

# DATA AS A POTENTIAL PATH OF THE AUTOMOTIVE AFTERSALES BUSINESS TO REMAIN ACTIVE THROUGH AND AFTER THE DECARBONISATION

## Abstract

Decarbonisation of transport implies transition and shift for many traditional businesses, one of which is the automotive aftersales. One of the strategies identified to address decarbonisation and meet GHG emissions targets is the adoption of Electric Vehicles (EVs) and other green power train technologies. Nonetheless, decarbonisation and EVs are not the only drivers that menace the automotive aftersales. Data also appears as an emerging actor in the industry that could prompt influential transformations in conjunction with EVs and decarbonisation strategies.

In this paper we aim to identify and understand the aftersales stakeholders' perspectives related to the current challenges posed by decarbonisation strategies and examine potential responses that the automotive aftersales business could undertake. Semi-structured interviews with a variety of automotive industry experts were used. The interview topics were based on results from an online survey and extensive document analysis. The interview sample involved expert stakeholders from original equipment manufacturers (OEMs) and the independent aftermarket (IAM) with experience in Latin American and European markets. The interviews addressed three main topics: (1) Trends and future expectations; (2) Impacts on aftersales; and (3) Public policy. This paper focuses primarily on impacts of decarbonisation on automotive aftersales and the potential role of data in that business.

Results show that investment in technology will be a condition for businesses that want to remain active in the industry which could affect small players. Furthermore, experts agree that incumbent manufacturers are not filling the technology gap that the energy transition is creating in the automotive sector, a consequence of which will be the entrance of new players from other sectors. The aftersales business will be transformed to B2B which potentially means loss of bargaining control of current players. Moreover, policy makers are seen as unreliable to lead the transition agenda.

These results will be used to inform further scenario-based research to develop future scenarios for aftersales business under different strategies and suggest recommendations for new business models considering decarbonisation strategies.

Keywords: Aftersales; Automotive sector; Decarbonisation; Customer service; Electrification of vehicles; Data; Remote diagnosis; New business models

## 1. Introduction

Today, the automotive industry is undertaking a transition toward decarbonisation. Alternative power train technologies have a key role to play in addressing climate change and global warming challenges from the transport sector. Traditional internal combustion engine (ICE) vehicles are over 95% dependent on fossil fuels, which generate over 95% of greenhouse gas (GHG) transport emissions (Graham-Rowe et al., 2011, Tapio et al., 2007).

The development of alternative technologies such as: Battery electric vehicles (BEV), Plug-in hybrid electric vehicles (PHEV), Fuel cell electric vehicles (FCEV) and Biofuels have the potential to disrupt the automotive aftersales market (Eslava-Bautista et al., 2021). Projections to find dominant power train technologies (PTT) or discard ICEs are not straightforward. Decarbonisation of transport implies not only the adoption of greener PTT but also disruptions for traditional business models in the aftersales business based around the use of fossil fuels. Electric mobility will potentially challenge the traditional aftersales value chains, as labour and parts revenue from an electric vehicle (EV) would drop between 1/3 and 1/2 compared to that generated by a traditional ICE vehicle (Truett, 2017). Furthermore, EVs require longer maintenance intervals that accompanied with other technologies improvement for example have reduced the labour force 14% in German dealers and workshops between 2000 and 2014 (Diez et al., 2014). EV adoption will require fewer 'wear & tear' parts and additional units (Truett, 2017, Dombrowski and Engel, 2014). 50% of aftersales business income comes from working parts, crash parts, diagnostics products, and service but it is estimated that working parts will deaccelerate their income share in the industry due to increasing parts quality, electric mobility, and price competence. Instead, growth is foreseen from diagnostic services and digitalization of car data (Breitschwerdt et al., 2017)

Aftersales is the time when manufacturers must supply technical support to customers (Díaz and Márquez, 2014). This definition differs from authors such as: Confente and Russo (2015) and Armistead and Clark (1991) who do not limit aftersales in time or Juehling, et al. (2010) who frame aftersales in the asset life cycle. An aftersales strategy involves warranty provision, extended service contract, availability of repair and maintenance services and spare parts (Confente and Russo, 2015).

Impacts of decarbonisation on automotive aftersales are a contemporary phenomenon that is relatively understudied (Dombrowski and Engel, 2014, Juehling et al., 2010). The current context and future scenarios for decarbonisation-aftersales interaction are not clear (Ortar and Ryghaug, 2019). Whilst there is significant research related to the transition to cleaner means of transport, decarbonisation impacts on automotive aftersales have not been examined comprehensively.

Traditional aftersales work around CO<sub>2</sub> emissions that ICEs generate and those necessary interventions to maintain, and repair these engines and additional units in ICEs (Dombrowski et al., 2011). Most of these interventions are not required by EVs. One of the strategies identified to address decarbonisation and meet GHG emissions targets is the adoption of EVs (Rozzo, 2016). However, alternative PTT are not alone in the background. Data and decarbonisation strategies seem to be disruptors of an industry which business model has not drastically changed through the last century. The automotive industry is not looking for simple technological innovation but it is examining for innovations related with the community and novelty on business models (Donada and Lepoutre, 2016). Business models describe how organisations use their own resources through a set of transactions that create value for customers and shareholders (DaSilva and Trkman, 2014).

The Latin American (LATAM)-Europe approach allowed exploration of decarbonisation-automotive aftersales interaction which would not be possible with a single study area. Potential future paths for the automotive sector presents multiple factors, such as geographic conditions and availability of

natural resources, for example, Norway has the potential to source its EVs from green energy sources, Poland has its coal industry and France can use the nuclear electricity which is its main energy source (Ortar and Ryghaug, 2019). LATAM, that contain emerging economies, have dissimilar green energy strategies such as: Biofuels in Brazil (Ackrill and Kay, 2012) and hydro-energy capacity in Colombia (Espinel et al., 2021). Furthermore, the vast Lithium resources and other rare minerals in Chile, Argentina, and Bolivia (Barandiarán, 2019).

