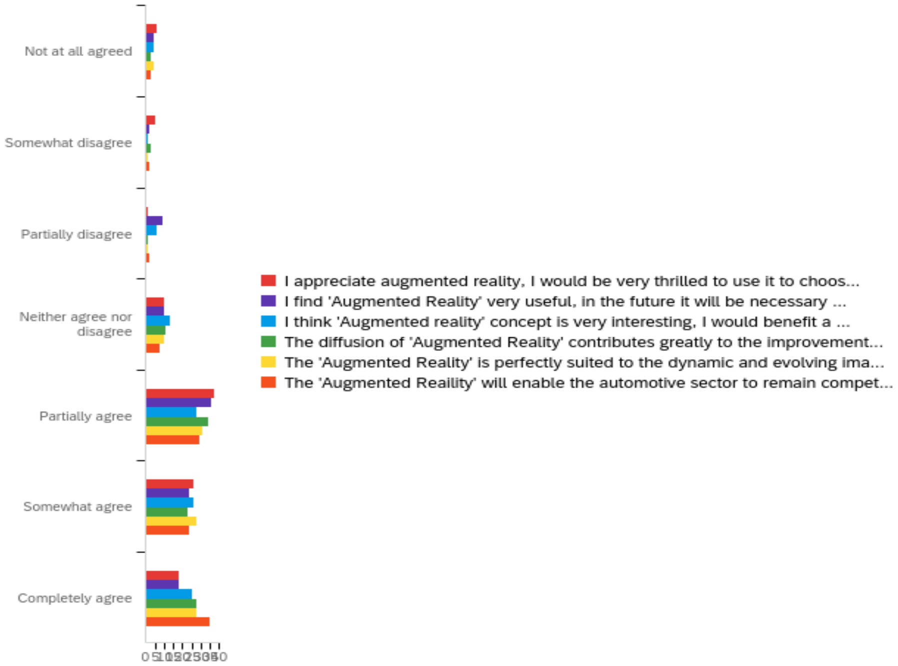
#	Question	Not at all agreed	Somewhat disagree	Partially disagree	Neither agree nor disagree	Partially agree	Somewhat agree	Completely agree	Total
1	I appreciate this concept, I would be very thrilled to share my asset for short periods.	5.77%	2.88%	14.42%	7.69%	30.77%	18.27%	20.19%	104
2	I find 'Smart Mobility' very useful, in the future it will be necessary for me.	4.81%	3.85%	12.50%	6.73%	26.92%	16.35%	28.85%	104
3	I think 'Smart Mobility' concept is very interesting, I would benefit a lot if it became more widely spread.	4.81%	3.85%	11.54%	6.73%	23.08%	15.38%	34.62%	104
4	The spread of Smart Mobility contributes greatly to the improvement of the automotive sector	4.81%	2.88%	5.77%	5.77%	29.81%	24.04%	26.92%	104
5	The 'Smart Mobility' is perfectly suited to the dynamic and evolving image of the automotive industry	3.85%	0.96%	5.77%	6.73%	26.92%	25.96%	29.81%	104
6	The 'Smart Mobility' will enable the automotive sector to remain competitive, up-to-date and forward-looking.	4.81%	0.96%	4.81%	8.65%	16.35%	29.81%	34.62%	104

Q5 - This dealer could make use of highly advanced technologies, including, for example, virtual reality. Virtual reality allows customers to be immersed in a driving experience very similar to the one they will have. Thanks to virtual reality, customers can choose the configuration of the car (e.g set-up, colour, fuel type, alloy rims, glass etc..) and get the result immeantely while wearing 3D glasses. Clients can also experience a virtual test drive without leaving the dealer.

#	Field	Min	Max	Mean	Std.Dev.	Variance	Count
1	I appreciate virtual reality, I would be very thrilled to use it to buy my car.	1.00	7.00	4.86	1.76	3.11	103
2	I find 'Virtual Reality' very useful, in the future it will be necessary for my choices about cars.	1.00	7.00	4.80	1.73	2.98	103
3	I think 'Virtual reality' concept is very interesting, I would benefit a lot if it became more widely spread in the automotive sector.	1.00	7.00	4.98	1.61	2.58	103
4	The diffusion of 'Virtual Reality' contributes greatly to the improvement in the automotive sector	1.00	7.00	5.23	1.66	2.76	103
5	The 'Virtual Reality' is perfectly suited to the dynamic and evolving image of the automotive industry	1.00	7.00	5.32	1.67	2.80	103
6	The 'Virtual Reaility' will enable the automotive sector to remain competitive, up-to-date and forward-looking.	1.00	7.00	5.39	1.66	2.74	103

#	Question	Not at all agreed	Somewhat disagree	Partially disagree	Neither agree nor disagree	Partially agree	Somewhat agree	Completely agree	Total
1	I appreciate virtual reality, I would be very thrilled to use it to buy my car.	6.80%	5.83%	10.68%	7.77%	29.13%	19.42%	20.39%	103
2	I find 'Virtual Reality' very useful, in the future it will be necessary for my choices about cars.	7.77%	2.91%	11.65%	11.65%	31.07%	15.53%	19.42%	103
3	I think 'Virtual reality' concept is very interesting, I would benefit a lot if it became more widely spread in the automotive sector.	4.85%	5.83%	5.83%	12.62%	28.16%	26.21%	16.50%	103
4	The diffusion of 'Virtual Reality' contributes greatly to the improvement in the automotive sector	4.85%	4.85%	2.91%	14.56%	23.30%	21.36%	28.16%	103
5	The 'Virtual Reality' is perfectly suited to the dynamic and evolving image of the automotive industry	5.83%	1.94%	6.80%	9.71%	20.39%	26.21%	29.13%	103
6	The 'Virtual Reaility' will enable the automotive sector to remain competitive, up-to-date and forward-looking.	3.88%	4.85%	3.88%	13.59%	15.53%	26.21%	32.04%	103

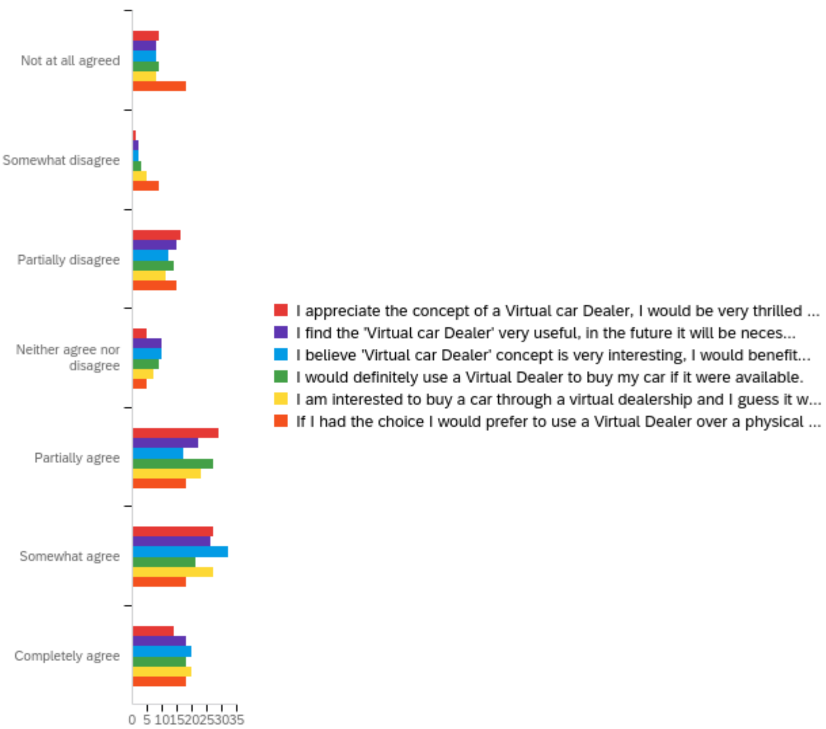
Q6 - An additional tool that would find wide application in the automotive sector is the Augmented Reality, used to be fully immerse in online showrooms. Augmented Reality allows the establishment of "gamification" logics, thanks to which the user can experience the car in a simple and funny way, becoming more aware about the distinctive features of the product. It also promotes "sensoriality" from the customer's side, who in this way experiences the car and its characteristics in a broad and innovative way. What do you think about the application of the 'Augmented Reality' for virtual dealership?



#	Field	Min	Max	Mean	Std.Dev.	Variance	Count
1	I appreciate augmented reality, I would be very thrilled to use it to choose my car.	1.00	7.00	5.11	1.56	2.44	103
2	I find 'Augmented Reality' very useful, in the future it will be necessary for my choices abuot cars.	1.00	7.00	5.10	1.47	2.17	103
3	I think 'Augmented reality' concept is very interesting, I would benefit a lot if it became more widely spread in the automotive sector.	1.00	7.00	5.31	1.48	2.19	103
4	The diffusion of 'Augmented Reality' contributes greatly to the improvements in the automotive sector	1.00	7.00	5.44	1.41	1.99	103
5	The 'Augmented Reality' is perfectly suited to the dynamic and evolving image of the automotive industry	1.00	7.00	5.51	1.39	1.94	103
6	The 'Augmented Reaility' will enable the automotive sector to remain competitive, up-to-date and forward-looking.	1.00	7.00	5.62	1.42	2.00	103

#	Question	Not at all agreed	Somewhat disagree	Partially disagree	Neither agree nor disagree	Partially agree	Somewhat agree	Completely agree	Total
1	I appreciate augmented reality, I would be very thrilled to use it to choose my car.	5.83%	4.85%	0.97%	9.71%	35.92%	25.24%	17.48%	103
2	I find 'Augmented Reality' very useful, in the future it will be necessary for my choices about cars.	3.88%	1.94%	8.74%	9.71%	34.95%	23.30%	17.48%	103
3	I think 'Augmented reality' concept is very interesting, I would benefit a lot if it became more widely spread in the automotive sector.	3.88%	0.97%	5.83%	12.62%	27.18%	25.24%	24.27%	103
4	The diffusion of 'Augmented Reality' contributes greatly to the improvements in the automotive sector	2.91%	2.91%	0.97%	10.68%	33.01%	22.33%	27.18%	103
5	The 'Augmented Reality' is perfectly suited to the dynamic and evolving image of the automotive industry	3.88%	0.97%	0.97%	9.71%	30.10%	27.18%	27.18%	103
6	The 'Augmented Reaility' will enable the automotive sector to remain competitive, up-to-date and forward-looking.	2.91%	1.94%	1.94%	7.77%	28.16%	23.30%	33.98%	103

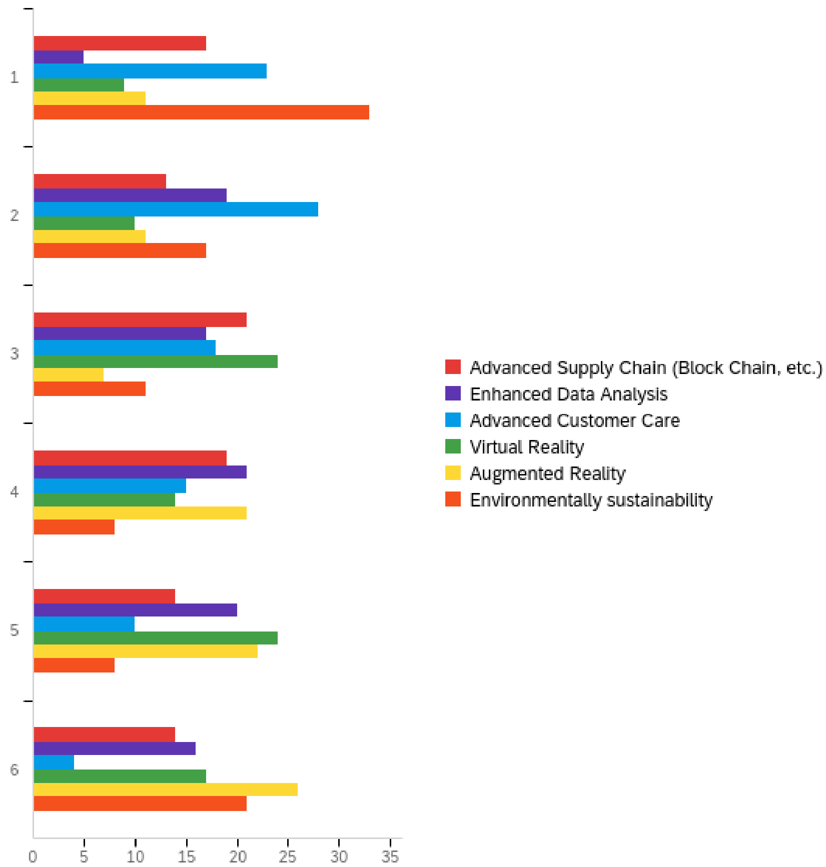
Q7 - Imagine, now, that you have a Virtual car Dealer, including an online touch point able to support the customer during the entire sale process, containing a Showroom which allows the client to interact virtually with the product. Let this be a dealer in which all the technologies described so far are implemented; virtual reality, augmented reality, advanced customer care, data analysis, block chain etc., and thanks to which the process of buying a car will become more environmentally sustainable. How much do you agree with the following statements?



#	Field	Min	Max	Mean	Std.Dev.	Variance	Count
1	I appreciate the concept of a Virtual car Dealer, I would be very thrilled to use it to choose my car.	1.00	7.00	4.79	1.73	2.98	101
2	I find the 'Virtual car Dealer' very useful, in the future it will be necessary for my choices abuot cars.	1.00	7.00	4.84	1.76	3.08	101
3	I believe 'Virtual car Dealer' concept is very interesting, I would benefit a lot if it became more widely spread in the automotive sector.	1.00	7.00	5.00	1.77	3.13	101
4	I would definitely use a Virtual Dealer to buy my car if it were available.	1.00	7.00	4.75	1.79	3.20	101
5	I am interested to buy a car through a virtual dealership and I guess it will be a key strength for the development of the sector.	1.00	7.00	4.91	1.81	3.27	101
6	If I had the choice I would prefer to use a Virtual Dealer over a physical dealer.	1.00	7.00	4.21	2.14	4.56	101

#	Question	Not at all agreed	Somewhat disagree	Partially disagree	Neither agree nor disagree	Partially agree	Somewhat agree	Completely agree	Total
1	I appreciate the concept of a Virtual car Dealer, I would be very thrilled to use it to choose my car.	8.91%	0.99%	15.84%	4.95%	28.71%	26.73%	13.86%	101
2	I find the 'Virtual car Dealer' very useful, in the future it will be necessary for my choices abuot cars.	7.92%	1.98%	14.85%	9.90%	21.78%	25.74%	17.82%	101
3	I believe 'Virtual car Dealer' concept is very interesting, I would benefit a lot if it became more widely spread in the automotive sector.	7.92%	1.98%	11.88%	9.90%	16.83%	31.68%	19.80%	101
4	I would definitely use a Virtual Dealer to buy my car if it were available.	8.91%	2.97%	13.86%	8.91%	26.73%	20.79%	17.82%	101
5	I am interested to buy a car through a virtual dealership and I guess it will be a key strength for the development of the sector.	7.92%	4.95%	10.89%	6.93%	22.77%	26.73%	19.80%	101
6	If I had the choice I would prefer to use a Virtual Dealer over a physical dealer.	17.82%	8.91%	14.85%	4.95%	17.82%	17.82%	17.82%	101

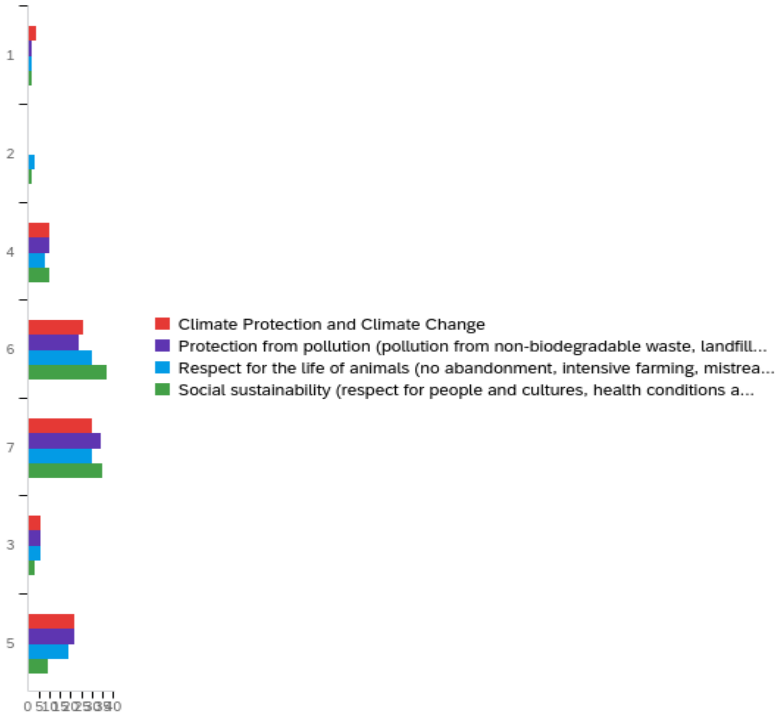
Q8 - What do you think is the most important factor or what aspects about the virtual dealer most appeals to you? Sort the options below from the most attractive to the least attractive. Draw the pictures up or down according to your preferences.



