Alma Mater Studiorum · Università di Bologna

SCUOLA DI SCIENZE

Corso di Laurea in Informatica

ANALISI DEI DATI PRODOTTI DALLE AUTO DI LUSSO: UNO STUDIO PRELIMINARE

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Sessione I

Anno Accademico 2022/2023

Sommario

Questa tesi pone particolare attenzione ai dati prodotti dalle auto connesse, cioè quei veicoli che, facendo uso di sensori, producono un'imponente quantità di informazioni ogni giorno. Principalmente, viene affrontato il tema della monetizzazione dei dati prodotti dalle auto, riportando sia strategie relative al settore automobilistico sia modelli di business appartenenti ad altri ambiti economici. Essendo il mondo dei veicoli connessi ancora ad uno stadio iniziale, non è facile trovare pattern di modelli di business da poter implementare nell'immediato, per cui viene anche riportata una tassonomia per la definizione di modelli basati sui dati. Come il titolo suggerisce, è stata effettuata una ricerca specifica sui servizi presenti nelle auto di lusso, con l'obiettivo di comprendere la disponibilità dei sensori e dei dati in questo segmento di mercato. Una volta chiarito ciò, sono stato in grado di ideare alcuni servizi connessi innovativi, che sono elencati nel capitolo 7. I capitoli 4 e 5 trattano rispettivamente: il ruolo del lusso come modello di business e l'importanza della connessione emotiva tra il cliente e il marchio. Entrambi i capitoli hanno lo scopo di supportare la ricerca di idee per lo sviluppo e l'implementazione di servizi per auto connesse, ma anche di evidenziare altre opportunità di monetizzazione dei dati. In particolare, nel capitolo 5 è presente una lista di servizi pensati per coinvolgere l'automobilista da un punto di vista emotivo e creare , così, un legame che tenga alta la considerazione che lui ha per il brand. Il capitolo 6 fornisce una panoramica dei sensori ad oggi disponibili , insieme ad un elenco di servizi implementabili a partire dai dati prodotti da tali sensori. Infine, nel capitolo 8 viene proposto un modello di dash-

board che consentirebbe alle case automobilistiche di lusso di analizzare: i comportamenti delle auto, l'uso del veicolo da parte dell'utente finale, le differenze tra i vari modelli, e le preferenze di guida.

Introduction

Connectivity is a major trend in the global automotive industry, transforming modern vehicles into highly intelligent computers on wheels. Privately owned vehicles are becoming increasingly connected and the number of sensors they possess is increasing accordingly, generating a massive amount of data. Overall, the monetization of this data has become one of the most promising profit pools across industries. Today, companies increasingly rely on leveraging this data for financial gain, personalize services and reduce costs. In this thesis there is a complete description about the state of the art of data monetization strategies and data-driven business models, that companies can implement in order to monetize data. In this first part we will not talk about the sale of data, in fact the major successful companies have based their business on the exploitation, thus avoiding giving great opportunities to generate value to other players in the sector. Furthermore, the importance of the luxury as a business model and the customers' emotional connection as a parameter influencing the company's profitability are discussed. Finally, an analysis of the car sensors and the data produced by them is made. In particular, the focus is on luxury cars because the aim is to propose ideas for high-end connected services and implement a dashboard that allows luxury car brands to obtain information over car usage.
Overall this thesis performs a literature review on car data monetization and exploitation opportunities. To this is added the research of factors that could influence this sector, with the aim of understanding how they can be exploited in offering services and products. Results that the op-

portunities are multiple because the world of connected vehicles is still in its infancy and there is still a long way to go before unlocking the true potential of this sector.

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Chapter 1

Data Monetization Strategies: State-of-the-art

1.1 Literature Review

An analysis by Milton Bark and Rami Sheik shows that "the academic literature about data monetization diverges in several aspects" [9]. Many authors agree that data should be exploit to generate value. However, many authors disagree on how to use the data. For instance, Alfaro et al. (2019), Gartner (2019), Liu and Chen (2015), Najjar and Kettinger (2013) and Prakash (2014) all say that data should be effectively used and managed, give less importance to how they are used [9]. Prakash (2014) is more specific in how to use data. He says that " data should be processed into usable observations and insights", giving an intangible view of the data [9]. On the other side, Woerner and Wixom (2015) they see monetization from a more concrete point of view, highlighting that data should be used to implement services and provide product based on data. Many authors argue that data generates economic value, and that the opportunities they offer go far beyond the simple sale to third parties [9]. Between the authors, Walker (2015) propose a framework for data monetization. He suggest to the OEMs to keep the control over data and

eventually share them with other companies in exchange for partnership [9]. Furthermore, making data visible and available to customers can be a successful data monetization strategy. Several studies by authors such as Opher et al. (2016) and Seiberth and Gründinger (2018) underline that having control over data generation is becoming increasingly important to have the full control over the data monetization process. Opher et al. (2016) state that OEMs should focus on developing platforms where they can collect additional information from customers [9]. However, could be some problems in using consumer data. That because using personal information, the concepts of privacy and security come into play. Furthermore, there are data protection laws in place, such as GDPR, PMADS and CCPA. Therefore, it is fundamental to understand which data can be process and how.

1.2 Main ways to monetize data

Companies can generate value from data in many ways,but in general revenues can be either direct or indirect. The opportunities are: trading data with other actors in the industry and creating products or services based on data [1]. Bartering is a form of data monetization in which two parts exchange something, mainly data and information. An example of this practice are Big Tech companies where ,in exchange of free services, the user must share some of his personal information. We know that these organizations earn money through selling advertising spaces to third-party companies, and most of all them also sell user profiles which has been individuated through activity on the social medias, such as likes, comments, contents posted [1]. In the end, data bartering enables collaboration between firms for value co-creation. Another method used to monetize from data is through wrapping, "this method leverages data and "wrap" them around traditional products to improve their usability, processes, and to accelerate service" [1]. Data wrapping is used to differentiate products, making them more attractive in the eyes of the customer. This strat-

egy allows to generate indirect revenues and is made for personalization, so must be well designed accordingly with the customer preferences and needs. Since this strategy is made for personalization, analytical techniques could be used to study the market and understand future customer preferences [1]. Advantages on using a predictive method are: preventing errors, lowering churn rate, triggering behaviours that are beneficial to the customer [1].

1.3 Other business strategies

In this section other generic strategies for monetizing data are described and they are based on an analysis of some real-world cases from diverse industries, made by Julius Baecker, Martin Engert, Matthias Pfaff, adn Helmut Kremar [2].

1.3.1 Contextualization

Data contextualization refers to the process of understanding and interpreting data within its specific context or setting. It involves examining data in relation to its surrounding circumstances, including the environment, conditions, and other relevant factors that may impact its meaning or significance. By considering the context, data analysts and researchers can gain a deeper understanding of the insights provided by the data and make more informed decisions.

1.3.2 Individualization

Data individualization refers to the process of tailoring or personalizing data analysis and insights to specific individuals or entities. It involves moving beyond generalized analysis and understanding data at a granular

level to provide more targeted and customized information. Data individualization recognizes that different individuals or entities have unique characteristics, preferences, and needs, and aims to deliver insights that are highly relevant and valuable to each individual.

1.3.3 Build and Strengthen Customer Relationship

Building and strengthening customer relationships with data involves leveraging customer data to gain insights, enhance customer experiences, and foster long-term loyalty. If products or services become essential to a customer, a 'vendor lock-in' effect may occur [2]. In particular, vendor lock-in refers to a situation in which a customer becomes heavily dependent on a particular vendor's products, services, or technologies, making it difficult to switch to an alternative vendor.

1.3.4 Data Enrichment

Data enrichment consists of integrating already available data with information from other sources, it also includes all data processing operations such as cleaning for example [2]. Data enrichment can provide organizations with a deeper understanding of their customers, enable more accurate analysis, and support better decision-making.

1.3.5 Data Privacy and Control Guarantee

Businesses that collect data by communicating with the customer can retrieve benefits by not using it or by granting full control over them [2]. Guaranteeing privacy and control, companies can see an increment in customer loyalty and market share, as well as they can build a better image and reputation [2].

1.4 Monetization strategies predominance in the Automotive

Today the car is strongly connected with the surronding environment, so several players besides the OEMs gravitate around this new ecosystem such as dealers, telcos, workshops, insurens, tech companies, etc. These players had to tailor themselves to this new setting changing completely their relationships with customers and their business models. We can think of a layered automotive ecosystem where each player has a range of opportunities, as reported in the article by Miro Confalone [1].

1.4.1 First Layer

The first layer comprises the automotive players most related to the vehicle. In this first level the traditional selling channel is include and it is composed of components suppliers, car manufacturers, and car dealers that sell to individual customers [1]. For example, by accessing the diagnostic data of the car, car manufacturers are able to prevent failures and schedule repair operations in advance. Dealerships, not associated with a specific brand, " can implement a Dealer Management system that can access the Car APIs and help them in scheduling car repairs, organizing the administrative aspect, check for the vehicle warranty status, and improving their customers' experience " [1]. This is the main layer of the ecosystem where car manufacturers have full control over data and they can rely on bartering and selling mainly [1].

1.4.2 Second Layer

The second layer is composed by rental companies, maintenance workshops, telematics players, mobility service providers, and fleet management companies [1]. OEMs often lack the knowledge and skills to com-

plete a project. Therefore, they create partnerships with other companies and work together to achieve a goal. In this layer car data can help rental car companies and fleet management firms to track the activities of their customer, predicting when vehicle's failures will occur or prohibit a driver to drive under influence of alcohol [1]. Furthermore, independent workshops can partner with OEMs and dealership and offer vehicle inspections or routine maintenance to customer that are far from affiliated workshops. In this second layer we find a predominance of data bartering since most of these players need to communicate together and exchange information [1].

1.4.3 Third Layer

The third layer completes the automotive ecosystem, where different companies allow the integration of features into cars and allow the whole system to function. For example, government agencies can use the data to make improvements to road infrastructure or they could use data to enforce the law more efficiently (e.g. speeding or parking violations). Fuel and charging stations can message nearby cars offering personalized discounts. They can, also, optimize their investments based on the models on the roads and the routes more common. Thanks to agreements between OEMs and telcos the customer can utilize connectivity services [1]. Tech companies are key because it is increasingly possible to use mobile applications via the car screen, so OEMs must interact with these companies and cure their infotainment interfaces. Car manufacturers can be partner with payment service providers, having the opportunity to provide mobile wallet and in-vehicle payment services [1]. In this layer we can observe a predominance of bartering and wrapping, with numerous exchanges between various players [1].

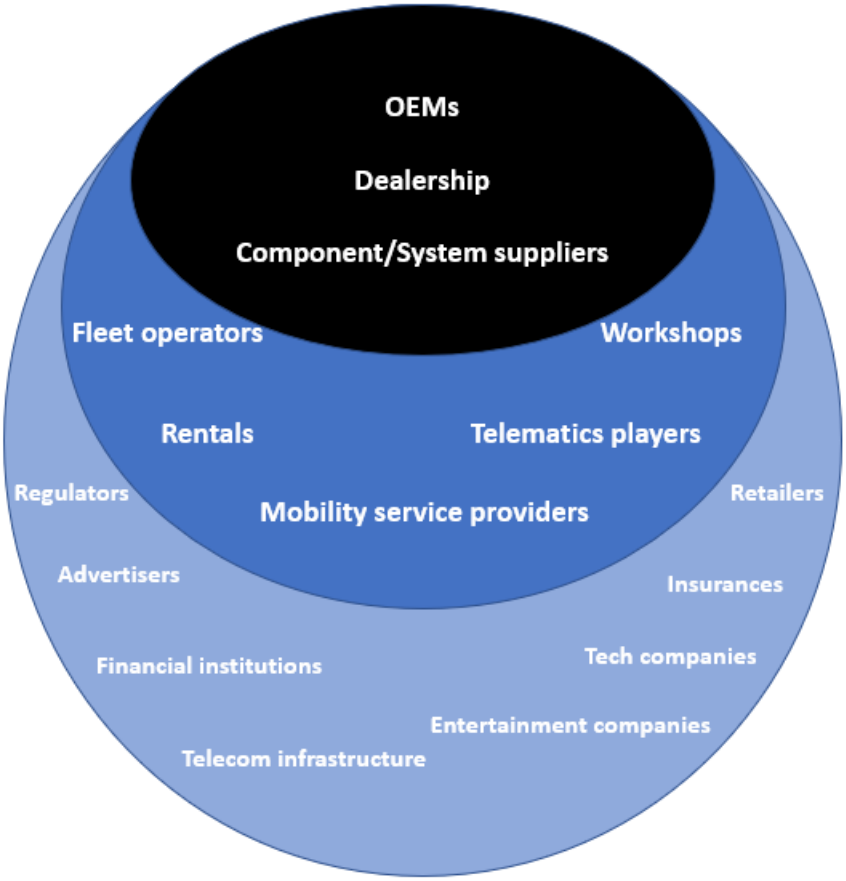

Figure 1.1: Automotive ecosystem layers

Chapter 2

Taxonomy of DDBMs in the Connected Car Domain

This section presents a taxonomy of DDBMs for connected car companies, proposed by specialists in this area [3, 18]. In the following you can see the dimensions and characteristics in detail.

2.1 Value Proposition

The value proposition refers to the unique value and benefits that a company provides to its customers through the use of data. This perspective comprises three dimensions: value for customers, influence of car data, and influence of autonomy.

1. *Value for customers* deals with the proposals made by the OEMs. Data monetization occurs when the customer perceives the importance and usefulness of a service or product. Consequently, if he likes the experience that is provided to him then he will also be willing to share his data. Overall, connected car services typically fall into six broad categories: safety and security, convenience, cost reduction, traffic efficiency, infotainment, data accessibility [3].

2. *Influence of car data* refers to the importance of exploit car data to realize certain business models [3]. Thanks to the level of connectivity that vehicles have achieved, it is possible to exploit a large amount of data to offer services. There are services that can only be implemented through the availability of data (e.g., predictive maintenance) and others that instead exploit the data at a later time (e.g., workshop booking) [3].

3. *Influence of autonomy* refers to the development of autonomous vehicles and its potential to bring about significant influences and transformations. It is clear that this dimension involves significant changes in the business model, as the driver will focus on doing other things rather than driving. Consequently, preferences are shifting from driving experience to infotainment.

2.2 Value Architecture

Value architecture refers to the strategic design and framework that an organization develops to create, deliver, and capture value for its customers and stakeholders. It comprises three dimensions, namely data categories, data access, and data sharing [18].

1. *Data categories* refers to all those categories of data relevant for the implementation and functioning of the connected services. Car data can be categorized into various types: sensor data, telematics data, infotainment data, diagnostic data etc.

2. *Data access* refers to the ability to obtain and utilize the data generated by vehicles for various purposes. Obviosly, OEMs have an exclusive and direct access to data, but which are the access opportunity for the other actors? Third-parties typically rely on data access through APIs, instead dealerships typically have access to vehicle data when servicing or repairing vehicles, and telematics services

collect and process telematics data, including GPS location, vehicle health, and driving behavior.

3. *Data Sharing:* It is the process to sharing information with other companies, often third parties that provide specific services leveraging the data. It is, also, vital to being transparent in which data are shared and anonymize them if necessary.

2.3 Value Network

Value Network refers to the ecosystem of stakeholders involved in the development, deployment, and utilization of connected car technologies and services. The perspective comprises four dimensions, namely primary end-users, secondary end-users, service providers, platform providers [18].

1. *Primary End-Users:* individual customers that should participate in the product design processes. Hence, the user is not a passive actor but a value co-creator [18].

2. *Secondary End-Users:* individuals or entities who indirectly benefit from the connected car technology or services. For instance, passengers, fleet operator, government authorities etc.

3. *Service Providers:* companies that offer a range of services related to the maintenance, repair, and care of vehicles. These providers specialize in servicing and addressing the specific needs of cars, ensuring their optimal performance and longevity.

4. *Platform Providers* are companies or entities that offer the underlying infrastructure, software platforms, and tools to enable connectivity, data management, and integration of various services and applications within the connected car ecosystem. Bosler et al. [19] identified three types of platform concepts which currently we can find in

the connected car industry. First, OEM platforms offering customers additional services or allowing them to control the car status (e.g., BMW ConnectedDrive). Next, platforms for smartphone integration enabling drivers to use their favourite smartphones apps via the built-in head unit (e.g., Spotify, Android Auto etc.). Last, platforms for connected cars offered by third-party providers [18].

2.4 Value Finance

Value finance refers to the financial models that enable the monetization of connected car technologies and services. It includes two dimensions, namely data monetization and revenue model [3].

1. *Data monetization* refers to the process of generating revenue from data. There are three main approaches that OEMs use today: selling car data directly to another party (e.g., data marketplaces as Caruso Dataplace), selling data-based analyses, selling data-driven services [3].
2. *Revenue model* refers to the strategies use to generate revenue. The best known method of generating income is direct selling. But there are also: usage fees ,subscription fees, transaction fees, licensing fees and the possibility to tailor the price according to customer requests [3].

Chapter 3

Data-Driven Business Models

3.1 Value Dimensions

Data are valuable if they allows you to expand your business by creating new opportunities. "The value dimensions can be summarized as **product or service** (what is offered?), **business processes** (how is it offered?) and **business model** (how is it monetized?)" [4]. Here you can find an overview of the three value dimensions.

3.1.1 Data-driven Product Innovation

Data-driven product innovation includes three categories. The first one is product enhancement where data are used to personalize products and optimize the customer experience [4]. Then we have the product augmentation, for instance data can make a product smart by using sensor data (e.g., wearable devices) [4]. The third category is data as a product which means it is sold to customers or other businesses.

3.1.2 Data-driven Process Innovation

"Process innovation leveraging data can be achieved in two ways" [4]. The first way is called enterprise process innovation where data can be used to improve and optimize business processes within an organization [4]. Instead, the customer process innovation use data to enhance and optimize various aspects of the customer experience [4].

3.1.3 Data-driven business model Innovation

Data-driven business model innovation refers to the process of leveraging data to create new business models [4]. We can consider two different basic forms. In this case, it must be taken into consideration that data could be both used to provide new method of value generation and to offer innovative ways of value recording [4].

3.2 Value creation models of car data monetization

Players in this segment of the industry are creating value from car data in one or many of three categories [6]. First, players in the ecosystem are generating revenues by proposing customized services to customers. Second, they are using car data to reduce costs, for example, analyzing the car behaviour it is possible to prevent failures and minimize the number of visits to workshops. Third, companies are developing safety&security services, such as lane keeping, blind spot detection and automatic parking. In general, the value can be captured via different modes. In fact, the price can be: rolled into vehicle (or mobility service) price, charged as a one-off payment after the initial vehicle purchase, paid regularly as a subscription, deducted/debited from a rechargeable credit, covered by monetizing tailored advertising [6].

3.3 Three main DDBMs

As data-driven business models are a nascent business practice there is not so much information about them, but in this section you can find three generic business models that can be used in the automotive industry, proposed by experts [4].

3.3.1 Data Harvesting

Data harvesting in connected cars refers to the collection and extraction of data generated by various sensors, systems, and connected devices within a vehicle [4]. This model is closely related to providing data-driven products and services, but there is also another way we can exploit these collections of data: selling insights. Selling insights in connected cars refers to the practice of extracting valuable information and knowledge from the vast amount of data and offering this information to other players in the ecosystem. For example, you could feed data mapping companies or municipalities and city authorities in order to patch holes in the street.