In this paper, we aim to identify and understand the aftersales stakeholders' perspectives related to the current challenges posed by decarbonisation strategies and examine potential responses that the automotive aftersales business could undertake. This paper is divided in five sections, beginning with a background review of the literature which introduces concepts that were explored in the interviews. The second section describes the methodology applied for the semi-structured interviews. The third section reports the results. Next, the conclusions section discusses the perspectives found in the interviews, finishing with a discussion of future work.

## 2. Background

Greenhouse emissions in transport sector are majorly contributed by passenger cars and light duty vehicles (EPA, 2023). Potential impacts of decarbonisation on the automotive aftersales industry have previously been reviewed by the authors (Eslava-Bautista et al., 2021). This evaluation studied academic and grey literature to assess the transport decarbonising strategies. It is suggested that new units and type of vehicle on the roads will be influenced by the proposed policies that intend to reduce car use and ownership (Eslava-Bautista et al., 2021). Reduction of units in operation (UIO) represents lower utilization of workshops and garages for service interventions. This review also found that national energy security and industrial policy concerns will influence the adoption of PTT depending on geographical conditions of regions and countries such as mineral resources (Ortar and Ryghaug, 2019, KPMG, 2019). Eslava-Bautista et al. (2021) found that further research on impacts of transport decarbonisation strategies upon automotive aftersales is needed. Moreover, new technologies that have the potential to threat the aftersales business must be analysed by the different stakeholders involved in the automotive sector (Gissler and Müller, 2008). Dombrowsky and Engel (2014) go beyond and state that literature do not examine properly the new technologies and their effects on small players such as IAM parts shops, garages and small OEM dealers.

Weidenbach et al. (2019) refers to the new business income streamline related to client data generated from a vehicle as: Car as a platform. It is emphasised that OEMs could prevail in this market if they control the interaction with the client. However, it is forecasted that client data which OEMs potentially could collect is not at the same level of depth and value as client data collected by technological firms such as e-commerce platforms (Weidenbach et al., 2019). Which could result in a convergence phenomenon, which is the overlapping in terms of activities, technologies, products, and customers (Sampler, 1998) and generate the collapse or repositioning of barriers within a sector driven by macro-environment forces .

Furthermore, Weidenbach et al. (2019) suggest that OEMs could focus on monetise car data instead of client data information to develop new models such as: road infrastructure, vehicle geolocation, usage-based taxation, traffic. flow management, parking, charging network systems, smart grid, location / time-based marketing, in-vehicle commerce and trunk delivery, health monitoring, insurance policies and fraud recognition. A similar approach is suggested by (Foundation et al., 2014)

which can be seen in Figure 1 that depicts a new ecosystem of needs, and new services, it seems a step forward for car manufacturers who are expected to be the players who manage the majority of issues around charging. (KPMG, 2017)

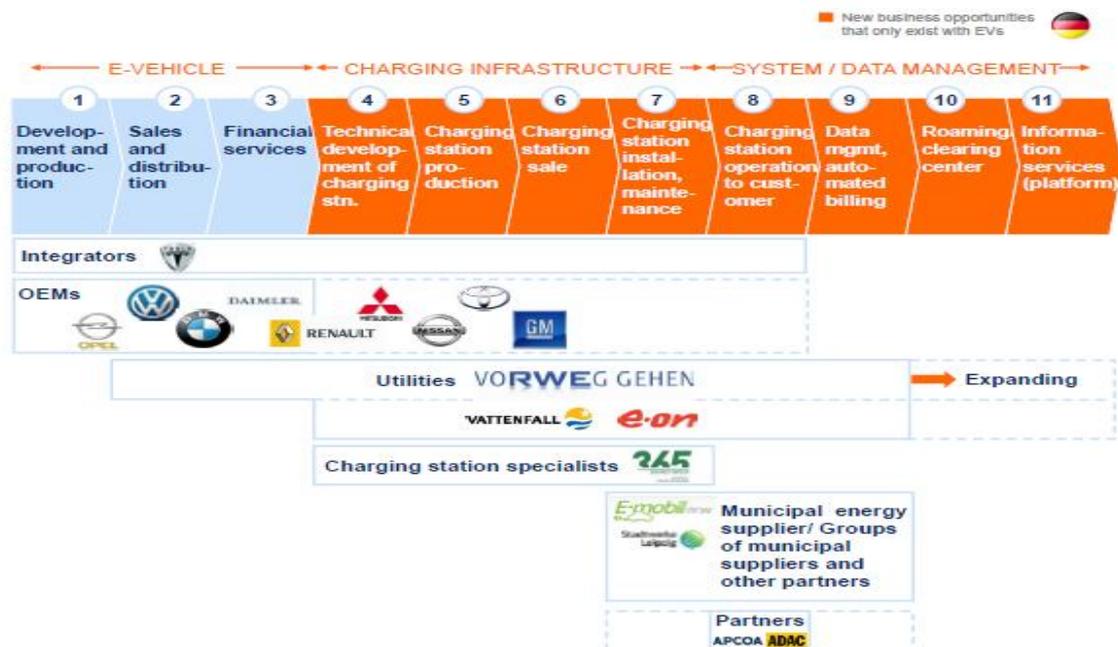


Figure 1 New business models opportunities exclusively generated by EV's Source: McKinsey (Foundation et al., 2014)

OEMs could prioritise partnerships rather than develop conventional capabilities to achieve targets (Weidenbach et al., 2019) permitting potential integration and consolidation strategies. Integration is an entry barrier which could delay the entrance of new players to a sector (Karakaya and Stahl, 1989) and consolidation is a defence mechanism to preserve the prevalent position of organisations in the existing market (Johnson et al., 2008).

