Exploring the digital transformation in the automotive industry to design an improved mobility service ecosystem for Mercedes-Benz

R. Schell

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Abstract

The automotive industry is simultaneously facing various forces of change and challenges. The broad aim of the research is to explore these forces of change and how they are impacting the automotive industry, to analyse and interpret their implications for Mercedes-Benz and to apply the insights gained to develop a new service innovation process. The digital transformation is responsible for an important paradigm change in many industries, but this is certainly true for the automotive sector. Digitalization and behavioural alterations of consumers opens new mobility service opportunities not only to the traditional automotive industry, but also to technology corporations. The qualitative research was performed with the philosophical stance of pragmatism and an explorative, inductive approach. The strategy of an embedded single case study with in-depth interviews and workshops, as methods for data collection, assured a focused but flexible qualitative research design. The research investigated intelligent mobility solutions, as well as future automotive connected services. The study captured the voice of the customer and the expertise of internal and external automotive managers via the introduction of an open service innovation approach. The research elaborated a stream of empirical research which resulted in original contributions to theory and practice in the field of service innovation management. The actual body of literature is still limited and generic on this topic. The findings detected political, economic, demographic, ecological, social, technological and legal changes that are affecting the automotive sector. Moreover, the study revealed that future, smart mobility solutions are linked to digital services and connectivity. Furthermore, the study discovered the importance of flexible finance solutions, electric cars, premium product-services and alternative, cleaner powertrain technologies. The findings confirmed the relevance of open innovation and co-creation as a methodology to introduce new mobility solutions in the automotive sector, which in general still operates in a closed innovation environment. Correspondingly, the research focused on the development of a customised service innovation process model, which valued integrated digital services. As a result of the study, the novel service innovation process model, entitled “DOING”, was developed to transform customer needs into valuable mobility services in the Mercedes-Benz ecosystem. Furthermore, this novel “DOING” process was implemented in a real-world business environment to design an improved mobility service ecosystem for Mercedes-Benz.

Author´s declaration

I declare that this thesis is in accordance with the regulation of the University of Worcester and has been composed solely by myself.

It has not been submitted, in whole or in part, in any previous application for a degree or professional qualification.

Except where states otherwise by reference or acknowledgment, the work presented is entirely my own.

_____ Date: 04.10.2020

Roland Schell

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Dedication

Ce travail est dédié à mes enfants, Rebecca et Raphael.

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Dissemination of DBA Work

Papers and Presentations of DBA-Related Work

- Schell (2019). Exploring the Challenges of an Open Product-Service System: The Case of Mercedes-Benz.
  Competitive Paper and Presentation for the Doctoral Colloquium at the University of Gloucestershire in July 2019.

DBA-Related Work into Teaching

- Guest lecturer European University Rome MBA Level (05.2017):
  "Future Technologies in the Automotive Industry".
- Guest lecturer Worcester University MBA Level (11.2018):
  "Emerging Challenges in the Automotive Industry".

DBA-Related Work into Professional Environment

- Schell (2018). "The Future of Individual Mobility".
  Presentation at the German Embassy in Madrid.

- Schell (2019). Introduction of the "DOING" Process in the Mercedes-Benz Spain organisation and recommendations to the European Board of Daimler AG.

Table of Content

Abbreviations

B2B	Business to Business
BMD	Business Model Design
BMI	Business Model Innovation
BRT	Bus Rapid Transit
CASE	Connected, Autonomous, Shared & Services and Electric
CEO	Chief Executive Officer
CO2	Carbon Dioxide
DBA	Doctor of Business Administration
DOING	Discover, Organize and Initiate
E&Y	Ernst & Young
EPR	Ethical Principles Research
EU Commission	European Commission
EUI's	European University Institute
EVs	Electric Vehicles
FEI	Front-End Innovation
FFE	Fuzzy Front-End
GDPR	General Data Protection Regulation
GR & AE	Group Research & Advanced Engineering
ICE	Combustion engine
ICT	Information and Communication Technology
LPG	Liquid Petroleum Gas
MBC	Mercedes-Benz Cars
MBUX	Mercedes-Benz User Experience
MDS	Mercedes-Benz Development System
MVP	Minimum Viable Product
NOX	Nitrogen oxides
OEM	Original Equipment Manufacturer
OI	Open innovation
PHEVs	Hybrid Vehicles
PSS	Product-Service System
R&D	Research and Development
SIPM	Service Innovation Process Model
SUV	Sport Utility Vehicle
TA	Thematic Analysis
USP	Unique Selling Proposition
WLTP	Worldwide harmonized Light vehicle Test Procedure

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1 Introduction to the research context