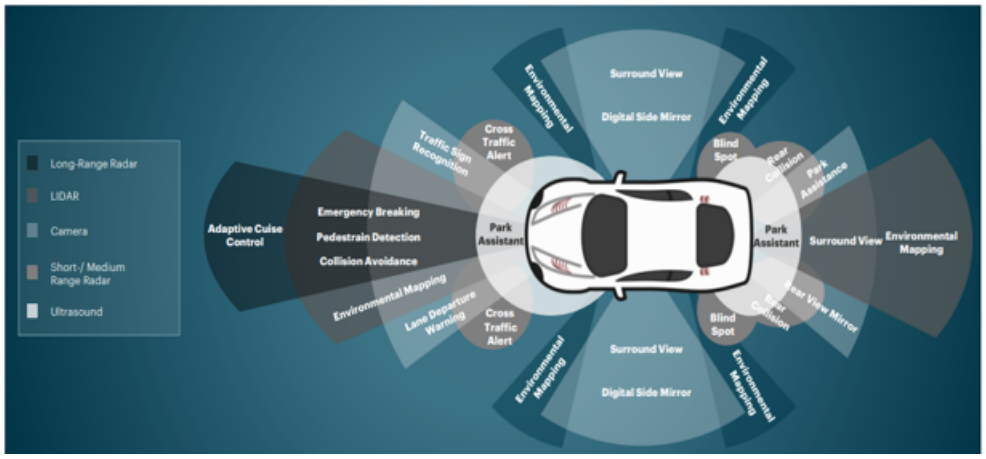

Figure 3.1: Connected car sensors [4]

An example of using data harvesting model could be detecting obstacles, measuring ambient conditions, analyzing driving patterns etc.

3.3.2 Data Matching

Data matching in the connected car domain refers to the process of combining or correlating data by means a digital platform [4]. Platforms are powerful tools. "They interpose themselves between the user and the asset owner and define the rules of the engagement: and whoever owns customer access, owns the business model" [4].
The most common business models of platforms are:

- **Freemium:** base membership for free, premium access for a subscription fee (e.g. LinkedIn).

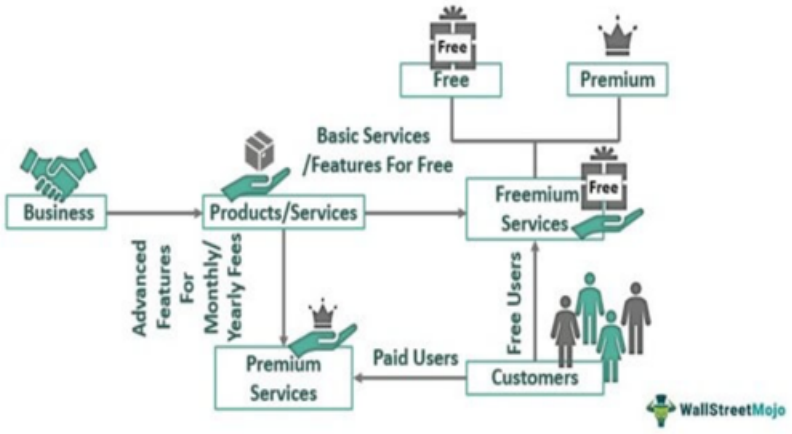

Figure 3.2: Freemium Model

- **Transaction fee:** making a match of demand and supply for a commission (e.g. Uber, the model was initially developed by credit card platforms).

Figure 3.3: Transaction Fee Revenue Model

- **Long Tail:** business strategy that allows companies to realize significant profits by selling low volumes of hard-to-find items to many customers, instead of only selling large volumes of a reduced number of popular items(e.g. eBay).

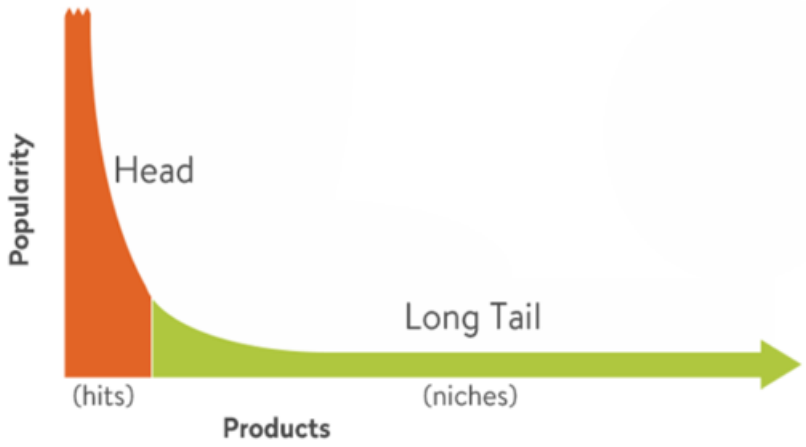

Figure 3.4: Long Tail Model

3.3.3 As-a-Service

In the car domain this model refers to the concept of providing mobility services rather than selling individual vehicles. Instead of owning a car, users can access a fleet of vehicles on-demand through a subscription or pay-per-use model. This monetization option allows for a continuous customer relationship.
Moreover, a practical example is given by Mercedes, indeed customers can close a flat rate contract with Mercedes-Benz Bank covering insurance, repair, tires and total mileage [4]. Then they choose a car-class, color, optional equipment etc. and all cost are managed by Mercedes, relieving the customer from associated risks.

3.4 Domains Definition

The next step is to understand what kind of activities we can undertake to generate value from data. "These activities translate into either customer services or internal cost optimization with direct and indirect monetization options" [4]. Therefore, seven core service domains are developed that can be used for classification and market potential determination [4] (see Figure 3.5).

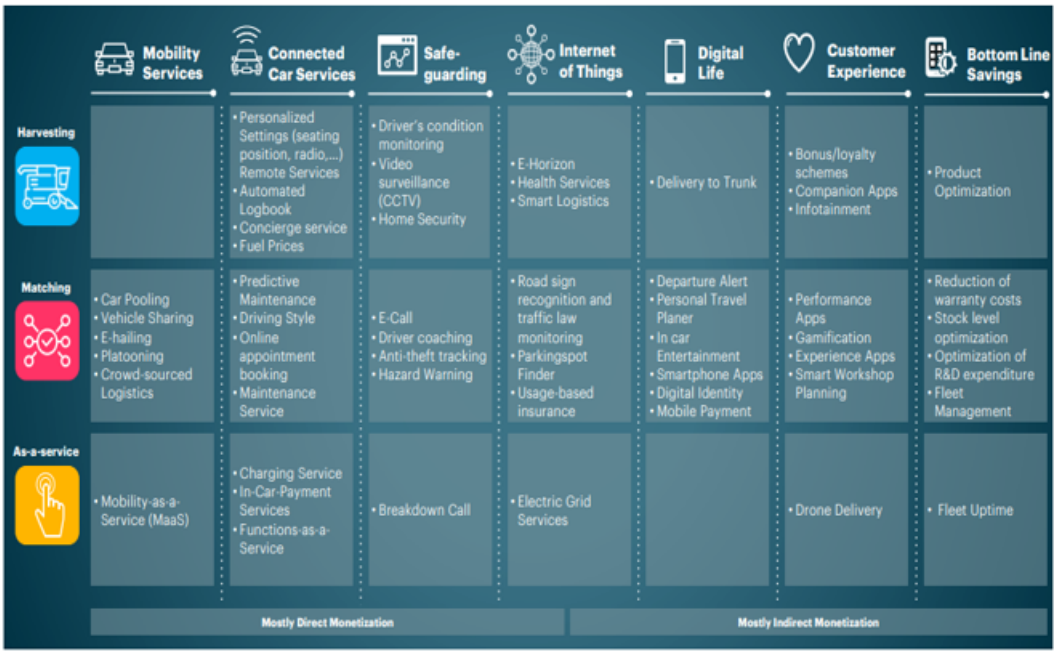

Figure 3.5: Connected car domains [4]

3.4.1 Driver Data

Some of the services described on the Figure 3.5 above refer to the use of personal information or driving behavior data for example. So, another monetization opportunity is based on the use of driver data. In this context, reference is often made to the implementation of services concerning driving behavior, such as safety systems, usage-based insurance, prevention systems, and so on. The first step is to collect a reasonable amount of realistic driving data. This amount of information help researchers understand the causes of crashes, detect critical events related to lanes and road boundaries, identify driving anger etc. Consequently it is possible to develop effective crash prevention measure. There are many data and sensors that can be used to profile the driver's driving habits: pedal pressure (gas, break), steering angle, gps, speech and noise, velocity, video (ahead, face, feet), heart rate. When analyzing driving behaviour, some variables that could influence the driver choices should also be considered: number

of passengers, weather, lighting, surface condition, traffic flow, traffic density, locality, weekday vs. weekend, alignment, intersection influence [8]. However, the definition of driver data is not limited to this. Indeed, an enormous value for businesses is given from tracking customers' identity: it allows OEMs to track and analyze customers and to tailor their offering accordingly. Establishing a simple way to collect the customer ID has been central for businesses, and it is why high-tech giants offer customer ID solutions [6]. The most of the OEMs are not capable to track events to a single customer ID yet can. But most progressive OEMs , in the premium segment, have recently started to pursue a "single ID" approach, however they face significant complexity due to a number of reasons. Therefore, the future challenge will be to be able to match the data produced by the car to the individual driver. Some examples of using a customer id could be: recommend music based on driver's musical tastes, let the car remember the seat settings, the mirror adjustment, the favourite driving mode, the most frequented places etc. Thus, you have the opportunity to provide services that are based on the individual preferences and habits of the driver.

3.5 Brand Impact & Customer Trust

In addition to the services and products that companies can offer, there are other precautions to take into account. One is the brand impact, that affects monetization. OEMs can leverage the power of different data-driven business models for their brand image and should "refrain from treating customers as a product for advertising" [4]. Furthermore, "offering free or ad-based services can have a negative impact on the brand image, especially for premium brands as the offer is not considered as exclusive anymore" [4]. For example, Apple creates an emotional connection with their customers. And combining their value proposition with confident pricing, they are able to generate incredible revenues.
Moreover, the critical aspect for end customers is the element of trust in

the brand they share their data with. Therefore, these are some rules of building and maintaining customer trust: do not stress customers by continuous questions or propositions, provide clarity and education on what kinds of data are to be used, do not misuse and do not allow potential third parties to misuse data, give customers the choice of what to share and what not to share, make gathered data available to customers [6].

3.6 Industry Convergence

"Innovations in the field of connected cars are redefining competitive dynamics in the industry" [6]. Industry partnerships in the connected car domain are crucial for driving innovation and accelerating development. These partnerships typically involve collaborations between automotive manufacturers, technology companies, telecommunications providers, and other stakeholders in the ecosystem. For example, collaborations between car manufacturers and tech giants like Google, Apple, or Microsoft aim to incorporate their operating systems, infotainment systems, or voice assistants into the car's interface.

3.7 Data Opportunity in Automotive

In this section you can find a forecast about future revenues in the automotive, made by industry experts [4]. In the figure below we can see that business such as car sales and aftersales will decline over the next years. In particular, aftersales business will decline because of the market entry of an increasing number of electric cars (easier to maintain). Traditional financial services business will grow until 2040 and then gradually decline as digital financial services business will rise. Mobility and shared mobility services will growth after 2030, driven largely by growing penetration autonomous vehicles. In the end, smart services will develop to

an independent business driven by AI.

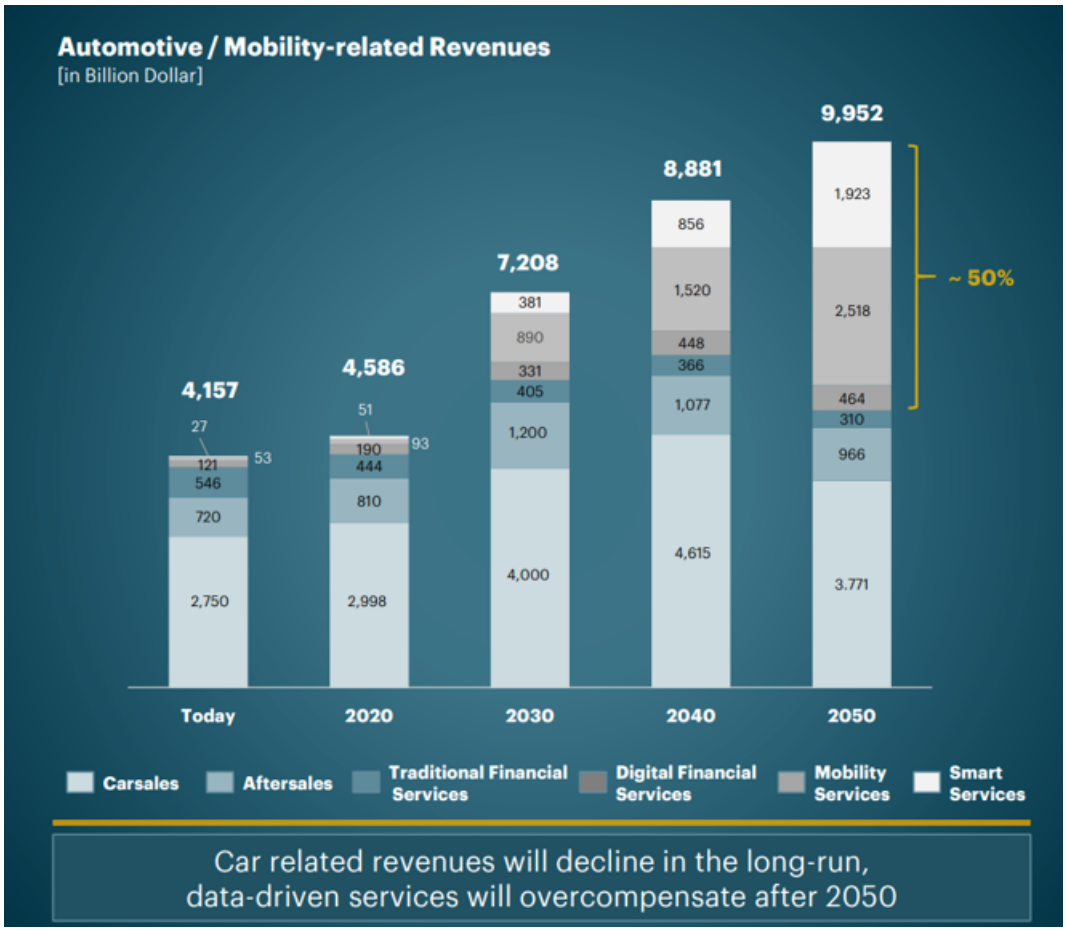

Figure 3.6: Forecasting future revenues in the automotive sector [4]

Chapter 4

Luxury as a business model

In order to provide a comprehensive overview of monetization opportunities and strategies, we will now describe the role of luxury as a business model. This is because we are mainly analyzing the case of luxury car brands. So, what are the key factors that allow a luxury brand to grow? Luxury brands such as Louis Vuitton, Chanel, Gucci, Herme‘s, Ferrari, and Rolex "have crafted a common, yet unique, business model: a pillar of their resilience and profitability" [25]. "This business model rests on strict principles that maintain the uniqueness of luxury and preserve the non-comparability of those luxury brands that adhere to its guidelines" [26].
Here are some examples of this guidelines:

- Do not delocalize production: Luxury is the ambassador of the local culture [25].
- Communicate to non-targets: The distinctive parts of the products must be the quality and the ability to be easily recognizable [25].
- Maintain full control of the value chain: A brand achieves the quality of luxury only if it has control over the entire product research and development chain [25].

- Maintain full control of distribution: Every luxury brand must know that the sales experience and customer relationship must be exclusive [25].
- Always increase the average price: The price must adapt to the economic conditions of the various social classes. Only certain people should be able to afford luxury products [25].
- Develop direct one-on-one relationships with clients: The aim must be to make the customer live a dream. Therefore, the shopping experience must be exclusive and personalized [25].

4.1 The role of scarcity

How scarcity creates value ? "It is a basic law of economics that when demand exceeds supply, price goes up" [25]. Luxury brands aim to create a perception of exclusivity and limited availability. By intentionally limiting the production or availability of their products, luxury brands enhance their desirability among consumers who seek unique and exclusive items.

4.2 Qualitative rarity

The objective rarity is not sufficient [25]. At some point the customer will be interested in the quality of the products they buy. Qualitative rarity goes beyond the mere scarcity of a product and encompasses elements that make the brand or its offerings truly distinctive and exclusive. Therefore, it is important for a luxury brand to spend time and money on the product creation (craftmanship, premium materials etc.).

4.3 Virtual rarity

"Rarity can also be artificially induced" [25]. Virtual rarity in luxury brands refers to the creation of exclusive and unique digital experiences or products that are not readily available to the general public. It involves leveraging digital technologies and platforms to offer luxury experiences that are scarce and accessible only to a select group of individuals. For example, brands release limited digital editions of their products in online platforms or create virtual showrooms.

4.4 'Starification' of designers

"A significant shift taking place in the luxury sector is the 'starification' of designers" [25]. The "starification" of designers refers to the phenomenon where fashion designers achieve celebrity status and gain significant recognition and fame. Today luxury is increasingly associated with art, and designers are seen as creators of contemporary works of art [25]. Designers are gaining a lot of notoriety and they are becoming real influencers. Therefore, to be successful it is essential to have the right personality and communication skills.

4.5 Luxury as driver for affective commitment

As we will see later, affections, bonds and emotions play an important role in the context of luxury brands. In particular, this section provides an overview of what affects the formation of affective commitment in the context of luxury car brands. But, before doing this it is fundamental to understand what effectively adds luxury value in the consumer's perception. This is because, it is the initial stage from which the process of building an affective commitment starts . A hierarchical and multidi-

mensional model describe that some aspects affect this perception, and they are: functional, individual and social [35]. The functional dimension of luxury value refers to the usability, uniqueness, quality, reliability and durability values given to the customer. The individual dimension addresses personal factors towards luxury consumption such as hedonism, materialism and self-identity [35]. The social dimension focuses on the perceived utility consumers obtain owning brands acknowledged within their social groups such as conspicuousness and prestige [35]. Now we can look at how affective commitment can be achieved.

4.5.1 Brand community

"Consumers with similar norms, values and habits tend to congregate in groups called communities of consumption" [35]. A brand community can be described as a group of individuals who share a common interest, passion, or affiliation with a particular brand. Brands gain numerous benefits when the customer takes their side. One of these is certainly the development of a positive word of mounth, i.e. the customer speaks well of the brand. Brand communities play a vital role in building long-term relationships, generating brand advocacy, and creating a sense of shared purpose and identity.

4.5.2 Brand tribalism

"Brand tribalism is a concept that identifies a community of self-selected individuals formed on the basis of an emotional attachment to a product or a brand" [38]. Brand tribalism is derived from the concept of brand community, and it is an important predictor of the strength of brand relationships. Brand communities and brand tribalism can generate indirect value for companies, as customers have the power to recommend products or services to other people, perhaps influencing their choices. This

dimension can have both positive and negative implications for brands. On one hand, it can drive brand loyalty, advocacy, and create a passionate customer base. On the other hand, it can create divisions or conflicts with rival brand tribes.

4.5.3 Brand reputation

Brand reputation is the set of opinions that customers, employees etc. hold about a particular brand. These thoughts are influenced by the history and behavior of the brand over time. All these factors influence the customer's willingness to pay. "Reputation is connected to long-lasting favourable relationships with stakeholders, especially with consumers, and refers to how various audiences evaluate the brand" [38]. Typically, a good brand reputation is characterized by positive perceptions, trust, and credibility.