#	Field	Min	Max	Mean	Std. Dev.	Variance	Count
1	Advanced Supply Chain (Block Chain, etc.)	1.00	6.00	3.43	1.64	2.69	98
2	Enhanced Data Analysis	1.00	6.00	3.82	1.49	2.23	98
3	Advanced Customer Care	1.00	6.00	2.72	1.44	2.08	98
4	Virtual Reality	1.00	6.00	3.87	1.55	2.40	98
5	Augmented Reality	1.00	6.00	4.12	1.67	2.80	98
6	Environmentally sustainability	1.00	6.00	3.04	1.96	3.86	98

#	Question	1		2		3		4		5		6		Total
1	Advanced Supply Chain (Block Chain, etc.)	17.35%	17	13.27%	13	21.43%	21	19.39%	19	14.29%	14	14.29%	14	98
2	Enhanced Data Analysis	5.10%	5	19.39%	19	17.35%	17	21.43%	21	20.41%	20	16.33%	16	98
3	Advanced Customer Care	23.47%	23	28.57%	28	18.37%	18	15.31%	15	10.20%	10	4.08%	4	98
4	Virtual Reality	9.18%	9	10.20%	10	24.49%	24	14.29%	14	24.49%	24	17.35%	17	98
5	Augmented Reality	11.22%	11	11.22%	11	7.14%	7	21.43%	21	22.45%	22	26.53%	26	98
6	Environmentally sustainability	33.67%	33	17.35%	17	11.22%	11	8.16%	8	8.16%	8	21.43%	21	98

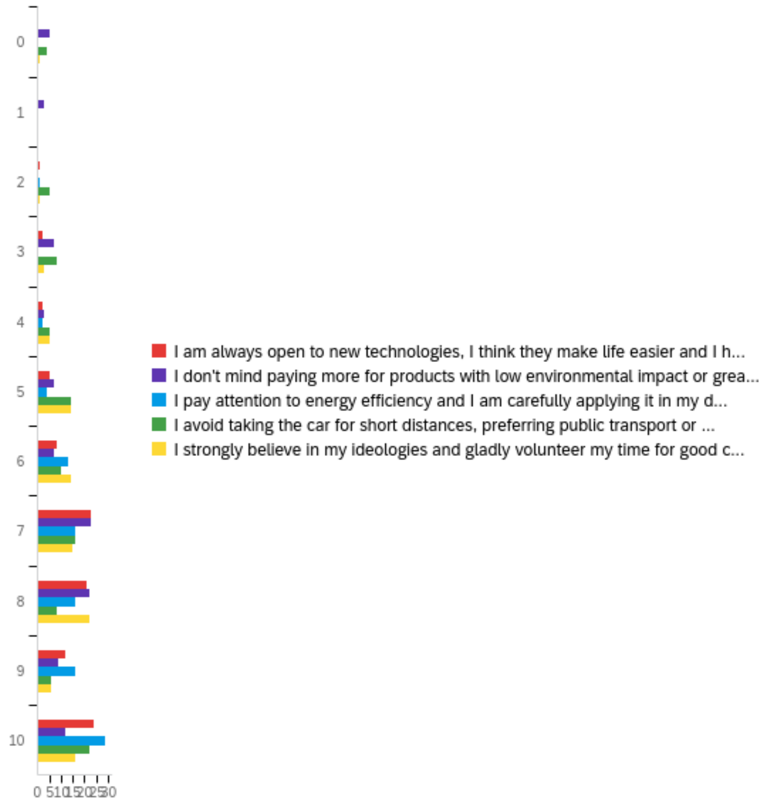
Q9 - Which of these factors are you interested in or actively involved in? (1= Minimum; 7= Maximum)



#	Field	Min	Max	Mean	Std.Dev.	Variance	Count
1	Climate Protection and Climate Change	1.00	7.00	4.88	1.51	2.27	98
2	Protection from pollution (from non-biodegradable waste, landfills, marine pollution)	1.00	7.00	4.98	1.39	1.94	98
3	Respect for the life of animals (no abandonment, intensive farming, mistreatment etc.)	1.00	7.00	4.81	1.43	2.03	98
4	Social sustainability (respect for people and cultures, health conditions and malnutrition, waste of resources in the western world)	1.00	7.00	4.49	1.20	1.43	98

#	Question	1		2		4		6		7		3		5		Total
1	Climate Protection and Climate Change	4.08%	4	0.00%	0	10.20%	10	26.53%	26	30.61%	30	6.12%	6	22.45%	22	98
2	Protection from pollution (pollution from non-biodegradable waste, landfills, marine pollution)	2.04%	2	0.00%	0	10.20%	10	24.49%	24	34.69%	34	6.12%	6	22.45%	22	98
3	Respect for the life of animals (no abandonment, intensive farming, mistreatment etc.)	2.04%	2	3.06%	3	8.16%	8	30.61%	30	30.61%	30	6.12%	6	19.39%	19	98
4	Social sustainability (respect for people and cultures, health conditions and malnutrition, waste of resources in the western world)	2.04%	2	2.04%	2	10.20%	10	37.76%	37	35.71%	35	3.06%	3	9.18%	9	98

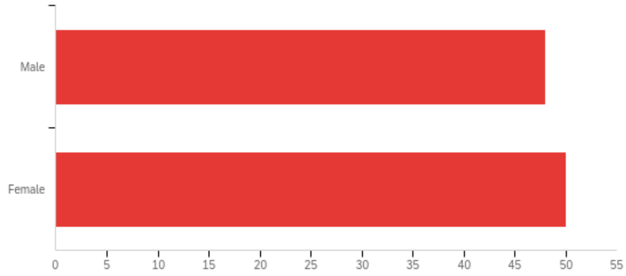
Q10 - How much do you agree with the following statements (0 = Not at all agree, 10 = Perfectly agree)



#	Field	Min	Max	Mean	Std.Dev.	Variance	Count
1	I am always open to new technologies, I think they make life easier and I have no problem applying them in my daily life.	3.00	11.00	8.82	1.81	3.29	98
2	I don't mind paying more for products with low environmental impact or greater sustainability	1.00	11.00	7.64	2.64	6.94	98
3	I pay attention to energy efficiency and I am carefully applying it in my daily life. For example, I always make sure I turn off the lights when I leave a room.	3.00	11.00	9.06	1.77	3.13	97
4	I avoid taking the car for short distances, preferring public transport or cycling or sharing.	1.00	11.00	7.47	2.79	7.78	98
5	I strongly believe in my ideologies and gladly volunteer my time for good causes.	1.00	11.00	8.01	2.10	4.40	97

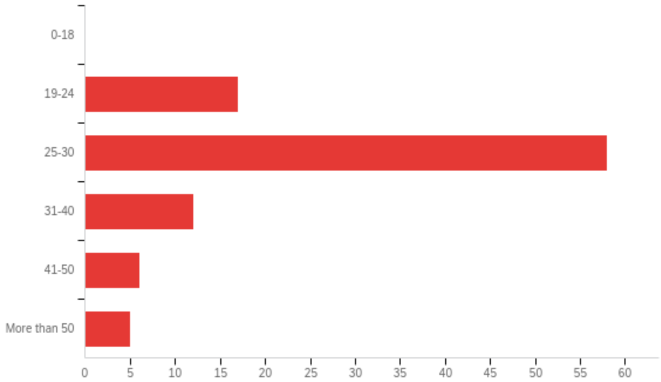
#	Question	0	1	2	3	4	5	6	7	8	9	10	Total
1	I am always open to new technologies, I think they make life easier and I have no problem applying them in my daily life.	0.00%	0.00%	1.02%	2.04%	2.04%	5.10%	8.16%	23.47%	21.43%	12.24%	24.49%	98
2	I don't mind paying more for products with low environmental impact or greater sustainability	5.10%	3.06%	0.00%	7.14%	3.06%	7.14%	7.14%	23.47%	22.45%	9.18%	12.24%	98
3	I pay attention to energy efficiency and I am carefully applying it in my daily life. For example, I always make sure I turn off the lights when I leave a room.	0.00%	0.00%	1.03%	0.00%	2.06%	4.12%	13.40%	16.49%	16.49%	16.49%	29.90%	97
4	I avoid taking the car for short distances, preferring public transport or cycling or sharing.	4.08%	0.00%	5.10%	8.16%	5.10%	14.29%	10.20%	16.33%	8.16%	6.12%	22.45%	98
5	I strongly believe in my ideologies and gladly volunteer my time for good causes.	1.03%	0.00%	1.03%	3.09%	5.15%	14.43%	14.43%	15.46%	22.68%	6.19%	16.49%	97

Q10 - You are:



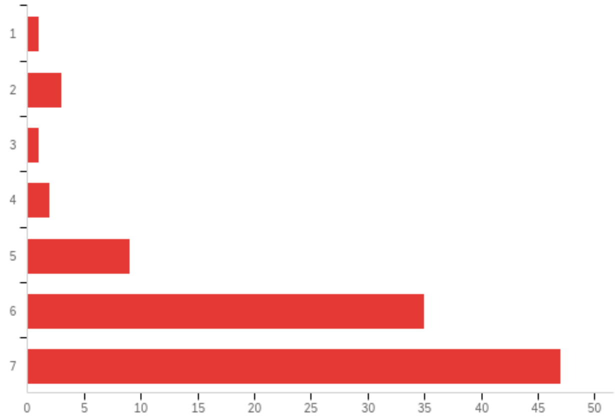
#	Answer	%	Count
1	Male	48.98%	48
2	Female	51.02%	50
	Total	100%	98

Q11 - What age group do you belong to?



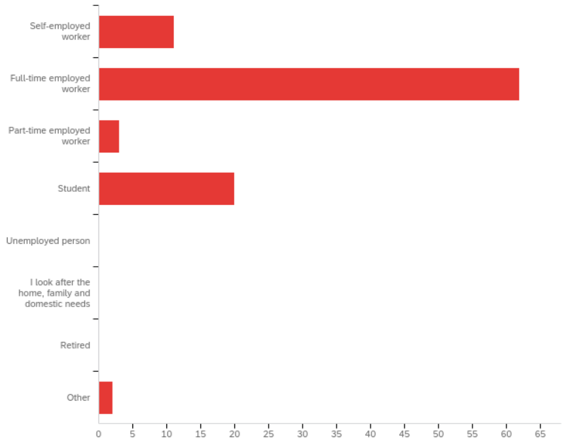
#	Answer	%	Count
1	0-18	0.00%	0
2	19-24	17.35%	17
3	25-30	59.18%	58
4	31-40	12.24%	12
5	41-50	6.12%	6
6	More than 50	5.10%	5
	Total	100%	98

Q12 - How familiar are you with the internet and social apps?



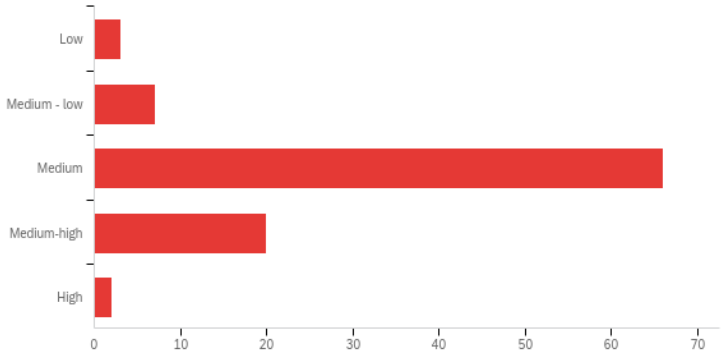
#	Answer	%	Count
1	1	1.02%	1
2	2	3.06%	3
3	3	1.02%	1
4	4	2.04%	2
5	5	9.18%	9
6	6	35.71%	35
7	7	47.96%	47
	Total	100%	98

Q13 - What is your occupation?



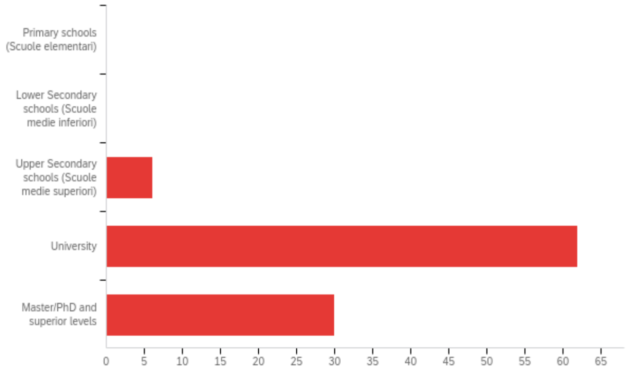
#	Answer	%	Count
1	Self-employed worker	11.22%	11
2	Full-time employed worker	63.27%	62
3	Part-time employed worker	3.06%	3
4	Student	20.41%	20
5	Unemployed person	0.00%	0
6	I look after the home, family and domestic needs	0.00%	0
7	Retired	0.00%	0
8	Other	2.04%	2
	Total	100%	98

Q14 - What economic status do you feel you belong to?



#	Answer	%	Count
1	Low	3.06%	3
2	Medium - low	7.14%	7
3	Medium	67.35%	66
4	Medium-high	20.41%	20
5	High	2.04%	2
	Total	100%	98

Q15 - What is your level of education?



#	Answer	%	Count
1	Primary schools (Scuole elementari)	0.00%	0
2	Lower Secondary schools (Scuole medie inferiori)	0.00%	0
3	Upper Secondary schools (Scuole medie superiori)	6.12%	6
4	University	63.27%	62
5	Master/PhD and superior levels	30.61%	30
	Total	100%	98

3.4 The sample and profiling of respondents

A total of interviews 167 were collected: of these those used for the statistical analysis were 98, as several interviews were eliminated as they were not complete or did not pass the quality tests. The sample involved subjects of both genders (49% men and 51% women) while, as far as age is concerned, almost 650% of the sample was concentrated in the 26-30 age bracket, while for the remaining age brackets, the population was divided in an almost homogeneous way. In terms of type of employment and economic status, the sample was also evenly distributed, with fashions in the category of full-time employees and students (bimodal), and in the middle economic bracket respectively.

As far as the level of education is concerned, there are no low-level respondents, but rather the average is maintained at fairly high levels, with a corresponding trend in the category of people with university-level education and no respondents with less than a diploma.

As can be seen from the graphs, the sample of individuals is also homogeneous in terms of their online browsing habits and use of apps and social networks, with a clear prevalence of people who are fairly confident in the tool and very low percentages of those who say they are not able to access the web at all. The interviews were conducted remotely via email invitation and link to the Qualtrics website.

The survey was conducted between December 2021 and the beginning of February 2022 and the geographical origin was varied, although mainly concentrated in Lazio and Lombardy.

It is interesting to note that a significant sample of the population, more than 60% of the sample, declares that it is rather strongly attached to its ideologies and is not willing to compromise, and that a large part of the respondents declares itself to be very sensitive to sustainability issues, with values well above 70%.

Among these, the issues of pollution and social sustainability are certainly the ones that attract the attention of most of the interviewees, while the issues of climate change and animal rights are preferred with high but much lower percentages.

With regard to the profiling questions, more than 70% of the respondents declared to be very open to the use of new technologies, while; with regard to the use of the internet, apps and social networks, almost 80% of the sample declared to be very expert on the subject and equally high percentages declared to be very expert.

Below are the questions included in the questionnaire with their answers and some basic statistical indicators.

The question: "What do you think is the most important factor or what aspects about the virtual dealer most appeals to you? Sort the options below from the most attractive to the least attractive. Draw the pictures up or down according to your preferences. "

From the statistical processing of the results achieved, the following ranking scale is obtained.

Variable	Obs	Mean	Std. Dev.	Min	Max
augmented_reality	98	4.122449	1.682324	1	6
virtual_reality	98	3.867347	1.557408	1	6
data_analysis	98	3.816327	1.501525	1	6
supply_chain	98	3.428571	1.649742	1	6
environment	98	3.040816	1.973632	1	6
customer_care	98	2.72449	1.448644	1	6

Table 3.1 Summary of responses to question Q8

From what can be seen in Table 3.1, the aspect that users think most characterises a virtual dealer is augmented reality, which takes on average the highest preference and is the only alternative proposedto exceed the average of 4. Its detachment from even close alternatives such as Virtual Reality is appreciable; from this consideration it emerges that the expectations customers have regarding the prerogatives they think a virtual dealer should possess are focused on technological factors, and in particular factors linked to augmented reality.