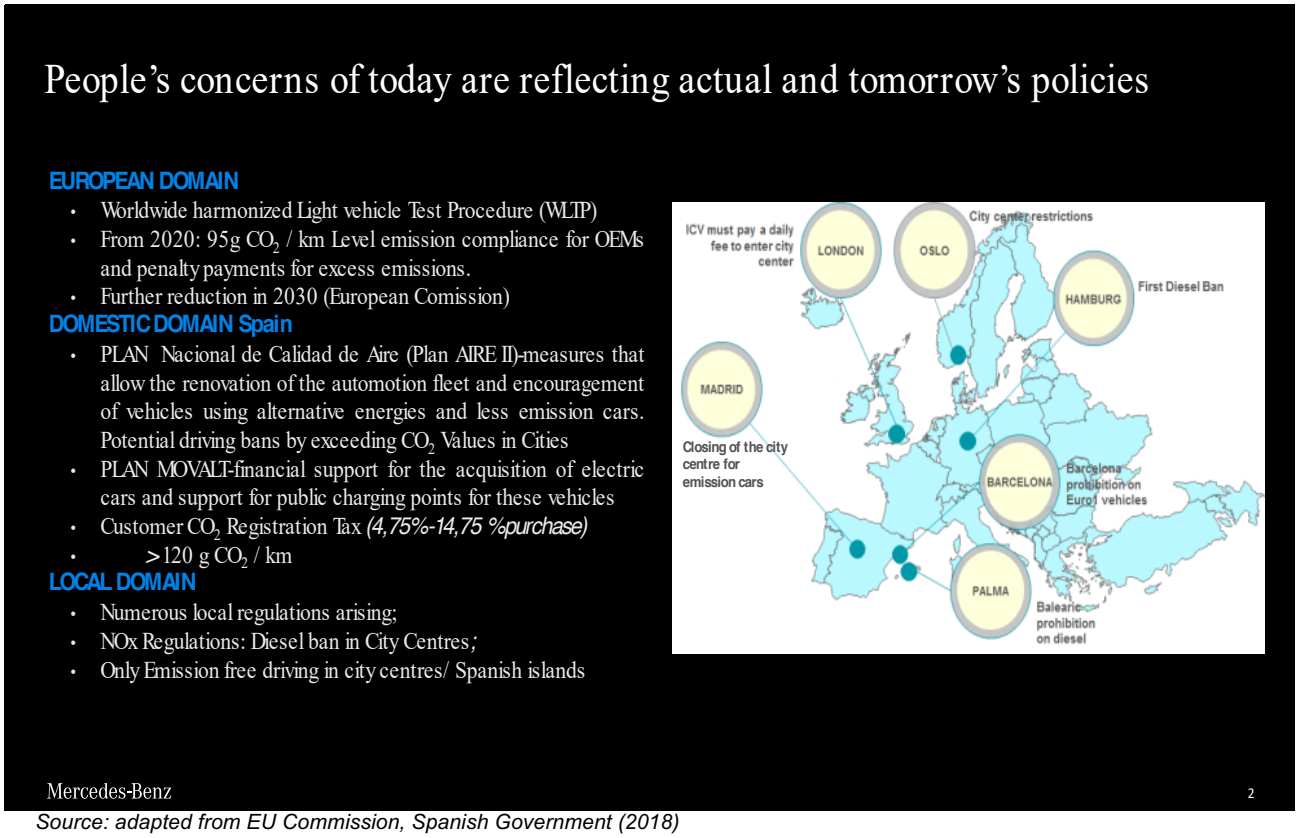
1.1 Industry context and challenge

1.1.1 Introduction

The automotive business environment is constantly changing. By means of environmental scan (Choo, 2001; Reinhardt *et al.*, 2017) and the use of information about events, trends, relationships in an organization and its external environment, the researcher is scanning the current business environment of Mercedes-Benz in order to understand the external forces of change (Choo and Auster, 1993; Watts, 2020). The actual situation in the automotive environment is facing political, economic, demographic, ecological, social, technological and legal changes. Due to new powertrain technologies, such as electric-, liquid petroleum gas (LPG)-, hydrogen fuel cell- or hybrid-drives and the on-going connectivity in the car (McKinsey, 2016), the automotive industry is facing an important technological and environmental change. Environmental restrictions in the European Union and other world regions, such as Co2 & NOx targets, oblige the car manufacturers to further innovation efforts towards the path for emission-free driving (European Commission, 2018). The challenge of environmental restrictions are acting actually on three different legal layers in Europe. As a first layer, the European Commission (European Commission, 2018) introduces the **W**orldwide harmonized **L**ight vehicle **T**est **P**rocedure (WLTP) from 2020 onwards with a Co2 emission level of 95g/km for the whole European car fleet of an Original Equipment Manufacturers (OEM). The penalty payments for excess emissions will be € 95 from the first gram of exceedance onwards multiplied by the number of registered cars in the year. A legislative proposal of the EU Commission (European Commission, 2018) and further reduction of 30 % of the Co2 emissions for 2030 onwards has been submitted to the European Parliament, the Council, the Economic and Social Committee and the Committee of the Regions for further consideration under the ordinary legislative procedure. The second layer is acting on the national domains. European countries are responding in different ways to environmental restrictions. The researcher is actually living and working in Spain; therefore, the study investigates the current Spanish legislation.

Spain introduced a national plan for the quality of air (Spanish Government, 2018), that allows the renovation of the automotive fleet and encouragement of vehicles using alternative energies, supported by public finances. These aspects are also challenging energy corporations to “support the spectrum of renewable energy needs such as, remote off-grid photovoltaics and wind systems, photovoltaic and solar power installation, wind turbine/wind farm and hydro developers and community renewable energy initiatives” (Thomas, Miller and Murphy, 2011, p.47). Moreover, inner-city driving bans are executed while exceeding Co2 limits in major cities. Additional Co2 registration taxes are decreasing the demand for conventional cars. The third layer consists of divers’ local regulations, such as Diesel ban and emission free driving in city centres and on major Spanish islands, as shown in the figure. 1.1. Public opinion and actual environmental trends are already reflected in current and future regulations.

Figure 1. 1. *Emerging ecological challenges in the automotive industry*

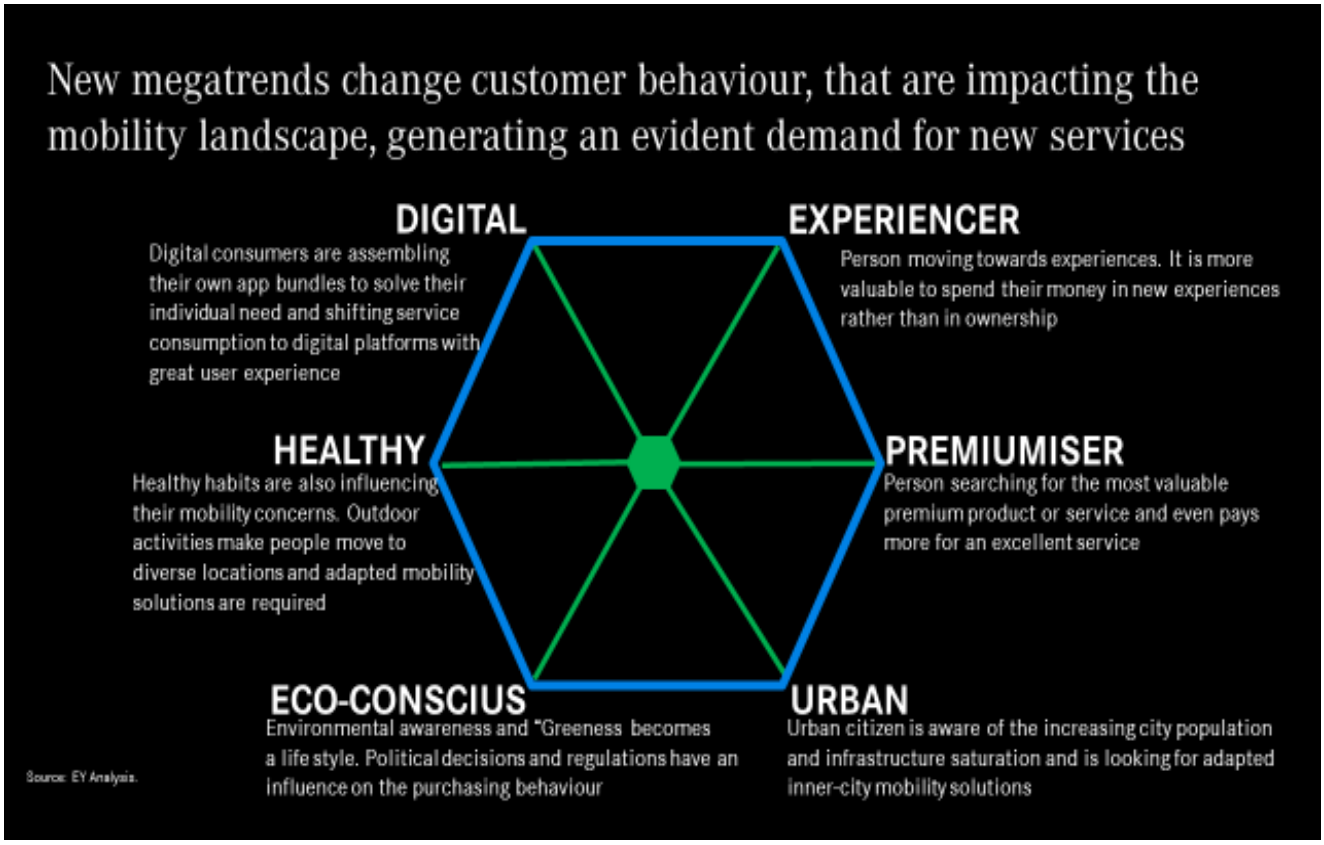


Source: adapted from EU Commission, Spanish Government (2018)

To achieve the challenging emission targets by 2020, the automotive industry must face new innovation mechanisms. Additional innovation investments in powertrain technology will unequivocally decrease the actual margin models.

This is especially true for premium manufacturers such as Mercedes, Audi and BMW, which have recorded higher fleet fuel consumption and thus higher Co2 emissions. Moreover, the current "Diesel-gate" scandal will surely leave its mark on all car producers. VW and Audi applied so-called defeat devices US (The United StatesDepartment of Justice, 2016) across the range to reduce emissions during the test cycle. The residual value of older Diesel cars dropped from desirable to almost dead stock within a few months. The reputation of the entire automobile industry is affected. Consumers will increasingly make the vote of confidence with respect to diesel and conventional powertrain technologies. The electric powertrain, under certain conditions, could become a disruptive technology for conventional engines. A further challenge consists in a demographic, ecological and social changes. The impact of these changes involves the creation of new customer-oriented services around the vehicle. Valuable services to increase the ease and comfort of consumers. Consumers are demanding more and more pay per use mobility, remunerating the use and time of the vehicle with its included services (McKinsey, 2016). Car-sharing models such as car2go (Mercedes), DriveNow (BMW), Stadtmobil and other providers are additional competitors in the battle for customers. Players in the New Economy would also like to expand into this high-turnover industry. Corporations such as Apple, Google and UBER are working on connected cars and autonomous driving. Google and ebay already possess marketing platforms for vehicles with "AutoScout24" and “Mobiles.com” and are already selling cars through their Internet-platforms. The Internet of Things, Big Data and the ability to transform this data into interesting customer-oriented information, are decisive factors of the future sales success. Producers and consumers are in constant evolution and new social trends in terms of mobility use are changing customer behaviour. The internal study of Mercedes-Benz Spain and E&Y (2018) introduces six customer groups, which are following new trends in the Spanish society. Consumer are changing their typical behaviour and the approach towards mobility and services. These megatrends create new customer groups and the automotive industry is starting only now to comprehend future consumers buying decisions, as shown in the following figure 1.2.