4.5.4 Implications

In the luxury car context, functional values seem to be more effective in building brand reputation [35]. Instead, social and individual values have more influence on brand tribalism, and they play an important role in building an emotional bond between the customer and the brand [38]. The three dimensions of individual values do not have the same strength, indeed hedonic values are the most impactful to build individual values, and brand tribalism is more important than brand reputation in the formation of affective commitment [38].

Chapter 5

The importance of Emotional Attachment

In this article we talked about monetization strategies, but one of the elements that allows you to significantly increase revenue is the customer's emotional connection. Therefore, it is necessary to take this aspect into consideration when offering products or services to customers. Emotions and feelings seem to be key elements for understanding the strength of the bond between customers and brands. This feeling of connection, affection, and passion subsequently affects their behaviour and in turn fosters firm profitability and customer lifetime value [20]. Customers who have an emotional bond with a brand tend to stick to it, as they experience feelings of satisfaction, security, etc. We can also say that emotions allow to establish more lasting relationships with brands. Moreover, in the luxury sector the abstract aspects are more important than the material ones.

5.1 Feeling the car

Before describing what influences the emotional connection with a brand, let's try to understand what it means to feel a car, in the end we will try to understand what the buyers' emotional needs are and how car de-

signers try to introduce emotions into their work. Feeling the car refers to the sensory experience and emotional connection one has while driving or being in a car. However, these emotions are not always positive, for example looking at the car can bring back accidents and bad memories. "The very passions that feed into certain kinds of love for the car or joy in driving may equally elicit opposite feelings of hatred for traffic, rage at other drivers, boredom with the same route, or anger at government transport policies" [43]. In some cases cars become the owner's projection because people tend to buy cars that reflect their personality and character. Daniel Miller suggests that "it is this highly visceral relationship between bodies of people and bodies of cars that forces us to acknowledge the humanity of the car in the first place" [41]. Feeling the car is subjective and can vary from person to person. It depends on individual preferences, driving style, and the specific characteristics of the car. It is a combination of both physical sensations and emotional connection, creating a unique and memorable experience for the driver.

5.1.1 Family cars

People have strong emotional investments in the relationship with the car and in the connection that exist between the car and other family members. This creates affective contexts that are also deeply materialised in particular types of vehicles, homes, neighbourhoods and cities [39]. Simon Maxwell argues that there is a positive implication in using cars, because it is associated with care and love for immediate others, as well as care for other within wider social networks [42]. Cars often become the personification of people, their role is no longer just to be a means of transport but they become family members. Therefore, they convey emotions like safety, security, love etc.

5.1.2 Car as a pattern of sociability

Driving offers many people a feeling of liberation, empowerment, and social inclusion, while inability to drive may lead to feelings of social exclusion and disempowerment in cultures of automobility [39]. In particular, there are several social reasons why people use a car, based on age or gender. The young and poor tend to feel a sense of revenge, power and self-expression when they drive, while older people and females look for an independence sense [43]. Richer people, on the other hand, tend to want to demonstrate their supremacy and importance.

5.1.3 National feelings

Cars can evoke a sense of national pride and cultural identity, particularly in countries where the automobile industry has played a significant role in shaping the national identity [39]. In countries with a rich automotive heritage, iconic car brands and models become symbols of national craftsmanship. Also the success in motorsports and racing can be associated at national sentiment, as people are pride of their national team. In the end, car can be cultural symbols, as they are featured in movies, songs [39] etc.

5.1.4 How customers evaluate affective design factors

Affective design focuses on creating positive emotional experiences and connections with customers. "In the customer environment the affective/cognitive system is an important factor in evaluating products and services" [45]. Mainly, customers evaluate how the design make them feel, they consider color schemes, materials, textures, and assess whether the design of a product reflects a distinct personality or character.

5.1.5 Emotional intent of car designers

In designing a new vehicle, a product designer uses information from a variety of sources, but mainly he should consider trends and fashions because they play a decisive role in affective design [45]. In particular, there are three types of affective design features, namely: visceral, behaviour and reflective [48].

- Visceral design refers to the visual aspects: colour, shape, texture, materials [48].
- Behaviour design has to do with the pleasure in using the object, such as steering a smooth and well-balanced vehicle [48].
- Reflective design has to do with things that have been learnt over the years [48]. People are interested to buy something that reminds them of family, past experiences, hobbies, etc. For instance, they may be looking for specific aesthetic features.

To conclude, car designers could , also, work to ensure that the design of a car aligns with the brand's identity and image.

5.2 Dimensions that affect emotional connection

There are some primary dimensions that have an impact on customer emotional attachment, which in turn has an impact on customer brand loyalty and brand love. Let's see what they are.

5.2.1 Corporate associations

Corporate associations refer to the mental connections and perceptions that people have about a particular company or brand [20]. A good mem-

ory and a positive opinion about a brand make the customer trust the actions that the brand will take in the future. Furthermore, the possibility of establishing a long-lasting relationship between the customer and the brand arises from the customer's blind and complete trust in the brand. Corporate associations can be formed through various interactions with the company, including its products, services, advertising etc.

5.2.2 Corporate activities

Corporate activities refer to the actions, initiatives, and operations undertaken by a company [20]. These corporate initiatives, are aimed at enhancing the customers' perceived brand image and brand reputation [59]. By perceiving positively the brand image, customers can become more and more attached to the brand itself and perceive it as more loyal. This can lead to the creation of long-lasting relationships.

5.2.3 Corporate values

Corporate values denote the principles guiding the mission of a firm [20]. Customers often evaluate the ideas and behaviors of a company and decide whether to perceive it positively or not, before starting a relationship with the brand. Again, brands that have a favorable identity are more likely to build long-lasting relationships with customers.

5.2.4 Corporate personalities

Corporate personalities reflect the set of feelings associated with a company's products, services, and mission. This feelings are affected by the company's values, culture, behaviors and actions it demonstrates. Positive corporate personalities, such as creativity, compassion, agility and collaboration, are able to mitigate the emotional risk that customers ex-

perience during brand purchases [20]. Favourable corporate personalities allow to enhance the brand loyalty and the emotional attachment [20].

5.2.5 Brand anthropomorphism

"Brands may be humanized because they are made and sold by people, and in fact, in some cases, are people" [29]. Therefore, we can say that a brand is said to be anthropomorphized when it is perceived as a human entity. Specifically, it is a marketing technique that involves creating a brand image that resembles human qualities, allowing consumers to relate to the brand on a more personal and emotional level. From the literature it emerges that consumers develop the brand anthropomorphism for two reasons: to demonize the brands they hate, to establish a love relationship with the brand [28]. The chosen traits and characteristics of an anthropomorphized brand should align with consumer preferences, values, and brand objectives, giving rise to the possibility to emotionally capture the customer and obtain benefits such as positive purchase intention.

5.2.6 NWOM

Negative word of mouth refers to the spread of unfavorable information, opinions, or experiences about a product, service, or brand [28]. It occurs when people share their negative experiences or opinions with others, either through personal conversations or other communication channels. To minimize the occurrence of negative word of mouth, brands should focus on promptly addressing customer concerns, and proactively seeking feedback to identify and resolve issues. Negative WOM have the power to discourage customers from buying a company's products or services again. Instead, a positive WOM can bring to enhance brand's global identity and brand trust.

5.2.7 Emotional stability

Emotional stability refers to a person's ability to remain calm and composed in the face of challenges, and this is highlighted as a positive aspect of personality [28]. Studies show that this type of people are happier ,more satisfied, more secure and more confident [32]. Furthermore, emotionally stable people would pay less attention to NWOM and will handle negative experiences with a brand in a more rational manner. To conclude, they tend to form deeper and more enduring connections with brands.

5.2.8 Corporate benefits

During purchase decisions, customers derive two key corporate benefits: functional and symbolic [20]. "Functional benefits pertain to the intrinsic value customers acquire from a product which serve to fulfil a customer's immediate and practical needs" [20]. "Symbolic benefits, on the other hand, are an extrinsic value that corresponds to the non-product-related attributes which communicate a variety of brand meanings to consumers" [20]. In particular, symbolic benefits can bring some advantages: increased loyalty, the development of long-term relationships between customers and the brand, and the strengthening of emotional attachment.

5.3 Strategies for emotional branding

Emotional branding can be implemented by employing four major strategies: sensory branding, storytelling, cause branding, and empowerment [21].

5.3.1 Sensory branding

Sensory branding is a marketing technique that aims to engage consumers' senses to create a unique and memorable brand experience [22]. It involves incorporating sensory elements such as sight, sound, smell, taste, and touch into the brand's communication and interactions with customers [21]. In order to be able to be successful in offering a shopping experience to the customer, it is necessary to know how to manage the pre-purchase stage, the purchase stage and the post-purchase stage [22]. At the pre-purchase stage, companies should provide advertisements and slogans that arouse positive reactions. At the purchase stage competence is a basic requirement for positive emotional response [22]. In particular, employees must follow specific rules and must be educated on how to treat the customer during the purchase. The after-sales phase is perhaps the most important one. Showing interest to customers even after they leave the store it is fundamental to build emotional connections. This can lead to strengthen the bond between brand and customer.

5.3.2 Storytelling

Brand storytelling is a powerful tool for building an emotional connection with customers [21]. Humans are naturally drawn to stories because they engage our emotions and capture our attention. Stories have the ability to evoke emotions and create a sense of empathy, moreover when brands share something that reflect their values it creates a sense of transparency and authenticity. Emotional connections fostered through brand storytelling can lead to long-term engagement and loyalty.

5.3.3 Cause branding

Cause branding, refers to a marketing strategy in which a brand aligns itself with a specific social or environmental cause to create a positive impact and build a beneficial relationship with its customers [21]. Customers are more likely to remain loyal to brands that demonstrate a commitment to social causes because they feel a sense of shared purpose and identity with the brand.

5.3.4 Empowerment

It is a type of strategy that aims to boost self-esteem by convincing clients that they are capable of gaining power, autonomy, and control over their own lives or work environments [21]. An empowerment strategy puts the customer at the center of the brand's focus by for example: involving him in the brand's decision-making and creative processes, design experiences that empower his self-esteem, celebrating his loyalty [21].

5.4 Ideas for emotional services and opportunities

After this overview of strategies to build an emotional connection with the customer, I tried to think about emotional services that can be implemented in the automotive industry.

5.4.1 Improve emotional experience

First of all, I thought about the possibility of improving the emotional and sensory experience of the driver. To do this it will be necessary to be able to understand the mood of the driver, either through biometric sensors or through artificial intelligence. At this point the opportunities are many,

for example the system could play some music to lift the driver's spirits if sad or could play music that fits with the surrounding environment. Many other possibilities can derive from the automatic management of the air conditioning, the lighting inside the car or in-seat functions designed to increase alertness or reduce stress.

5.4.2 Communicate in a human and personal way

One of the pillars of the emotional connection with the client is the ability to establish relationships with him. Therefore, I thought about the possibility of involving the customer in the construction and preparation of his new car. Many car companies already allows customers to receive information or photos about the production of their car, but we could go one step further. One could think of sending videos (or even live streaming), where the mechanics or designers tell what they do, their story, their passions and establish a relationship with the customer.

5.4.3 Brand Story

Trying to connect the customer with the brand's story is certainly another way to create bonds. So, I thought that a specific function could be implemented in the navigation system. The customer could be shown a map with a series of highlighted places relating to important pieces of history of the company and its cars (where the company is born etc.). The driver can thus try to reach the place and feel part of the history of the brand. Obviously by clicking on the map it will be possible to receive information on why that place is so important and what significance it has for the company's history.

5.4.4 Reward the customer

The emotional attachment can be reinforced by showing that the company care about the customer, as well as providing enjoyable experiences. I thought of some kind of game based on a "battle pass". In the video game industry, a battle pass is a type of monetization approach that provides additional content for a game usually through a tiered system, rewarding the player with in-game items for playing the game and completing specific challenges. But in the case of cars I thought of an adaptation. My idea is to reward the customer based on the completion of some objectives, which provide points that allow him to advance in this tiered system. The goal is to reach the last level where there is the most valuable prize. The challenges may relate to brand attachment, for example one could be driving a car for 1000 hours or achieve a certain number of years of membership in a car club. The prizes could be gadgets, the possibility to visit a car company, up to the final prize which could be the possibility of inserting a photo of the customer in an online bulletin board (or in a physical one in the company) of the most loyal customers. By doing this, the goal is to make the customer feel an integral part of the company.

5.4.5 Safety features

Safety is a priority for customers and it elicits positive feelings during the driver experience. In this context a feature like fatigue detection or bad mood detection can be implemented, in order to prevent bad driving styles and accidents [49]. For example, an intelligent voice assistance can be implemented with the aim of calm down the driver and make sure the driver got back to a correct mood. An alternative might be to simply signal the driver to stop. This service opens up other possibilities, such as a system that rationally analyze and explain the situation in case of an accident. With this feature customers can perceive the car as a "human" or as a "friend" that is taking interest in you.

5.4.6 Emotional journey

Many drivers could be interested in "plan routes and stops according to scenic views" [49] (e.g., scenic mountain routes with picnic stops). This aims to generate memories with the family or with a girlfriend/boyfriend. In addition, a photo/video function (take photo/video both inside and outside the vehicle) can be provided, so they can "re-enjoy the scenery" after the ride. All the media could be used to make a scrapbook and this "memories" could be displayed in the car screen or in the smartphone application after one year "from the shot", in order to let the driver remember the experiences and the feelings.

5.4.7 Thank other drivers

A feature to convey nice thoughts to other drivers is something that can enforce the "automotive community" [49]. It often happens that a car stops to let you pass or warns you that your lights are off. Therefore, the opportunity to thank other people, for example with predefined messages in order to avoid that the service could be used for negative reasons, can generate positive emotions in drivers, with consequences in mood and driving style changes. Obviously this feature requires the possibility to communicate with other cars through external signals or direct communication.

5.4.8 Handle anxiety

It can happen that some drivers experience anxiety and fear while driving. For example, people that have just had an accident don't feel very safe driving. Or just thing about people that have just bought a powerful car and they have never driven one. Therefore, sharing real-time information about the car's status or the upcoming trajectory (e.g., "be careful there

is a sharp bend") it can be a way to make the driver feel comfortable. Obviously, this service could be implemented as a mode that can be activated as needed, because many drivers (not anxious) don't want to be annoyed by unwanted information.

5.4.9 Replicate driving style

We've seen in the previous sections that the car really is a "member of the family". We can therefore think of considering the car as a way to welcome and put others at ease. In particular, a vehicle , perhaps a SUV, could be also used by family or friends and we can think of a feature that can reflect their habits and driving styles (e.g., give me tips on my mother's driving style to make her feel more comfortable in the car). Obviously, this require that the system has previously registered the different driving style and personal characteristics. Starting from this information, the driver could receive real-time information on the driving style to follow that corresponds to that of the passenger.

5.4.10 Opportunities

In the near future, one of the challenges will be to capture the driver's emotions and propose services and measures to manage his mood. Therefore, the concept of "Improving driver emotions with affective strategies" is being born. Let's see what some strategies can be.

Distraction

In the automotive domain drivers can be distracted from negative affective states [50]. The goal is to lead them towards more positive feelings, by providing real-time services that could make then feel better.

Driver State Display

In the context of emotion assessment, the idea to display the detected driver states within a graphical UI has been born [50]. This type of technology may have the potential to improve car safety by knowing the driver's current capacities [51].

Reappraisal

"After facing negative emotional events, affective states can be regulated through reappraisal of the experienced situation" [53]. This has shown evidence for positive effects on emotions and driving performance.

Affective Symmetry

"Systems which mimic empathy by reflecting the detected driver state might possibly be accepted well by users due to similarity attraction theory" [54]. "Studies report positive effects on emotions and driving performance when the system matches the driver's state" [50]. This idea can be improved through visual avatars, voice assistants or social robots.

Chapter 6

Sensors and Services

Today, a very large number of sensors are available in the automotive field, currently just a few of them, mostly proprioceptive ones, are used. So, in this section we will take a look at what sensors are currently available in the industry, especially exteroceptive ones [5].

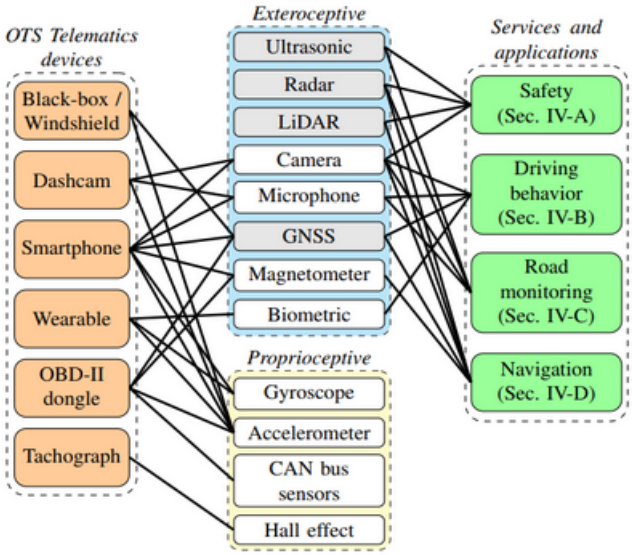

Figure 6.1: Proprioceptive and Exteroceptive sensors [5]

In general, proprioceptive sensors measure variations in signals generated by the vehicle's internal systems [5]. Data produced by these sensors allow estimating measurement such as speed, fluid levels, acceleration etc. Instead, exteroceptive sensors allow vehicles to communicate with the surrounding environment.

6.1 Global Navigation Satellite System

We can implement Location-Based Systems using an embedded GNSS receiver. It is a term that refers to a system of satellites and ground-based stations that enable positioning, navigation, and timing services for various applications around the world. The most well-known GNSS is the Global Positioning System (GPS).

6.2 Magnetometer

Magnetometers are used in navigation systems, such as compasses, to determine the direction or heading of an object relative to the Earth's magnetic field.

6.3 Microphone

A microphone can be used as a real-time processor in cars to capture and process audio signals on the fly. In this context, the microphone acts as an input sensor, while the processing capabilities are typically performed by dedicated hardware or software systems within the car's audio or infotainment system.

6.4 Biometric Sensors

The integration of biometric sensors in cars aims to enhance safety, security, and personalization of the driving experience. By capturing and analyzing biometric data, cars can adapt to the driver's needs, detect potential risks, and provide a more comfortable and personalized environment. For instance, ECG devices could be installed in the steering wheel and in the driver's seat to measure heart activity, through touch or photoelectric sensors.

6.5 Ultrasonic Sensors

Ultrasonic sensors are devices that use ultrasonic sound waves to measure distances and detect objects. They work by emitting high-frequency sound waves and then measuring the time it takes for the sound waves to bounce back after hitting an object.

6.6 Radar

A radar sensor uses radio waves to detect and track objects in its surrounding environment. It operates based on the principles of radar technology, which stands for "Radio Detection and Ranging." Radar sensors emit radio waves and analyze the reflections or echoes of those waves when they bounce off objects in their path. It is used for short, mid and long-range object detection and adaptive cruise control at high speeds.

6.7 LiDAR

Lidar (Light Detection and Ranging) sensors uses laser light to measure distances and can generate highly accurate 3D maps and capture detailed information about the shape, distance, and composition of objects.

6.8 Camera

Camera cars have become increasingly common and important for various applications, such as object detection, lane departure warning, pedestrian detection, parking assistance, traffic sign recognition etc.

6.9 Sensor based services

Relying on this set of sensors, it is then possible to develop a series of services, divided into categories: safety, driving behavior and road monitoring [5].