From the aftersales stakeholder perspective, the business network appears consistently in any geographic context, interacting with each other no matter the regional level of integration and firm size (Breitschwerdt et al., 2017). Automotive aftersales business integrated by 5 stakeholder groups (parts manufacturers, parts distributors, workshops, intermediaries, and end customers) and two supplier models, OEM, and the IAM.

Durugbo (2020) identified and analysed 249 peer reviewed articles, published between 1970 and 2018, all of them related to aftersales with the purpose to examine aftersales literature. Related to the examination of aftersales by industry sectors papers, the automotive sector is the most scrutinised with 25% (62 out of 249), followed by manufacturing-industrial sector that concentrate 15% (37) of reviewed literature and electrical-electronic with 9% (22). Furthermore, 62 papers in almost five decades support the scarce research on automotive aftersales. Gissler and Muller (2008) highlight the importance of aftersales. Whilst aftersales contribute 54% of the automotive sector profits, sales of new cars only contribute 11%.

Through an insightful assessment of the relevant literature about electrification, it is evidenced that there is no extensive literature that analyses the relationship between decarbonisation and aftersales of alternative PTs. Moreover, Durugbo (2020) categorise the retained articles for his review by peer reviewed journal, and it is evidenced that there is no journal focused on environmental sustainability.

The major contributions of research on aftersales are: product life cycle, aftersales strategy, spare parts logistics and process-oriented approach (Saccani et al., 2006).

Another noticed void in this literature is the lack of research of automotive aftersales in emerging and developing economies. Only Gissler and, Muller (2008) refers tangentially to the robustness of the independent aftermarket in countries such as Russia.

Decarbonisation matters are extensively discussed by both academic and grey sources, with varied methodological approaches. By contrast, for the automotive aftersales topic, relevant and rigorous literature is scarce. Consultancy reports are the main source of evidence in the topic area and whilst this work is often timely and interesting it often lacks clear evidence of methodological design and associated rigor.

To sum up the main drivers to investigate aftersales in the automotive industry, it could be concluded that decarbonisation or environmental causes are not among the reasons to approach aftersales field examinations even in the last decade that decarbonisation and sustainability concepts have gained importance in the academic debate. Aftersales was long neglected by OEMs in their strategic planning, until noticing relatively recently that their aftersales business units are more profitable than sales of new cars (Gissler and Müller, 2008). Aftersales is not commonly seen as an independent profit and income stream or independent business, in industries other than the automotive sector.

### 3. Methodology

Semi-structured interviews with automotive industry experts were used to identify and understand the aftersales stakeholders' perspectives related to the current challenges posed by decarbonisation strategies and examine potential responses that the automotive aftersales business could undertake. Interviews assist exploratory studies to understand information in its context that would be impossible to examine otherwise (Easterby-Smith et al., 2021). These are the most popular primary data collection methods in exploratory studies (Dudovskiy, 2014).

A stakeholder map was developed identifying 16 different groups segmented by 22 levels of strategic responsibilities to identify the population of interest. Mapping is an important stage to understand who the research stakeholders are, where they come from and what their role is in a business (Morris and Baddache, 2012). This methodology involves four phases: Identifying, analysing, mapping and prioritizing. The process develops a list of criteria to analyse each identified stakeholder, these criteria are: Expertise, willingness and value, which is evaluated by stakeholder influence and necessity of involvement. Table 1 lists the stakeholder groups that were approached to participate in this research.

STAKEHOLDER GROUP	SUB-GROUP	STAKEHOLDER GROUP	SUB-GROUP
DEALERS	BOARD	SPECILISED MEDIA	SPECILISED MEDIA
DEALERS	UPPER MANAGEMENT	ACADEMIA	ACADEMIA
DEALERS	MIDDLE MANAGEMENT	CONSULTANTS	CONSULTANTS
DISTRIBUTORS	BOARD	INTERMEDIARIES	UPPER MANAGEMENT
DISTRIBUTORS	UPPER MANAGEMENT	INTERMEDIARIES	MIDDLE MANAGEMENT
DISTRIBUTORS	MIDDLE MANAGEMENT	EMPLOYEES	TECHNICAL
CAR MANUFACTURERS	MIDDLE MANAGEMENT	CUSTOMERS	FLEETS
PARTS SUPPLIERS	UPPER MANAGEMENT	CUSTOMERS	INDIVIDUALS
POLICY MAKERS	GOVERNMENT	GUILDS	GUILDS

INDEPENDENTS WORKSHOPS	UPPER MANAGEMENT	ENVIRONMENTAL ORGANISATIONS	ENVIRONMENTAL ORGANISATIONS
AFTERMARKET PARTS SHOPS	UPPER MANAGEMENT	INFLUENCERS	INFLUENCERS

Table 1 Stakeholder's list to participate.

This research involved 22 online or phone-based semi-structured interviews. Twelve Latin American (participant IDs L1-L12) and ten European professionals (participant IDs E1-E10) in the automotive sector with experience at top and middle management levels and automotive and aftersales consultants participated in this investigation. The recruitment of participants and completion of interviews took place between September 2020 and June 2021. Due to the geographic origin of a significant part of the potential participants, the interviews were undertaken in both English and Spanish.

The participants were identified from:

- the lead author's personal contacts met during his professional career.
- participants who took part in the earlier online expert survey and indicated a willingness to participate in further activities (9/22 participants).
- and other persons suggested by interviewees or identified by internet searches through social network such as: LinkedIn.