As far as the analysis of the remaining results is concerned, the focus was placed on the study of the possible dependency relations between the various variables extrapolated from the answers to the questionnaire, with particular attention to those directly traceable to the independent variables whose impact on the outcome variable, i.e. the Propensity towards virtual dealers, was to be studied.

The processing and analysis of the data obtained made it possible to formalise a relational model between the various factors considered that could profitably be used to make the desired estimates. In this specific case, the survey served to understand whether the independent variables influenced the stimuli respondents regardless or not of the different stimuli they were subjected to; this in orderto understand how much the company reputation, career prospects and sustainable dimension are really relevant in setting up a correct recruitment strategy. In addition, we wanted to understand whether it is possible to exploit a possible synergistic effect by using them simultaneously and modulating their effect through control factors represented by moral satisfaction and the attitude to sustainable behaviour. The study was structured in several phases as listed below:

- Univariate analysis of the identified random variables;
- Reliability analysis of the questionnaire using Cronebach's Alpha
- Principal Component Analysis (FCA);
- Bivariate analysis of the relationships between the individual variables;
- SEM analysis
- Verification of the Empirical Model;

For the statistical analysis the dataset was extracted from the report of the survey results.
The dependent variables were generated from the variables containing the preferences expressed by the respondents when they were asked to express a relative opinion as a result of the questions presented to them.
As illustrated in section 3.1, the research questions that we want to try and answer within this thesis work can be summarised in the five research hypotheses that formed the basis for the formulation of the empirical model and which are set out below:

H1.: *The intention to use a virtual dealership to buy or rent a car depends on the user's attitude towards advanced automation technologies, including the development of a framework for autonomous car driving.*

H2.: *The propensity to turn to a virtual dealership to buy or rent a car depends on the user's attitude to appreciate connectivity to different types of devices and the network during the driving experience.*

H3.: *The propensity to turn to a virtual dealership to buy or hire a car depends on the customer's preference for mobile cars in which electrification is not negligible, whether in total form as in electric cars, or in partial form as in hybrid cars.*

H4.: *The propensity to use a virtual dealership to buy or rent a car depends on the customer's attitude towards intelligent modes of transport, e.g. sharing, car pooling, leasing etc.*

H5.: *The propensity to use a virtual dealership to buy or hire a car depends on the proximity of the user, potential customer, to sustainability issues in general, both from a social and environmental point of view.*

The hypotheses thus expressed can be used to formulate a conceptual model that can be used to interpret consumer response to different strategies for promoting and developing supplementary pension products to be offered to citizens. In this section of the empirical analysis, a structural equation model (SEM) was developed using the statistical software STATA, which represents the core of the Theory of Consumer Values.
SEM models aim to resolve the causal complexity present in the set of independent (or explanatory) variables, which produces changes in the dependent variable (to be explained). In addition to testing the validity of the hypothesis of a causal link between the variables, structural equation models assess the strength of the relationship between the variables.

3.4.1 Univariate analysis of variables

The processing and analysis of the data obtained consequently made it possible to formalise a relational model between the various factors considered that could profitably be used to make the desired estimates.

Variable	Obs	Mean	Std. Dev.	Min	Max	Type
autonomous1	98	5.163265	1.544487	1	7	IV
autonomous2	98	5.142857	1.546529	1	7	IV
autonomous3	98	5.255102	1.514951	2	7	IV
auto_sector1	98	5.887755	1.165506	1	7	IV
auto_sector2	98	5.826531	1.148962	2	7	IV
auto_sector3	98	5.94898	1.17861	2	7	IV
connectivity1	98	6.102041	1.12598	2	7	IV
connectivity2	98	6.122449	1.077084	2	7	IV
connectivity3	98	6.071429	1.105283	2	7	IV
connect_sector1	98	6.112245	0.9936152	2	7	IV
connect_sector2	98	6.193878	1.071257	1	7	IV
connect_sector3	98	6.234694	1.091684	2	7	IV
electrification1	98	5.030612	1.633755	1	7	IV
electrification2	98	5.295918	1.593862	1	7	IV
electrification3	98	5.377551	1.403349	1	7	IV
electr_sector1	98	5.704082	1.245273	1	7	IV
electr_sector2	98	5.77551	1.222897	1	7	IV
electr_sector3	98	5.867347	1.321025	1	7	IV
smart_mobility1	98	4.867347	1.702865	1	7	IV
smart_mobility2	98	5.122449	1.724686	1	7	IV
smart_mobility3	98	5.244898	1.75899	1	7	IV
smart_sector1	98	5.346939	1.547209	1	7	IV
smart_sector2	98	5.489796	1.493939	1	7	IV
smart_sector3	98	5.602041	1.571261	1	7	IV
virtual_reality1	98	4.928571	1.724595	1	7	IV
virtual_reality2	98	4.857143	1.698999	1	7	IV
virtual_reality3	98	5.081633	1.544351	1	7	IV
virtual_sector1	98	5.326531	1.629468	1	7	IV
virtual_sector2	98	5.408163	1.629855	1	7	IV
virtual_sector3	98	5.530612	1.547889	1	7	IV
augmented_reality1	98	5.183673	1.494643	1	7	IV
augmented_reality2	98	5.163265	1.440889	1	7	IV
augmented_reality3	98	5.377551	1.453863	1	7	IV
augmented_sector1	98	5.5	1.401398	1	7	IV
augmented_sector2	98	5.581633	1.354058	1	7	IV
augmented_sector3	98	5.683673	1.374262	1	7	IV
propensity1	98	4.836735	1.703204	1	7	DV
propensity2	98	4.887755	1.734327	1	7	DV
propensity3	98	5.05102	1.74316	1	7	DV
wtb1	98	4.795918	1.770079	1	7	DV
wtb2	98	4.94898	1.778291	1	7	DV
wtb3	98	4.244898	2.149376	1	7	DV

Variable	Obs	Mean	Std. Dev.	Min	Max	Type
supply_chain	98	3.428571	1.649742	1	6	CV
data_analysis	98	3.816327	1.501525	1	6	CV
customer_care	98	2.72449	1.448644	1	6	CV
virtual_real	98	3.867347	1.557408	1	6	CV
augmented_real	98	4.122449	1.682324	1	6	CV
environment	98	3.040816	1.973632	1	6	CV
climate_change	98	4.877551	1.514639	1	7	MV
pollution	98	4.979592	1.399408	1	7	MV
animal	98	4.806122	1.43346	1	7	MV
social_sustainability	98	4.489796	1.203473	1	7	MV
new_technologiess	98	8.816327	1.823936	3	11	MV
environmental_sustainability	98	7.642857	2.648672	1	11	MV
energy_efficiency	97	9.061856	1.778426	3	11	MV
public_transport	98	7.469388	2.803547	1	11	MV
ideologies	97	8.010309	2.108983	1	11	MV
web_addicted	98	6.142857	1.218415	1	7	MV
gender	98	-	-	1	2	CV
age	98	-	-	2	6	CV
occupation	98	-	-	1	8	CV
wealth	98	-	-	1	5	CV
education	98	-	-	3	5	CV

Table 3.2 - List of variables in the questionnaire and results

where:

- IV=Independent variable
- DV=Variable Dependent
- MV=Moderating control variable
- CV=Control variable

3.4.2 Test reliability: calculation of Cronbach's Alpha

A propaedeutic action to carry out the actual principal component analysis is to assess the reliability of the variables to which the FCA is to be applied, being a fundamental property to define a measurement scale: reliability allows to analyse the logic underlying the verification tools used in the validation of the consumer perception of packaging sustainability questionnaire, the subject of this thesis. Reliability is a necessary, but not sufficient condition for a measurement scale to be effective. Peter (1979) defines reliability as the degree to which a measurement is free from error and thus generatesconsistent outcomes.

Considering the following relationship:

$$X_o = X_T + X_S + X_R$$

where:

- X_O = observed value;
- X_T = true value of the latent (unobservable) variable;
- X_S = systematic error (i.e. respondent characteristics that condition responses);
- X_R = random error (i.e. mood of respondents, degree of fatigue);
- it can be said that a measurement scale is perfectly reliable when $X_R = 0$, i.e. when the change in the observed value compared to the true score is not due torandom errors.

To check the reliability of a scale, its internal consistency is analysed in particular.

The items constituting a scale should be logically related to the underlying latent variable; if this relationship is strong, the items are highly correlated with each other.

Among the tools for testing internal consistency, a very important reliability index is *Cronbach's alpha* coefficient. Cronbach's alpha is a measure of internal consistency, i.e. it measures how closely related a set of items is as a group. It is considered a measure of scale reliability. A "high" value for alpha does not imply that the measure is one-dimensional.

If, in addition to measuring internal consistency, it is desired to provide evidence that the scale in question is one-dimensional, further analysis can be performed. Exploratory factor analysis is a method to check dimensionality. Technically speaking, Cronbach's alpha, rather than being astatistical test, is a reliability (or consistency) coefficient and is a function of the average intercorrelation between the elements of the variables considered.

The values of Cronbach's alpha vary between 0 and 1, and the test is more reliable the closer it is to one,

Values of 0.6 suggest sufficient reliability, which can then increase as the alpha increases.Below, for conceptual purposes, is the formula for Cronbach's alpha.

$$\alpha = \frac{N\bar{c}}{\bar{v} + (N-1)\bar{c}}$$

where:

- N is equal to the number of articles,
- c is the mean covariance between the elements and
- v is equal to the mean variance.

It can be seen from this formula that if the number of elements increases, Cronbach's alpha increases accordingly. Also, if the average correlation between the elements is low, the alpha will be low. As the average correlation between the elements increases, the Cronbach's alpha also increases (keeping the number of elements constant).

For the questionnaire analysed, we proceeded to analyse the Alpha coefficient for groups of variables with similar contents, obtaining the following results.

Starting from the analysis of the mediating variables, we obtained:

Test scale=mean (unstandardized items)

Item	Obs	Sign	Item-Test Correlation	Item-Rest Correlation	Average Variance Extracted	Alpha
autonomous1	98	+	0.8944	0.7604	1.767305	0.8599
autonomous2	98	+	0.9015	0.7746	1.720808	0.8475
autonomous3	98	+	0.9167	0.8105	1.646539	0.8161
Test scales					1.711551	0.8883

Interitem covariances (obs = in98 all pairs)

	autonomous1	*autonomous2*	*autonomous3*
autonomous1	2.3854		
autonomous2	1.6465	2.3918	
autonomous3	1.7208	1.7673	2.2951

Test scale=mean (unstandardized items)

Item	Obs	Sign	Item-Test Correlation	Item-Rest Correlation	Average Variance Extracted	Alpha
auto_sector1	98	+	0.8397	0.6373	0.8570377	0.775
auto_sector2	98	+	0.8607	0.6828	0.7880286	0.7291
auto_sector3	98	+	0.8626	0.6789	0.7741426	0.7326
Test scales					0.806403	0.8149

Interitem covariances (obs = in98 all pairs)

	auto_sector1	*auto_sector2*	*auto_sector3*
auto_sector1	1.3584		
auto_sector2	0.7741	1.3201	
auto_sector3	0.788	0.857	1.3891

Test scale=mean (unstandardized items)

Item	Obs	Sign	Item-Test Correlation	Item-Rest Correlation	Average Variance Extracted	Alpha
connectivity1	98	+	0.8752	0.7171	.9499264	0.8874
connectivity2	98	+	0.9163	0.8109	.8379971	0.8047
connectivity3	98	+	0.9132	0.7995	.8327372	0.8137

Interitem covariances (obs = in98 all pairs)

	connectivity1	*connectivity2*	*connectivity3*
connectivity1	1.2678		
connectivity2	0.8327	1.1601	
connectivity3	0.8380	0.9499	1.2216

Test scale=mean (unstandardized items)

Item	Obs	Sign	Item-Test Correlation	Item-Rest Correlation	Average Variance Extracted	Alpha
connect_sector1	98	+	0.8819	0.7365	0.5932043	0.673
connect_sector2	98	+	0.8454	0.6425	0.6744162	0.7647
connect_sector3	98	+	0.836	0.6177	0.6996634	0.7919
Test scales					0.6557613	0.8128

Interitem covariances (obs = in98 all pairs)

	connect_sector1	*connect_sector2*	*connect_sector3*
connect_sector1	0.9873		
connect_sector2	0.6997	1.1476	
connect_sector3	0.6744	0.5932	1.1918

Test scale=mean (unstandardized items)

Item	Obs	Sign	Item-Test Correlation	Item-Rest Correlation	Average Variance Extracted	Alpha
electrification1	98	+	0.8832	0.723	1.742794	0.8719
electrification2	98	+	0.9219	0.8121	1.503787	0.7867
electrification3	98	+	0.8925	0.7763	1.836209	0.8269
Test scales					1.694263	0.8791

Interitem covariances (obs = in98 all pairs)

	electrification1	*electrification2*	*electrification3*
electrification1	2.6692		
electrification2	1.8362	2.5404	
electrification3	1.5038	1.7428	1.9694

Test scale=mean (unstandardized items)

Item	Obs	Sign	Item-Test Correlation	Item-Rest Correlation	Average Variance Extracted	Alpha
electr_sector1	98	+	0.9089	0.7943	1.145171	0.8282
electr_sector2	98	+	0.9146	0.8095	1.135599	0.8159
electr_sector3	98	+	0.8897	0.7411	1.190616	0.8775
Test scales					1.157129	0.8875

Interitem covariances (obs = in98 all pairs)

	electr_sector1	*electr_sector2*	*electr_sector3*
electr_sector1	1.5507		
electr_sector2	1.1906	1.4955	
electr_sector3	1.1356	1.1452	1.7451

Test scale=mean (unstandardized items)

Item	Obs	Sign	Item-Test Correlation	Item-Rest Correlation	Average Variance Extracted	Alpha
smart_mobility1	98	+	0.9092	0.8028	2.794446	0.9589
smart_mobility2	98	+	0.9626	0.9139	2.321481	0.8730
smart_mobility3	98	+	0.9549	0.8947	2.346308	0.8882
Test scales					2.487411	0.9370

Interitem covariances (obs = in98 all pairs)

	smart_mobility1	*smart_mobility2*	*smart_mobility3*
smart_mobility1	2.8997		
smart_mobility2	2.3463	2.9745	
smart_mobility3	2.3215	2.7944	3.0940

Test scale=mean (unstandardized items)

Item	Obs	Sign	Item-Test Correlation	Item-Rest Correlation	Average Variance Extracted	Alpha
smart_sector1	98	+	0.9405	0.8654	2.062908	0.9349
smart_sector2	98	+	0.9580	0.9068	2.00547	0.9040
smart_sector3	98	+	0.9501	0.8844	1.972649	0.9206
Test scales					2.013676	0.9451

Interitem covariances (obs = in98 all pairs)

	smart_sector1	*smart_sector2*	*smart_sector3*
smart_sector1	2.3939		
smart_sector2	1.9726	2.2319	
smart_sector3	2.0055	2.0629	2.4689

Test scale=mean (unstandardized items)

Item	Obs	Sign	Item-Test Correlation	Item-Rest Correlation	Average Variance Extracted	Alpha
virtual_reality1	98	+	0.9121	0.7961	2.279823	0.9276
virtual_reality2	98	+	0.9456	0.8715	2.036819	0.8637
virtual_reality3	98	+	0.9377	0.8669	2.268041	0.8726
Test scales					2.194894	0.9224

Interitem covariances (obs = in98 all pairs)

	virtual_reality1	*virtual_reality2*	*virtual_reality3*
virtual_reality1	2.9742		
virtual_reality2	2.2680	2.8866	
virtual_reality3	2.0368	2.2798	2.3850

Test scale=mean (unstandardized items)

Item	Obs	Sign	Item-Test Correlation	Item-Rest Correlation	Average Variance Extracted	Alpha
virtual_sector1	98	+	0.9560	0.8987	2.183253	0.9272
virtual_sector2	98	+	0.9488	0.8827	2.237324	0.9395
virtual_sector3	98	+	0.9595	0.9111	2.257101	0.9188
Test scales					2.225892	0.9511

Interitem covariances (obs = in98 all pairs)

	virtual_sector1	*virtual_sector2*	*virtual_sector3*
virtual_sector1	2.6552		
virtual_sector2	2.2571	2.6564	
virtual_sector3	2.2373	2.1833	2.3960

Test scale=mean (unstandardized items)

Item	Obs	Sign	Item-Test Correlation	Item-Rest Correlation	Average Variance Extracted	Alpha
augmented_reality1	98	+	0.9154	0.8067	1.772775	0.9167
augmented_reality2	98	+	0.9433	0.8718	1.651588	0.8635
augmented_reality3	98	+	0.9328	0.8481	1.701662	0.8824
Test scales					1. 708272	0.9222