6.9.1 Safety Services

The safety area includes four categories of applications, related to vehicle maintenance, driving and external events: tire wear, collision detection, collision avoidance and lane departure [5]. Using a mmWave radar it is possible to measure tire wear as the difference between the tread and the groove of the tire [5]. Furthermore, it is possible to detect a car accident through sound analysis and hence be able to detect collisions [5]. Sensors such as camera, radar, and LiDAR , can determine the proximity of objects around the vehicle and allow collision avoidance. Finally, automotive manufacturers install cameras, usually on the vehicle windshield, in order

to warn the driver about lane crossing risk [5].

6.9.2 Driving Behavior Services

Incorrect driving behaviors represent a great risk for road safety. The main action that can help risk predictions is the driving profiling, hence analyze the driving behavior with the support of historical GNSS, weather and traffic conditions [5]. Another service is the driver detection, where the vehicle seats could be splitted in four quadrants and then it is possible to analyze drivers' signals during maneuvers [5]. Furthermore, it is possible to monitor the driver health using ECG signals on steering wheel, driver's seat or smartwatches. Finally, tracking drivers' eyes and gestures is possible to analyze the driver distraction [5].

6.9.3 Road Monitoring Services

Poor road conditions pose several risk to cars: tire damage, reduced tracion, steering problem etc. Different approaches have been developed to monitor the road surface, here six road monitoring services are listed [5]:

- Road porosity: "infer road conditions through acoustic analysis of the tire and road surface" [5].
- Road Wetness: "real-time acoustic analysis of tire-road interaction noise" [5].
- Pothole detection: analyze road surface damage through cameras installed on the vehicle [5].
- Road slipperiness: "slippery road spots using data from digital tachographs" [5].
- Road type classification: "use a short-range ultrasonic sensing system" [5].

- Parking Space Detection: use LiDAR or camera to sense the roadside and compare occupancy with pre-defined parking lots map [5].

6.10 Data and Services in modern luxury cars

In this section there is a comparison between connected services in modern high-end cars. The purpose of this analysis is to understand the level of connectivity of modern cars and find out what data and sensors they use. The tables below show some of the more unique connected services in the context of luxury cars. In Table 6.1 you can see that Ferrari and Lamborghini have a "special" privacy mode, but with some differences. In Lamborghini cars changing privacy settings through the Privacy mode implies activating or deactivating the processing of certain types of data, e.g. localization data. As a result, by deactivating the processing of certain types of data, the related services may be disabled. Instead Ferrari brag about his privacy mode, because they have developed a read-only system to limit interactions between the car and third-party tech systems, which thus boost its intrusion prevention capabilities. Other OEMs offer this feature but with less possibilities. For example, in Lexus connected cars when you switch on the Privacy Mode you simply disable the GPS function, instead in Porsche and Tesla, communication between the vehicle and app is suppressed. Next, we can find a list of remote services mainly owned by Lamborghini and Porsche cars. The Valet Alert service allow to select and area and speed limit that the car should not leave and exceed. Likewise, with the Geofencing services we can select a safety zone that the car should not leave and a forbidden zone in which the car should not enter. Instead, the curfew alert allow to select a time duration in which the car must not be moved. Always in the same table you can find the assist system. It specifies that in the event of activation of the airbag or crash sensors, the vehicle will automatically trigger a call to the near-

est emergency services call center. Some luxury automakers allows the customers to view the data produced by the vehicle or partially remove them. In Table 6.2 you can see that there are some services that permit to analyze the driving style in order to offer tailor-made offers, like Pay per drive connected and RCA connected. Finally, there are services about car safety and feature that use cameras to analyze the environment and the driver.
In general, each car manufacturer offers services divided into several categories: navigation, status and condition of the car, safety and security, and entertainment. Mainly, the mostly available data are: speed, mileage, fuel tank status, door/windows status, traffic data, GPS data, diagnostic data and parking information.

Table 6.1: Some connected services in modern cars

	Lamborghini	Ferrari	Porsche	Lexus	Rolls Royce	Tesla
Privacy Mode*	Yes	Yes	No	No	No	No
Valet Alert	Yes	No	Yes	No	No	No
Geofencing Security Zone	Yes	No	Yes	No	No	No
Geofencing Forbidden Zone	Yes	No	No	No	No	No
Curfew Alert	Yes	No	No	No	No	No
Rear entertainment system headphones	No	No	No	No	Yes	No
Assist System*	No	No	No	No	Yes	No
CarData Overview	No	No	No	No	Yes	No

Table 6.2: Some connected services in modern cars

	Lamborghini	Ferrari	Porsche	Lexus	Rolls Royce	Tesla
Dynamic Light System Plus	No	No	Yes	Yes	No	No
Pay per drive connected	No	No	No	Yes	No	No
RCA connected	No	No	No	Yes	No	No
Remove Personal Data	No	No	No	Yes	No	No
Road Sign Assist	No	No	No	Yes	No	No
Active Lane Keeping	No	No	Yes	Yes	No	Yes
Collision avoidance	No	No	No	Yes	No	Yes
Sentry mode	No	No	No	No	No	Yes
Cabin camera	No	No	No	No	No	Yes
Driver profile	No	No	No	No	No	Yes

Chapter 7

Ideas for Premium Connected Services

Here is a number of services that luxury car owners may want to have and they are classified according to different project scopes. Furthermore, for each service I tried to create a hypothetical JSON file of the produced/useful car data, abstracting the unavailable ones and specifying which additional sensors could be used.

7.1 Research and development

This section present a comprehensive compilation of services aimed at comprehending the car's behaviour over time and improving other projects.

7.1.1 On-demand fueling and cleaning

Do you have a commitment or just you haven't time to waste? Using a specific app, a driver can call fueling or cleaning services. The driver is alerted when the service is completed, and he can pay easily on the app. To implement this service you need to use the remote lock and

unlock of the car and obviously the GPS for the position, furthermore is essential to have a trusted staff, that must to be available all around the world. In the end, it is also advisable to provide information on the fuel level in the car, this allows the customer to decide whether to fill up or fill the tank by a certain number of liters. This on-demand function gives the OEMs the possibility to receive information about car consumptions for example. Another opportunity, given by the cleaning service, is to check the conditions and reasons why the car gets dirty and if the car is subject to external wear by specific atmospheric agents. Source: `https://otonomo.io/blog/5-innovative-on-demand-car-services/`


```
{
  "timestamp": "2023-05-04*16:27:25",
  "vehicleid": 239932068,
  "position":{
    "latitude":43.1604184,
    "longitude":13.7161408,
    "elevation":317
  },
  "tank":{
    "fuel_level_liters": 30,
    "tank_capacity_liters": 80
  }
}
```


Figure 7.1: On-demand fueling and cleaning JSON example

7.1.2 Book a circuit

Luxury car companies could make some circuits available to customers, making agreements with the owners. So the customers could have the possibility to book a circuit for a weekend or just for a time slot, and have fun with friends or club members. Here the difficulty lies in being able to actually provide this service, i.e. find circuits that allow you to do this. Being aware of when the car will go on the track, OEMs can monitor its behavior with different parameters or purposes, and store

information about circuits (add the position of the circuit to the data provided). Therefore, all the information about speed, driving mode, kilometers travelled, pedals pressure, engine coolant temperature and rpm (affect fuel consumption) can be useful.


```
{
  "timestamp": "2023-03-17*09:43:06",
  "vehicleid": 239932068,
  "circuit_location":{
    "latitude":44.34103585,
    "longitude":11.711617281218663,
    "elevation":55
  },
  "position":{
    "latitude":44.34102402,
    "longitude":11.711617281345633,
    "elevation":55
  },
  "status":{
    "speed": 180,
    "driving_mode":"sport",
    "odometer": 20340
  },
  "pedal":{
    "brake_pressure": 70,
    "throttle_pressure": 70
  },
  "engine":{
    "rpm":5000,
    "coolant_temperature": 70,
    "oil_temperature": 70
  },
  "gear": 5
}
```


Figure 7.2: Book a circuit JSON example

7.1.3 Improve sound experience

The driver has the possibility to set a special route on navigator in order to enjoy the car sound (e.g., go through tunnels, under bridges etc.). First of all it is necessary to understand what are the conditions for which the sound is "boosted/enhanced" by the environment. Then you need to be able to implement a navigation system that recognizes the presence of these conditions, and that can automatically set personalized routes. This service allows to monitor the car in stressful situations because it involves for sure abrupt accelerations and brakes on specific environmental conditions. Therefore, an analysis of the vehicle could be made, based on the study of speed data, fuel consumption, pedal pressure, engine status and position.

```
{
  "timestamp": "2023-03-17*09:43:06",
  "vehicleid": 239932068,
  "position":{
    "latitude":45.5102424,
    "longitude":11.6064384,
    "elevation":27
  },
  "status":{
    "speed": 115,
    "driving_mode":"sport",
    "odometer": 20340
  },
  "pedal":{
    "brake_pressure": 50,
    "throttle_pressure": 40
  },
  "tank":{
    "fuel_level_liters": 50
  },
  "engine":{
    "rpm":8000,
    "coolant_temperature": 60,
    "oil_temperature": 60
  },
  "gear": 3
}
```


Figure 7.3: Improve sound experience JSON example

7.1.4 Preserve the car

Configure a course on the GPS device to safeguard vehicles with low ground clearance, circumventing obstacles such as speed bumps and road imperfections. Alternatively, establish the route to prioritize vehicle maintenance, considering the detrimental effects of regular stop-and-go traffic on the engine or frequent driving on dusty terrains like dirt roads. Such circumstances often necessitate more frequent oil and air filter replacements and are also linked to increased repair needs. The problem is how to collect road information globally and include them in the navigation system. To date, lot of cars can't collect data about road conditions. However, assuming cars are capable of producing this data, one possibility is to share anonymous information with other OEMs that produce low cars. In this way we will have a broader view of road conditions worldwide. Among the various methods of detecting road conditions, the literature proposes one based on the use of GPS and a 3-axis accelerometer [52]. It collects signals using the accelerometer and then uses machine learning algorithm to identify road anomalies. I have included this service to the research and development category because it actually involves a study of road conditions and will certainly contribute to the development of other projects (e.g., maintenance related services).

```
{
  "timestamp": "2023-06-2*13:05:56",
  "vehicleid": 239932068,
  "position":{
    "latitude":45.4641943,
    "longitude":9.1896346,
    "elevation":125
  },
  "accelerometer":{
    "acceleration_x":0.024584363388433294,
    "acceleration_y":-0.025781464218510998,
    "acceleration_z":9.798708257907775
  }
}
```


Figure 7.4: Preserve the car JSON example

7.2 Marketing research

Within the realm of marketing, we encompass the provision of services that enable us to gain insights into the ways in which the ultimate consumer utilizes the automobile.

7.2.1 Real-time Challenge Mode

The system proposes a series of goals to be completed using the car, within a certain time limit. At the end of the challenge, the score obtained is calculated and possibly compared with that of the other participants, if present. Many sensors could be included in the operation of this mode and they must interact in real time with this feature.
e.g. reach 300 meters in height (altitude sensor from GPS), find a place only by following road signs (disabling the navigation system), reach a place A without going through a place B (Geofencing Forbidden Zone), try not to exceed a fuel consumption threshold in the next kilometer. This service could provide a different driving style analysis (e.g., analyze speed,

pedal pressure, consumption etc.) because the context affect the user in an emotional way. So, it can be useful to study the driver behavior when he is anxious and involved in a competitive situation.


```
{
  "timestamp": "2023-06-2*13:05:56",
  "vehicleid": 239932068,
  "position":{
    "latitude": 41.4620482,
    "longitude": 15.5432595,
    "elevation": 77
  },
  "tank":{
    "fuel_level_liters": 24
  },
  "status":{
    "odometer": 25694,
    "speed": 58,
    "driving_mode": "normal"
  },
  "pedal":{
    "brake_pressure": 40,
    "throttle_pressure": 40
  },
  "engine":{
    "rpm": 3000
  }
}
```


Figure 7.5: Real-time Challenge Mode JSON example

7.2.2 Virtual Chef

The car suggests restaurants that are compatible with your diet, once the driver has chosen the restaurant, he can automatically communicate the caloric intake and then enjoy a balanced meal as required. You can implement an application or feature available in the car, which is able to identify restaurants in the area using GPS and match the type of meals provided by them with the driver's diet. The driver must first enter his diet

into the system. Mainly, this virtual chef gives the OEMs the opportunity to analyze some customer preferences (where he stops to eat) and carry out a route and driving style analysis when he/she is hungry. You can interpret the "restaurant" field, in the figure below, as coming from external signals (e.g., by the navigation system).


```
{
  "timestamp": "2023-06-2*13:05:56",
  "vehicleid": 239932068,
  "position":{
    "latitude":44.5011924,
    "longitude":11.3432897,
    "elevation":58
  },
  "status":{
    "speed": 30,
    "odometer": 54098,
    "drivign_mode": "comfort"
  },
  "tank":{
    "fuel_level_liters": 45
  },
  "pedal":{
    "brake_pressure":5,
    "throttle_pressure":10
  },
  "restaurant": "L'Arcimboldo"
}
```


Figure 7.6: Virtual Chef JSON example

7.2.3 Personalized tyres

Based on data about the driving style and the tire wear, tire dealers can create a personalized product that adapts to the driver's use. It is essential to provide access to tire wear data to tire dealers (data can be obtained by installing specific radars near the tire). When the tire needs to be replaced, it can be given to the dealer so that he can analyze it and

understand the use that has been made of it and consequentially obtain information about the driving style of the driver. At a preliminary level, one could think of installing mmWave radars near the tyres, with the aim of measuring wear as the difference between the tread and the groove.


```
{
  "timestamp": "2023-06-2*13:05:56",
  "vehicleid": 239932068,
  "position":{
    "latitude":44.4938203,
    "longitude":11.3426327,
    "elevation":74
  },
  "front_left_tire":{
    "pressure":2.3,
    "tread_depth": 5.6
  },
  "front_right_tire":{
    "pressure":2.3,
    "tread_depth": 5.6
  },
  "rear_left_tire":{
    "pressure":2.3,
    "tread_depth": 5.7
  },
  "rear_right_tire":{
    "pressure":2.3,
    "tread_depth": 5.7
  }
}
```


Figure 7.7: Caption

7.2.4 Tourist Service

Relying on vehicle location, tech companies can develop a "tourist service" that illustrates the history of the place. They could provide exclusive access to information about museum or churches by, also, displaying images or videos on the car screen. This service requires the use of GPS and a

search system for historical and cultural information regarding the surrounding area. As well as the virtual chef, the tourist service could be used to carry out a route analysis. In particular OEMs can analyze the customer preferences during trips, weekends and free time.


```
{
  "timestamp": "2023-06-2*13:05:56",
  "vehicleid": 239932068,
  "position":{
    "latitude":44.4938203,
    "longitude":11.3426327,
    "elevation":74
  },
  "status":{
    "speed": 40,
    "odometer": 22098,
    "drivign_mode": "comfort"
  },
  "tank":{
    "fuel_level_liters": 21
  },
  "pedal":{
    "brake_pressure":10,
    "throttle_pressure":5
  }
}
```


Figure 7.8: Tourist Service JSON example

7.3 Personalization

In the end, the personalization field is useful to propose services that could fit with the customer experience, needs and habits.

7.3.1 Personal Health management

Monitor the biometric parameters using, for example, ECG signals on steering wheel, driver's seat or smartwatches. In case of anomalies an ambulance is called and sent to the car location, or a doctor in not worrying situations (the driver's personal doctor if he is nearby). So, the combination of the driver's biometric data with the vehicle location is required.


```
{
  "timestamp": "2023-06-2*13:05:56",
  "vehicleid": 239932068,
  "position":{
    "latitude": 41.4620482,
    "longitude": 15.5432595,
    "elevation": 77
  },
  "biometrical_data":{
    "heart_rate": 70,
    "systolic_blood_pressure": 120,
    "diastolic_blood_pressure": 80,
    "blood_oxygen_level": 98
  }
}
```


Figure 7.9: Personal Health management JSON example

7.3.2 Natural Disaster management

In case of earthquakes, tornadoes, floods etc. the driver can make a distress call (or the service provider checks the car location and the occurrence of a disaster and send help) and wait for the arrival of a personal helicopter or a SWAT team, for example. To implement this service it is necessary to know the position of the car and possibly monitor the weather conditions. Furthermore, there is the need to collaborate with specific service providers such as helicopter private flights companies or on-demand flights companies for example.

```
{
  "timestamp": "2023-06-2*13:05:56",
  "vehicleid": 239932068,
  "position":{
    "latitude":41.8933203,
    "longitude":12.4829321,
    "elevation":46
  }
}
```


Figure 7.10: Natual Disaster Management JSON example

7.3.3 Recommended for you

Marketing and Ads companies can use data from vehicle fleets to profile customer preferences (e.g. frequented places, listened music, online purchases made from car, favourite news). So a "recommended for you" feature can be implemented on car display, where the customer can find event or product suggestions. In addition, the user can benefit from this advertising by getting vip treatment e.g. free and fast shipping of online purchases, premium seats for the booked event etc.
Companies must be able to access the data of the car (access GPS data to understand which places are frequented e.g. restaurants, shops etc.) and of the applications that the customer uses.


```
{
  "timestamp": "2023-06-2*13:05:56",
  "vehicleid": 239932068,
  "position":{
    "latitude": 45.4077172,
    "longitude": 11.8734455,
    "elevation": 25
  }
}
```


Figure 7.11: Recommended for you JSON example

7.3.4 Delete data logs

OEMs could offer data analysis with the possibility to delete the first and last few minutes of the trip from the data logs, so that start and end point would remain undiscoverable [10]. In this way, the driver has a sort of privacy mode, but he can continue to use gps services. In the figure below the "ignition_status" field assumes the value 0 when the car is off and 1 when the car is on. This way I know when the car has finished its journey and it is possible to delete the location information.


```
{
  "timestamp": "2023-06-2*13:05:56",
  "vehicleid": 239932068,
  "position":{
    "latitude": 41.4620482,
    "longitude": 15.5432595,
    "elevation": 77
  },
  "ignition_status": 0
}
```


Figure 7.12: Delete data logs JSON example

7.3.5 Advanced Theft mode

In case of unauthorized accesses or movements, take a photo/video of the outside of the car (by using vehicle cameras) and send it to the owner and eventually the police (together with a continuous real-time location of the car). In the end, the cameras could also be installed inside the car to allow to recognize those who manage to enter the car in an unauthorized way.

```
{
  "timestamp": "2023-06-2*13:05:56",
  "vehicleid": 239932068,
  "position":{
    "latitude":41.8933203,
    "longitude":12.4829321,
    "elevation":46
  }
}
```


Figure 7.13: Advanced Theft Mode JSON example

7.3.6 Video tutorial

By continuously analyzing the condition of the car, the workshops/OEMs could provide video tutorials aimed at preventing damage and wear of the vehicle or something else. They can be either driving videos or technical videos in the workshop. Furthermore the customer could also choose the person who will provide the explanations in the video, thus developing a relationship of trust and confidence. A section can be added to the customer application where him can view or request videos and even talk to the mechanics. In the figure below you can see some data that could be useful for analyzing the car conditions, from the oil and fuel levels to the speed and pedal pressure data useful for studying the customers driving style. I assume there is also a way to get information about the road surface. Furthermore, you can see the presence of a steering angle sensor. It is responsible for synchronizing the movements of the steering wheel to the car's wheels and sending signals to other systems such as electric power steering. Therefore, it is essential to keep this parameter under control.

```
{
  "timestamp": "2023-06-2*13:05:56",
  "vehicleid": 239932068,
  "status":{
    "speed": 80,
    "odometer": 56700,
    "battery_level": 60
  },
  "engine":{
    "rpm": 5000,
    "fuel_level_liters": 40,
    "oil_level_liters": 4,
    "coolant_temperature": 90,
    "oil_temperature": 90
  },
  "pedal":{
    "brake_pressure": 30,
    "throttle_pressure": 30
  },
  "steering_angle": 19,
  "road_surface": "cobbleston"
}
```


Figure 7.14: Video tutorial JSON example

Chapter 8

A dashboard to analyze car data

This chapter show an example of a dashboard implemented to be able to study and analyze the data produced by individual vehicles and the fleet. As with connected services, the dashboard is made up of graphs divided into four application categories that many car manufacturers take into consideration to analyze their cars. All the data used in the charts has been invented.