All the participants have been in the automotive industry for more than 10 years, with exception of three individuals with consultancy background experience related to the automotive industry. Some participants initially expressed hesitation to participate in the interview as they presupposed the discussion would focus upon high level technical issues related to electric vehicles.

Topics addressed in the interviews included: 1) Perceptions of trends and scenarios regarding alternatively fuelled vehicles, 2) Opinions regarding potential impacts of alternatively fuelled vehicles on the automotive aftersales market, and 3) Opinions regarding policy and market influences on adoption of alternatively fuelled vehicles.

The semi-structure interviews were performed using video conferencing tools and were recorded and transcribed, before being analysed and coded in the software NVIVO. (One interview took place via email).

Furthermore, understanding the cultural, historical, geographical, and industrial context of this research data is one of the strengths of the lead author given his experience in the automotive and aftersales sector.

#### 4. Results and Discussion

The result section is structured in three main sections. The first section discusses trends and future expectations related to new business models in the automotive industry. The second section integrates the impacts of decarbonisation and new business models on traditional automotive aftersales, and the third section discusses public policy, considered necessary to have a successful transition from ICEs to alternative PTTs.

## 4.1 Trends and future expectations

This section discusses the trends and futures expectations from the perspective of new business models that the automotive industry could adopt driven and caused by the energy transition. The evidence reveals that participants identified three potential new business opportunities relating to: (1) Mobility practices, (2) distribution of energy, (3) data. Addressing any of these business opportunities by car manufacturers would imply integration, consolidation, and convergence.

### 4.1.1 Mobility practices

Disincentivising the use and ownership of passenger cars appears as a main decarbonisation strategy (Xenias and Whitmarsh, 2013) alongside promotion of active transport such as cycling and walking which are considered more environmentally friendly (Matowicki et al., 2021)

Car-sharing schemes (CSS) are a flexible model, that appears as an option to car users, in which the user occasionally enjoys the benefits of a private car without incurring in the common detriments of car ownership (Ceccato and Diana, 2021) such as higher fixed and variable costs (Schaefers et al., 2018). It seems that the concept of CSS in the participants is not completely understood, and the general perception is that CSS mean fewer UIOs but there was little reflection about the level of utilization that a vehicle could have.

It is evidenced that there is no unified interpretation or opinion about the impacts of CSS on automotive aftersales. E1, E9, L2, L4, L9 and L12 do not perceive positive impacts on automotive aftersales while E2, E3, L3 and L6 say that the CCS could be a good option but are not completely sure.

Furthermore, E5 addressed the saw potential benefits from CSS with the increase of car utilisation which would benefit the IAM maintenance services as an effect of increased speed of fleet ageing. Some participants interpret that CSS could generate a drop of UIOs which would affect negatively aftersales, and these kind of schemes would lead to a shift in the nature of customers as corporations and fleet would become the new large group of clients. E1, E3, E5, E6 and L12 think that this result would be risky for OEMs as it could change the bargaining balance between suppliers and customers such as: insurers, fleet customers with stronger negotiating power and solid data analytics capabilities. E2 and E3 highlight that CSS could succeed only in urban areas and E2, E7, E8, L1, L3, L6, L11 consider that is car ownership is still considered a necessity for certain demographic groups and cultural change is needed to accept such alternative mobility options.

### 4.1.2 Distribution of energy

Participants considered the potential opportunities that could arise from distribution and storage of energy. Five participants expressed positions related to distribution and storage of energy as an opportunity or trend that the automotive manufacturers could develop. Related to BEVs, L9 states that automotive brands will need to develop own capabilities or agree alliances with architects or construction companies to provide the charging point at home. L8 suggest that OEMs wholesalers could develop integrated customer services such as: the intermediation between vehicle customers and their electricity supplier.

If FCEVs prevail in the market, the new aftersales would change drastically as the infrastructure to charge hydrogen would not be allocated at home. L12 states: *“85% of EV recharging is done at home rather than in the public grid and hydrogen will not have that option”*. E9 highlighted the lack of industry experience in distributing renewable energy and pointed to limited infrastructure coverage and the importance of economies of scale to deploy infrastructure. Amelang (2023) affirms that natural gas transport and distribution infrastructure can be used for the same hydrogen purposes.

Distribution of energy creates a link with potential applications of hydrogen in vehicle segments and type of clients. As commented earlier the path for FCEVs is seen feasible for buses and heavy-trucks rather than passenger cars (Trencher and Edianto, 2021) and Hydrogen is seen as complementary option for other type of transport such as trains (Amelang, 2023) which economy of scales would help the development of FCEVs for busses and heavy truck segments. Subsequently the nature of FCEVs clients would be drastically different, which would be associated with the shift in supply-client bargaining power, also discussed in the mobility practice and spare parts sections.

#### 4.1.3. Data

Data is a very popular term which underpins top trends in the future of the automotive industry (Becker et al., 2018, Breitschwerdt et al., 2017, Weidenbach et al., 2019). Literature and participants use terminology such as: digitalisation, data monetisation, big data, or data analytics. Evidence from these interviews suggests that most participants include the use of data as a top trend in the industry and a source of new potential business models. Data is understood by some participants as the potential instrument to keep the contact with the customer and create barriers to competitors along with to oblige customers to keep a relationship. Although most of participants are uncertain about the potential of data, some participants such as E2, E5, E6, E9 perceive the difference between the data which belong to the car (**car data**) and the data that can be used to know the client (**client data**). E2, E3, E4, E5, E6, E9 L7 think that **car data** will transform maintenance in a more predictive and anticipated maintenance. From LATAM, L7 predicts *“It will have to become more predictive... EVs have very few materials that wear out”*. Furthermore, E6 supported predictive maintenance trend indicating a positive scenario for OEMs. E9 agrees to the concept of data as a remote diagnosis enabler. E5 infers some advantages that **car data** would provide for aftersales business and the customer experience.: *“... the manufacturer can decide much earlier on service demand, and they can interact with the consumer immediately”*. L11 expects more efficient logistics with lower operation costs.