Figure 1. 2. *New Megatrends and Customer Groups*



Source: Mercedes-Benz Spain and E&Y (2018)

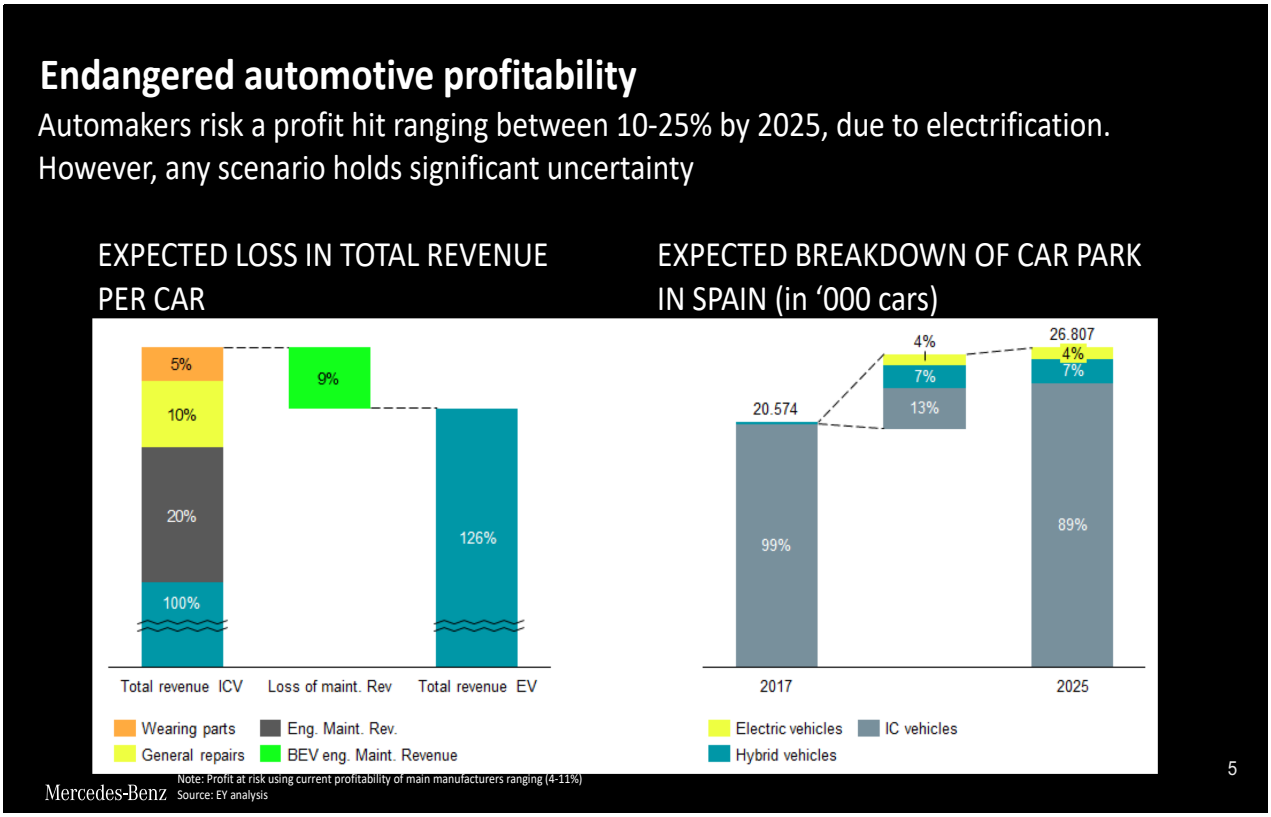
The "**Experiencer**" is a person moving towards experiences and for this population it is more valuable to spend their money in new experiences rather than in ownership.
The "**Premiumiser**" is searching for the most valuable premium product or service and pays even more for an excellent experience.
The **"urban"** citizen is aware of the increasing city population and infrastructure saturation and is looking for adapted inner-city mobility solutions.
"Eco-Conscious": Environmental awareness and "Greeness" becomes a lifestyle. Political decisions and regulations have an influence on the purchasing behaviour. People are seeking for a stress-free and active life.
"Healthy" habits are also influencing their mobility concerns (bike & scooter sharing). Outdoor activities make people move to diverse locations and adapted mobility solutions are required.
"Digital" consumers are assembling their own app bundles to solve their individual needs and shifting service consumption to digital platforms with great user experience. These improvements in mobile and user experience are creating new opportunities.

To optimize the customer approach, the industry needs to generate more information about the customers and the vehicle, to manage efficient data driven marketing. As a consequence, to these new megatrends, the definition of ownership is actually changing towards experiencing mobility as a service and pay per use.

1.1.2 Endangered automotive profitability

Due to environmental regulations and political decisions, the automotive industry is facing new tasks. The automotive future will be most likely electric, fully connected and autonomous. Another critical factor remains customer´s behaviour in terms of available powertrain technology and service products and the preferred choice of the consumer. The report of McKinsey (2016) explains that the Original Equipment Manufacturers (OEM) need to find the right strategy for differentiating their products and services, which largely means evolving their value proposition from hardware provider to integrated mobility service provider. The report further suggests that, “product differentiation, as a strategic approach, should be pursued through a digital end-to-end user experience with a customer focus similar to software companies keeping products attractive throughout the lifecycle” (McKinsey, 2016, p. 16). The market share of electric cars will potentially increase in the next years. The automotive electrification with its higher battery costs in comparison to conventional powertrain technology, as well as the inferior after sales penetration for electric cars, will possibly decrease the margins of the OEMs`, as shown in table 1.1.

Table. 1. 1. *Endangered automotive profitability*



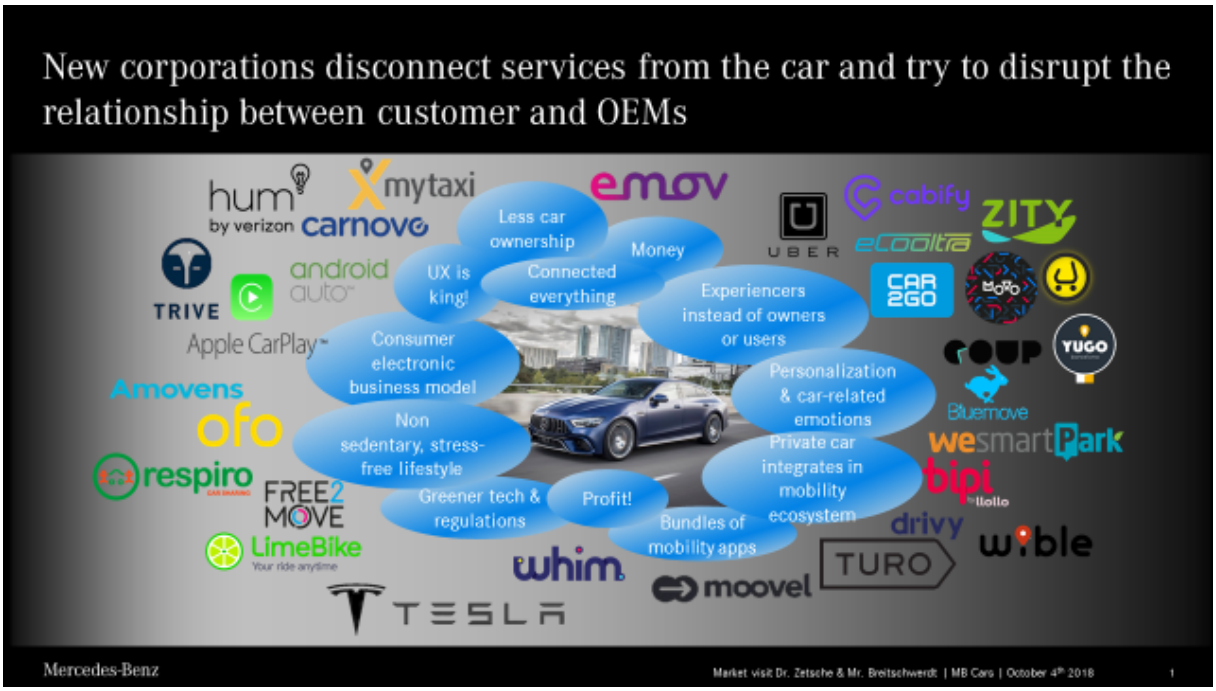
Source: Mercedes-Benz Spain, EY analysis (2018)

The development of customer-oriented services represents an effective alternative to generate additional profitability for OEMs`. Customers are willing to compensate mobility services through the transformation from their personal needs to valuable services. “Data is the new oil” (Humby, 2006), this is the new paradigm of most of the industries, but this is certainly true for the automotive industry. Corporations in the new economy are already generating big data and process these data to customer- and sales-relevant information. New Economy corporations will perhaps not develop and produce vehicles themselves, yet they aspire to integrate their digital technologies and mobility services into the automobiles of the traditional car manufacturers. Implementing their mobility services will further decrease the margins of the OEMs`.