8.1 Tool description

The tool used for creating the dashboard is Grafana. Grafana is an open-source software that can be downloaded and used locally or accessed directly through a web browser. Additionally, there are paid versions available with additional benefits. In general, Grafana allows for interactive visualization and analysis of data, providing extensive support for various types of databases and data sources. To connect the data source to Grafana, you need to specify the host address where it resides, along with the name of the database to use and the access credentials. However, some data sources do not require connections but allow you to directly input data in JSON, CSV, etc. format.

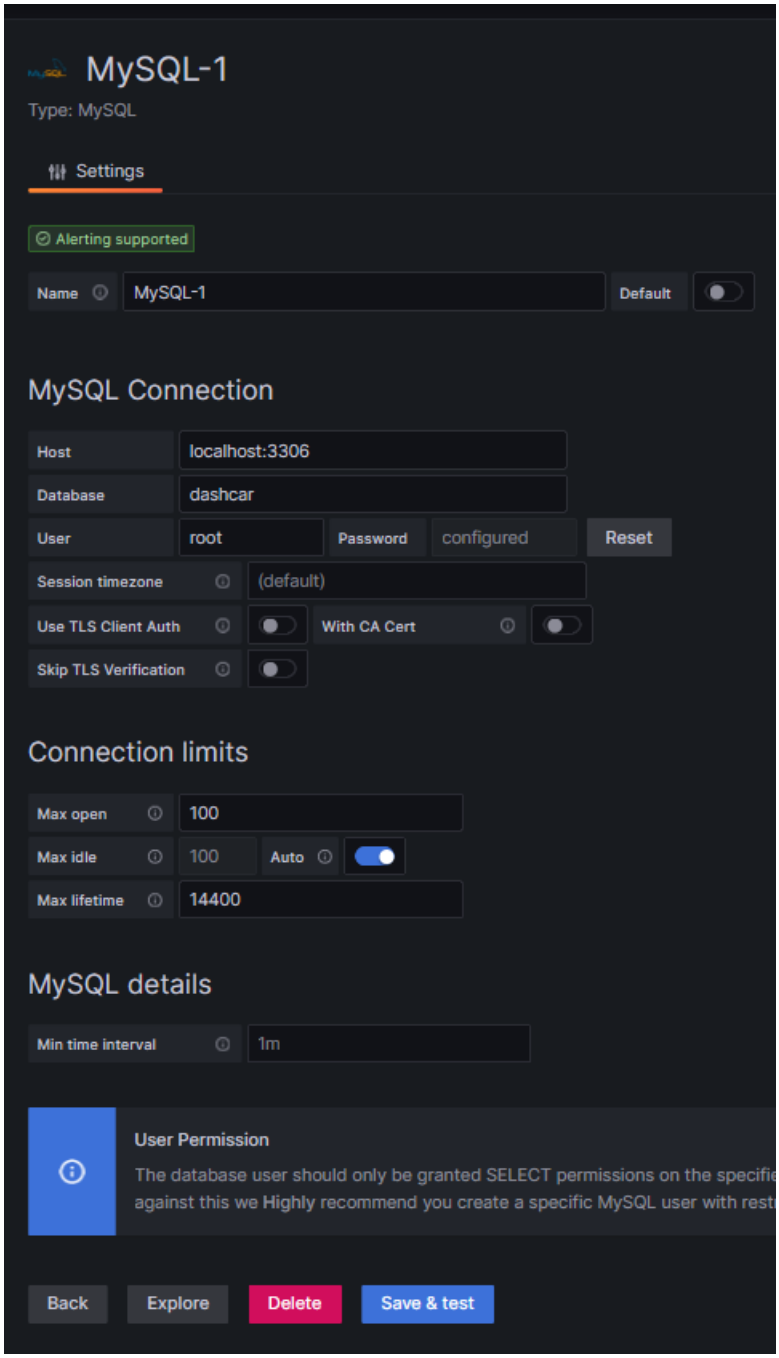

Figure 8.1: Data Source Connection

Grafana offers various plugins for creating graphs, furthermore third parties have the ability to create and publish their own custom plugins, ex-

panding the functionalities beyond those already available by default.

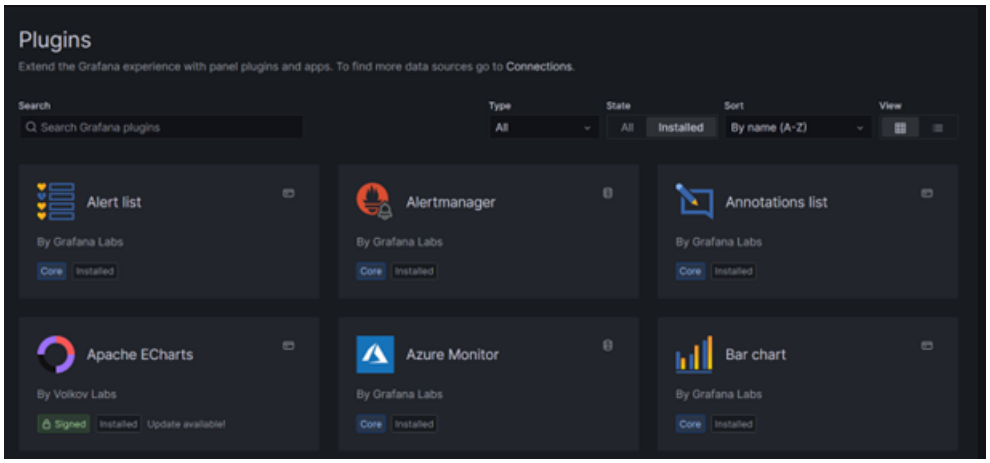

Figure 8.2: Plugins

To get started with this tool, the first thing to do is to create a dashboard, or you have the option to import an existing one that can be modified later.

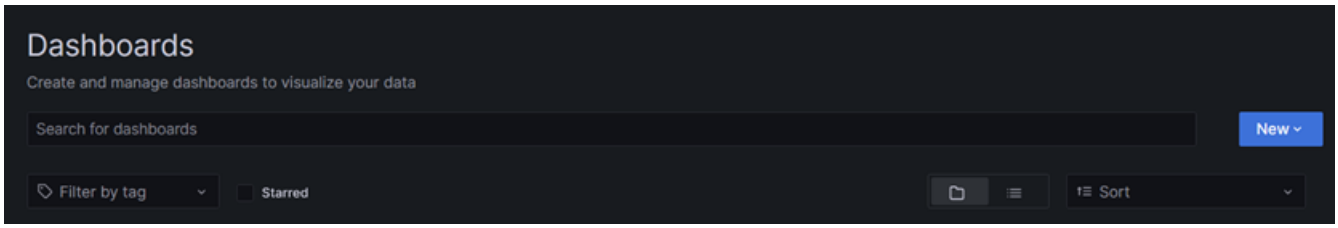

Figure 8.3: Dashboard creation

Before you can start creating the graphs, it is necessary to add the data source that will be used to display the information and construct the appropriate data query based on the requirements.

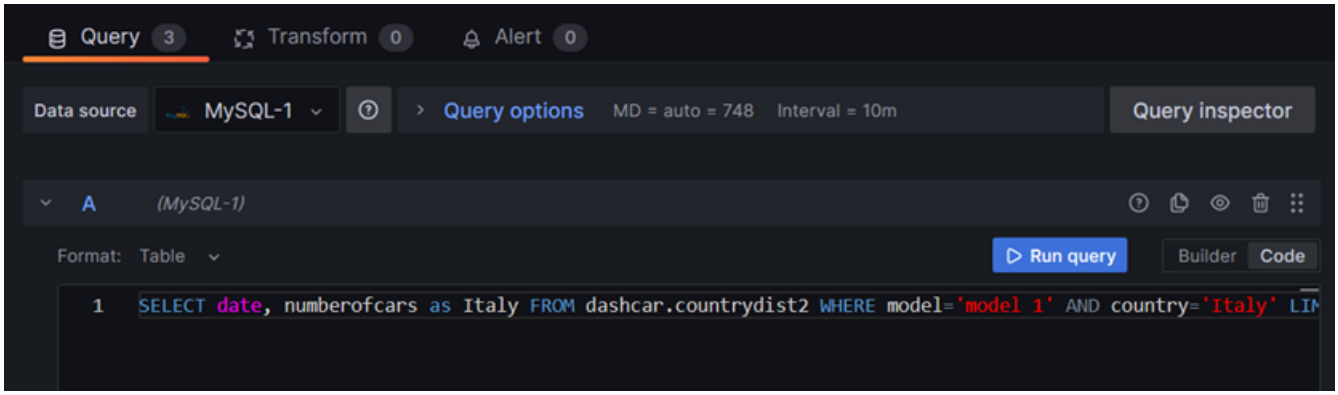

Figure 8.4: Data source and query options

After that, the system will suggest suitable graphs for visualizing the available data, or you can select a specific graph and then make the necessary adjustments. This last option should be considered when you want to make use of a plugin that is not integrated by default in the system, but downloaded at a later time.

Figure 8.5: Panel choice

Once the data visualization type is chosen, you can also modify a series of settings such as the legend, tooltip, text, colors, and much more.

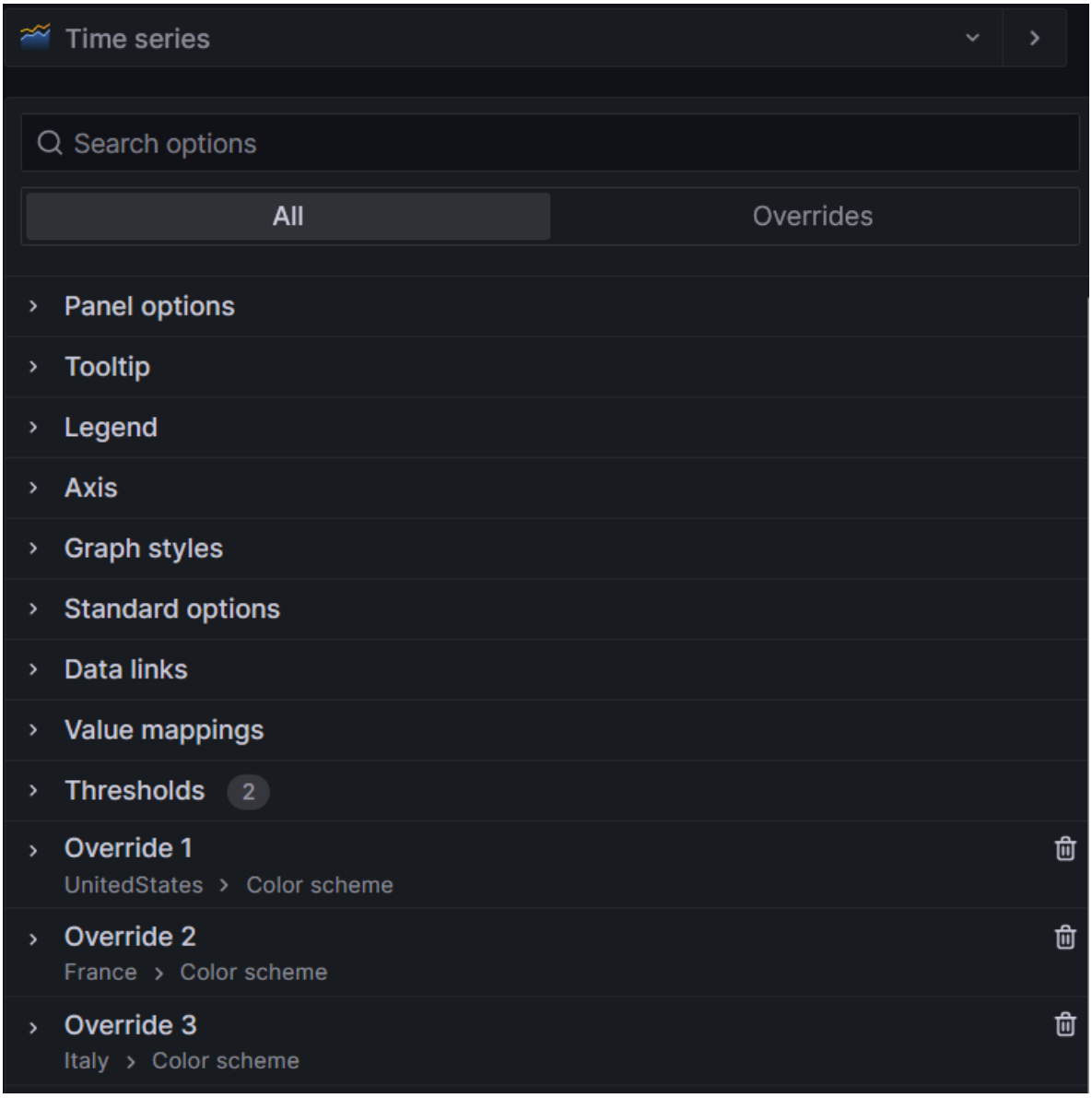

Figure 8.6: Panel settings

If you want to keep separate graphs containing unrelated information, it is possible to create different dashboards and link them together to have easy and universal access. In the following figure, it can also be observed

that it is possible to select a custom time range. In the case of graphs with date and time as dimensions, this option allows for automatic data updates across all panels.

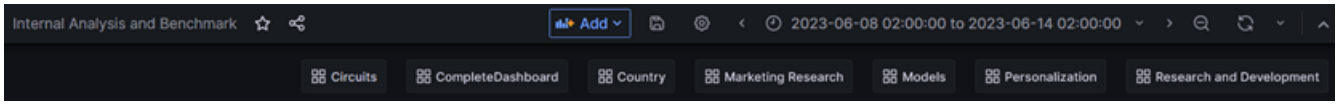

Figure 8.7: Link dashboards together

8.2 R&D Dashboard

In order to better understand the car behaviour over time, can be useful to analyze the occurrences of vehicle failures. In particular, the failures could be analyze on different dimensions, such as time and number of vehicle involved. Furthermore, analyzing CO2 emissions can help understand the environmental impact of cars and assist automotive companies in staying compliant with pollution regulations.

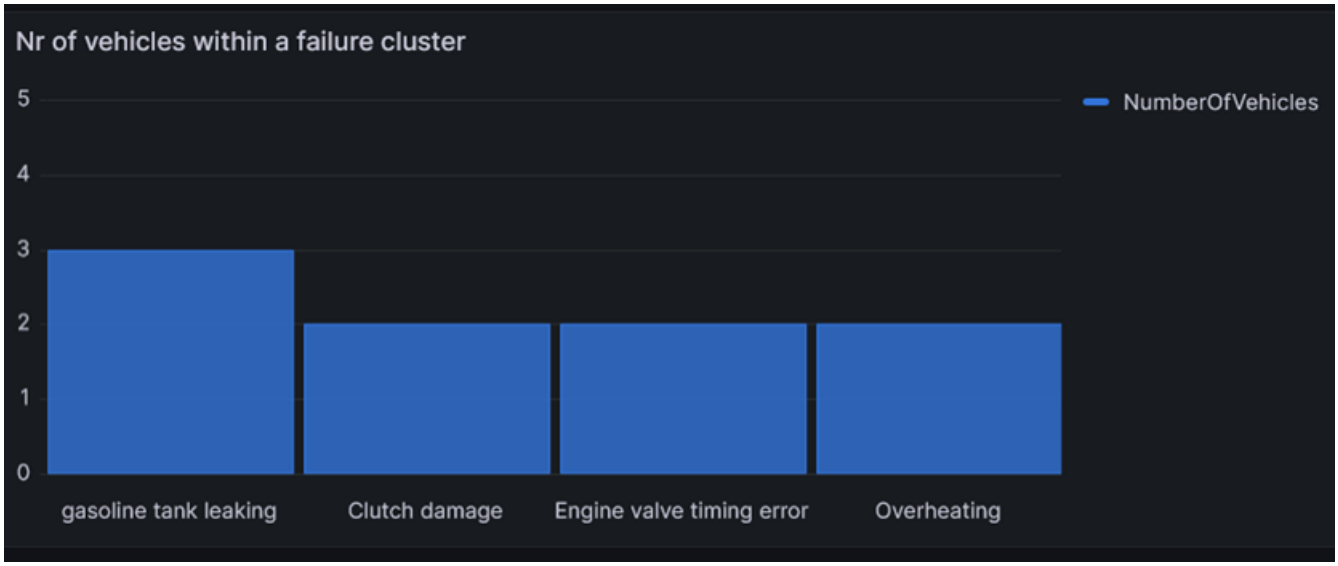

Figure 8.8: Nr of vehicles within a failure cluster

To create the previous chart, it is necessary to classify the types of failures (identified by a unique name) and keep track of the number of vehicles in which each failure occurs.

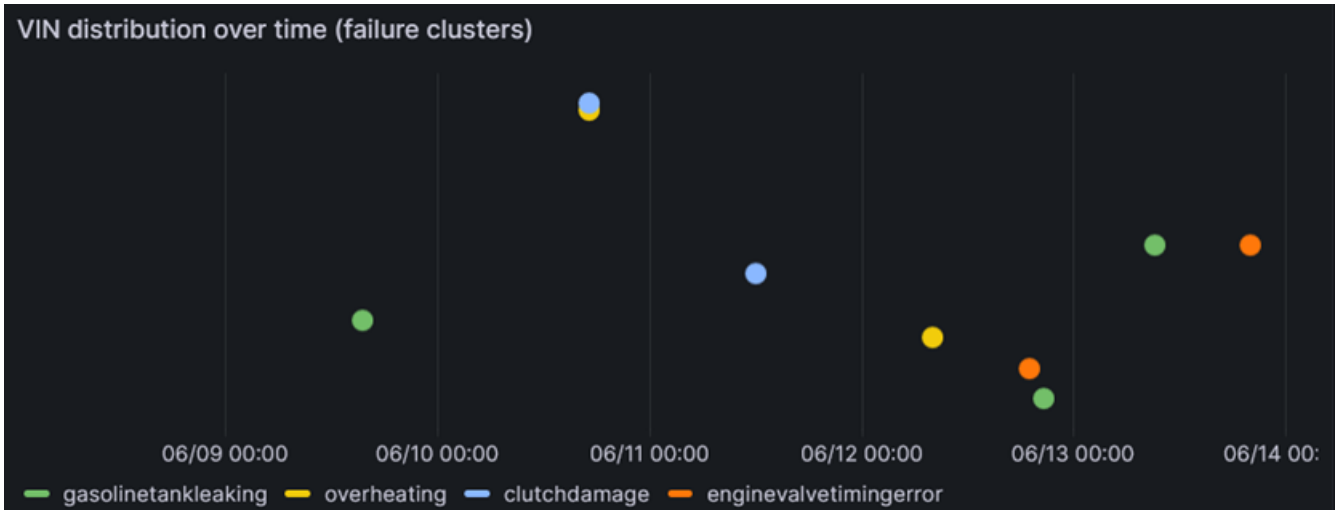

Figure 8.9: VIN distribution over time by failure cluster

In Figure 8.9, the following data is used to create a timeline chart: Vehicle VIN, breakdown name, and occurrence date.