In relation to **client data**, participants identified issues such as: associated data services outside the automotive industry and potential new players, capabilities such as data storage, data ownership and legal issues. The entrance of new players, with stronger capabilities to deal and manage data, is seen as a strong threat to the incumbent players. Companies such as: Google, IBM, Amazon which are specialised in technological capabilities and their core business is to create income streamlines from data generated by customers as E6 states *“Google would love to have all of the information regarding every single car on the road ... It's data about the users of the car”*. L8 considers that the barriers for digital sector giants are more complicated to overcome than those constraints that incumbent OEMs could surpass. Moreover, OEMs are capable to prevail in the battle for the customer relationship (KPMG, 2020).

Some participants agreed that incumbent OEMs could feel out of their core business and face new challenges dealing with data: *“OEMs don't generate the data themselves, they generate lots of*

*internal data testing and transactions, they know a lot about the technology, they know very little about the market. In any case, an intense dispute is expected between incumbent car manufacturers and new players from the digital sector for the new data aftersales income streamline (Breitschwerdt et al., 2017) as E6 stated: "There will be a whole raft of people wanting to enter the market, because data is valuable".*

E6 infers that OEMs will find the way to monetize that data *"OEMs, put a lot of resources in place to ...make some sort of value from that"*. Some other participants consider that OEMs are capable to develop the needed resources to deal with data. L8 is aligned with the view that **client data will change the role of aftersales in the industry**: *"Aftersales will not be the mechanic,...the ftersales will be to give the customer... solution and give them the added value.... Example, financing, insurance, keeping an eye on the customer's apartment, who keep the key in the apartment? [or] renewing the flood insurance"*.

At the same time, L8 highlights the emerging challenges related to cybersecurity issues *"... if they hack their cell phone but hacking a car have serious consequences"*.

## **4.2 Impacts on aftersales**

This subsection focuses on impacts upon the traditional aftersales operation from decarbonisation and growth in EVs. Evidence illustrates shifts in the characteristics of vehicle workshops and parts operation due to remote operations permitted by specialised tools and software, elimination of lubricant handling, and reduction in maintenance frequency.

### **4.2.1 Technical customer service**

Evidence related to this topic suggests that technical and traditional services will be negatively impacted or could experience a drastic transformation due to decarbonisation. This transformation will be disruptive but is likely to generate opportunities, allowing space for new services which facilitate the creation of new business models underpinned by better exploitation of data and software advancements. Anticipated new business model trends point to a closer relationship with the customer using data generated by the vehicles.

Nearly two thirds of participants highlighted the importance of data and software to facilitate new technical customer services. Key areas for development in this regard were identified as **remote diagnostics** which is an application in new vehicles which is related to connectivity instruments (Dragojević, 2018) and **predictive maintenance** which is based on monitoring data to detect anomalies in production processes, manufacturing equipment and products, and diagnose and prognose (Compare et al., 2019)

It is generally agreed by interviewees that remote interventions to vehicles, using specialised tools and software, will be common. These remote interventions imply consequences on the labour force reduction. E3 associates the reduction in number of workshops with the decline in the number of technicians from 2030 to automation in diagnosis and a consolidated industry. Under these conditions OEMs could benefit, as they have the innovation capability to create customised tools and specific diagnostic equipment.

Participants identified the need of creating new reasons to make the customer return to the workshops which are not necessarily physical workshops but virtual (E2, E5, E6, E7, L3 and L8). It

could be inferred that as the investment will not be addressed toward hardware assets the number and size of workshops could be reduced, as E1, E5, E7, E9, L2 and L3 expressed. Fewer workshops could remain in the market.

Associated with this perception, almost a fifth of interviewees considers inefficiency as a common factor inside OEM aftersales networks. If it is assumed that service interventions to EVs are less frequent but need high investment in specialised tools, a high margin should be involved in the final price to keep viability in the business. However, these interventions are simpler and do not demand intense labour force or other resources such as time. So that currently inefficiency would convert in a fair margin for the dealer and fair price for the customer as L6 denotes: *“if a current dealer were to charge the customer fairly there would be no impact on the customer, the costs would simply be re-coupled to the customer”*.

Participant E9 considers the EV aftersales market size would not accept inefficient practices: *“there's not going to be the market to support the industry as it currently sits, I think there's inefficiency in the aftersales business as it stands today”*. It could be interpreted as a threat that could materialise upon OEM aftersales which could be uncovered as a consequence of the EVs adoption.

E9, L8 and L11, shows a common interest on the use of physical space as a source of inefficiency. E9 assessed potential opportunities such as reduction in the size of workshops and garages to eliminate inefficiencies E9: *“Many service centres in the US in Europe, when you remove waste oil storage and you remove exhaust gases from the equation, the repair facility become different, you can go into just about any warehouse, you can build them very small, they're very inexpensive to consolidate a lot of bays. And existing capacity to me, there's plenty of floor space if you go into any workshop anywhere at least half of the workspaces not being used”*.

L6 identified a type of intervention that currently is practiced with ICEs and concludes that EVs cannot have that kind of intervention: *“Out of every 100 cars, 90 enter the workshop because gauges are lit. And that problem is linked to emissions...”*.