Interitem covariances (obs = in98 all pairs)

	augmented_reality1	*augmented_reality2*	*augmented_reality3*
augmented_reality1	2.2340		
augmented_reality2	1.7017	2.0762	
augmented_reality3	1.6516	1.7728	2.1137

Test scale=mean (unstandardized items)

Item	Obs	Sign	Item-Test Correlation	Item-Rest Correlation	Average Variance Extracted	Alpha
augmented_sector1	98	+	0.9501	0.8860	1.691037	0.9521
augmented_sector2	98	+	0.9734	0.9401	1.613402	0.9116
augmented_sector3	98	+	0.9541	0.8968	1.695876	0.9436
Test scales					1.666772	0.9563

Interitem covariances (obs = in98 all pairs)

	augmented_sector1	*augmented_sector2*	*augmented_sector3*
augmented_sector1	1.9639		
augmented_sector2	1.6959	1.8335	
augmented_sector3	1.6134	1.6910	1.8886

Test scale=mean (unstandardized items)

Item	Obs	Sign	Item-Test Correlation	Item-Rest Correlation	Average Variance Extracted	Alpha
climate_change	98	+	0.5824	0.1748	.299506	0.9097
energy_efficiency	97	+	0.6849	0.1637	.5644856	0.8196
pollution	98	+	0.6347	0.2922	.378329	0.9437
Test scales					.4146219	0.8771

Interitem covariances (obs = in98 all pairs)

	climate_change	*energy_efficiency*	*pollution*
climate_change	2.2941		
energy_efficiency	0.3783	3.1628	
pollution	0.5645	0.2995	1.9583

For the dependent variables it was obtained:

Test scale=mean (unstandardized items)

Item	Obs	Sign	Item-Test Correlation	Item-Rest Correlation	Average Variance Extracted	Alpha
propensity1	98	+	0.9506	0.8906	2.727435	0.9486
propensity2	98	+	0.9720	0.9356	2.503261	0.9148
propensity3	98	+	0.9547	0.8970	2.641279	0.9440
Test scales					2.414629	0.9771

Interitem covariances (obs = in98 all pairs)

	propensity1	*propensity2*	*propensity3*
propensity1	2.9009		
propensity2	2.6413	3.0079	
propensity3	2.5033	2.7274	3.0386

Test scale=mean (unstandardized items)

Item	Obs	Sign	Item-Test Correlation	Item-Rest Correlation	Average Variance Extracted	Alpha
wtb1	98	+	0.9431	0.8787	3.043551	0.8778
wtb2	98	+	0.9302	0.8522	3.153587	0.8972
wtb3	98	+	0.9412	0.8475	2.638965	0.9121
Test scales					*2.945368*	*0.9273*

Interitem covariances (obs = in98 all pairs)

	wtb1	*wtb2*	*wtb3*
wtb1	3.1332		
wtb2	2.6390	3.1623	
wtb3	3.1536	3.0436	4.6198

For the dependent variables, the alpha values obtained are also all well above 0.9 It can therefore be assumed that the reliability test was fully successful for these variables.
For the questionnaire analysed, the alpha coefficient for the various groups of variables was around the mean value of 0.8, which indicates good reliability of the construct. $\alpha_{Cronbach} = 0.90$ with a minimum of 0.8128, which reveals a good reliability and consistency of the construct.
The reliability of the measurement elements was tested using Cronbach's alpha and composite reliability to assess the internal consistency of the factors in the model.
From the tables shown in the previous pages, other important parameters are briefly indicated, in addition to $\alpha_{Cronbach}$, other important parameters for assessing the applicability of SEM analysis and compliance with the assumptions that this methodology imposes: among these, the most important are the *Average Variance Extracted (AVE*) and *Composite reliability (C*R), where:

- composite reliability is a kind of weighted average of the reliabilities of the individual factors and mathematically is given by a ratio in which, at the numerator, there is the square of the sum of the reliabilities of the individual factors, and at the denominator, the sum of the numerator and the square of the sum of the variances of the error.
- the average variance extracted is a kind of weighted average of the variances extracted from the factors and mathematically is given by a ratio where at the numerator is the square of the sum of the reliabilities of the individual factors, and at the denominator, the sum of the numerator and the sum of the variances of the error.

The values in the tables show that all the $\alpha_{Cronbach}$ exceed or are very close to the threshold point of 0.7 in relation to the expected factors (Hair et al., 2010; Nunnally and Bernstein, 1994), denoting a strong inter-measure reliability. As can be seen by looking at the data in Table 2, Cronbach's alphas and composite reliability take values that exceed or are very close to the 0.7 threshold with respect to the expected factors, denoting strong inter-measure reliability (Nunnally and Bernstein, 1994; Hair et al., 2010).
Furthermore, the Average Excerpted Variances (AVE) of the latent constructs take on values ranging from 0.54 to 1.1, exceeding the threshold value of 0.5 (Fornell and Larcker, 1981; Segars, 1997; Hair et al., 2010). This means that more than half of the item variances are represented by its constructs. Consequently, the data manifest adequate convergent validity, i.e. high correlation with other measures of the same construct (Fornell and Larcker, 1981).

3.4.3 Confirmatory Factor Analysis

In order to highlight the existence of a structure of factors or dimensions, not directly measurable, within the directly observed variables that relate to these latent traits, a *Confirmatory Factor Analysis was* carried out.

Within empirical research, the dimensions are characterised by their own theoretical coherence, so that the different factors do not merely represent the existence of a statistical association between variables but must also be interpretable from a scientific-rational point of view.
The *Confirmatory Factor Analysis* model then proceeds to calculate a series of fit indices (technically referred to as estimating saturations) that describe how well the model fits the data, i.e. in simpler terms, how well the model is able to describe the observations.
Factor analysis is a technique using principal component analysis, or *CFA, which* is a statistical procedure that allows the content of information in large data tables to be summarised by a smaller set of 'summary indices' that can be more easily managed and analysed.
Principal component analysis is today one of the most popular multivariate statistical techniques; it has been widely used in the areas of pattern recognition and signal processing and is a statistical method with the broad title of factor analysis. *CFA* forms the foundation of multivariate data analysis based on projection methods. The use of summary indices allows trends to be observed, jumps, clusters and outliers to be highlighted, and latent relationships between observations and variables and between different variables to be discovered.
CFA dates back to Cauchy but was first formulated in statistics by Pearson, who described the analysis as the search for "lines and planes of fit closest to point systems in space" (Jackson, 1991).
It is a very flexible tool and allows the analysis of data sets that may contain, for example, multicollinearity, missing values, categorical data and imprecise measurements. The aim is to extract important information from the data and express this information as a set of summary indices called principal components.
Statistically, the CFA finds lines, planes and hyperplanes in K-dimensional space that best approximate the data using the least squares method. A line or plane representing the least squares approximation of a set of data points makes the variance of the co-ordinates on the line or plane as large as possible. The choice of the number of factors to be considered in the factorial solution can be made using the Kaiser criterion, according to which all factors whose eigenvalue is greater than or equal to 1 are evaluated (eigenvalues are related to the proportion of variability "explained" by the factor, assuming lower values as one moves from the first factor towards the last).
The result is then further treated by performing a 'rotation': this can be done using different methods. The most widely used are:

1. the oblique rotation method (Promax) which releases the independence constraint on the factors to make them easier to interpret.
2. the orthogonal rotation method (Varimax) which releases the independence constraint.

In general, having observed p variables $X_1, X_2, \ldots, X_p$, we would like to represent them as the superposition of their averages $\mu_{12}, \mu, \ldots, \mu_p$, of $m < p$ latent factors $F, F_{12}, \ldots, F_m$, with zero mean, unit variance and uncorrelated, and of p error terms $e_1, e_2, \ldots, e_p$, also zero mean and uncorrelated, neither among themselves nor with the latent factors.

This is known as the orthogonal factorial model; the coefficients L_{jk} are said to be *Loading of* factor k on variable j. The model would be expressed as :

$$\begin{cases} X_1 = L_{11} \cdot F_1 + L_{12} \cdot F_2 + .. + L_{1m} \cdot F_m \\ X_2 = L_{21} \cdot F_1 + L_{22} \cdot F_2 + .. + L_{2m} \cdot F_m \\ \quad\quad\quad\quad .... \\ X_p = L_{p1} \cdot F_1 + L_{p2} \cdot F_2 + .. + L_{pm} \cdot F_m \end{cases}$$

From here, the Principal Component method is completed by introducing the weights W_{jk} and placing $L_{jk}=\sqrt{\lambda_{jk}} \cdot W_{jk}$, where λ_{jk} is the variance of C_k and we have $F_k=\frac{1}{\lambda_{jk}} \cdot C_k$.

The observed variables are expressed as linear combinations of the principal components, using the same weights.

The choice of the number of *m* factors to be considered in the factorial solution can be made according to the Kaiser criterion, according to which all factors are considered whose eigenvalue is greater than or equal to 1 (the eigenvalues relate to the share of variability "explained" by the factor and assume descending values as one moves from the first factor towards the last). The result can then be subjected to rotation by various methods: the one used here is the orthogonal rotation method (Varimax).

The tests most commonly associated with factor analysis are:

1. *Bartlett's Sphericity Test*;
2. The *KMO (Kaiser-Meyer-Olkin) Test.*

Bartlett's test for sphericity examines the null hypothesis that the matrix R reproduced by the factorial solution is equal to the identity matrix (R=I). If the test is significant, factor analysis can be performed. The KMO Test compares the magnitude of the observed correlations with respect to the partial correlations. If the sum of the latter is smaller than the sum of the former the KMO is close to 1 and the matrix can be factorialised. The test measures the adequacy of sampling for each variable in the model and for the complete model. The statistic is a measure of the proportion of variance between variables that could be a common variance. The lower the proportion, the more suitable the data are for factor analysis. A rule of thumb for interpreting statistics:

- KMO returns values between 0 and 1.
- KMO values between 0.8 and 1 indicate adequate sampling.
- KMO values between 0.6 and 0.8 indicate that sampling is acceptable.
- KMO values below 0.6 indicate that sampling is inadequate and that corrective action needs to be taken. Some authors put this value at 0.5, so use your judgement for values between 0.5 and 0.6.
- KMO values close to zero indicate that there are large partial correlations with respect to the

sum of correlations. In other words, there are widespread correlations that represent a major problem for factor analysis.

With the dataset thus modified, the CFAs were carried out. Below are the results of the Confirmatory Factor Analysis applied to the different types of variablesused in the analysis. Starting from the analysis of the mediator variables, the following tables show the results.

Factor Analysis and Kaiser-Meyer-Olkin measure of sampling adequacy		
Variable	**KMO**	**Scoring coefficients (method = regression; based on varimax rotated factors)**
autonomous1	0.8071	0.3486
autonomous2	0.8243	0.3206
autonomous3	0.8601	0.2603
Overall = autonomous	**0.8402**	**LR test: independent vs. saturated: chi2(3) = 165.03 Prob>chi2 = 0.0000**

Factor Analysis and Kaiser-Meyer-Olkin measure of sampling adequacy		
Variable	**KMO**	**Scoring coefficients (method = regression; based on varimax rotated factors)**
auto_sector1	0.7058	0.5019
auto_sector2	0.7568	0.4272
auto_sector3	0.7534	0.4324
Overall = auto_sector	**0. 7250**	**LR test: independent vs. saturated: chi2(3) = 99.34 Prob>chi2 = 0.0000**

Factor Analysis and Kaiser-Meyer-Olkin measure of sampling adequacy		
Variable	**KMO**	**Scoring coefficients (method = regression; based on varimax rotated factors)**
connectivity1	0.7573	0.4264
connectivity2	0.8683	0.2460
connectivity3	0.8594	0.2615
Overall = connect	**0.7015**	**LR test: independent vs. saturated: chi2(3) = 166.92 Prob>chi2 = 0.0001**

Factor Analysis and Kaiser-Meyer-Olkin measure of sampling adequacy		
Variable	**KMO**	**Scoring coefficients (method = regression; based on varimax rotated factors)**
connect_sector1	0.8106	0.3430
connect_sector2	0.7267	0.4719
connect_sector3	0.6922	0.5209
Overall = connect_sector1	**0. 7260**	**LR test: independent vs. saturated: chi2(3) = 104.12 Prob>chi2 = 0.0000**

Factor Analysis and Kaiser-Meyer-Olkin measure of sampling adequacy		
Variable	**KMO**	**Scoring coefficients (method = regression; based on varimax rotated factors)**
electrification1	0.7661	0.4130
electrification2	0.8701	0.2429
electrification3	0.8356	0.3017
Overall = electrification	**0.7528**	**LR test: independent vs. saturated: chi2(3) = 161.65 Prob>chi2 = 0.0000**

Factor Analysis and Kaiser-Meyer-Olkin measure of sampling adequacy		
Variable	**KMO**	**Scoring coefficients (method = regression; based on varimax rotated factors)**
electr_sector 1	0.8494	0.2786
electr_sector2	0.8627	0.2557
electr_sector3	0.7834	0.3864
Overall = electr_sector	**0.8210**	**LR test: independent vs. saturated: chi2(3) = 166.01 Prob>chi2 = 0.0000**

Factor Analysis and Kaiser-Meyer-Olkin measure of sampling adequacy		
Variable	**KMO**	**Scoring coefficients (method = regression; based on varimax rotated factors)**
smart_mobi~1	0.8205	0.3268
smart_mobi~2	0.9525	0.0927
smart_mobi~3	0.9396	0.1172
Overall = smart_mobility	**0.8602**	**LR test: independent vs. saturated: chi2(3) = 281.98 Prob>chi2 = 0.0000**

Factor Analysis and Kaiser-Meyer-Olkin measure of sampling adequacy		
Variable	**KMO**	**Scoring coefficients (method = regression; based on varimax rotated factors)**
smart_sector1	0.8893	0.2092
smart_sector2	0.9338	0.1281
smart_sector3	0.9127	0.1669
Overall = smart_sector	**0. 7250**	**LR test: independent vs. saturated: chi2(3) = 274.76 Prob>chi2 = 0.0000**

Factor Analysis and Kaiser-Meyer-Olkin measure of sampling adequacy		
Variable	**KMO**	**Scoring coefficients (method = regression; based on varimax rotated factors)**
virtual_reality1	0.8222	0.3240
virtual_reality2	0.9157	0.1615
virtual_reality3	0.9097	0.1725
Overall = virtual_reality	**0.8515**	**LR test: independent vs. saturated: chi2(3) = 231.86 Prob>chi2 = 0.0000**

Factor Analysis and Kaiser-Meyer-Olkin measure of sampling adequacy		
Variable	**KMO**	**Scoring coefficients (method = regression; based on varimax rotated factors)**
virtual_sector1	0.9234	0.1474
virtual_sector2	0.9039	0.1829
virtual_sector3	0.9351	0.1256
Overall = virtual_sector	**0. 9260**	**LR test: independent vs. saturated: chi2(3) = 293.54 Prob>chi2 = 0.0000**

Factor Analysis and Kaiser-Meyer-Olkin measure of sampling adequacy		
Variable	**KMO**	**Scoring coefficients (method = regression; based on varimax rotated factors)**
augmented_reality1	0.8371	0.2992
augmented_reality2	0.9104	0.1711
augmented_reality3	0.8892	0.2093
Overall = Augmented_reality	**0.8528**	**LR test: independent vs. saturated: chi2(3) = 209.65 Prob>chi2 = 0.0000**

Factor Analysis and Kaiser-Meyer-Olkin measure of sampling adequacy		
Variable	**KMO**	**Scoring coefficients (method = regression; based on varimax rotated factors)**
augmented_sector1	0.9079	0.1757
augmented_sector2	0.9616	0.0753
augmented_sector3	0.9227	0.1486
Overall = augmented_sector	**0.9210**	**LR test: independent vs. saturated: chi2(3) = 324.04 Prob>chi2 = 0.0000**

Factor Analysis and Kaiser-Meyer-Olkin measure of sampling adequacy		
Variable	**KMO**	**Scoring coefficients (method = regression; based on varimax rotated factors)**
climate_change	0.7380	0.8082
energy_efficiency	0.7692	0.9275
pollution	0.7269	0.8177
Overall = sustainability	**0.7310**	**LR test: independent vs. saturated: chi2(3) = 10.63 Prob>chi2 = 0.0163**

Confirmatory Factor Analysis allowed us to verify convergent validity for all the independent variables, even though the KMO of the groups of the *sustainability* variable actually assumes rather modest values compared to the others, but still acceptable.

In the case of the dependent variables, too, Confirmatory Factor Analysis allowed us to verify convergent validity, since the KMO of the WTB group of variables is characterised by rather high values, but not less than 0.95.