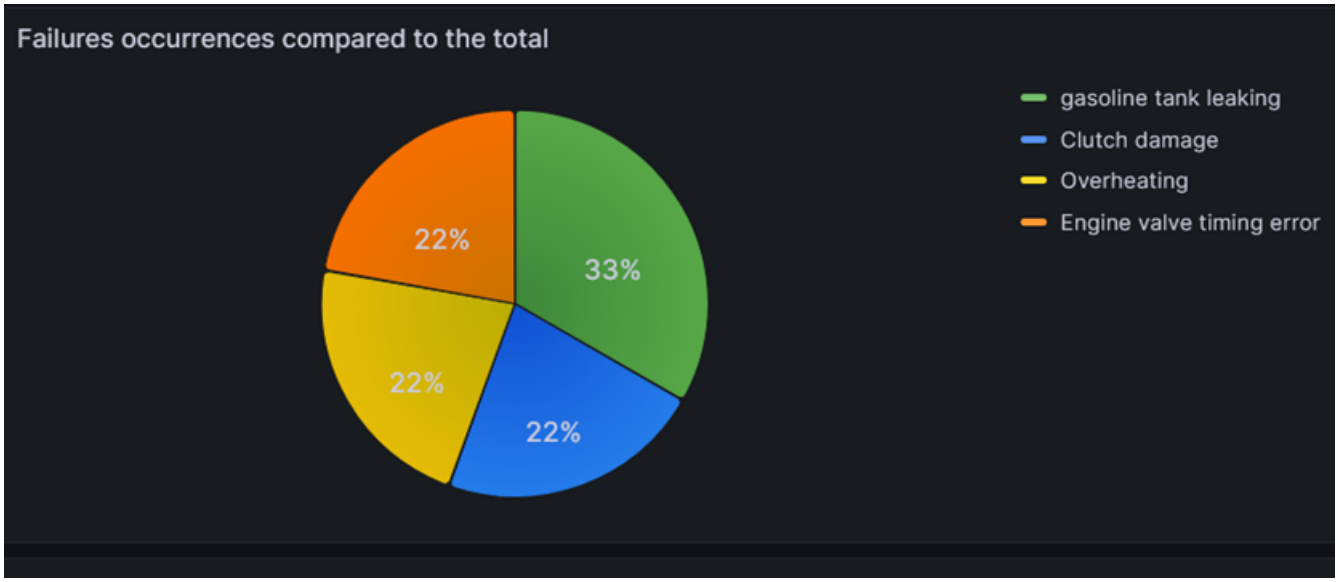

Figure 8.10: Failures occurrences compared to the total

In Figure 8.10, the breakdown name and the number of vehicles involved are used to compare the percentage of breakdown occurrences out of the total.

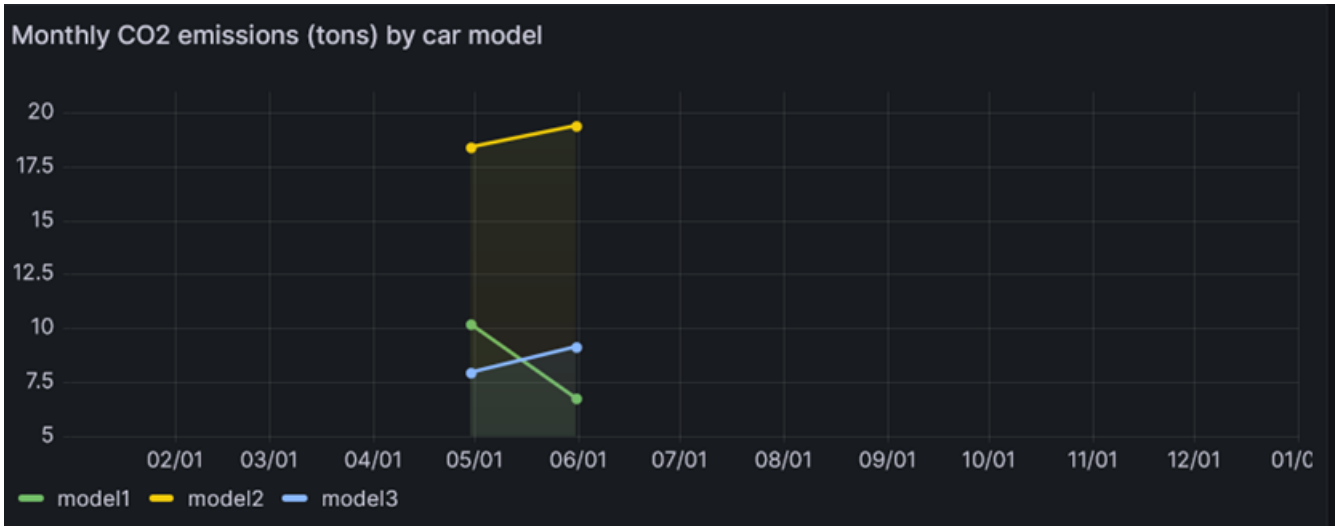

Figure 8.11: Monthly CO2 emissions by car models

Regarding emissions, the following data is used: car model, average CO2 emissions in tonnes, and the reference month's end date.

8.3 Marketing Research Dashboard

The marketing section includes an analysis of the end-user's usage of automobiles from an automotive company. Therefore, there are multiple types of data and information that can be taken into consideration. In this case, the dimensions of analysis can include: driving mode usage, pedal pressure in different contexts, driving style adopted on different road surfaces (e.g., speed, distance traveled), driving style and duration of trips in different countries.

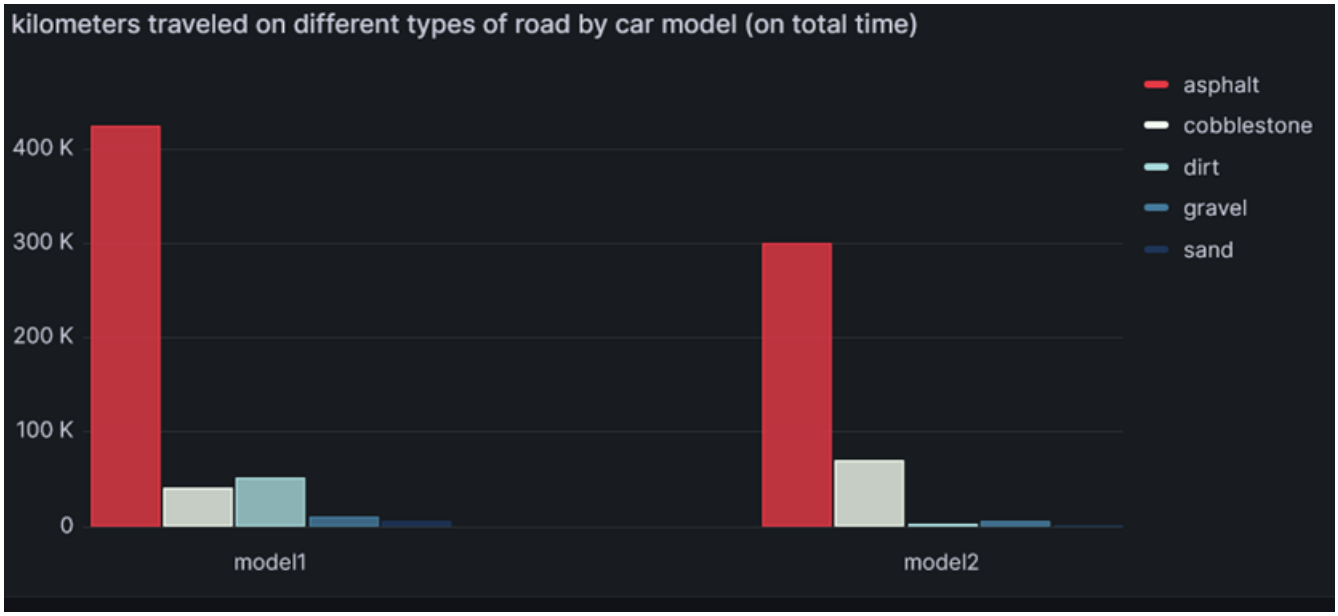

Figure 8.12: Km traveled on different types of road by car model

In Figure 8.12, the used data has the following structure: each car model is associated with the number of kilometers traveled for each road type.

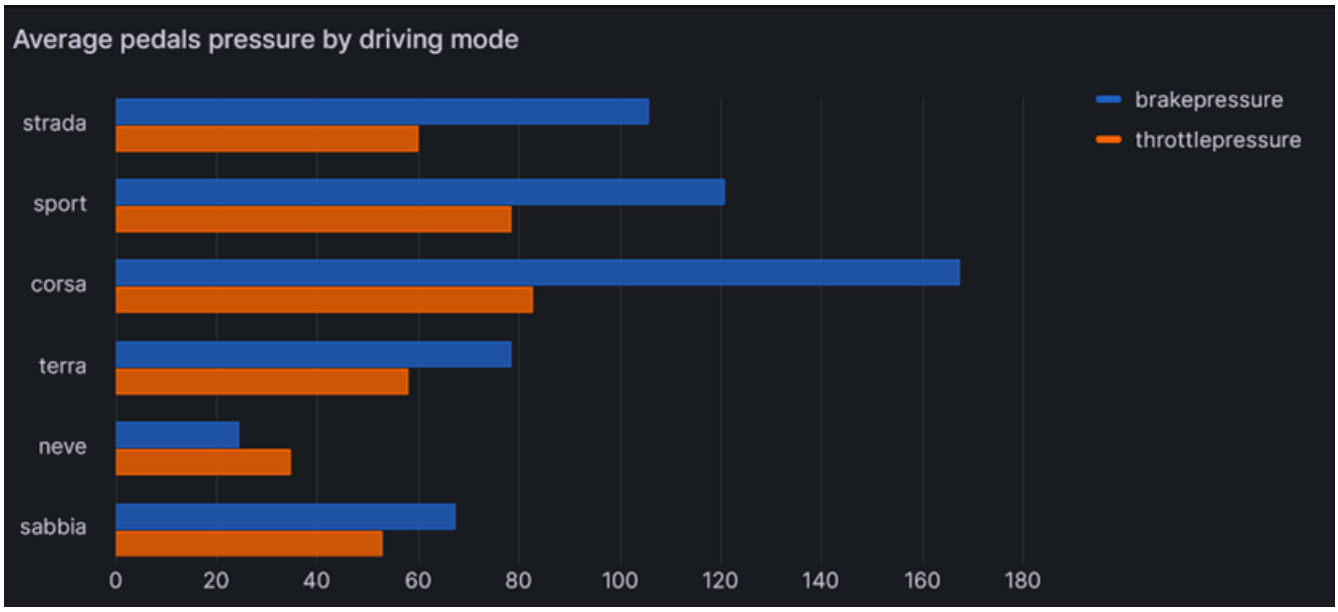

Figure 8.13: Average pedals pressure by driving modes

For the graph in Figure 8.13, the requirements are: unique name of the driving mode, average accelerator pedal pressure, and average brake pedal pressure.

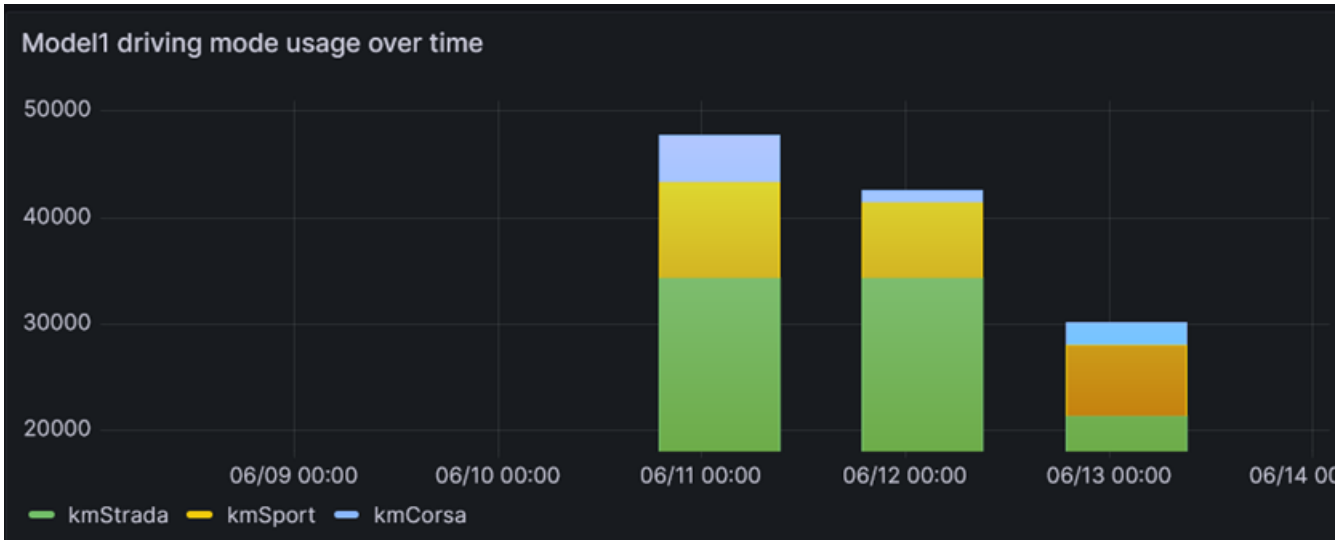

Figure 8.14: Model1 driving mode usage over time

In Figure 8.14, the used data includes car model, kilometers traveled for each driving mode, and the date and time of parameter recording. Instead, in the next two figures, a comparison between countries can be observed. In the first one, the requirements are: country, average vehicle speed, average trip duration, and reference day. In the second figure, in addition to the country name and day, the average pressure on the car pedals is also considered.

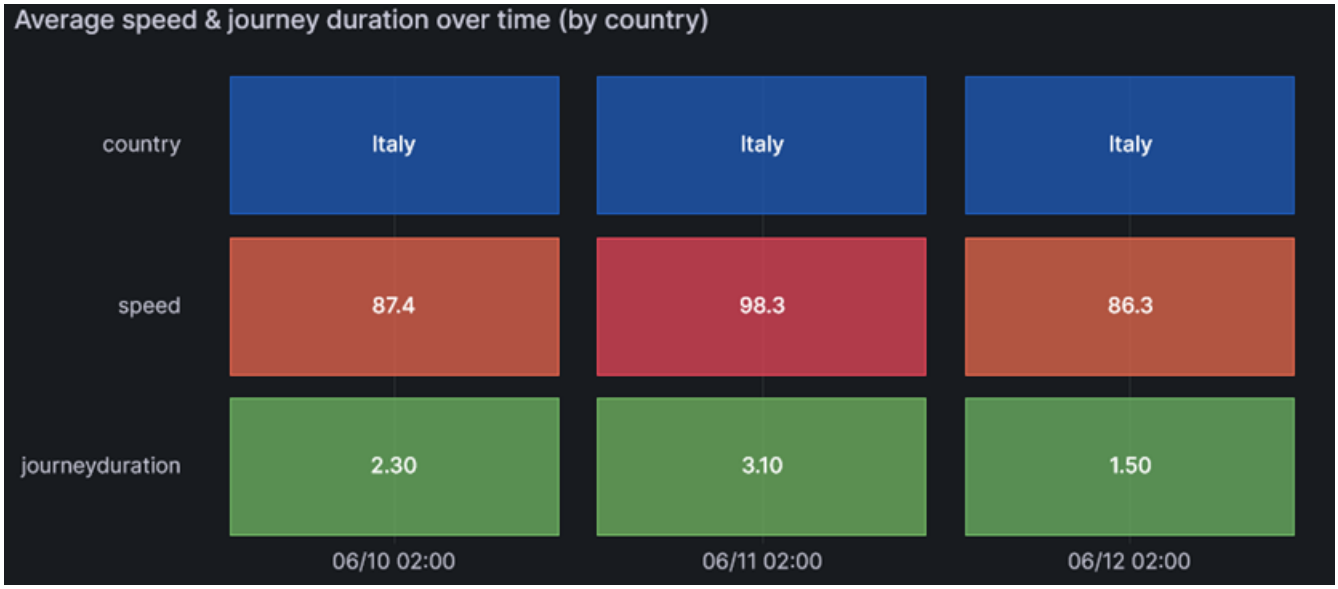

Figure 8.15: Average speed and journey duration over time by country

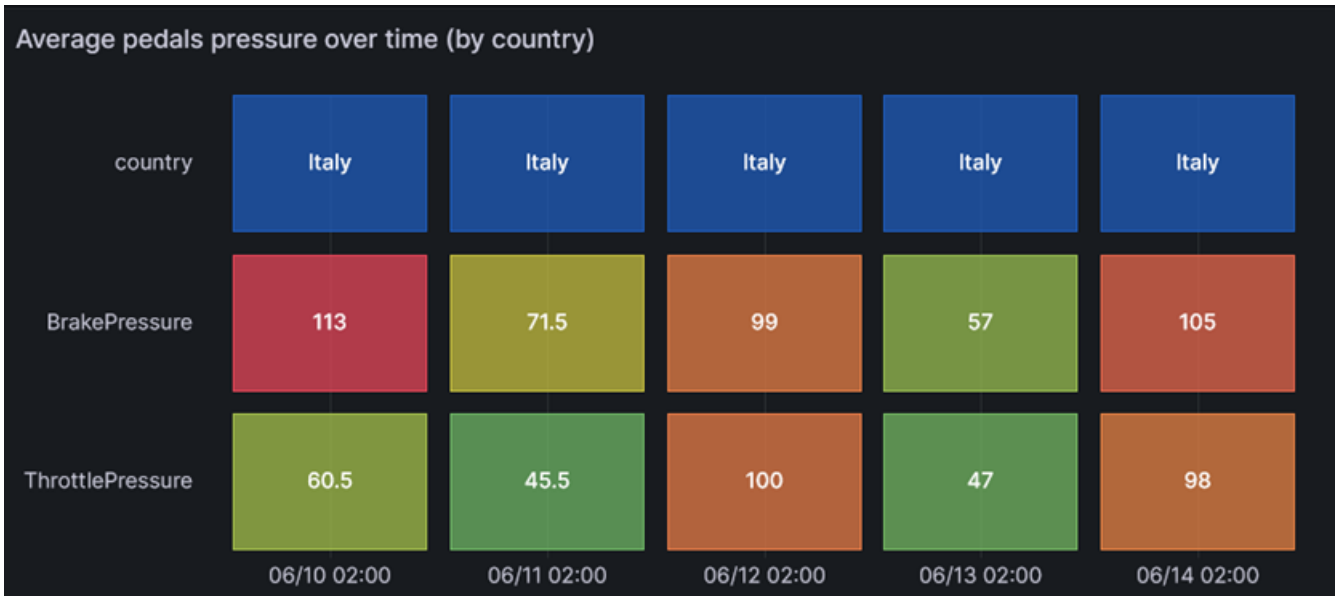

Figure 8.16: Average pedals pressure over time by country

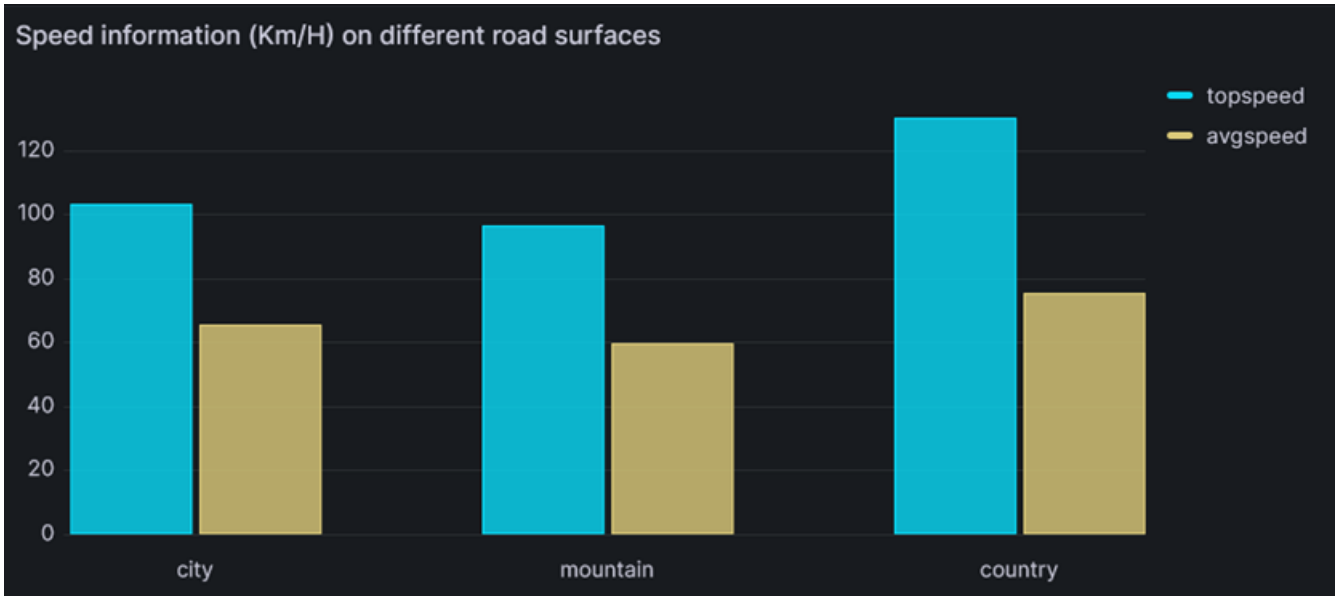

Figure 8.17: Speed information on different road surfaces

In Figure 8.17, the required data has the following format: unique identifying name of the road surface, maximum speed, and average speed recorded on that surface. Instead, in the next graph the speed values are replaced with pedal pressure values.