1.1.3 Customer interaction and disconnection between vehicles and services

Through the development and subsequent operation of vehicle-related service platforms, such as Android (Google) and iOS (Apple), the New Economy Corporations could represent an imminent danger for the actual business model of the car manufacturer. Via the direct link between technology corporations and the end customer, the new economy companies could be in the position to integrate their automotive services, by creating their own automotive ecosystem and disrupt the traditional value chain of the car manufacturer. Not only New Economy Corporations such as, Apple, Google, UEBER are acting in the Spanish automotive environment, but small, medium firms and new start-ups (e.g. drivy, TRIVE, Lime bike, ofo, etc.), are disrupting the relationship between the customer and the OEMs`, as shown in the following figure 1.3.

Figure. 1.3. *Mobility service offers in the Spanish automotive environment*



Source: Mercedes-Benz Spain and E&Y (2018)

These corporations are creating user platforms for mobility services and disconnect the product (vehicle) from the service offer. These mobility providers are offering mobility in use. Consumer only pay per use and time without owning a vehicle.

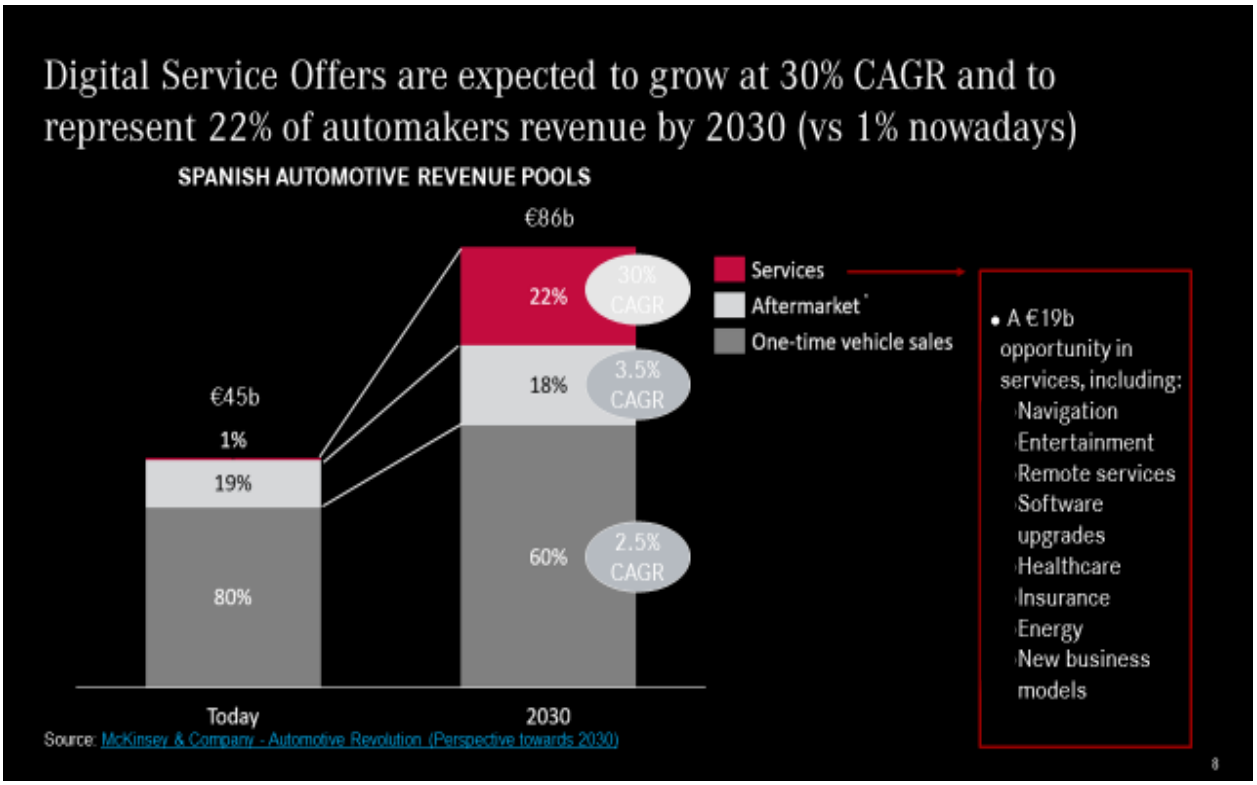
This consists in a potential threat for the traditional car industry, which could endanger the profitability and their value chain. These platforms manage the direct link to the end-customer while providing valuable services and generate high turnover from these mobility offers. The platform providers decide from which car brand they buy the assets to complete their service offer. Car manufacturers could be potentially reduced to simple hardware suppliers and will not manage the customers interface any longer. Therefore, the automotive industry could reflect on investigating digital mobility services along their value chain to counter this potential threat. For example, OEM could consider creating digital mobility services, such as specific remote services, special entertainment offers (Netflix, Spotify, etc.), insurance and financing offers, charging info for electric cars and other services to craft their proper ecosystem. However, the development of such digital mobility services represents a main challenge for the car manufacturing companies.

1.1.4 New growth potential for Mercedes-Benz

Digital services could potentially grow and compensate the reduced margins from electrification. A considerable potential of digitalized services for entertainment, navigation systems, remote services, healthcare and insurance services and energy providing services could be developed to satisfy customer needs and their expectations. A future entertainment system of a Mercedes-Benz vehicle could introduce Netflix for passengers, Spotify and other entertainment applications, navigation systems with additional customer value, such as recharging points for electric cars, cost management, energizing lunch breaks and many more. Giving the opportunity to the customer for a flexible car leasing, changing the car several times a year, from a convertible to a SUV and vice versa.

The growth potential of digital services is considered to increase up to 30% by 2030, as shown in the table. 1.2.

Table. 1.2. *Potential Growth of Digital Services*



Source: McKinsey, Automotive Revolution (2016)

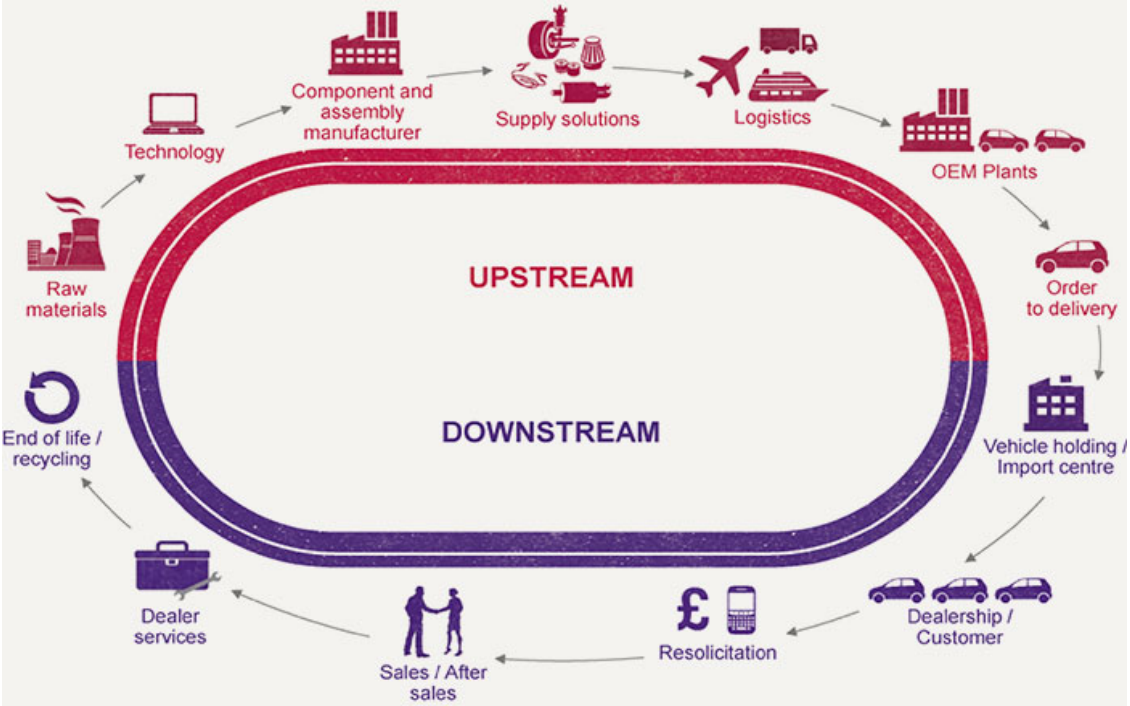
An integrated and systematic digital service offer, connected to a vehicle, could create a significant product differentiation.