Factor Analysis and Kaiser-Meyer-Olkin measure of sampling adequacy		
Variable	**KMO**	**Scoring coefficients (method = regression; based on varimax rotated factors)**
propensity1	0.9123	0.1676
propensity2	0.9572	0.0839
propensity3	0.9201	0.1534
Overall = propensity	**0.9212**	**LR test: independent vs. saturated: chi2(3) = 319.74 Prob>chi2 = 0.0000**

Factor Analysis and Kaiser-Meyer-Olkin measure of sampling adequacy		
Variable	**KMO**	**Scoring coefficients (method = regression; based on varimax rotated factors)**
wtb1	0.9117	0.1688
wtb2	0.8862	0.2147
wtb3	0.8776	0.2298
Overall = wtb	**0.8810**	**LR test: independent vs. saturated: chi2(3) = 239.69 Prob>chi2 = 0.000**

Therefore, in summary, the results show that Barlett's Sphericity Test gave significant chi-square values for all the factorial analyses performed, while the KMO Test gave values between 0 7015and 0.9260 for all the variables tested, and therefore acceptable.

Continuing with the analysis, further CFAs were made on the CFAs already carried out, thus obtaining a multilevel CFA system.

In particular:

- From a CFA between *autonomous* and *auto_sector,* the factorial variable *auto_drive* was obtained;
- From a CFA between *connect* and *connect_sector,* the factorial variable *connectivity* was obtained;
- From a CFA between *electrification* and *electr_sector,* the factorial variable *electric* was obtained;
- From a CFA between *smart_mobility* and *smart_sector* the factorial variable *smart* was obtained;
- From a CFA between *virtual_reality*, *virtual_sector, augmented_reality* and *augmented_sector* the factorial variable *tech_innovation* was obtained;
- From a CFA between *propensity* and *wtb,* the factorial variable *virtual_dealer* was obtained;The following factor variables were thus introduced:
- *auto_drive, connectivity, electric, smart, tech_innovation* and *sustainability* as independent variables;
- *virtual_dealer* as a dependent variable.

The main statistics of the restructured dataset, including the newly coined variables, is shown in the table below.

Variable	**Obs**	**Mean**	**Std. Dev.**	**Min**	**Max**	**Type**
auto_drive	98	-2.98E-09	0.7648835	-2.538429	1.037786	IV
connectivity	98	-6.84E-09	0.9232782	-3.782356	0.8313825	IV
electric	98	6.72E-09	0.8423773	-3.303657	1.057887	IV
smart	98	3.88E-09	0.8542758	-2.552628	0.9889396	IV
tech_innovation	98	-1.52E-09	0.7837973	-2.629139	1.074965	IV
sustainability	97	1.86E-09	0.5711567	-1.925867	1.545203	IV
virtual_dealer	98	9.39E-09	0.9454439	-2.167375	1.240752	DV

Table 3.3 - Source: Own elaboration

where:

- IV=Independent variable
- DV=Variable Dependent

3.4.4 Bivariate analysis between individual aggregate variables

Before applying multivariate analysis to the set of variables considered, we proceeded with an examination of the bivariate relationships between pairs of variables. Considering two variables, for simplicity called X and Y, the distributions of X and the distribution of Y, in addition to being considered individually using univariate methods (any property describing the behaviour of only *X* values ,or only Y_i values is called a marginal property), analyses can be conducted on bivariate data concerning X and Y simultaneously; these properties are called joint properties.

The most common method used to analyse these properties is the correlation coefficient, called *Pearson's correlation coefficient:*

$$r = \frac{\sum_i (X_i - \bar{X}) \cdot (Y_i - \bar{Y})/(n-1)}{\hat{\sigma}_X \cdot \hat{\sigma}_Y}$$

where the numerator is the covariance between X and Y and the denominator is the product of their standard deviations.

The correlation coefficient r (which is a function of the data and should therefore actually be called the sample correlation coefficient) estimates the population correlation coefficient ϱ: both the sample and the population correlation coefficients are always between -1 and 1.

- If r = 1, the pairs X_i *and* Y_i fall exactly on a line with a positive slope.
- If r = -1 then the pairs X_i *and* Y_i fall exactly on a line with a negative slope.
- If r is strictly between -1 and 1, then the points X_i *and* Y_i do not fall exactly on any line.

Considering the term in the correlation coefficient $(X_i - \bar{X}) \cdot (Y_i - \bar{Y})$:

- if X_i and Y both $_i$fall on the same side of their respective averages, this term is positive;
- if X_i *and* Y_i fall on opposite sides of the respective averages, then this term is negative.

So *r*> 0 if *Xand*$_i$ Y_i tend to fall on the same side of their means together. If they tend to fall on opposite sides of their means, then *r* is negative. The bivariate analyses performed here tested the connectedness between each pair of variables examined by calculating *Pearson's connectedness* index through the Chi-square index, which can also be interpreted as the sum of the relative quadratic contingencies.

Taking into account, however, the fact that the value of this index is influenced by the number of collectives and the number of modes of the two variables to be compared, it is therefore impossible to use this variable to compare in absolute terms two index values referring to pairs of different variables.

However, one aspect that makes it very interesting as an index is that it is associated with a significance test with calculation of the *Pvalue*: *Pvalue* values above 0.05 tell us, in fact, that the requiredlevel of significance has been reached and that the hypothesis of independence of the variables testedcannot be rejected.

In other words, the test reveals dependence only if the *Pvalue is* lower than the established significance level. A relative measure of association that, being variable between zero andone, allows, therefore, a comparison in absolute terms between different values obtained for the indicator itself, is given by *Cramer's V* index: it consists of a normalised version of the mean squaredcontingency index, which calculates the mean of the relative squared contingencies.

For the bivariate analysis using the STATA software, reference was mainly made to the dependent variable defined in the previous paragraphs, *WTB,* especially with regard to the independent variables. The results obtained from the above analysis are reported below, and starting with the dependent variable *WTB,* we obtain:

Variable #1	**Variable #2**	χ^2	**p-value**	**V of Cramer**	**Connection**
virtual_dealer	*auto_drive*	3 200	0.004	0.8570	Excellent

virtual_dealer	*connectivity*	2 100	0.000	0.9028	Excellent
virtual_dealer	*electric*	5 000	0.000	0.8722	Excellent
virtual_dealer	*smart*	5 100	0.000	0.8803	Excellent
virtual_dealer	*tech_innovation*	3400	0.004	0.8334	Excellent
virtual_dealer	*sustainability*	3 300	0.005	0.8251	-
virtual_dealer	*gender*	72.21	0.282	0.8643	Excellent
virtual_dealer	*age*	246.75	0.820	0.7934	Excellent
virtual_dealer	*wealth*	250.42	0.773	0.7993	Excellent
virtual_dealer	*education*	129.44	0.595	0.8126	Good
virtual_dealer	*web_addicted*	383.82	0.735	0.8079	Excellent
virtual_dealer	*public_transport*	605.57	0.463	0.8286	Excellent
virtual_dealer	*environment_care*	661.51	0.040	0.4553	Excellent

Table 3.4- Report of double-entry tables related to WTB, Source: Own elaboration

In the table we have provided some indications for the interpretation of the correlations between the calculated aleatory variables, reporting the Chi-square and the Cramer's Vs. (χ^2) and Cramer's V of all the variables analysed with the addition of a column in which the strongest correlations have been highlighted with respect to the weakest ones: it should be noted that the dependent variable analysed seems to be strongly correlated with all the independent variables, most of the control variables (practically all of them except gender) and all the mediator variables.

Another bivariate analysis that can be usefully done is the multivariate correlation analysis between dependent and independent variables, by means of the correlation matrix.

The correlation matrix, which in these pages is represented in the form of a table, groups the correlation coefficients between the different variables considered. It is crossed by a diagonal consisting of all ones, since on this diagonal fall the correlations between a variable and itself and, obviously, this corresponds to the perfect correlation, expressed by the unit coefficient.

Moreover, this matrix is symmetrical, since the correlation between A and B is identical to that between B and A; in particular, in the matrix shown in the table 3.5, under each coefficient the corresponding p-values are reported, which give an indication of the significance of the coefficient found. The table confirms 3.5 the correlation between *virtual_dealer* and all the independent variables, making it clearthat this is a positive correlation, but notes a lack of correlation with the information variable, as wellas with the control variable gender, and notes that the correlation with all the other control variablesis barely significant.

Table 3.5- Correlation Matrix, Source: Own elaboration

	virtual_dealer	auto_drive	connectivity	electric	smart	tech_innov.	sustainability	new_tecnologies	environment_care	public_transport	web_addicted	gender	age	wealth	occupation	education
virtual_dealer	1															
auto_drive	0.1573	1														
	0.1219															
connectivity	0.2106	0.4059	1													
	0.0374	*0*														
electric	0.1142	0.3378	0.0954	1												
	0.2628	*0.0007*	*0.3499*													
smart	0.2444	0.3262	0.1656	0.4446	1											
	0.0153	*0.001*	*0.1032*	*0*												
tech_innovation	0.4567	0.4253	0.4033	0.0947	0.167	1										
	0.0000	*0.0000*	*0.0000*	*0.3539*	*0.1002*											
sustainability	-0.2287	-0.2376	-0.224	-0.1333	-0.084	-0.1903	1									
	0.0243	*0.0191*	*0.0274*	*0.193*	*0.4133*	*0.0619*										
new_tecnologies	0.0534	0.2383	0.4589	-0.001	0.2488	0.1792	-0.3468	1								
	0.6017	*0.0181*	*0.0000*	*0.9924*	*0.0135*	*0.0775*	*0.0005*									
environment_care	0.0338	0.0382	0.0194	0.2351	0.0776	0.1193	-0.0974	0.1975	1							
	0.7414	*0.7090*	*0.8495*	*0.0198*	*0.4475*	*0.2420*	*0.3425*	*0.0512*								
public_transport	0.3240	0.1307	-0.0349	0.3051	0.3018	0.0195	-0.2388	0.0090	0.2783	1						
	0.0011	*0.1997*	*0.7329*	*0.0023*	*0.0025*	*0.8492*	*0.0185*	*0.9301*	*0.0055*							
web_addicted	-0.0428	-0.0699	-0.1442	0.0123	-0.0389	-0.2147	0.0515	0.0769	0.0703	0.0888	1					
	0.6757	*0.4943*	*0.1567*	*0.9046*	*0.7035*	*0.0338*	*0.6166*	*0.4518*	*0.4917*	*0.3845*						
gender	0.0324	0.1114	-0.1209	0.1908	0.0684	0.0726	-0.0745	-0.0204	0.1771	0.0771	0.0818	1				
	0.7512	*0.2749*	*0.2355*	*0.0598*	*0.5031*	*0.4775*	*0.4684*	*0.8417*	*0.0811*	*0.4507*	*0.4233*					
age	-0.0315	0.1896	0.1143	-0.0027	0.0171	0.1673	-0.1281	0.0118	0.0272	-0.1702	-0.4677	-0.1094	1			
	0.7585	*0.0615*	*0.2626*	*0.9788*	*0.8671*	*0.0996*	*0.2110*	*0.9084*	*0.7900*	*0.0939*	*0.0000*	*0.2834*				
wealth	0.0259	0.0292	0.1185	-0.1210	0.0223	0.1419	0.1120	0.0413	0.0733	-0.1829	-0.0933	-0.0780	0.0694	1		
	0.8000	*0.7754*	*0.2453*	*0.2353*	*0.8278*	*0.1635*	*0.2746*	*0.6863*	*0.4734*	*0.0715*	*0.3610*	*0.4450*	*0.4970*			
occupation	-0.0435	-0.2016	-0.3109	-0.0491	-0.1190	-0.1778	0.1292	-0.4093	-0.0104	0.0340	-0.1053	0.0426	-0.1447	-0.1337	1	
	0.6703	*0.0465*	*0.0018*	*0.6314*	*0.2430*	*0.0798*	*0.2072*	*0.0000*	*0.9189*	*0.7398*	*0.3020*	*0.6769*	*0.1552*	*0.1893*		
education	-0.0093	-0.1791	-0.0644	-0.0006	-0.0850	-0.1489	0.0122	0.0143	0.1437	0.1236	0.2820	-0.0458	-0.3851	0.0082	0.0034	1
	0.9278	*0.0777*	*0.5287*	*0.9956*	*0.4051*	*0.1434*	*0.9053*	*0.8890*	*0.1581*	*0.2252*	*0.0049*	*0.6540*	*0.0001*	*0.9358*	*0.9736*	

Starting from the indications provided by the correlation matrix, it is useful to examine graphically the scatterplots between *virtual_dealer* and the most interesting variables that are correlated with it.