At the same time, the technical human resource would need to be retrained and formalised with higher skills. One example is the knowledge that the utilisation of cutting-edge tools such as: scanners, potentiometers, and applications that permit remote access will demand from the technical labour force.

#### **4.2.2 Spare parts**

Most participants considered that the spare parts business will be the most affected business stream due to EVs requiring fewer wear & tear parts and additional units such as pumps and clutch. E7 considers that small players in the OEM channel, such as dealers, parts shops and workshops in the IAM channel, will be the most negatively affected. E5 stated that IAMs parts business will need to invest in technology, innovation and develop some cooperative models within the channel.

It is understood that risks are not coming straight from new PTTs and innovation in general but from inner movements in the aftersales sector as E5 agrees. E5 foresees that OEMs want to appear in the IAM channel without damaging their core OEM parts business which could mean acquisitions of IAM channel companies which E5 calls horizontal integration with other OEMs or IAMs stakeholders.

Over one third of participants (E1, E3, E7, E10, L1, L6, L7, L11) agree that the role of digital platforms such as Amazon or eBay will be feasible on generic or easy-install parts, which do not have significant

profit margins for OEMs, rather than complex and captive components, which is the main interest of OEMs, arguing that they are the most profitable and interesting parts for the OEM channel. Some participants think that selling automotive parts implies the assembly of the new parts on the vehicle. Digital platforms would need to develop new capabilities which may not be attractive for them in order to assemble new parts. On the other hand, there are restrictions of specific information that are exclusive to manufacturers such as the electronic parts catalogues (EPC). EPCs are the main source to identify the right part code to a specific car. Although, interviewees are aware that digital platforms such as Amazon have developed automotive divisions, for OEMs, creating alliances with digital platforms to market parts would mean sharing commercially sensitive information which would be a risk.

Participants foresee standardization of parts and specialisation as the main strategic responses. Specialisation of parts is based on evolution of own capabilities to innovate and maintain new players outside their niche of interest. Most participants saw an opportunity for OEMs to create specialization in some parts which are apparently generic using innovation to create entry barriers to new potential business players. E3, E7 and L6 agree about the limitation for digital platforms to supply installation as their business is based on intangible transactional information such as availability of reliable data related to have low financial costs, rather than physical tangible interventions such as assembly of new parts. E9 emphasises the interest that OEMs have in captive parts, as main source of profits: *“[OEMs] make more money on captive parts. Parts that only they make, it's their core technology, they don't really have competition from the aftermarket ... The core technology in EVs is even more [than in ICEs].* Most of the participants estimate that digital platforms such as: Amazon or eBay could obtain a strong portion of the spare parts trade business but in the segment of generic parts rather than captive parts.

E9, who has a background in EV manufacturing, contradicts the opinion of most of participants in terms of negative projections for income and profits of spare parts business: *“Don't assume that it's going to be simpler, don't assume that you can have fewer SKUs (parts), sort of parts value content, just take the complexity of the engine and the simplicity of the fuel tank and swap it. Now you have a very ... simple motor, and then a very complex energy storage system, which is the battery and they both require maintenance. The number of components in the engine are now in the battery - it gets much more complex... the thing that people miss is that it's going to change your inventory, that you can't store that [a battery] in the same way you store an engine block. If you don't maintain it on the shelf, and you just leave it there, it will eventually...degrade, so it depreciates ... I don't think it has fewer working parts. You've got 1000s of cells, each one of those has a connection, or two connections, there are temperature sensors, there are PCBs, there are bleed resistors: there's a whole host of technology and complexity. ... It's just shifted into the energy storage and people forget ... in an AC induction motor in EVs battery ...it contains many 1000s of small wear items. I think it's more of a shift than a replacement or an elimination of complexity and value and content for the after sales”.*

Few participants brought to the discussion arguments related to competence & consumer protection. E1 states that there is a high level of uncertainty related to repair rights which is relevant to the warranty process *“None of us know the impact... repairers is going to have the government's moving towards much more rights and repair. I'm not sure where the legislation will move, about enshrining right to repair, and we don't know what that looks like”*

Díaz and Marquez (2014) defines warranty as the agreed period which the manufacturer is committed to support the client without enquiring them any kind of monetary compensation if the sold good fails. Warranty management is a main driver of some studies where it is argued that complex products and services need assistance (warranty) and businesses resources to supply the

client with technical services (Díaz and Márquez, 2014, Trencher and Edianto, 2021). Warranty regulation is another uncertain matter that regulators must approach to the transition debate, E5 reflects *“Warranties role!...Oh difficult question because there is a market regulation, But practice shows different consumer perception I imagine that warranty can play a major role for OEMs”*. L1 remembered that one of the OEMs obligations by law is to offer support and back the consumer for 10 years in the Colombia case *“even by law, aftersales must have infrastructure when the EV is released to the market”*.

Warranty is among the principal non-technical factors that significantly impact the willingness to buy an EV (Wicki et al., 2022). It is expected that warranty claims increase for the OEM with the growth of EVs in the roads (Tavant, 2023), but this kind of conclusion lacks scientific support and need further examinations. Furthermore, it contradicts L6 who suggests that as EVs have fewer parts, so fewer failures will occur.

Matters related to EVs warranty usually point out to the battery. EV batteries are seen as potential source of income for dealers and manufacturers but solid business models are not structured yet (Slattery et al., 2024). Most manufacturers support the customer with eight years warranty (Fallah and Fitzpatrick 2022). OEMs decide if the batteries that fail in the warranty period are: Refurbished, remanufactured for reuse, repurposed as stationary battery or recycled for scrapping (Slattery et al., 2024).