1.1.5 Challenges for Daimler AG and Mercedes-Benz

Daimler AG is one of the worlds' most successful automobile companies. With its divisions Mercedes-Benz Cars, Daimler Trucks, Mercedes-Benz Vans, Daimler Buses and Daimler Financial Services, the vehicle manufacturer is one of the biggest suppliers of premium cars (Daimler AG, 2017) and is the largest producer of commercial vehicles with a global reach. Daimler Financial Services provides financing, leasing, fleet management, insurance, investment products and brokerage of credit cards, as well as innovative mobility services. To better understand the challenge, it is indispensable to present the traditional business model of Daimler AG, with its passenger car brands Mercedes-Benz, Maybach, AMG and smart.

The business model involves the value generating through research and development, production and sales of automotive products, such as cars, vans, trucks, buses and services. Daimler (Daimler AG, 2017) can look back on a tradition covering more than 130 years, a tradition that goes back to Gottlieb Daimler and Carl Benz, the inventors of the automobile, and features pioneering achievements in automotive engineering. Today, the Daimler Group is a globally leading vehicle manufacturer with an unparalleled range of premium automobiles, trucks, vans and buses. Daimler's goal is to continue playing a leading role in the development of products and services for the future of mobility. The automotive industry is in the process of a fundamental transformation, and Daimler intends to play a major role in promoting and shaping that change. With the strong core business, Daimler is creating the financial foundation for investments in the future-oriented technologies. The annual report 2017 of Daimler AG claims that innovations from the future-oriented technologies enable Daimlers to safeguard the attractiveness and profitability of the core business. The main upstream business of Daimler AG (see Fig. 1.4.) consists in the development, production and distribution of cars, vans, trucks and buses. The research and development activities are concentrated in the R&D department in Stuttgart, Germany. A range of customized financial services and mobility services rounds up its downstream product portfolio. These additional services are basically integrated as a typical post sales offer to support the core business. Service innovation is still designed in the sales & marketing department in an unstructured way. The development of these services are executed in a closed environment and automotive managers anticipate customer needs without taking into the account the personal "voice of the customer". The limitations of the current business model consist in lack of additional mobility solutions and services, which are yet not in the focus and neither considered as core business of the corporation.

Figure. 1. 4. Current Business Model of DAIMLER AG



Source: Daimler AG, Intranet (2018)

The research will be executed in the environment of the global car manufacturer Daimler AG in its Spanish Mercedes-Benz Cars organisation. Mercedes-Benz Spain is a marketing and sales organisation and responsible for the distribution of the whole model range and the current service offers in the Spanish market. The Spanish automotive sector is a highly competitive but established marketplace. Managing the direct link to the Mercedes-Benz dealer network and big fleet customers, the researcher has access to automotive experts and customers. The challenges for Mercedes-Benz consider the development of valuable services to create additional margins and to keep the customers loyal to the brand. The broader aim of the research consists in the development of a new process model for the required service innovation.

1.1.6 Research context

The world is constantly changing and these forces of change (Choo, 2001; Reinhardt *et al.*, 2017; Watts, 2020) impact the automotive industry. Customers are increasingly demanding new mobility solutions to satisfy their needs and expectations.

Companies have to anticipate which ones of the innovations are important for the customer (Dannenberg and Burgard, 2015). In the case of the automotive industry, this might entail new powertrain technologies, such as hybrid, electric or fuel cell cars (Williams, 2006; Baines *et al.*, 2007). New trends in individual, shared and connected mobility are emerging and companies in the automotive industry are transforming their business from product to service-oriented companies (Dombrowski and Engel, 2014; Wedeniwski, 2015). Tesla Motors (Mahut *et al.*, 2017) for example, is an already advanced player in the automotive sector through the sales of supplementary services. The automotive industry (Athanasopoulou *et al.*, 2019) explores four different types of technology-enabled services, such as personalisation in additional services, enhanced user experience services, generic mobility services, shared mobility, and Internet of Things-enabled connected cars. Upcoming generations of cars will be progressively connected to the external environment; therefore, it is a logical consequence to develop systematically mobility service solutions (Tukker, 2004; Tan *et al.*, 2010; Beuren, Ferreira et al., 2013) for customers. The key for mobility service development is innovation in general and service innovation in specific. Innovation is a process of constant, industrial mutation and implementation of new ideas (Schumpeter, 1942; Thompson, 1965). With the shift from a product-centred approach to a service-oriented approach in the industry, service innovation allowed the specific development of intangible products (Walters and Rainbird, 2007; Chesbrough, 2011). To gather the voice of the customer and integrate business partners and other expertise in the innovation process, the specific model of open innovation (Chesbrough, 2003; Chen, Zhao and Wang, 2015) has found its way into the industry. The voice of the customer (Griffin and Hauser, 1993) is a term used in business and information technology to describe the in-depth process of capturing customer`s expectations, preferences and aversions. The convergence of mobility services and the hardware product (vehicle) to a complete Product Service-System (PSS) (Goedkoop *et al.,* 1999) is a consequent evolution of service innovation (Baines, 2015; Barquet *et al.*, 2016; Mahut *et al.*, 2017). A PSS is a system of products, services, networks of players and supporting infrastructure that continuously strives to be competitive and satisfy customer needs. The impact of digitization could become a game changer in the automotive industry. All these value-creating service products are undergoing significant innovative changes (Mahut *et al.*, 2017) as a result of environmental and competitive influences.

Transforming customer needs into valuable services, requires structured processes, as indicated in the literature. The “Stage Gate” innovation process (Cooper, 2008) and the approach of “Design Thinking” (Robert and Curedale, 2013; Schallmo, Lang and Williams, 2018) are the prominent processes for product and service innovation in the industry. Service innovation processes in the automotive industry remain relatively unexplored and researchers have to identify organizations it will be the most productive to study (Baines, 2015) and yet the automotive industry is one of them.

1.2 The research problem

1.2.1 Introduction

Simultaneously, the automotive industry is facing several main challenges. External forces of change are impacting the automotive industry. New automotive megatrends are changing typical customer behaviour and the approach towards mobility and services. Less consumers want to really own a vehicle, instead they are using mobility and want to pay for the use of the vehicle. Likewise, these trends endanger the profitability of Mercedes-Benz on the one hand, but on the other hand, these megatrends offer new growth potentials for additional business. The research sets the focus on the creation of new customer-oriented mobility solutions. The body of literature shows limitations in terms of mobility solutions, trends, co-creation of mobility services. Likewise, the literature proposes limited and adequate service innovation processes for the automotive industry. The academic literature also shows deficiencies of how to deliver customer value through an efficient and systematic service proposal. The research aims to identify key drivers of change and how they are impacting the automotive industry, including implications for Mercedes-Benz. Connecting automotive management expertise with the voice of the customer, it might be possible to develop a new service innovation process model for Mercedes-Benz to better satisfy customer needs and expectations.

1.2.2 Lack of understanding of external forces of change and their impacts

Generating additional profits from customer-oriented and valuable services, linked to the vehicle, will be one of the most important challenges to sustain the value chain of Mercedes-Benz.