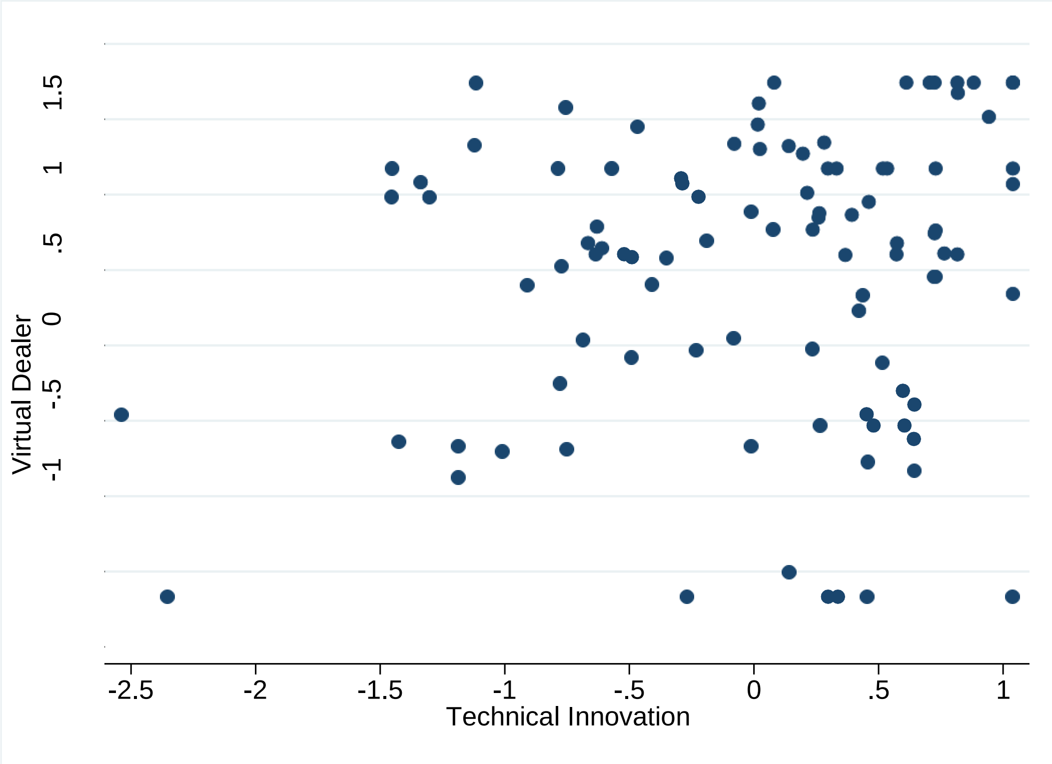


Fig 3.3 - ScatterPlot between virtual_dealer and technical_innovation

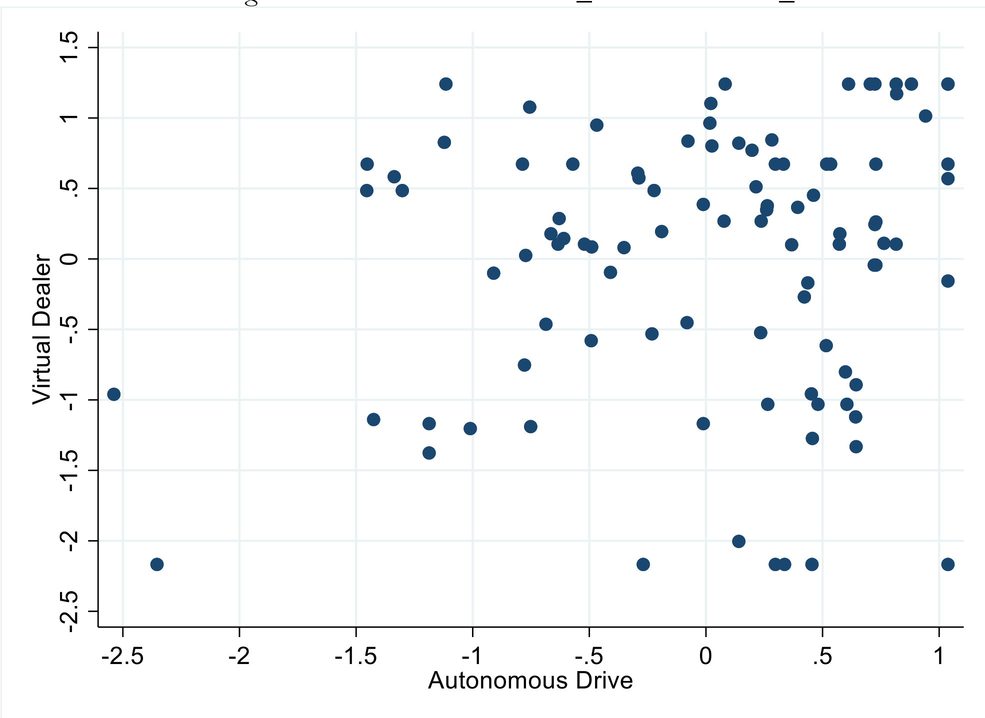


Fig 3.4 - ScatterPlot between virtual_dealer and auto-drive

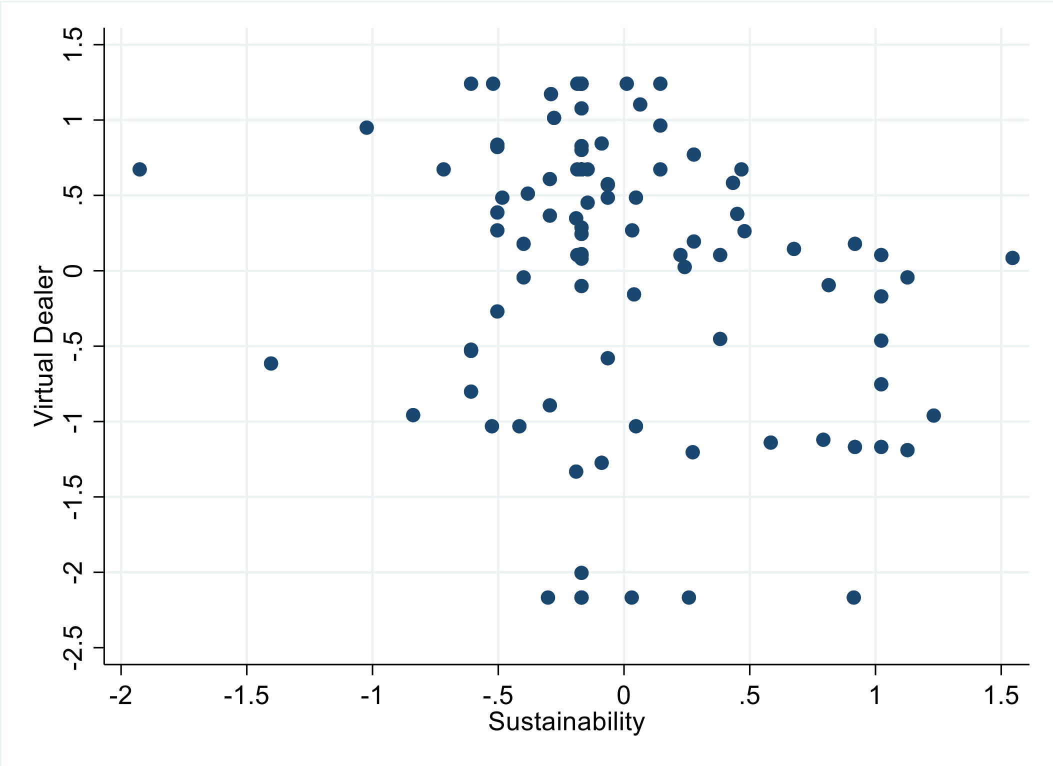


Fig 3.5 - ScatterPlot between virtual_dealer and sustainability

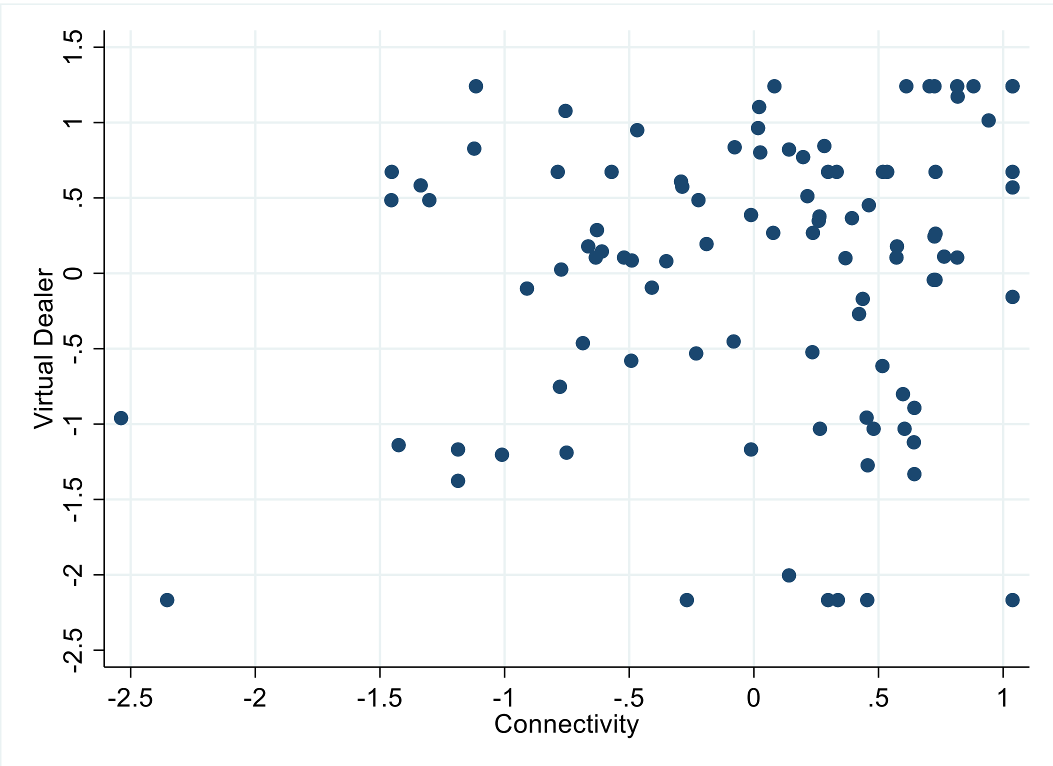


Fig 3.6 - ScatterPlot between virtual_dealer and connectivity

3.5 Structural equation modelling (SEM)

Structural equation modelling (SEM) encompasses a diverse set of mathematical models, computer algorithms and statistical methods that fit networks of constructs to data; they areoften used to evaluate unobservable 'latent' constructs using one or more observed variablesand a structural model that imputes relationships between the latent variables. The use of SEM is common in the social sciences because of its ability to impute relationships betweenunobserved constructs (latent variables) and observable variables. Structural Equation Modelling is an evolution of Sewall Wright's earlier methods of genetic path modelling; its modern structure arose with the development of computationally intensive computers in the 1960s and 1970s. The development of computing processors made it easy for beginners to apply structural equation methods in the analysis of large data sets in complex, unstructuredproblems. A simple example (taken from Westland, J. C.'s 2015 text "Structural Equation Modeling: From Paths to Networks"), of SEM modelling can be obtained by applying it to the concept of human intelligence: intelligence cannot be measured directly as one might measure height or weight, therefore, psychologists to measure it develop a hypothesis and devise an intelligence test consisting of questions to be used as tools to measure intelligenceaccording to their hypothesis. They then use SEMs to test their hypothesis by analysing datacollected from people who have taken the intelligence test; with SEMs, 'intelligence' would be the latent variable and the test items would be the observed variables.

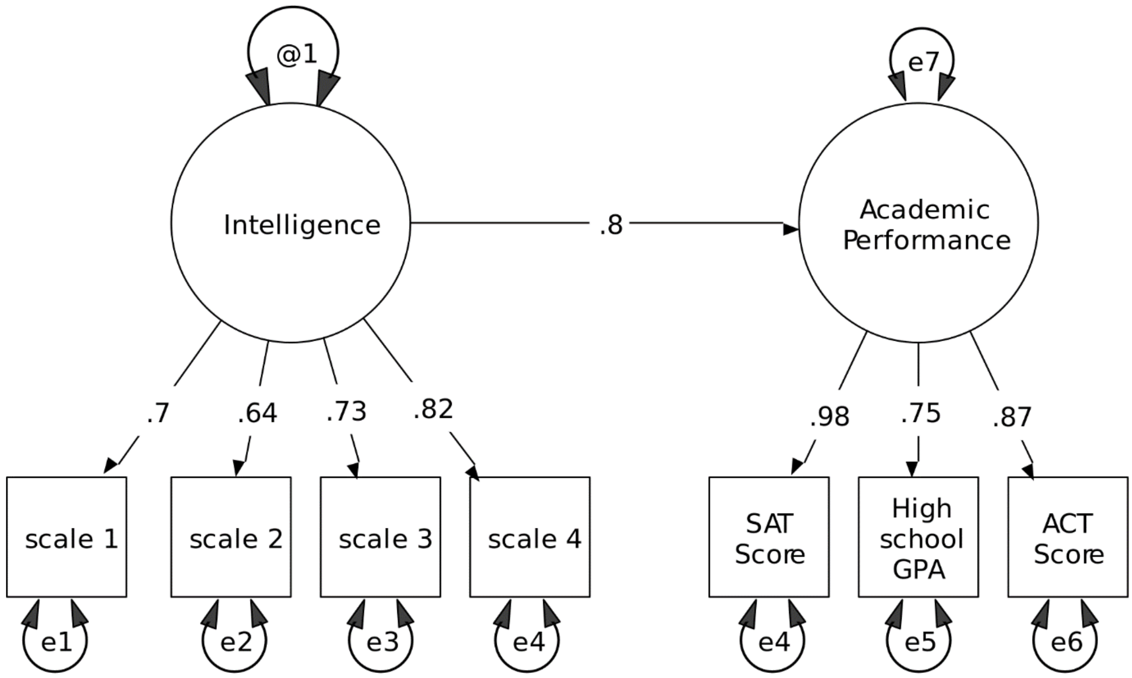


Figure3.7 - SEM for intelligence - Source: "Structural Equation Modeling: From Paths to Networks".

A simplified model is shown in the figure where latent variables are drawn as circles, manifestor measured variables are displayed as squares, and residuals and variances are drawn as double-headed arrows in an object.
The model suggests that intelligence is measured by four questions and can predict academic performance (as measured by high school SAT, ACT and GPA; latent variables are commonly shown as ovals and observed variables as rectangles. The diagram above shows how error (e) affects each intelligence question and the SAT, ACT and GPA scores, but doesnot affect the latent variables. The SEMs provide numerical estimates for each of the parameters (arrows) in the model to indicate the strength of the relationships. Therefore, inaddition to testing the general theory, the SEM allows the researcher to diagnose which observed variables are good predictors of the latent variables.
SEM path analysis methods are popular in the social sciences because of their accessibility; statistical software allows researchers to obtain results by interacting with simple and intuitiveinterfaces that automate calculation procedures, making them easier to manage.
Although each technique in the SEM family is different, some aspects are common to manyof them; commonly, two components can be distinguished in SEMs:

- the structural model showing potential causal dependencies between endogenous and exogenous variables;
- the measurement model showing the relationships between latent variables and their indicators.

When specifying paths in a model, the modeller can place two types of relationships:

1. free paths, in which the hypothesised (in fact counterfactual) causal relationships between variables are tested, and thus left 'free' to vary;
2. relationships between variables that already have an estimated relationship, usually based on previous studies, which are 'fixed' in the model.

Often a set of theoretically plausible models is defined in order to assess whether the proposed model is the best of the set of possible models. An identified model is one in whicha specific parameter value uniquely identifies the model (recursive definition) and noequivalent formulation can be given by a different parameter value. The parameter is the value of interest, which could be a regression coefficient between the exogenous and endogenous variable or the load factor (regression coefficient between an indicator and its factor).
Parameter estimation is performed by comparing the actual covariance matrices representingthe relationships between the variables and the estimated covariance matrices of the best- fitting model. This is achieved through numerical maximisation by expectation-maximisationof a fitting criterion provided by maximum likelihood estimation, near-maximum likelihoodestimation, weighted least squares or asymptotically distribution-free methods.
It is important to examine the "fit" of an estimated model to determine how well it models the data

to accept or reject models and, more often, to compare competing models with eachother. Formal statistical tests and indices of fit have been developed for this purpose. Someof the most commonly used measures of fit include:

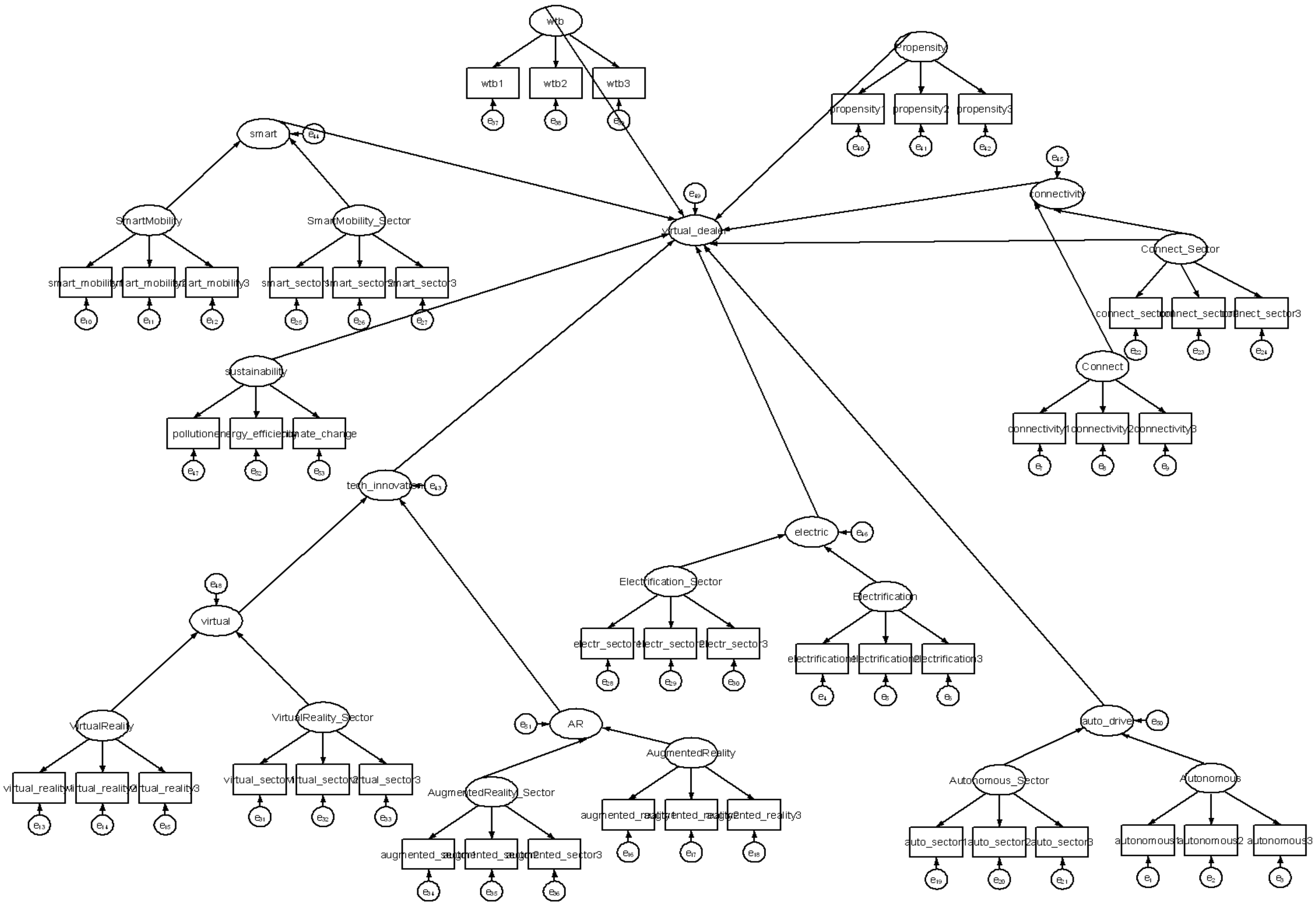
- *Chi square*: a fundamental measure of fit used in the calculation of many other measures of fit. Conceptually, it is a function of the sample size and the difference between the observed covariance matrix and the model covariance matrix.
- *Bayesian information criterion (BIC) and Akaike information criterion (AIC):* These statisticsare not used to judge the fit in absolute terms, but instead to compare the fit of different models. Smaller values indicate a better fit.
- *Root Mean Square Error of Approximation (RMSEA):* Index of fit where a value of zeroindicates best fit. Most researchers agree that an *RMSEA* of 0.1 or higher indicates poor fit.
- *Standardized root mean squared residual (SRMR):* SRMR is a popular indicator of absolutefit. Hu and Bentler (1999) suggested that values of 0.08 or lower indicate a good fit.Kline (2011) suggested 0.1 as a limit below which a good fit occurs.
- *Comparative fit index (CFI):* When examining basic comparisons, the CFI depends largely on the average size of the correlations in the data. If the average correlation between the variables is not high, the CFI will not be very high. A CFI value of 0.90or higher is desirable.
- *Non-standardised fit* index *(Tucker - Lewis index - TLI*): stands for an index whose valuewill not be very high if the average correlation between the variables is not high. A value of 0.90 or higher is also desirable for the TLI.