#### **4.2.3 Impacts on investment strategy**

Uncertainty surrounds the automotive industry from different angles. The investment strategy that stakeholders must adopt to remain in the market is still uncertain as E1 states, *“There is uncertainty about how the aftermarket supply chains will develop and how sales will develop and how the vehicle manufacturers will react”*. Most participants accept that incumbent manufacturers are not filling the technology gap that the energy transition is creating in the sector which could simplify the entrance of new players from other sectors.

Although a participant from a European consultancy firm states that car manufacturers have been developing and executing aftersales strategies related to new business models, the perception of most participants, particularly from LATAM, is that that kind of strategic decision-making is not disseminated down toward aftersales top and middle management.

Another important agreed element between participants that contributes to the uncertainty in investment is the unpredictability of governments' role, highlighted by L1: *“Brands risk boosting technologies and then the government will regulate and put absurd rules to catch up with technology adoption”*.

Many of the interview participants agreed that there was likely to be coexistence of technologies in the long term (2050), such as: BEV, PHEV, FCEV, Biofuels and current ICEs based on traditional fossil fuels or natural gas (NG), which could be classified as an alternative technology.

Around one-third of participants agreed that in the long term (after 2050) the coexistence of technologies will not be feasible and there will be one dominant technology. A few participants (E1 and L1) considered it impossible to determine the final outcome.

Another element that increases the uncertainty for investment is due to commercial practices of OEM stakeholders such as: dealers, and distributors as E2 highlights *“They still offer dealer bonuses*

*linked to the ICEs rather than the EVs*". It is understood that OEMs dealers do not have substantial incentives to sell EVs instead of ICEs based on the potential negative impact of EVs on aftersales. Current practices associated with ICEs business models are perceived of as out-dated and the fact that new players come from different sectors, even without experience manufacturing vehicles, would disrupt the inner thinking of the industry.

### **4.3 Public Policy**

To provide a wider and deeper understanding, this section considers technological issues and new business models under the following perspectives: market acceptance of strategies to decarbonise transport, and the roles of local governments to accelerate the adoption of EVs.

#### **4.3.1 Market acceptance of strategies to decarbonise transport**

European participants addressed their opinion mainly toward aspects such as nonconformity and the low credibility of regulators to set the decarbonisation agenda. Additionally, to nonconformity and low credibility, LATAM participants also discussed matters such as: unfamiliarity, inexperience, and improvised measures to address decarbonisation agenda. Both regional groups highlight the influence of population age and generational change of mind and suitability of those strategies in terms of capability and sufficiency to address transport decarbonisation.

Some European participants explicitly considered that decarbonisation strategies would be accepted by their markets. E8 emphasises the lack of focus on ownership by younger generations, who may be more attuned to the customer experience.

Against a positive acceptance of decarbonisation strategies, half of all participants considered no acceptance or discouragement of the use and ownership of cars soon. Two interviewees considered EVs will not help to meet decarbonisation targets in the short term. Furthermore, the subsidies to buy EVs were criticised as they are addressed to those sections of the public who do not need subsidies to make the decision of buying an EV. E5 referenced external elements to the transport decarbonisation debate such as use of subsidies and better ways to decarbonise *"I think subsidies alone make no sense. We have discussions here. These subsidies we have today are going in the wrong direction..."*

Examining the LATAM responses, around one-third of participants expressed that decarbonisation strategies will be accepted by the market after a generational change. A similar proportion of participants considered decarbonisation strategies such as discouraging use and ownership of cars will not be accepted in the short or midterm. Security and safety of cyclists and pedestrians and lack of plans to invest in active transport infrastructure are factors that support this perspective.

#### **4.3.2 Role of policymakers to promote the adoption of EV**

The discussion about the role of policy makers to promote the adoption of EVs identifies two major types of policies which policy makers could focus: Infrastructure and Labour force. There was no agreement about one specific type of policy or instrument being the best to improve EV adoption.

#### 4.3.2.1 Infrastructure

Participants stated that the role of government should be addressed toward availability of EV charging points for houses with and without street parking. Furthermore, it is necessary that governments involve more green technologies in the decarbonisation debate. It was stated that strategies to promote EV charging points at home would be more effective than car purchase subsidies (E5). Participants (E1, E5 and E6) expressed awareness of pressure and biased debate in benefit of BEVs while some other technologies have been neglected. E5 referenced external elements to the transport decarbonisation debate such as use of subsidies and better ways to decarbonise. *“People who can afford an electric car today, do not depend on subsidy of 6000 euro”*. E5 also point out to charging infrastructure of ‘neglected’ technologies, such as: FCEVs: *“We [Germany] would like to have a more, technological open discussion on power trends. ... there are no clear plans to invest in infrastructure to make hydrogen a feasible solution.”*

Three participants from BRICS (Brazil, Russia, and India) economies suggested that there will be different options depending on regions and energy matrices, industrial interest, and policy. L10 cites the example of Brazil, where ethanol has been developed in the last decades: *“In Europe, you have one energy matrix; in Asia, you have another one. West, you have another one. In Brazil, we have a different energy matrix.” “The difference is that here in Brazil, we have a large adoption of ethanol.” “There won't be to invest a lot in infrastructure.”* E3 also refers to Brazilian case: *“Yes, if power generating capacity does not match with BEVs electricity demand”; “[Countries have] local priorities resources: e.g., Bio-ethanol in Brazil”*

Supporting the discussion about potential technologies that could change the pace of EV adoption, incumbent car manufacturers have different approaches. FCEV is backed by Toyota as the future for passenger cars, FCEV finds contradictors such as: Volkswagen that expresses that for passenger cars all factors incline the balance toward BEVs (Baxter, 2020). Additionally, BloombergNEF concluded that the majority of the car, bus and light truck segments aim to adopt BEV technology because is a cheaper option than FCEV, however, BloombergNEF leaves an open window for FCEV as viable technology for vans and trucks (Baxter, 2020).