External forces of change (Choo, 2001; Reinhardt *et al.*, 2017, Watts, 2020) are impacting current mobility services and future automotive trends. Knowing these influences is a prerequisite for further research development and analysis. New technologies and mobility solutions (Lengton et al., 2015; Schöttle, 2018) are entering into our modern society, providing flexible, efficient, smart and user-oriented (Wedeniwski, 2015; Audenhove *et al.*, 2018) mobility services. Customer information and its impact on individual mobility behaviour (Elliott and Urry, 2010) and preferences have a huge relevance for understanding and facing individual needs, as well as their impact on spatial phenomena. Moreover, environmental awareness experience a positive impact on the purchasing intention (Williams, 2005; Xu, Prybutok and Blankson, 2019) of environmentally friendly cars. The evolution of mobility trends and connected services in a whole system is the creation of Product Service -System (Baines *et al.*, 2007; Cherubini, Iasevoli and Michelini, 2015; Mahut *et al.*, 2017), which is an integrated product and service offering (Williams, 2005; McKinsey, 2016), that delivers value for the customer using this services.

Thus, OEMs` offer only scarce digital services (McKinsey, 2016) to preserve a sustainable value chain and keep the business model and the margins upright. The car manufacturer Mercedes-Benz is a key player in the transport sector and provides only few mobility services to its passengers. The world is constantly changing and these changes are impacting the automotive industry. To anticipate these potential changes, organisations should consider to scan the environment (Choo and Auster, 1993; Reinhardt *et al.*, 2017) in order to understand the external forces of change (Shore, 2012; Erwin, 2015; Watts, 2020). Environmental scanning could identify political, environmental, social, legal and technological changes in the Spanish automotive environment to consider appropriate reactions. The actual body of literature on the product side of the automotive industry is mature, whereas the service side is still limited and very generic in terms of mobility solutions and connected services (Baines, 2015; Mahut *et al.*, 2017). Only few studies (Tan *et al.*, 2010; Lerch and Gotsch, 2015) with mobility and service solutions from similar industries are available. Nevertheless, the literature lacks a holistic and updated positions on future mobility services, trends, connected services and eco-friendliness in the automotive environment.

1.2.3 Difficulties of integrating Open Innovation and co-creation into an automotive service innovation process

The systematic development of mobility services and the consequent link of the vehicle to a complete service system is a main challenge for Mercedes-Benz. Nevertheless, understanding the demand side is very important before operating a systematic service approach (Barquet *et al.*, 2016). In a contemporary hyper-competitive marketplace, customer value co-creation (Tommasetti, Troisi and Vesci, 2017; Ili, Albers and Miller, 2010) has gained increasingly more relevance as a cutting-edge phenomenon. The open innovation model (Chesbrough, Vanhaverbeke and West, 2006) claims the use of purposive inflows and outflows of knowledge to accelerate internal innovation, and expand the markets for external use of innovation, respectively. Open innovation (OI) (Walters and Rainbird, 2007; Chesbrough, 2012; Townsend and Calantone, 2014) is a paradigm that assumes that firms can and should use external ideas as well as internal ideas, and internal and external paths to market, as they look to advance their technology. The combination of a systematic service approach through open innovation could create a competitive advantage for corporations in the general context of business innovation. The literature on OI describes the potential to improve the innovation performance in very generic terms (Chesbrough, 2006; Walters and Rainbird, 2007; Townsend and Calantone, 2014), but lacks the concrete integration of customers and other stakeholders (Cano-Kollmann, Awate, Hannigan, 2017) to capture ideas, contents and service proposals into a service innovation process.

1.2.4 Lack of a new adapted service innovation process for Mercedes-Benz

The development of a systematic service approach linked to the vehicle with the integration of the voice of the customer consists in an important task for Mercedes-Benz. The service innovation process is mainly responsible for the successful development of mobility services. Car manufacturers (McKinsey, 2016) need to find new strategies for differentiating their products and services by evolving their value proposition from hardware provider to integrated mobility service provider, through a digital end-to-end user experience.

New Economy Corporations, such as Google, Apple, Amazon, represent an imminent danger for the traditional business model of OEMs`, by creating their own automotive ecosystem disrupting the traditional value chain of the car manufacturer. Manufacturing firms are supposed to “servitize” their offer, in order to sustain their value proposition (Neely, 2007). To counter the potential danger of disruption, OEMs` are supposed to create valuable services and connect them to the vehicle. Therefore, the introduction of a new SIPM could sustain the value chain, through the development of customer-oriented services.

The development of a systematic product service offer increases the competitive position, satisfies customer needs (Goedkoop *et al.*, 1999; Baines *et al.*, 2007) and shifts the business from physical products only, to design a system of products and services which are jointly capable of fulfilling specific customer demands (Mont, 2002; Manzini and Vezzoli, 2003). The creation of a new SIPM for Mercedes-Benz focuses on customers` needs, which are challenged through new kind of offers merging products and services under one common offer (Mahut *et al.*, 2017). The development of a systematic product and service proposal, via a new SIPM, increases customer loyalty and satisfaction.

There exists a large number of studies for the development of products (Cooper, 1990; Cooper and Edgett, 2003; Ettlie and Elsenbach, 2007; Schallmo, 2018) in the automotive industry, but only scarce literature for service innovation frameworks in the automotive sector. The majority of the OEMs` is using the Stage Gate process (Cooper and Edgett, 2003; Ettlie and Elsenbach, 2007; Schallmo, 2018) or a modified form to develop their products. Nevertheless, some literature is criticising the Stage Gate process as too rigid and lacking flexibility (Schallmo, 2018). The Process underpins the development of hardware products and neglect the development of services. A new approach in the industry appears with the Design Thinking process, which incorporates additionally to the Stage Gate process, customer needs and expectations in the design of service innovation. Design Thinking helps to solve concrete problems in a collaborative, team based approach (Plattner, 2011; Schallmo, 2018) in a more flexible way than the rigid Stage Gate process. The integration of external user knowledge into the development process is yet not clearly defined (Brown, 2008) and should be further developed.

The body of literature of Design Thinking in the automotive sector is still limited and has potential for further studies (Schallmo, 2018). Mercedes-Benz is using a modified form of the Stage Gate process (Räse, 2010) for their service innovation with limited results, as demonstrated in their current service offer. Only through the development of a new adapted SIPM, Mercedes-Benz will be in the position to focus on new mobility services to sustain their business model upright. The lack of an adapted service innovation process is relevant for the automotive sector in general and especially for Mercedes-Benz. A new SIPM would sustain and enlarge the current value chain of Mercedes-Benz. The lack of a structured service innovation approach with regard to the development of a systematic product and service offer, is relevant to satisfy customers` needs and expectations.

1.2.5 Necessity to satisfy customer needs and expectations through a systematic service offer

Services satisfies customer by delivering value in use and fulfils customer demand (Manzini and Vezzoli, 2003; Baines *et al.*, 2007). A systematic service offer (Mahut *et al.* 2017) is focusing on the consumers' needs, the limits between tangible and intangible offer, which are challenged through new kind of offers merging products and service under one common offer to gratify consumers. "In the case of the automotive industry, the product side (Mahut *et al.*, 2017, p. 2102) of the industry is mature, whereas service side is currently increasing". The service side needs further attention to satisfy customer needs and expectations. Containing a complete system of services (Williams, 2006) in the all-over value proposition, enable passengers to drive and travel more efficiently and comfortably. A service system increases the customer satisfaction (Williams, 2006) and could support the corporation to maintain the customers in the Mercedes-Benz ecosystem. Product differentiation through a systematic service offer, could provide additional profits for OEMs` and obstruct new economy corporations to disrupt the actual value chain of the car manufacturers.

1.2.6 Research purpose

The digital transformation is responsible for an important paradigm change in many industries, but this is certainly true for the automotive sector. The digital transformation and behavioural alterations of consumers opens up new perspectives not only to the classic automotive industry, but also to technology corporations.

The automotive industry is facing major challenges due to new powertrain technologies and the on-going digitalization, which is transforming the automotive environment. Corporations such as Apple, Google and UBER are working on connected cars and autonomous driving and would also like to expand their business to the automotive industry. With their approach to integrate their technologies into the vehicles, the automotive industry obtained new competitors along their value chain. Managing mobility solutions, service innovation and customer loyalty, by anticipating customer needs and expectations, represents a fundamental task for Mercedes-Benz. The evolution of a systematic mobility service approach and the requirement of new innovation mechanisms involve the development of a new service innovation process model in the automotive sector. The research is positioned in the theoretical area of business innovation and specifically in the limited field of service innovation in the automotive industry.