However, for each measure of fit, in order to decide whether a fit between the model and the data is good enough, certain contextual factors such as sample size, the ratio of indicatorsto factors and the overall complexity of the model must be taken into account. For example,very large samples make the chi-square test overly sensitive and more likely to indicate a lackof fit of the model data.

After assessing the sufficiency of the measurement model analysis using CFA, a structural model analysis was performed to evaluate the proposed assumptions, examining the overallfit of the model and significant effects between factors at a significance level of 0.05.

The following page shows the graphic scheme of the SEM applied to the case studied.

Figure3.8 - SEM Chart



Number of observation	=	97
F(8, 88)	=	5.02
Prob > F	=	0.0000
R-squared	=	0.2812
MSE Root	=	0.83386

virtual dealer	Coef.	Std. Err.	t	P>t	[95% Conf. Interval].	
tech_innovation	0.5792699	0.1348034	4.3	0.000	0.3113765	0.8471633
sustainability	0.31352	0.1519489	2.06	0.042	0.01155340	0.6154865
c.public_transport#c.smart	0.0110693	0.0145217	0.76	0.448	-0.0177894	0.0399281
c.environment_care#c.electric	0.0049042	0.015231	0.32	0.748	-0.0253641	0.0351726
c.web_addicted#c.connectivity	-0.000228	0.0152816	-0.01	0.988	-0.030597	0.0301409
c.new_technologies#c.auto_drive	0.0263175	0.0132722	1.98	0.050	0.0000583	0.0526933
education	-0.0798505	0.1561375	-0.51	0.610	-0.390141	0.23044
age	-0.1150438	0.1011967	-1.14	0.259	-0.3161509	0.0860633
_cons	0.7305878	0.7779248	0.94	0.350	-0.8153743	2.27655

Table 3.6- Correlation Matrix, Source: Own elaboration

The results in the Table specify3.6 that the chosen model is the *robust* model and that the model has been verified to be significant, as the F(8, 88) is equal to 5.02, which correspondsto a p-value of practically zero. We obtain an R^2 a 0.2812, which indicates an adequate fit; therefore, the hypothesised model can be considered a good and satisfactory fit.

Standardised beta coefficients from the structural model were used to report the strength ofthe effects between the exogenous and endogenous constructs. The Table 3.6 and Fig. 3.8 show that among the relationships tested, three paths were significant at the 0.05significance level. Firstly, the results of the standardised estimation indicate that the attractionto the technological innovation represented by virtual and augmented reality had a significantly positive impact on the propensity to use a virtual dealership by consumers (b_{1b}
=0.5792699 , $p < 0.05$). The same is true for the sustainability variable, being interested andinvolved in sustainability issues has a positive impact on the propensity to use a virtual dealerby potential customers (b_{1b} =0.31352 , $p < 0.05$). However, the attitude towards smart mobility was not shown to have a significant impact on the propensity to use virtual dealerships (b_{1a} = 0.0110693, $p > 0.05$).

The empirical results shown in the Table specify3.6 that the interest and attitude towards autonomous driving of vehicles also has a positive impact on the propensity to choose virtualdealers as an interface with a car manufacturer for the purchase of a car, even if moderated by the interest in new technologies (b_2=0.0263175 , $p < 0.05$).

All the other independent variables hypothesised by the empirical model do not appear to have any significant influence on the dependent variable: therefore the propensity towards virtual dealerships does not appear to be influenced either by the attitude towards electrification or by that towards vehicle connectivity, since for both variables the test-t provided p-values above the 0.05 value chosen as the level of significance.

The control variables tested were also non-significant, so that the propensity towards virtual dealerships was found to be dependent neither on the age nor the level of education of the respondents.

Taking into account what has emerged so far, the final empirical model can be written as:

$$virtual\_dealer = 0.5792699 \cdot technical\_innovation + 0.31352 \cdot sustainability + 0.0263175 \cdot new\_technologies\#auto\_drive$$

CONCLUSIONS

4. Discussion of results

Starting from the analysis reported in Chapter 3, some interesting considerations can be drawn. This analysis, starting from the data collected during a survey carried out at the beginning of the year 2022, produced a series of results relative to the empirical model that was to be tested. The above-mentioned tests were carried out through econometric analyses on the variables obtained from the answers using the scales reported in the paragraphs of the previous chapter.

In particular, after having carried out mono-variate and bivariate analyses on the data obtained, an analysis was carried out by means of the *Structural equation modelling (SEM)* methodology used because it is able to evaluate unobservable 'latent' constructs using one or more observed variables and a structural model that imputes relationships between the latent variables.

This methodology was used to obtain the latent variables relating to the model's covariates, represented by the four ACES factors with the addition of sustainability and technological innovations through the use of virtual and augmented reality.

The applied analytical methodology allowed to verify a dependence of the proxy variable of the users' propensity to turn to a virtual dealership for a car purchase or rental, on some of the above mentioned covariates: in particular, a significant influence of the factors related to the user's attitude towards autonomous driving, technological innovations and proximity to sustainability issues was verified.

The interest for the remaining ACES factors, i.e. the attitude towards those factors linked to the exaltation of the connectivity of the devices present on the vehicle and towards the intelligent mobility that foresees a sustainable sharing of the means of transport, did not result significant in terms of influence with respect to the propensity towards virtual dealers. The same thing occurred for the attitude towards the implementation of electrically powered propulsion: the attitude towards the electrification of automotive components was not influential and therefore cannot be considered a driver to increase the propensity of potential customers towards the use of virtual dealerships.

It is possible, therefore, to express final considerations regarding the hypotheses formulated from the research question and on the basis of which the empirical model on which the analysis was structured was formulated.

Based on the findings and comments, it can be argued that:

H1	*The intention to use a virtual dealership to buy or rent a car depends on theuser's attitude towards advanced automation technologies, including the development of a framework for autonomous car driving.*	***ACCEPTED***
H2	*The propensity to turn to a virtual dealership to buy or rent a car depends on the user's attitude to appreciate connectivity to different types of devices and the network during the driving experience.*	***NOT ACCEPTED***
H3	*The propensity to turn to a virtual dealership to buy or hire a car dependson the customer's preference for mobile cars in which electrification is not negligible, whether in total form as in electric cars, or in partial form as in hybrid cars.*	***NOT ACCEPTED***
H4	*The propensity to use a virtual dealership to buy or rent a car depends on the customer's attitude towards intelligent modes of transport, e.g. sharing, car pooling, leasing etc.*	***NOT ACCEPTED***
H5	*The propensity to use a virtual dealership to buy or hire a car depends onthe proximity of the user, potential customer, to sustainability issues in general, both from a social and environmental point of view.*	***ACCEPTED***

Table3.7 - Discussion of empirical hypotheses. Source: Own elaboration

4.1 Managerial implications

The aim of the study carried out in this thesis was to provide an overview of how business has evolved in the automotive sector over the last few years, following the COVID19 pandemic and the subsequent definitive establishment of the digitalisation process. Starting from an initial analysis, it was possible to grasp which are the innovative trends that characterise and will characterise the cars currently on the market and those that will be produced in the near future.

The first chapter of the study provides an overview of what we expect to be the trends that will characterise the automotive industry in the immediate future, namely those factors now universally grouped under the acronym ACES (Autonomous driving, Connectivity, Electrification, and Smart mobility), to which a large section is dedicated, detailing what has been achieved so far and what car manufacturers will be aiming for in the short term: very interesting topics such as autonomous driving, in which car manufacturers continue to invest, and on which research continues to make giant strides, thanks in part to the collaborations and partnerships that have sprung up over the last few years between the major car manufacturers and software houses specialising in the creation of automation systems, whose contribution has proved to be fundamental in quickly achieving the automated vehicle.

There was talk of connectivity: COVID19 has now made remote connection a habit that cannot be dispensed with, given the undoubted advantages it offers: considering the extent to which society is now solidly structured around the possibility of remote connection, it will be essential to equip vehicles with tools that enhance connectivity, even contextualising it in the driving experience. There is no doubt that the new products that will circulate on the roads will include systems capable of providing the driver with information, transforming the driving experience to which we are traditionally attached into something completely revolutionary that will increase comfort during transfers and safety on the roads.

Alongside technological innovation, the theme of sustainability was also explored, another major driver to be considered when strategically steering the evolution of the automotive sector, taking into account its compelling topicality and the importance it is increasingly assuming in the international debate. Sustainability at 360° was discussed, and the environmental impact was analysed, both in terms of CO_2 and PM10 particulate pollution, as well as alternatives to traditional internal combustion, electrification and saving natural resources.

But there was also talk of circularity, sharing, flexibility and a sustainable approach to mobility, especially in large cities.

Naturally, the management of companies involved in the automotive sector will have to take into account everything that has been said so far. The research carried out in the first chapter has shown the dedication of car manufacturers to the development and reading of big data, which represents a major challenge for the future and for the connection of all vehicles, which will be able to receive and send information in real time.

Naturally, this process of renewal and digitalisation is bringing with it a change of strategy on the part of car manufacturers, who are increasingly investing their efforts in trying to understand what the new needs of the consumer are, by means of reports carried out by consultancy firms, reports that assess how the customer's eye is changing.

The most current theme, pioneering the digitisation of supply, has been online sales, which, given the emergency that has affected the whole world, has allowed e-commerce to take hold within the modern economy in countless business sectors.

The strengths have been time and geographical advantages, which certainly explain the success of e-commerce and make it possible to understand why it is increasingly used by those interested in buying a new, and even used, vehicle.

There are various scenarios that could arise in the future regarding the recovery of the market and the possible configurations that sales channels could assume; what represents the greatest unknown in this respect is the possibility that the capillarity of dealerships present throughout the country could be considerably reduced to be replaced by so-called virtual dealerships.

The importance that application systems are assuming in their realities emerges since, depending on the activities to be carried out, they allow work plans to be managed and organised in an orderly manner and allow collaboration between departments via cloud systems.

Countless names of applications have been mentioned that are associated with the different car brands, for which the manufacturers themselves take care to organise training courses for correct use.

Application systems are changing and are directing the relationship with the customer, and sales methods, towards new horizons never experienced before: increasing the presence on digital social platforms and attracting new customers with innovative product knowledge devices, such as the virtual test drive and the online configurator.

Car manufacturers are dedicating themselves to their customers, pampering them with content that presents the product in a transparent way, driving the customer to convenient and safe information.

In conclusion, automotive is therefore a sector that is constantly changing and growing at a dizzying pace: products have a short life cycle and technology is impacting and changing the patterns and strengths of car manufacturers.

In the past, manufacturers focused on engines, now the trends are totally different, and often not even developed by the parent company, as is the offer.

And it is precisely on this issue that the investigation carried out in the empirical analysis section of this work has focused.

The analysis carried out allowed to outline the elements that should be strategically taken into account as drivers to promote the use of virtual dealers.

From the results it is clear that the most important drivers are those of a purely technological nature, since the propensity of users towards this innovative type of dealership depends significantly on the attitude towards innovative technologies represented by virtual and augmented reality, and the attitude towards devices aimed at automating car driving.

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The focus was on the study of the possible dependency relationships between the various variables extrapolated from the answers to the questionnaire, with particular attention to those directly related to the independent variables whose impact on the outcome variable, i.e. the propensity towards virtual retailers, was to be studied.

From the results it is clear that the most important drivers are those of a purely technological nature, since the propensity of users towards this innovative type of dealership depends significantly on the attitude towards innovative technologies represented by virtual and augmented reality, and the attitude towards devices aimed at automating car driving.

The results are confirmed not only by the SEM analysis that studies latent variables not directly expressed by users, but also by a direct survey of users in which they were expressly asked to give an assessment of which factors they considered to be most important in encouraging them to use a virtual dealership.

From what reported in paragraph 3.4, the aspect that according to users most characterises a virtual dealership is augmented reality, which takes on average the highest preference and is the only alternative proposed to exceed the average of 4. Its detachment from even close alternatives such as Virtual Reality is appreciable; from this consideration it emerges that the expectations customers have regarding the prerogatives they believe a virtual retailer should possess are focused on technological factors, and in particular on factors related to augmented reality.

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Summary

The automotive sector is one of the most important trade sectors in the world and has been an important economic resource in Italy since the appearance of the first cars.
Due to the high costs of production and sales, the number of passenger car models was initially very limited, both in terms of the type of models and the quantity in circulation; on the contrary, nowadays they have become countless and capable of meeting the different needs of the consumer.
The wide range available has not only benefited from their size and technical characteristics, but also from the important technological equipment that supports them, which has quickly gone from being absolute novelties, introduced inside the machines themselves, to being accessories that are taken for granted.
The frenetic succession of innovations that has accompanied the automotive world in its development for over a century has contributed to creating a business that mobilises billions of Euros, transforming cars into a fundamental and indispensable tool for human life, a tool that most people consider beyond its function purely as a means of transport, equating it to a status symbol and giving it such importance as to make it an object of social identification, an object of desire, one of the first objectives of purchase in adulthood, second only to housing.
The scope of the study conducted in this thesis was to provide an overview of how business has evolved in the automotive sector in recent years, following the COVID19 pandemic and the subsequent definitive establishment of the digitisation process.
Starting from an initial analysis, it was possible to grasp which innovative trends characterise and will characterise the cars currently on the market and those to be produced in the near future.
Since the beginning of the 20th century, every evolution and transformation of society has been reflected in a change and a metamorphosis of the automotive sector; in the past, the automotive has been the instrument and means through which society has expressed itself, and even today society tells, describes and depicts itself through it.
The car is the emblem of speed, of power, and it is not surprising that both dictators saw in the car a means by which the nation could symbolically acquire awareness of its own power, was considered to be the very symbol of extreme right-wing ideology and that, as a result, it was excluded from all infrastructure investment plans for years, years in which no roads were improved, no car parks were built and no modernisation or upgrading was carried out. It took years for life to return to normal and for the car to be freed from this negative image.
In Europe, however, this conflictual relationship with the car continued to remain dormant, only to explode again around the mid-1960s. And so, while at that time in America the car became an

increasingly popular cult object as it had come to embody the ideal of freedom, the dream of independence, in Europe the image of the car was associated with the symbol of the struggle to be faced in social conflicts: hence the obvious parallelism between the images of the Florence flood of '66, with cars rolling in the mud, and those set on fire during the French May '68 in Paris.
These always very 'hard' associations and this conflictual relationship have aroused the interest of many researchers who have concentrated on investigating the reason for this relationship.
Some scholars, such as Tuminelli (2018), argue that it all stems from the fact that the car, understood as a private, personal means of transport, embodies the concept of consumerism and that the price we pay for the abundance of consumption is guilt: he argues that now the verb has become sharing, but that the scenario that politicians such as Merkel hope for, where autonomous vehicles will only be allowed with special permission, is unlikely to be realised.
In his opinion, man is not ready to accept this, as self-determination has been the main driving force behind his evolution up to now, and property has come as a reward for this. Changing the rules of mobility would mean completely changing a system in which man has lived for 4500 years in a society based on movement, and it is difficult to imagine this system being wiped out in a single generation.
The interpretation of some scholars such as Tuminelli would also seem to explain the fact that the automotive sector is always on the lookout for something better to add to its models so that they not only remain in step with the evolution of time and the technologies that accompany them, but also manage to precede them, if not actually lead them.
It is not for nothing that the entrepreneur Enzo Ferrari described the world of the automobile and everything else with his timeless verve in these words:
"The best car is the one that has yet to be built".
The aim of this thesis work is therefore to investigate the automotive sector in depth, starting with the elements that distinguish it and have characterised it since its origins, in order to try and analyse which of these can constitute a strategic element that the entire sector can use to meet the changes and challenges that will involve society and, more specifically, the sector itself over the next decade, together with the recent crisis brought about by the COVID-19 pandemic.
The first chapter of the study provides an overview of what we expect to be the trends that will characterise the automotive industry in the immediate future, namely those factors now universally grouped under the term *ACES*.
The acronym ACES derives from the words that make up the four most important *trends* of the moment: *"Autonomous driving, connectivity, electrification, and smart mobility"*, and which represent the features that will characterize the automotiveworld in the coming years. In the shared opinion of the major research institutes, these are the majortrends that concern the future of the car, and to these could be added themes such as the use of hydrogen as an energy vector, which have not yet had an affirmation on a par with the others but could have one in the near future.