The EV adoption in Europe is gradually growing since 2010. The European EV market share in 2022 was 22% which means a growth of 4% compared to 2021 (EEA, 2023). BEV is the prevailing PTT with 12% market share in 2022 while PHEV scored 9.4%. The highest market share was found in Norway 89%. In LATAM the EV market share is almost insignificant as the EV market share in the region is lower than 1%. Costa Rica has the highest EV market share (2.7%) (BloombergNEF, 2022)

#### 4.3.2.2 Labour force

Related to labour force, three characteristics were identified. First, a combined effort from Government and car manufacturers to retrain labour resource is needed; second, the type of skills required will demand different capacities by technicians and third reduction of technical labour force.

LATAM participants show concerns about labour force education and training policies for EV adoption that seemingly have been neglected by the public agenda. L2 agrees with the need to retrain labour force, but additionally adding the need to formalise the technical human resource in the LATAM market.

L5 is concerned about how small OEMS dealers and IAMs could cope with labour retraining: *“The tools are provisioned by brands. For a concession workshop it is not easy, so brands and governments will have to subsidize especially small OEM dealers and small independent workshops”.*

Skills will be different and even lower skills after a period where technicians will acquire the sufficient skills in electronics and data dealing. Furthermore, E9 emphasises that fewer people will be involved in repair operations as the interventions to EVs are simpler and once labour force overcome the learning curves, operations will need to use diagnostic tools such as scanners that just need to plug-in to the car.

It is generally agreed by interviewees that remote interventions to vehicles, using specialised tools and software, will be common. These remote interventions imply consequences on the labour force reduction. Germany is an example of how new technologies associated to aftersales technical service has contributed with the reduction of technical labour force (Diez et al., 2014).

## 5. Conclusions

This set of semi-structured interviews has developed detailed understanding of aftersales stakeholders’ perspectives on decarbonisation impacts. The examination detected data related to new business models, impacts on traditional aftersales operation, and public policy framed upon an uncertainty context which were discussed extensively in this paper.

It is demonstrated that uncertainty and a lack of consensus about the impacts of decarbonisation on the automotive aftersales sector is one of the main results of this investigation. Uncertainty in the automotive aftersales sector is currently a common factor through different issues that represent concerns for the industry.

Table 2 summarise the key concerns related to that uncertainty.

Aftersales business players’ key concern	Description
<b>Loss of bargaining control</b>	New business models such as CSS would imply a B2B approach that reduce the bargaining power of current model where OEMs prevail over individuals.
<b>New capabilities to develop new business models</b>	Understanding the potential of Data and how to monetise it means new investment in software, infrastructure and retraining of labour force.
<b>New players from technology sector</b>	It exists in the automotive sector a perception that companies from the technological sector such as: Google, Amazon, IBM could come and take advantage of their data handling capabilities
<b>High dependency on car manufacturers</b>	Small players such as OEM dealers think that strategic decision-making is not disseminated down toward regional aftersales top and middle management.
<b>Keep the customer loyalty</b>	EVs do not demand the same frequency of visits to workshops. Through the years aftersales have been the link between the brand and the customer that ensure the repurchase cycle.

<b>Limited capacity to invest of small players in the OEM dealer network and IAM</b>	Small regional dealers are usually companies with limited capital to invest. The IAM in Latin America is a large extent distribution channel but highly fragmented.
<b>Unpredictability of governments</b>	Low credibility of regulators to set the decarbonisation agenda in Europe and unfamiliarity, inexperience, and improvised government measures to address decarbonisation agenda in LATAM have been evidence through the public policy section.

Table 2. Key concerns of aftersales business

New players from other sectors could find a gap generated by the perceived indifference from incumbent car manufactures. The development of alliances with stakeholders from the technological sector and convergence of separate industries are perceived as potential responses from incumbent car manufacturers. The transformation of aftersales business toward B2B models is foreseen as a prevalent trend. This study established that monetisation of data is one of the drivers of the new aftersales business model.

Although, there is evidence that suggests an aggressive environment for the traditional aftersales business, there are elements that open optimistic angles to the aftersales sector if it can evolve toward new aftersales concepts which use and take advantage of the data wave. Additionally, it was found two main strategic responses for the future of spare parts business: Standardization of parts and specialisation based on evolution of own capabilities to innovate and maintain new players outside their niche of interest.

There is a high degree of scepticism from both European and LATAM participants regarding key aspects of decarbonisation strategy, namely (1) the credibility of regulators to lead the agenda in the eyes of automotive experts and (2) the suitability and likely effectiveness of disincentives to ownership and use of cars.

From the point of view of promoting the adoption of EVs, there is no agreement about one specific type of policy or instrument being the best to improve EV adoption. Based on participants opinion, it is understood that holistic public policy frameworks, that involve policy about charging points infrastructure, fiscal incentives, and labour force education, are needed.

## 6. Limitations and Future work

Data from other regions, where the automotive industry is pivotal for their economies, could have given more strength to the research in terms of extent with the purposes to generalise and apply the research results. High level of commercial sensitivity could be involved through all the research stages which could generate intentional selectivity from participants answers.

The results from these interviews were used to inform next activity that involved a expert's workshop replicated in two different geographic locations to develop potential future scenarios for aftersales businesses under different decarbonisation strategies.

It would be interesting to examine the demand side opinions and expectations about the role of aftersales and associated organisational strategies about customer retention and repurchase cycle.

Prevalence of incumbents car manufacturers, alliances with stakeholder of technological sector, and convergence are some of the potential responses that deserve further and detailed research due to the importance of the data as a new aftersales driver, which was found in this research.

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