1.2.7 Research aim

The broad aim of the research is to explore the forces for change that are impacting on the automotive industry, to analyse and interpret their implications for Mercedes-Benz and to apply the insights gained to the development of a new process model for service innovation. The research will necessitate a stream of empirical research which should result in original contributions to knowledge in the field of innovation management. The study will also make a significant contribution to practice in this field and will systematically investigate the literature of innovation management to improve knowledge, expertise and the actual academic debate in this research area.

1.2.8 Research questions

The focus of the thesis is to answer the following four research questions. To accompany the investigation and to take action on the research questions, the researcher sets clear objectives to obtain academic results.

- **RQ 1: How do external forces of change impact the automotive industry?**

The research identifies, and analyses forces of change and their impact on mobility solutions and trends. The investigation of this subject area generates the obligatory knowledge transfer and expertise for further study. The literature review will partially answer the question.

Only through accurate knowledge and a holistic understanding of the key drivers of change, it will be possible to later develop a new process model for mobility service innovation.

- **RQ 2: What are the internal and external perspectives on individual mobility needs and connected services in the case of Mercedes-Benz?**

The researcher collects and analyses customer needs and expectations in terms of desired mobility solutions and connected services. The literature review will partially respond to the RQ through the analysis of available literature in terms of mobility needs and connected services. The researcher analyses the inside-outside perspective of Mercedes-Benz managers and the outside-inside perspective of automotive experts and customers. The collected data of automotive experts and customers is supporting the relevance for the future development of mobility services.

- **RQ 3: How can Mercedes-Benz develop a novel service innovation process model to better satisfy customer needs and expectations?**

The development of a new service innovation process model is the key success factor to satisfy future customer service demands. The literature review will partially answer the RQ in terms of existing service innovation processes for the automotive sector. The actual body of literature shows a clear deficiency of an adequate service innovation process in the automotive sector. Therefore, the investigation sets the focus on the development of a new service innovation process model and the usefulness for the implementation in the automotive environment.

- **RQ 4: How might this novel service innovation process model support the design of customer-oriented services connected to Mercedes-Benz vehicles?**

The development of a new service innovation process model is only beneficial and contributes to practice, when the framework demonstrates its practicality. To do so, the case study participants apply the new model to transforms customer needs into a service mobility portfolio. This approach carries onwards the exploration of mobility services and their evolution in the Mercedes-Benz environment.

1.2.9 Research objectives

The overall objective of the study will support the transition of Mercedes-Benz from a traditional automotive manufacturer to an integrated mobility service provider. The following objectives will help to answer the research questions.

- The study will investigate key drivers of change in the automotive industry. To do so, the researcher will execute a brief environmental scanning of the automotive sector in Spain to explore these forces of change and their potential impacts for the automotive sector.
- Furthermore, the investigation will analyse current and future mobility trends, connected services by means of in-depth interviews with internal and external participants.
- The study will explore the required paradigm change in the industry from closed to open innovation and co-creation by gathering the voice of the customer via in-depth interviews with internal, external automotive experts and customers.
- The investigation will develop a new service innovation process model to transform customer needs into valuable services. The workshop method with internal experts will support the development of a service-oriented innovation model.
- The study will explore a future mobility service ecosystem. The second workshop with internal experts will explore digital services to shape a mobility service ecosystem for the car manufacturer Mercedes-Benz.

1.3 Evolution of the research topic

The researcher has over 25 years of professional background in the Daimler Group. He occupied various managerial positions in Germany, France, Italy and Spain. The researcher acquired a deep insight into the various cultures and automotive environments of these countries. His academic education includes a degree in economics and an executive “Master in Leadership”. The researcher completed also an executive MBA in 2016. The MBA thesis discussed the impacts of the ongoing digitalization in the automotive industry. The limited research of the MBA could not completely answer all remaining questions of the investigation; even more questions emerged during the MBA course. The ongoing transformation process in the automotive industry represents an immense challenge for the investigator and is of great importance for the company. The researcher was attracted to further investigate this automotive transformation process. The practitioner researcher is very much interested in the concept of lifelong learning through an ongoing, voluntary, and self-motivated pursuit of knowledge for personal and professional reasons.

Therefore, and as a consequence of the former raised questions, the researcher´´ decided to start a new research endeavour. The researcher joined the DBA program in 2016 to satisfy his desire for knowledge and to make a meaningful academic contribution.

1.4 Overview of the research design

Throughout the study, the researcher took different roles, such as workshop leader, moderator, interviewer, line manager and practitioner researcher. Being actively implicated in the research field and acting as interviewer and workshop-leader, the researcher has the responsibility for the investigation, the development of a novel service innovation process model and the exploration of digital services. These different roles of the researcher certainly have an influence on the research strategy. Making significant academic contribution in the field of business innovation and obtaining practical solutions to specific business problems are important objectives for the researcher. The research is executed in the environment of the global car manufacturer Daimler AG in its Spanish Mercedes-Benz Cars organisation. The researcher is the current CEO of Mercedes-Benz Spain. Adopting the role as a practitioner researcher (Saunders, Lewis and Thornhill, 2008) provides an understanding of the complexity of the organisation but simplifies the research access as well in the corporation. Due to his position, the researcher has a permanent and easy access to undertake the research in the company. The sensitive issue of ethical concerns and power relation will be discussed in a later section of the thesis. The research uses the approach of case study with Mercedes-Benz managers, external automotive experts and customers as participants. The qualitative research is performed with the philosophical stance of pragmatism and an explorative, inductive approach. The strategy of an embedded single case study with in-depth interviews and workshops, as methods for data collection, assures the necessary flexibility. The single case study investigates specific aspects and two different units of interest in the Mercedes-Benz Spain Corporation. The first unit of interest provides an understanding of future mobility solutions, trends and connected services. Furthermore, the study encompasses the perspective of the customer and the expertise of automotive managers to develop ideas for future service solutions. To analyse a holistic approach for the study, the researcher uses in-depth interviews.

Mercedes-Benz managers are interviewed for the inside- outside perspective (from the company to the market) to gain insights and interpretations. External automotive experts and customers are interviewed for the outside-inside perspective. The different perspectives allow a holistic view and wider interpretations to draw conclusions. The researcher involves seven internal and eight external participants for the interviews. The second unit of interest provides an insight of how Mercedes-Benz Spain can develop an adapted service innovation process model and how to explore digital services to better satisfy customer needs and expectations. To achieve the research objectives, the researcher designs two separated workshops. The first workshop is supporting the development of a new service innovation process model with 14 internal Mercedes-Benz participants (experts and managers). In the second workshop, the same participants of the first workshop transform customer needs into a service portfolio and explore digital services. The flexible research approach and the research methods allow a better understanding of the qualitative data to analyse the meaningfulness and to make sense of the subjective and social constructed meanings (Saunders, Lewis and Thornhill, 2009) of the participants.

1.5 Thesis structure

The thesis is structured in a traditional DBA format. The already introduced Chapter 1 describes the dissertation context, purpose and relevance of the research. The literature review, Chapter 2, provides a thorough understanding of already existing academic work on the topic of business and service innovation. The researcher selects relevant literature, critically evaluates and analyse the sources to become the theoretical framework of the research. Chapter 3 describes the research methodology and how the research is conducted. The findings of the in-depth interviews and workshops are reported in Chapter 4. The findings are merged together with discussion and analysis. This approach explores the meaning and implications of the study findings in relation to the four research questions. The conclusion Chapter 5 answers the research questions, including final reflections of the researcher. This chapter shows how the findings contribute to knowledge in the field of business innovation, but also includes research limitations and recommendations for future research. The complete reference list and the list of appendices can be found at the end of the thesis.

2 Literature Review

2.1 Introduction

This chapter explains the choice, the methodology and the structure of the integrative literature review. According to Randolph (2009), conducting a literature review is a means of demonstrating an author's knowledge about a particular field of study, including vocabulary, theories, key variables and phenomena, and its methods and history. Literature reviews are considered as a form of research (Cooper, 1988) and therefore should meet the same standards as primary research in methodological rigour. The literature review shapes the theoretical background of the research. The literature search is carried out to select relevant academic literature in business innovation, in particular within the contexts of manufacturing industry and a turbulent environment. The researcher adapted the process model of Cooper (1989) to conduct the literature review in a systematic manner. The process of conducting a literature review is organised through Cooper`s model encompassing five stages:

a. Problem formulation stage.
b. Literature search stage.
c. Data evaluation stage.
d. Data analysis stage.
e. Presentation stage.