The problem is that if these are the trends the car is moving towards, the road to reach them is anything but obvious. And this is where the real game of our future lies.
As ACES trends are emerging simultaneously, it is crucial to include all four areas in one development, as they need to be developed and find their place in the market at the same time.
This interconnected perspective can help car manufacturers, suppliers and new entrants in the mobility market to create offers in line with customer needs.
Traditionally, vehicle technology trends have been renewing very slowly, success in this environment usually relies on a variety of seemingly unrelated *inputs* that are difficult to determine in advance: looking forward, it is necessary to understand how the industry will link connected, automated and electric vehicle technologies to drive the new vehicle paradigm.
In the first chapter, these technological trends are analyzed one by one in order to highlight their characteristics and peculiarities, as well as to analyze their links and possible correlations.
In this chapter a large section is dedicated, detailing what has been achieved so far and what car manufacturers will be aiming at in the short term: very interesting topics such as autonomous driving, in which car manufacturers continue to invest and on which research continues to make giant strides, thanks in part to the collaborations and partnerships formed in recent years between the major car manufacturers and software houses specialising in the creation of automation systems, whose contribution has proved fundamental to the rapid realisation of the automated vehicle.
Connectivity was mentioned: COVID19 has now made remote connection a habit that cannot be done without, given the undoubted advantages it offers: considering how solidly structured society is now around the possibility of remote connection, it will be essential to equip vehicles with tools that enhance connectivity, even contextualising it in the driving experience. There is no doubt that the new products that will hit the roads will include systems that provide information to the driver, transforming the driving experience that we are traditionally attached to into something completely revolutionary that will increase transfer comfort and safety on the roads.
Alongside technological innovation, the theme of sustainability was also explored, another important driver to be considered in strategically guiding the evolution of the automotive sector, taking into account its pressing topicality and the importance it is increasingly assuming in the international debate. We talked about sustainability and international initiatives such as the 2030 Agenda, created with the aim of disseminating this concept in all its social, economic and environmental aspects. And indeed, the environmental impact was analysed, both in terms of $CO2$ and PM10 pollution, and of alternatives to traditional internal combustion, electrification and saving natural resources.
But there was also talk of circularity, sharing, flexibility and a sustainable approach to mobility, especially in large cities. The presence of long and short-term rental companies would seem to have rewritten the rules of making competition even tighter: the sharing economy, car sharing, thanks to their high mobility and the economic advantage they offer, are really able to take over market shares

that until a few years ago were a monopoly of dealers.
The central topic therefore revolves around the evolution of cars and the supply chain that surrounds them, with the ultimate aim of investigating what improvements dealers and sales networks can make in order to achieve commercial objectives and increase company turnover.
The second chapter focuses on the figure of the dealer and on what the future holds for the activities of dealers who, at the moment, are in a phase of transition and transition from the business concept linked to the role of the classic dealer to one based on e-commerce, virtualised and dematerialised business.
Having metrics is crucial, in virtually every business, whether you teach high school maths or work as a digital marketer, metrics are how everyone monitors performance and based on which decisions are made. This is all the more so in e-commerce, which, compared to other marketing efforts, offers much more visibility into behaviours and actions: after all, you can't count how many people see a billboard on the street, but you can see how many people access a website, just as you can't tell how many people went to a restaurant after seeing an ad for it in the community newspaper, but you can measure how many people arrived at a site by clicking on a banner ad.
But before we get to the metrics that can improve the performance of e-commerce activities, the question arises as to what metrics are of value and how they relate to performance measurements such as KPIs.
KPI stands for 'Key Performance Indicator', i.e. measurable data that monitors the progress of an activity to see if it is achieving its goals. As a first step, it is important to understand just that: what is the main objective behind your strategy, to have a clear and, above all, measurable purpose and to be clear about what information is really relevant. In this context, attention has been focused on all the "core" issues of digital transition, Big Data, network and connectivity, especially following the effects of Covid-19.
Often, when doing e-commerce, especially for large companies, the amount of data to be processed becomes huge: we then talk about "big data". In the field of statistics and computer science, big data is generically defined as "a collection of information data that is so extensive in terms of volume, velocity, and variety as to require specific technologies and analytical methods for value or knowledge extraction" (Bellini, 2019).
Generally speaking, we talk about Big Data when the set of data is so large and complex that it requires the definition of new tools and methodologies to extract, manage and process information within a reasonable timeframe.
Described in less complex words, Big Data represents data that is defined as unstructured, i.e. not having a well-defined structure and organisation, which results in irregularities and ambiguities that make it difficult to understand them and prevent traditional programs from deciphering them.
According to the trend that has been emerging and establishing itself lately, the way forward would

be that of independence: to evolve from simple resellers linked with the parent company by a franchising relationship, to independent activities, with their own image and brand, developing their own marketing and personal relationship with the customer.

In this contest two concepts were introduced that are perhaps the most emblematic expression of the technological innovation that virtual dealers should be able to offer their customers: virtual reality and augmented reality.

Virtual reality allows the user of the experience to be totally immersed in a different environment, from a sensory (visual and auditory) point of view. With it is possible to create true immersive experiences where customers have the freedom to move around in space: this could be a flat that is still under construction, or the inside of a car, or even the square of a city in Roman times, for example.

Augmented reality, on the other hand, leads to the vision of one's own environment enriched with virtual elements, which always recall the real world; it enriches human sensory perception through information, manipulated and conveyed electronically, which cannot be grasped through the five senses.

This chapter tries to understand which changes will have to be used within the dealer business model and which are the necessary changes that dealers should promote in order to adapt to new market trends, to survive and to succeed.

The new needs linked to connected mobility, to the customer's need to find a variety of information through an online channel and to the new opportunities for purchasing through e-commerce are analysed, with a focus on the importance that these new remote purchasing formulas are acquiring.

Taking into account what has been said above about e-commerce already accounting for a significant proportion of total purchases in Italy, fashion continues to be the sector that registers the most activity and accounts for 48% of online purchases made.

The overwhelming majority of purchases fall to millennials, with more than 57% admitting to making such purchases via the Internet.

The following sales rankings are occupied by the beauty and technology sectors with 38% and 36% of total online purchases in Italy respectively. The report highlights the emergence of online purchasing of fresh food and beverages in the top 10, accounting for 18% of total national sales; in addition, 14% of Italians who buy online acknowledge that they buy food online at least once a month.

Knowing the opinion of online shoppers is a key factor for success if you want to get into e-commerce: a simple and secure purchase will have a positive impact on the consolidation of more business conducted on the Internet as the satisfied customer will repeat the experience and recommend it to their friends and family. This is demonstrated by the same study, which shows that 85% of shoppers felt that their online purchase was easy and 75% were very satisfied with the experience.

In this respect, the effects of the COVID-19 epidemic on the automotive sector in all its spheres have undoubtedly been important: the shock caused by the lockdown in which the whole world has locked itself can be seen not only in the contingent fall in supply and demand but also in the consequences that have permanently changed the automotive business and made its impact similar to that of a prolonged recession.

It is not only a new phase of economic crisis that has opened up, but also consumer behaviour in the medium to long term, which does not appear to have been immune to the events that are still unfolding, thus changing everything that until before the pandemic had characterised the habits of the average customer: New challenges are now opening up to respond to the sudden change in needs dictated by a new context in which dematerialisation and remote connection are seen as a necessity for providing advice, assistance, information and support to people who prefer this type of iteration to going to the dealership for fear of contagion.

The priority seems to have shifted from the study of market techniques in general to the analysis of a modus operandi that allows the capture and retention of customers, perhaps through commercial policies or product innovations, bearing in mind what are now the new fears, such as that of contagion, of those who must try a car of unknown origin.

Digital transformation is a great support in this period in which the future seems to be tending almost exclusively towards digital platforms, which allow the customer not only to book the company's range of cars, but also to receive concrete answers also in the field of financing.

In the third chapter, starting from research questions, hypotheses were elaborated on the basis of which an Empirical Model was proposed, which in turn formed the basis for an empirical investigation on the topic.

Starting from the first Research Question, the first research hypothesis is as follows:

- H1: The intention to use a virtual dealership to buy or rent a car depends on the user's attitude towards advanced automation technologies, including the development of a framework for autonomous car driving.

In this hypothesis the concept of attitude towards an advanced level of technology recurs with explicit reference to those who feel involved and interested in technological innovations related to autonomous driving. From a statistical point of view, this condition can be obtained by asking a specific question on the subject, taking into account the level of attitude towards products with a high degree of technological innovation declared by the user. If this hypothesis is confirmed, the predictive power of the attitude towards autonomous driving could be used to identify levers to increase the propensity of users to turn to a virtual dealership, for example.

The second research question gives rise to the second research hypothesis, which can be expressed as follows:

- H2: The propensity to turn to a virtual dealership to buy or rent a car depends on the user's attitude to appreciate connectivity to different types of devices and the network during the driving experience.

In this case, it refers to the ability of the potential customer to appreciate the presence in the car of devices and functionalities that allow him to stay connected to the network, social networks, smartphones, and other tools that he uses for both work and personal activities. If the results of this RQ confirm the importance of connectivity, it could provide useful indications for managers of car manufacturers to understand how to act on these levers to encourage potential customers to use the online dealership for a service related to the purchase or rental of a car.

Starting from the same premises formulated in Chapter 1, the third research question also arises: in fact, it has been pointed out that the drive towards electrification, both total and supplementary in hybrid cars, could, in particular, be an additional motivation for potential customers to opt for dematerialised dealerships.

This leads to the formulation of the third Research Question as follows.

- H3: The propensity to turn to a virtual dealership to buy or rent a car depends on the customer's attitude to prefer mobile cars in which electrification as power supply is not negligible, either in total form as in electric cars, or in partial form as in hybrid cars.

The fourth ACES factor, Smart-Mobility, on the other hand, is the protagonist of the fourth hypothesis, so it arises from the fourth research question and can be posed in the following terms:

- H4: The propensity to use a virtual dealership to buy or rent a car depends on the customer's attitude towards intelligent modes of transport, e.g. sharing, car pooling, leasing etc.

Such a hypothesis, if tested, would allow a better interpretation of the tastes and inclinations of potential future users of virtual dealerships.

The last hypothesis to be tested, on the other hand, departs from the ACES model and relates more generally to the approach to sustainability and circularity issues that dealership users may have.

Considering this, the fifth hypothesis is as follows.

- H5: The propensity to use a virtual dealership to buy or rent a car depends on the proximity of the user, potential customer, to sustainability issues in general, both from a social and environmental point of view.

The Conceptual Model presented in fig. 1 is formulated on the basis of what emerges from the literature review that has been made concerning the actual perception of citizens to the topic of the thesis reported in the previous chapters; on this Conceptual Model the empirical analysis that is reported in Chapter 3 was conducted.

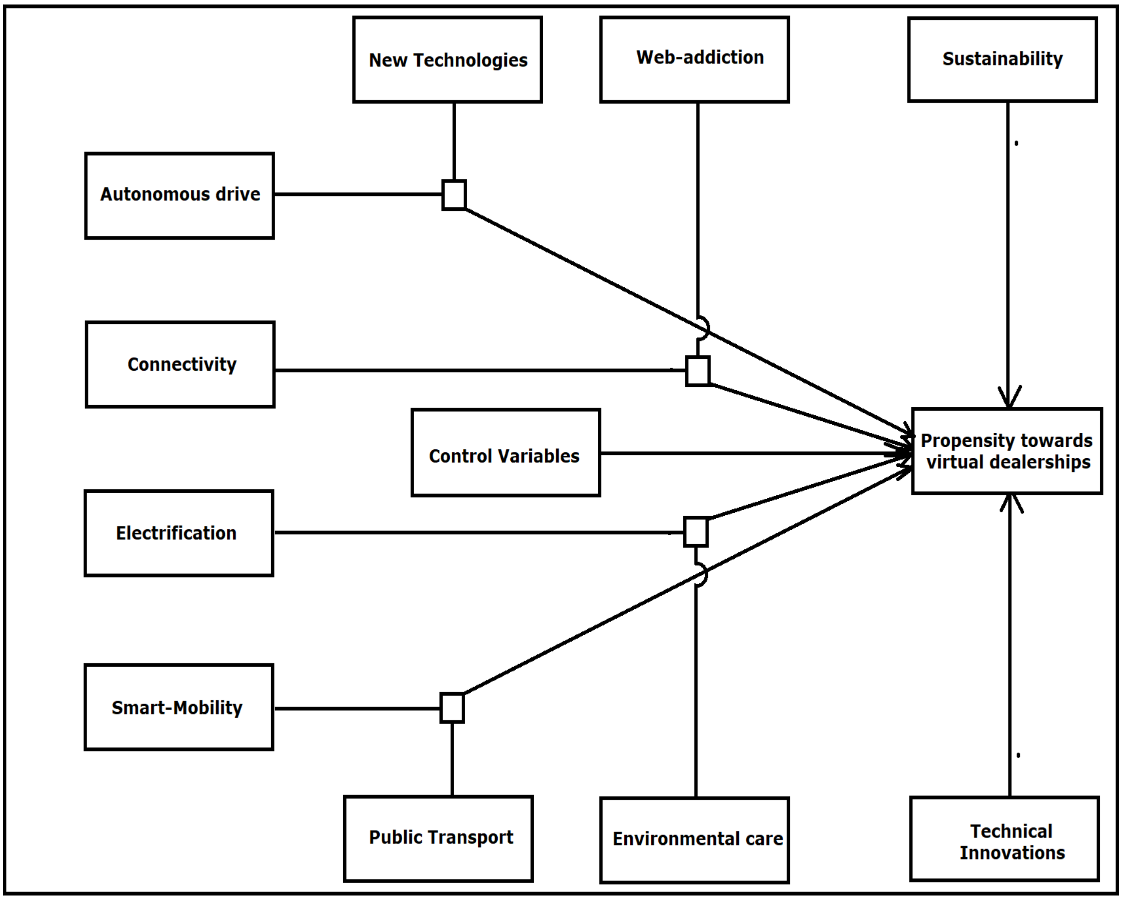

Figure 1 - Empirical Model

The survey focused on analysing the answers to a specially designed questionnaire that was submitted to consultants and industry experts in order to understand what customers' needs and priorities are and what expectations they have of retailers.

The survey focused mainly on virtual dealers, in terms of how they intend to present themselves to users in a way that meets their needs and expectations, implementing technological innovation tools such as augmented reality and virtual reality, so as to recreate, if not improve, the experience that customers have when they come into contact with the physical dealer in person.

The study was structured in several phases as listed below:

- Univariate analysis of the identified random variables;
- Reliability analysis of the questionnaire using Cronebach's Alpha
- Principal Component Analysis (FCA);
- Bivariate analysis of the relationships between the individual variables;
- SEM analysis
- Verification of the Empirical Model;

For the statistical analysis the dataset was extracted from the report of the survey results.

Based on the findings and comments, it can be argued that:

H1	*The intention to use a virtual dealership to buy or rent a car depends on the user's attitude towards advanced automation technologies, including the development of a framework for autonomous car driving.*	***ACCEPTED***
H2	*The propensity to turn to a virtual dealership to buy or rent a car depends on the user's attitude to appreciate connectivity to different types of devices and the network during the driving experience.*	***NOT ACCEPTED***
H3	*The propensity to turn to a virtual dealership to buy or hire a car dependson the customer's preference for mobile cars in which electrification is not negligible, whether in total form as in electric cars, or in partial form as in hybrid cars.*	***NOT ACCEPTED***
H4	*The propensity to use a virtual dealership to buy or rent a car depends on the customer's attitude towards intelligent modes of transport, e.g. sharing, car pooling, leasing etc.*	***NOT ACCEPTED***
H5	*The propensity to use a virtual dealership to buy or hire a car depends onthe proximity of the user, potential customer, to sustainability issues in general, both from a social and environmental point of view.*	***ACCEPTED***

Table 1- Discussion of empirical hypotheses. Source: Own elaboration

The analysis carried out allowed to outline the elements that should be strategically taken into account as drivers to promote the use of virtual dealers.

From the results it is clear that the most important drivers are those of a purely technological nature, since the propensity of users towards this innovative type of dealership depends significantly on the attitude towards innovative technologies represented by virtual and augmented reality, and the attitude towards devices aimed at automating car driving.

The results are confirmed not only by the SEM analysis that studies latent variables not directly expressed by users, but also by a direct survey of users in which they were expressly asked to give an assessment of which factors they considered to be most important in encouraging them to use a virtual dealership.

From the answers to these questions, the aspect that according to users most characterises a virtual dealership is augmented reality, which takes on average the highest preference and is the only alternative proposed to exceed the average of 4. Its detachment from even close alternatives such as Virtual Reality is appreciable; from this consideration it emerges that the expectations customers have regarding the prerogatives they believe a virtual retailer should possess are focused on technological factors, and in particular on factors related to augmented reality.