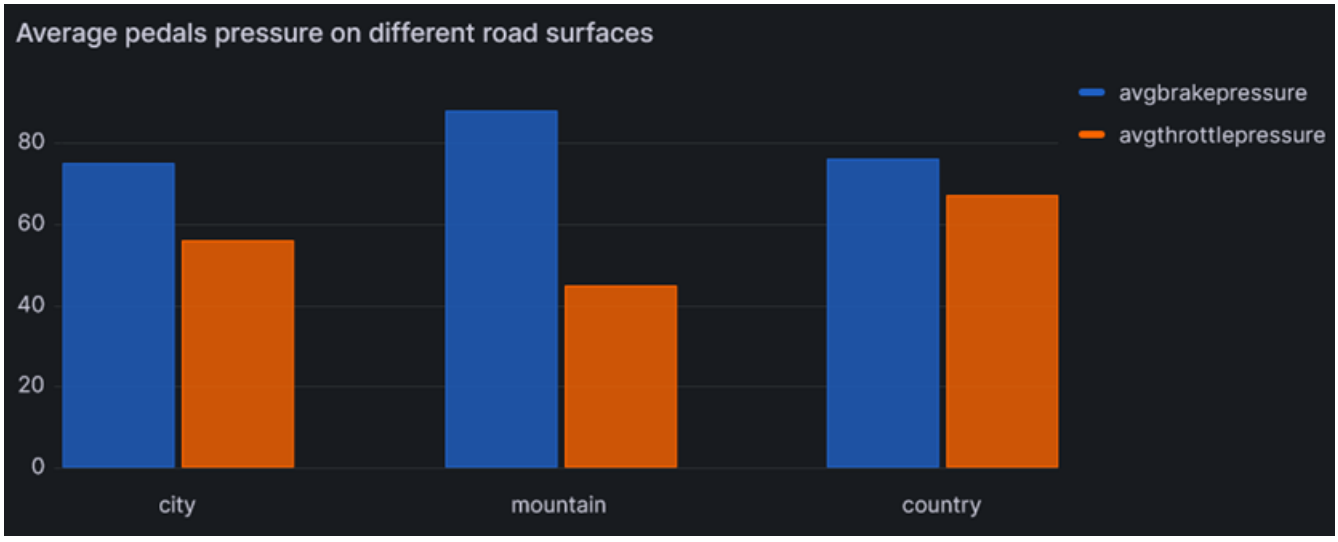

Figure 8.18: Average pedals pressure on different road surfaces

8.4 Internal Analysis Dashboard

In the internal analysis, we proceed with studying the behavior of fleet vehicles and comparing various car models of the automotive company with each other. For example, it is possible to monitor the movement and concentration of vehicles in different countries and create a ranking of the most frequented areas. Additionally, it is possible to analyze the distance traveled by different car models over time and estimate the time spent driving these types of vehicles.

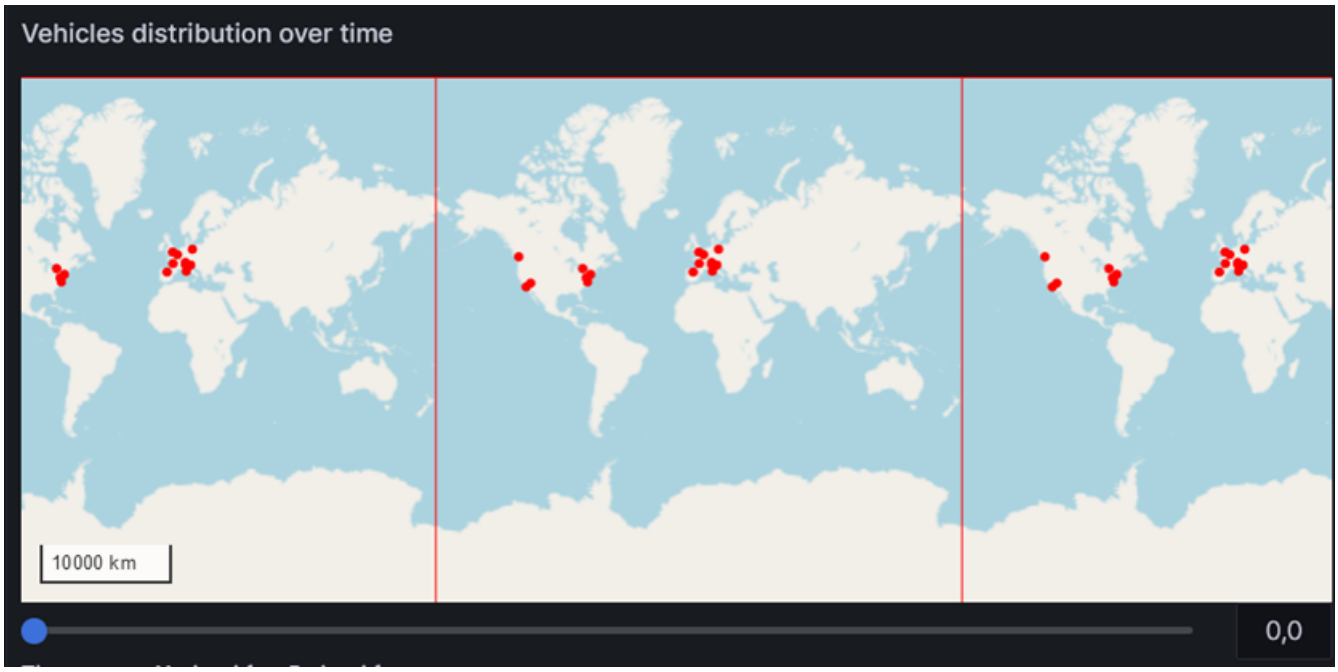

Figure 8.19: Vehicles distribution over time

Figure 8.19 displays the positions of vehicles using latitude, longitude, date, and time data.

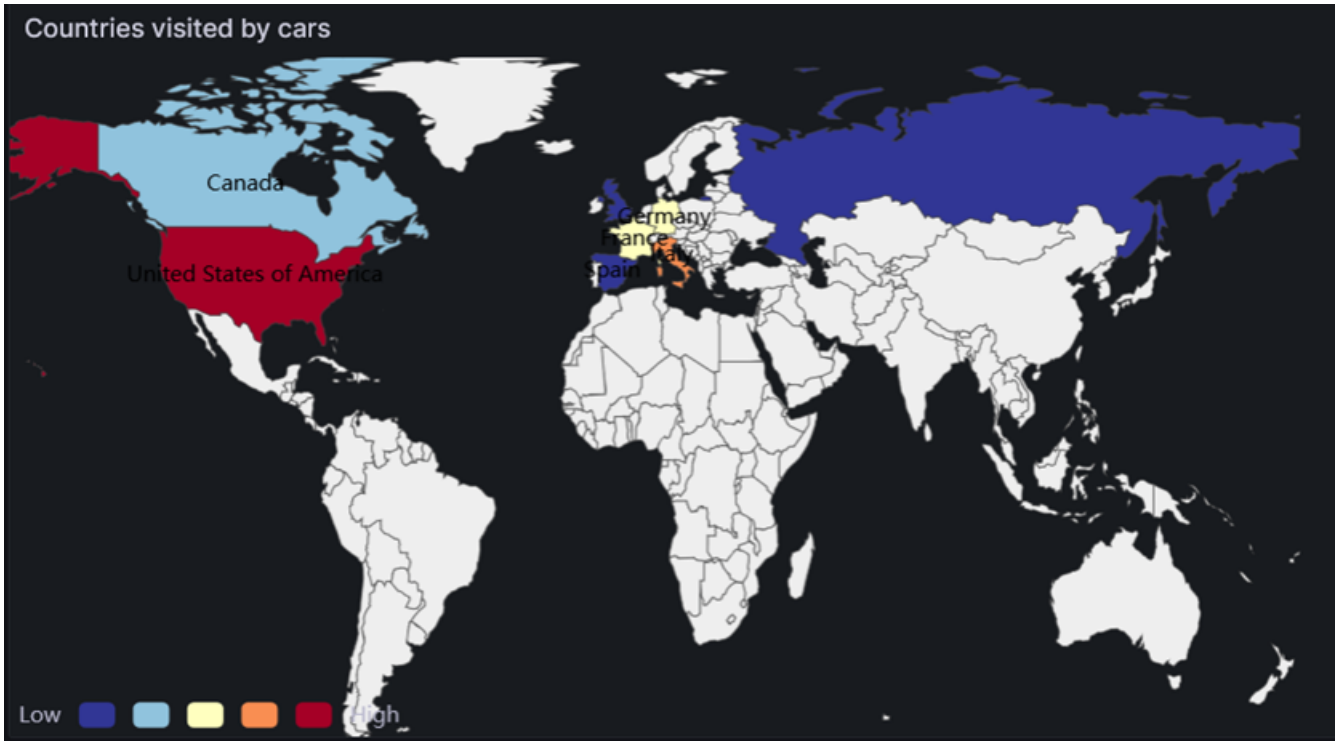

Figure 8.20: Country visited by cars

To create the chart in the Figure 8.20, it is necessary to know the number of visits made by the fleet's vehicles to each country (identified by its English name).

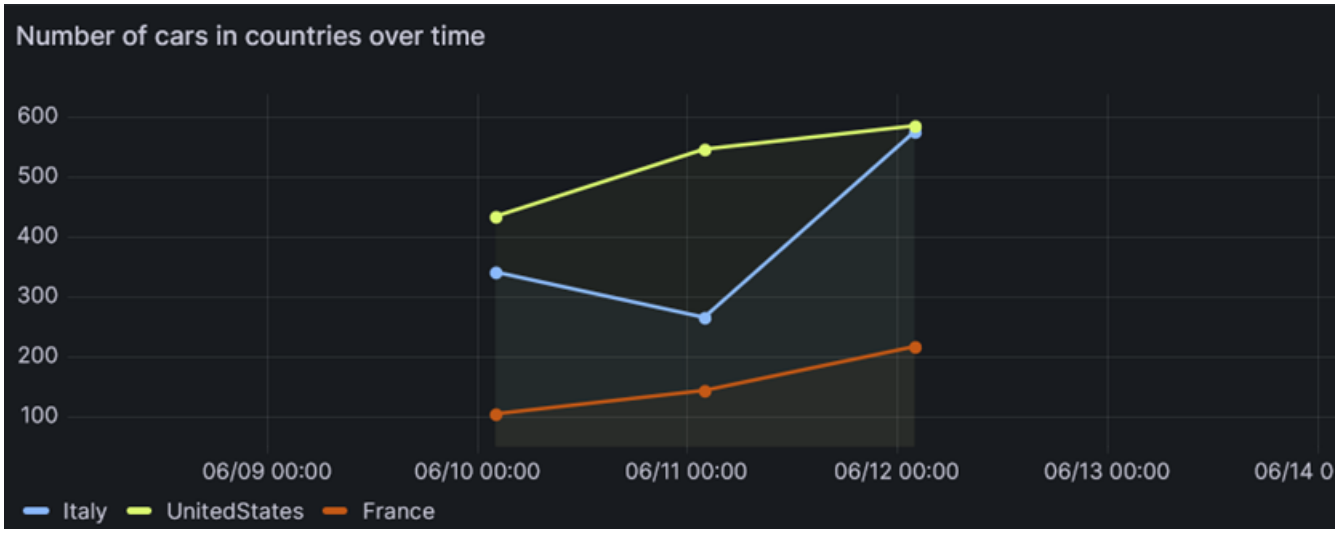

Figure 8.21: Number of cars in countries over time

In the previous chart, the input data includes the country name, the number of cars present, and the reference date and time.

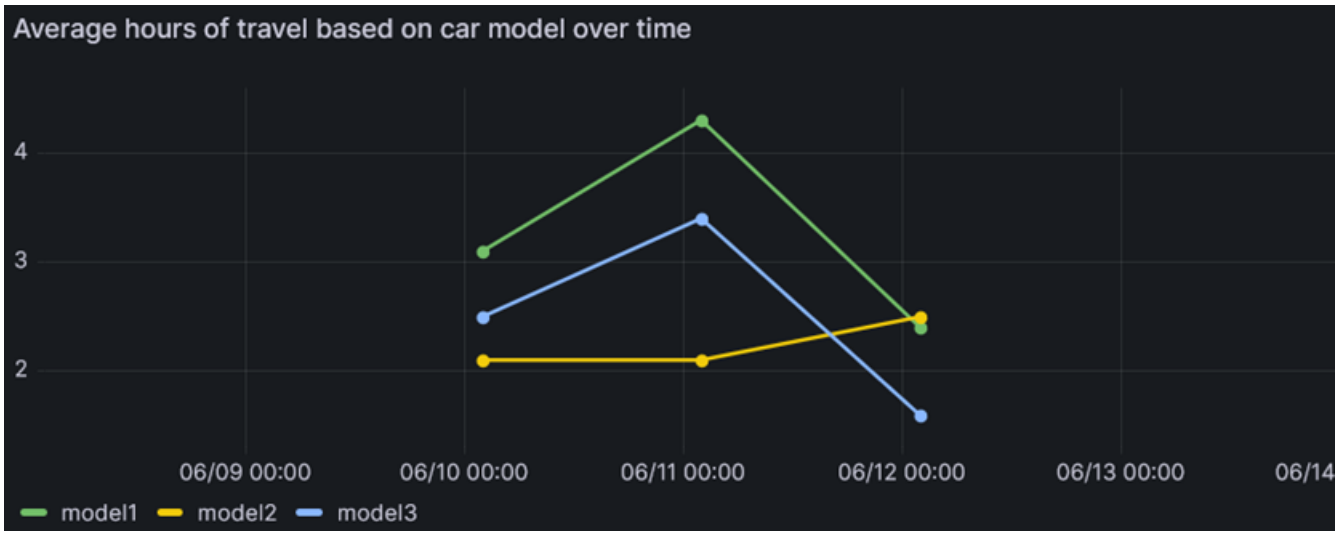

Figure 8.22: Average hours of travel based on car model over time

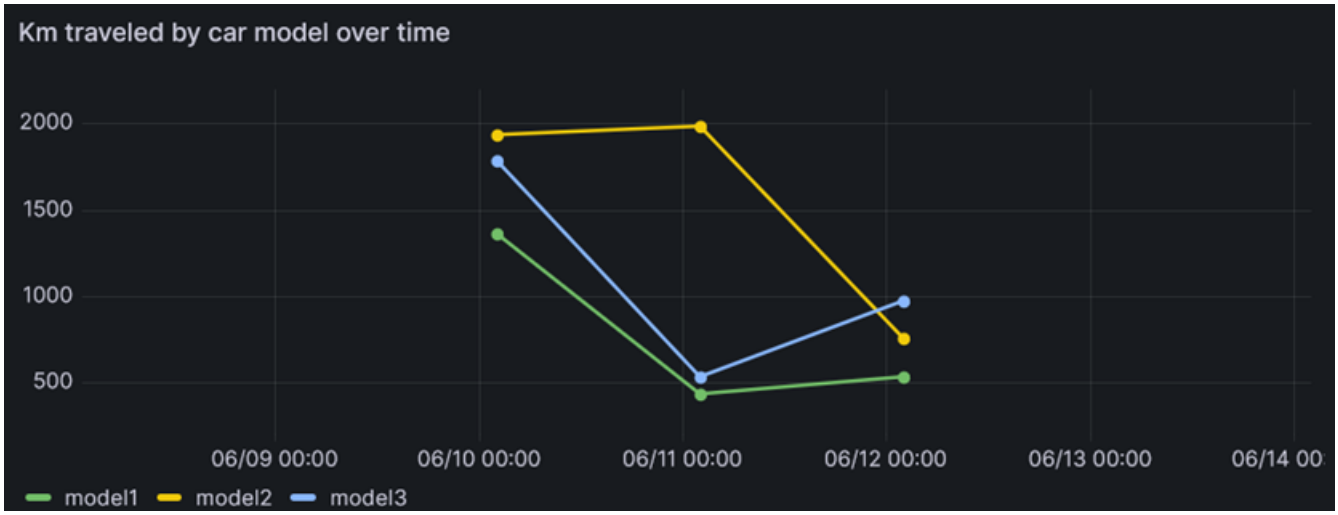

Figure 8.23: Km traveled by car model over time

Graphs in figures 8.22 and 8.23 use common data such as the car model name and date, but they differ in including the average travel hours and kilometers traveled for each model.

8.5 Personalization Dashboard

The last area of research is that of customization. Here, we can both study the behavior of the vehicle fleet and analyze the usage that individual customers make of their cars, with the aim of offering personalized services. From the fleet data, we can derive important information such as the areas most frequently visited by vehicles and the most popular points of interest. On the other hand, utilizing data from individual vehicles offers opportunities such as analyzing driving style, understanding the types of roads frequented, receiving information about travel duration, and analyzing driving modes used in different weather conditions.

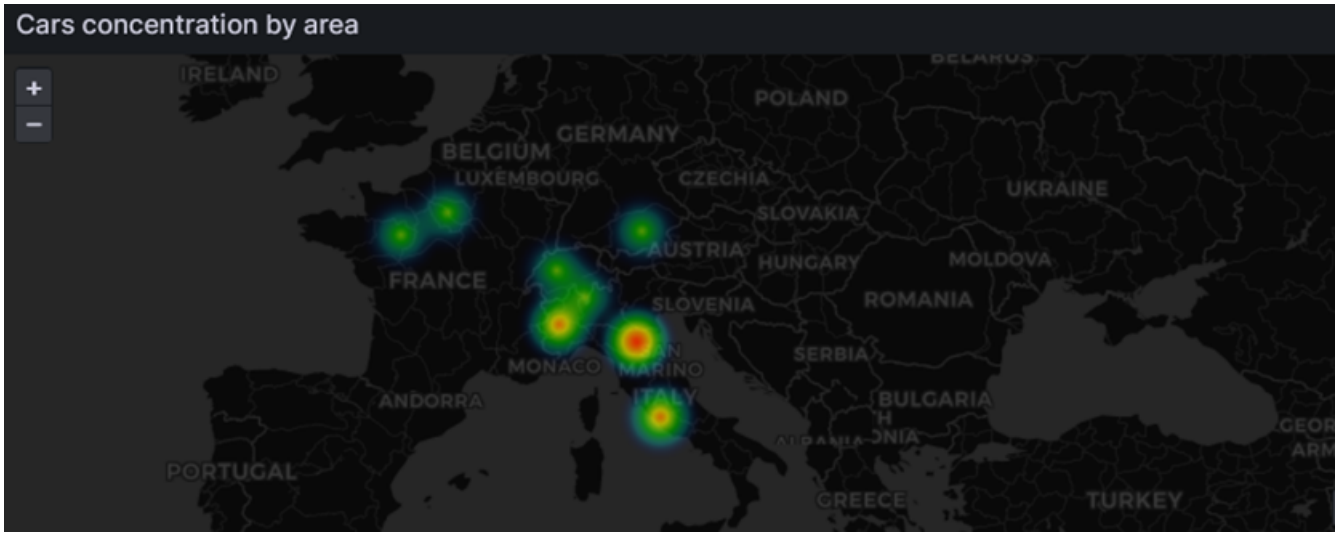

Figure 8.24: Cars concentration by area

In the first figure, the concentration of vehicles is shown based on the area, simply using the latitude and longitude data of the cars. In the next chart, a distinction is made based on the percentage of visits to points of interest according to age. Therefore, it is necessary to calculate these percentages and associate them with the age groups that are being considered.

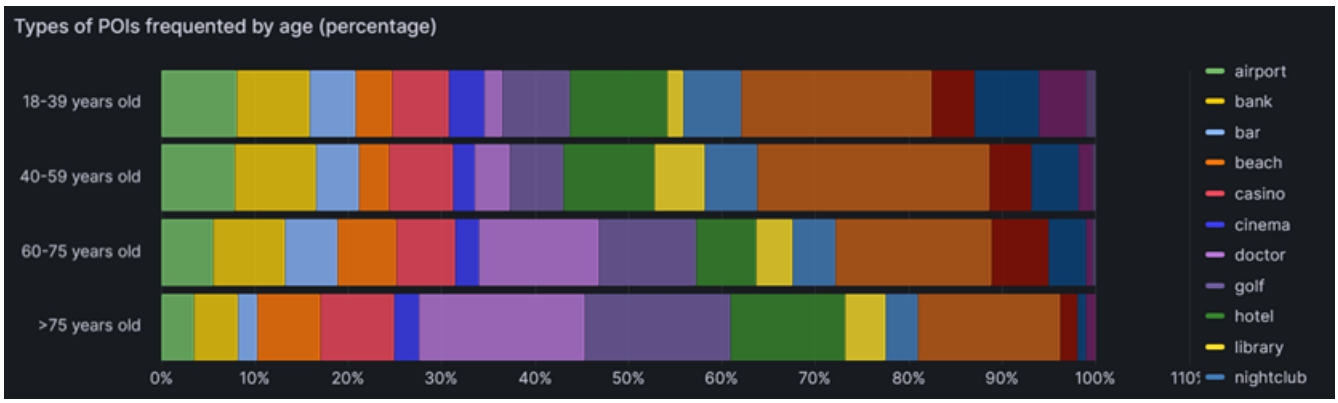

Figure 8.25: Type of POIs frequented by age

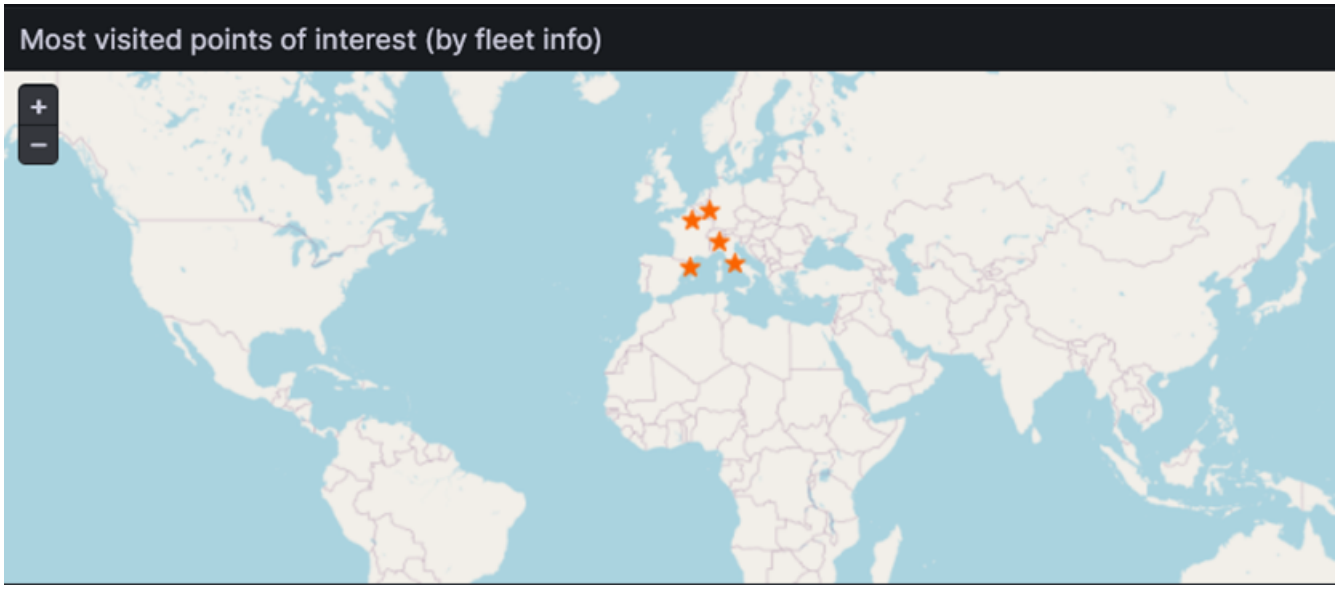

Figure 8.26: Most visited points of interest by fleet info

The graph in Figure 8.26 displays the most visited points of interest on a map, using the GPS coordinates of the locations along with their names. You can choose how many points of interest to display or filter them based on the number of visits.

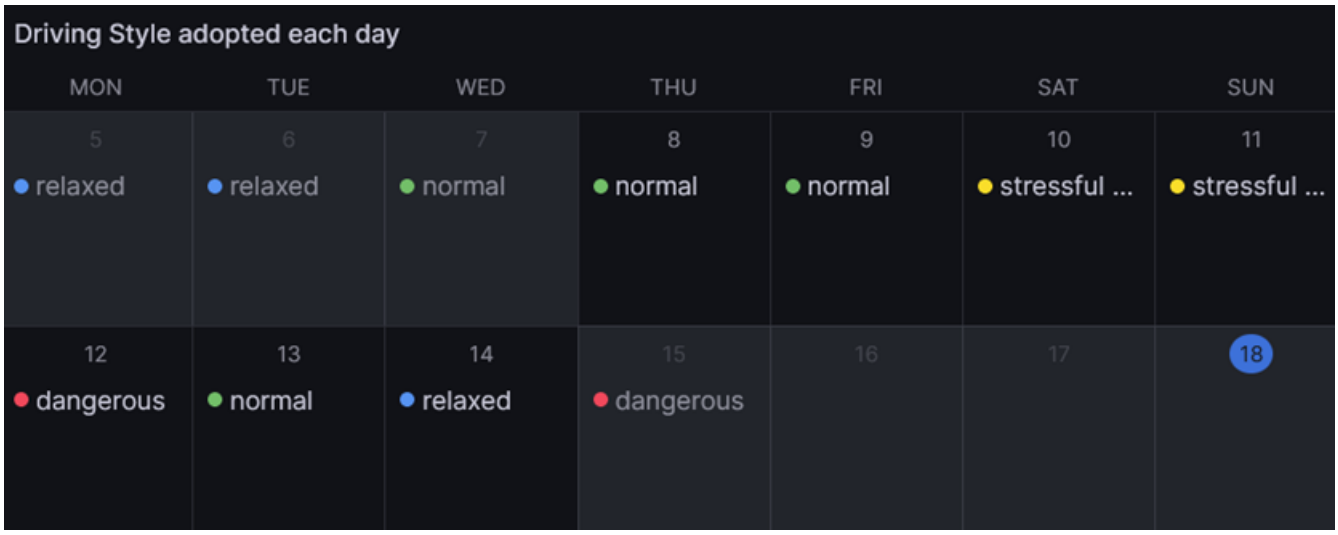

Figure 8.27: Driving style adopted each day

The graph in Figure 8.27 is a calendar useful to show data over time. In this case we want to analyze the driving style and the following data is required: description of the adopted driving style and the corresponding date.

Figure 8.28: Driving mode usage and weather condition over time

To create the graph in Figure 8.28, the used data includes the name of the driving mode, weather condition, precipitation level in millimeters, and the reference date and time.

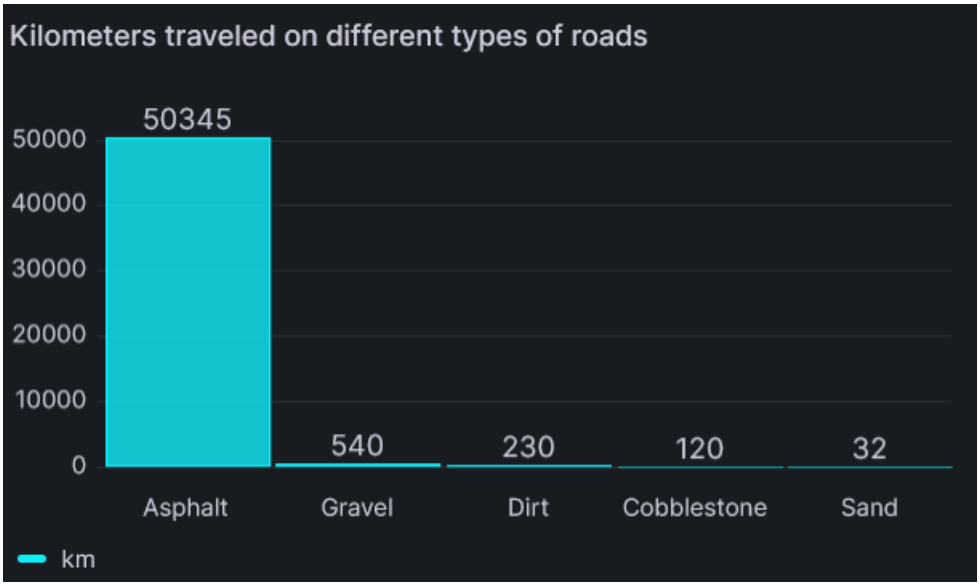

Figure 8.29: Kilometers traveled on different types of roads

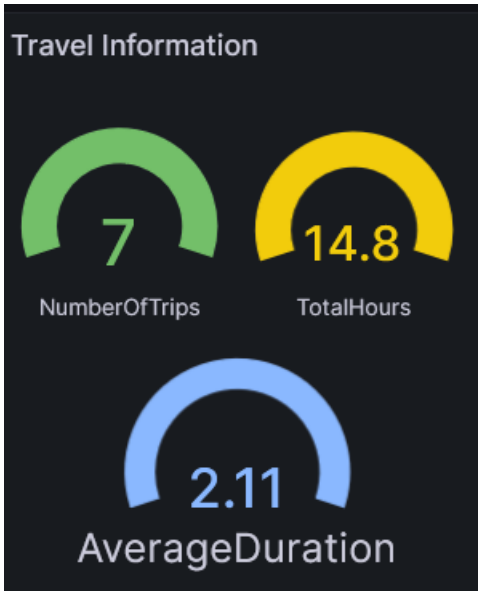

Figure 8.30: Travel information

Finally, in Figure 8.29, the required data is the road type and the kilometers traveled on it, while in the last graph, travel-related information is displayed. We need to calculate and return the number of trips, total hours of travel, and average duration in hours of a vehicle.

8.6 Complete Dashboard

Grafana allows you to move and resize panels at any time. Therefore, in order to have a complete overview of the composition of the various dashboards, in this final appendix, you can observe the organization of the several charts.

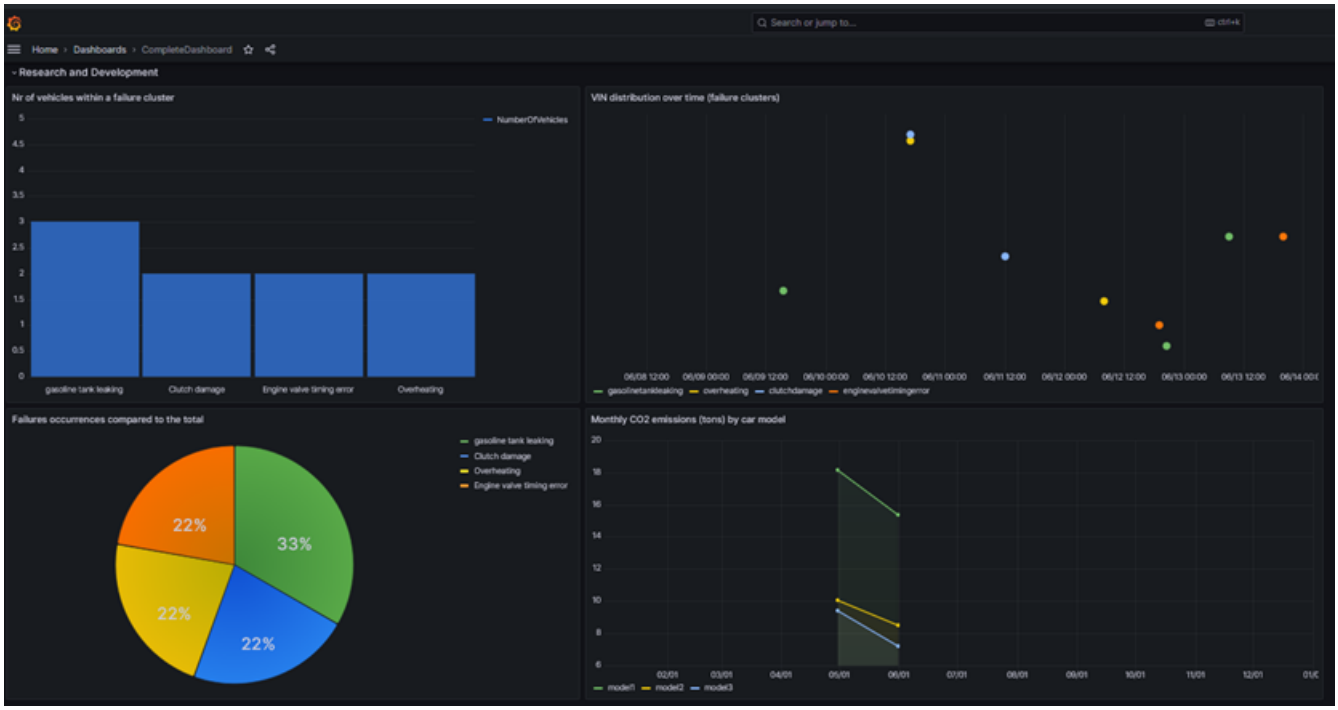

Figure 8.31: Research and Development Dashboard

Figure 8.32: Marketing Research Dashboard

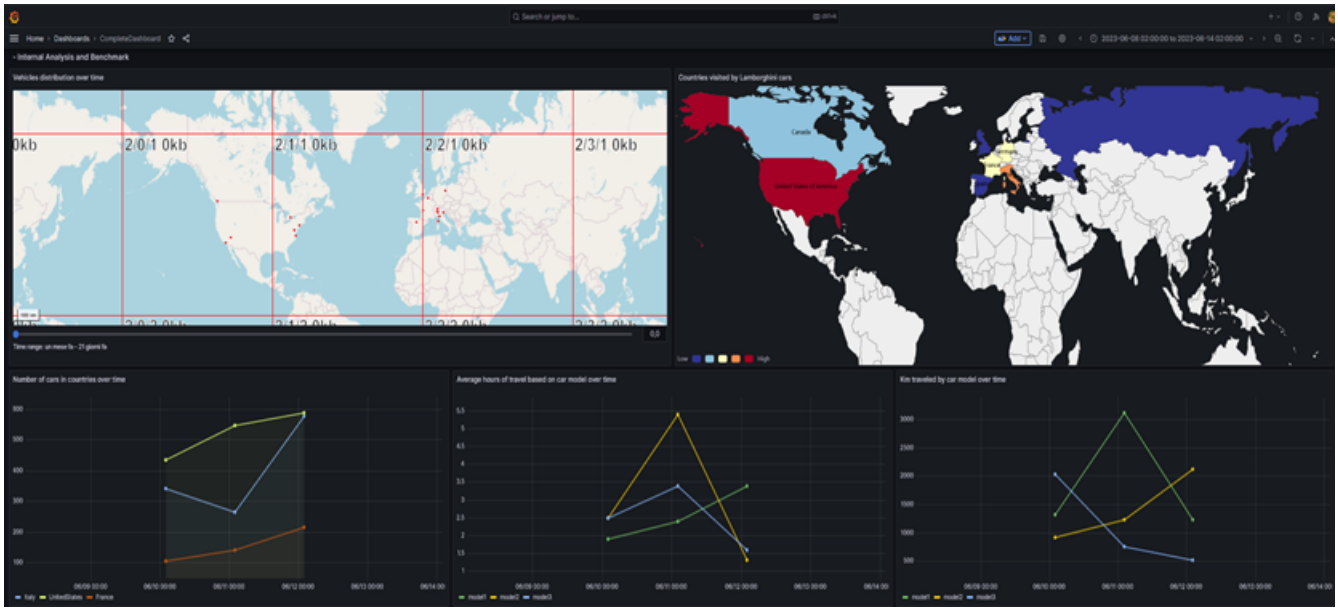

Figure 8.33: Internal analysis Dashboard

Figure 8.34: Personalization Dashboard

Conclusions

This thesis highlights the state of the art on data monetization strategies. In particular there is still little information on generic models applicable to the automotive industry. We have seen that the main ways of monetization are wrapping and bartering and that there are numerous other opportunities when considering other industries. Furthermore, in the automotive sector, the prevalence of these strategies varies according to the actors involved. So, we have understood that data-driven business models are a nascent business in this sector, but three generic models can be defined: data harvesting, data matching and as-a-service. Starting from these models, it is then possible to define activity domains that can be applied to generate value from the data. Furthermore, a literature review on the concept of luxury was carried out, with the aim of understanding how it can influence data monetization in the luxury car sector. In addition, research has been conducted on the role and influence of emotions in the relationship between the brand and the customer. The result is that aspects such as reputation and brand value should always be considered, as well as making the customer feel an integral part of the project and engage him emotionally. Taking all these aspects into account, a series of premium services have been proposed that owners of luxury cars could wish for. Moreover, a dashboard has been implemented that OEMs can use to study the behavior of the car and its driver, thus having the possibility of offering a wide range of services, ranging from predictive maintenance to the creation of customized products.

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