2.1.1 Purpose of the literature review

The integrative literature review is a customized approach for an explorative study, due to the fact that it will summarize past research (Cooper, 1989), drawing conclusions from different studies and different perspectives. The purpose of this literature review is to summarize the actual knowledge in the field of business innovation and to define the starting point for further investigation. The literature review stands with its findings (Cooper, 1989) as an integrative part of this study. The review presents the state of knowledge concerning the relation of interest and highlights important topics (Cooper, 1989) of the research and tries to direct future research with a maximum amount of new information.

The integrative review of literature presents as a distinctive form of research that uses existing literature to create new knowledge and reviews, critiques, synthesizes representative literature on a topic, in an integrated way, such that new frameworks and perspectives on the topic are generated (Torraco, 2016). The review will take different perspectives, discuss varied topics and different process frameworks, which supports the drawing of conclusions from various studies. Torraco (2016) argues furthermore, that integrative reviews are also used to review new emerging topics that generate a growing body of literature, that may include contradictions or a discrepancy between the literature and observations about the issue, which are not addressed in the literature.

Secondly, the purpose of literature review is to answer research questions and addressing the issues that are stated in the specific research questions for the review (Kyndt and Baert, 2013). The research questions also define the structure of this integrative literature review (Kyndt and Baert, 2013) and the boundaries of the entire research. These aspects support the development of the research and underpin that the integrative literature review also helps to develop our qualitative, explorative study.

The third purpose of this literature review is to provide the guidance towards knowledge creation and expertise in the field of study. The reviewed literature is an integrated part of the investigation and allows the researcher to draw conclusions and develop further research steps for this explorative study. The literature review is consequently updated throughout the study and findings are integrated in the all-over investigation. The literature review and the research are subject to an iterative process over the entire study period. The major part of the review (Whittemore and Knafl, 2005) includes diverse data sources, such as academic literature, articles, but also reveals different consulting studies, which enhance the holistic understanding of the topic. Service innovation in the automotive sector is a relatively new research topic (Torraco, 2005) and did not yet experience comprehensive review of the literature, the review is more likely to lead to a preliminary conceptualization rather than a reconceptualization of previous models. The review tries to tell a story (Torraco, 2005) by critically analysing the literature and arriving at specific conclusions about the investigated subject. The review highlights areas of knowledge concerning our research questions, but also discusses limitations of the actual body of literature. The literature review will investigate and explore to partially answer the research questions and to determine the subsequent research.

2.1.2 The problem formulation stage

According to Cooper`s (1989) five stages model for literature review, the problem formulation stage explains the organization of the review and the problem articulation. The review is organised as a deductive analysis from the general to the particular theory of business and service innovation. The literature review situates the study in the current field of business innovation and will reveal the necessity of further research to contribute to knowledge and practice of the thesis. The review establishes the holistic and academic penetration of the research topic, distinguishing what has been done (Hart, 1998) from what needs to be done, clarifying the specific research gap for this study in the different fields of business innovation. This review presents the relevant literature of business innovation in general and specifically the literature of actual and future mobility trends, service innovation, co-creation, Product Service-Systems and innovation processes. Latest available studies give direction to the actual investigation. The review is critically appraising, analysing and synthesizing the existing literature in the general field of business innovation in order to connect arguments in support of the investigation.

2.1.3 Main topics of the literature review

The literature review mainly discusses the following four topics to outline and connect the theoretical background of the study. The review structure is following a logical approach. The first topic explains the forces of change in the automotive environment and their impact on the industry. As a consequence, new mobility trends and connected services originate. The literature review investigates the creation of valuable services through innovation in general and Open Innovation in specific, to better comprehend their origin. The second topic reviews and connects service innovation and the creation of a systematic product service offer, as an extension to the first topic. The concept and the evolution to a digital PSS in the automotive environment consists in the essential requirement for a subsequent development of a new service innovation process. Therefore, the third topic discusses current service innovation processes and their limitations, to demonstrate the necessity for a new adapted SIPM in the automotive sector. The concluding summary and fourth topic discusses the different approaches and the opportunity to develop a new and adapted SIPM for Mercedes-Benz.

The acquired knowledge through the literature review serves to further pursue and guide the explorative study in the right direction.

Overview of the literature review

- **Section 2.2** is discussing forces of change, resulting current mobility trends, connected services and value creation through innovation
- **Section 2.3** debates service innovation and different methods to integrate the voice of the customer and other stakeholders, into the innovation process and the concept of digital PSS.
- **Section 2.4** reviews main innovation processes in the long-term consumer goods market. The stimulus of innovation and service innovation is explicitly explored as basis for a future service innovation process model for Mercedes-Benz.
- **Section 2.5** concludes and discusses these forces of change, new mobility trends, the opportunity to develop a new service innovation process with customer oriented digital services.

2.1.4 Literature search stage

Cooper (1989) proposes to specify the target populations in terms of accessible literature. As already mentioned, the review includes in the major part academic literature and articles. The primary channel of information consists in different online and offline libraries. Another important channel consists the Internet search by key search words. The researcher applies a structured literature search procedure to facilitate the reproduction of the search results (Hart, 2001; Torraco, 2016). The example for the literature search of open innovation demonstrates the proceeding with key search words such as, open innovation, service innovation, concepts of OI, cooperation with customer in OI, innovation management, cooperative/partnership innovation and co-creation. The secondary search channel involves relevant academic studies on the research topics. The researcher has also access to different consulting studies in the automotive environment. These primary and secondary channels (Cooper, 1989) enhance the holistic understanding and validity of the topic of interest and reduce the risk of personal bias.

The search for literature on integrative literature reviews begins by listing keywords (Torraco, 2016), such as mobility trends, individual and shared mobility, environmental awareness in the automotive sector, innovation, service innovation, open innovation, Product-Service Systems, digitalization of PSS, innovation processes, Stage Gate Process, Design Thinking and fuzzy front-end innovation. The researcher developed an analysis tool (see f. fig. 2.5) with a track history, which keywords and databases led to relevant literature and which did not (Torraco, 2016). A careful, comprehensive and structured literature search is vital to the quality of the literature review (Hart, 2001). This structured procedure facilitates the reproduction of selected literature for the integrative literature review (Torraco, 2016).

2.1.5 Data evaluation stage

The data evaluation stage (Cooper, 1989) involves decisions whether or not to include individual data points in the inquiry. The challenge of the researcher consists in the quest for the right criteria to integrate relevant data into the thesis or not. All academic work is selected according to the criterion of peer reviewed literature, main topics of the literature review (see section 2.1.2) and search for key words (e.g. OI, service innovation, customer co-creation, PSS, digital services, etc.). Secondary channel literature is chosen according to topicality and the expertise of the researcher. Moreover, secondary literature is also included in the evaluation tool. The researcher developed an Excel evaluation tool for the main topics of the literature review. The tool allows evaluation of all relevant literature according to different criteria. The tool determines the subject, the author, title and year of publication, as shown in figure 2.5. The researcher includes a short summary and a first analysis of the work for a better understanding and selection of the literature. A short discussion of the main points and the key search word complete the assessment. Likewise, the track history is integrated to facilitate the traceability for other researchers. The tool gives an overview alongside main criteria and the possibility to compare different works in terms of relevance. Cooper (1989) proposes an appropriate approach, judging methodological adequacy. The summary supported mainly the evaluation task for the decision whether to incorporate points of data or not. Nevertheless, having the complete information of the analysis and the short discussion supports this crucial decision in a very effective way.

The following figure 2.5 introduces the excerpt of the whole literature evaluation and analysis tool, which is available in Appendix D.

Fig. 2.5. *Literature Evaluation & Analysis Tool*

SUBJECT		Open Innovation/ open service innovation/ customer co-creation			
AUTHOR	TITLE	SUMMARY	ANALYSIS	CRITICAL DISCUSSION	TRACK HISTORY
Chesbrough, Vanhaverbeke and West	**Open Innovation (2006)**	Historical summary oft the concept oft OI and further development. Utilization oft Business models to define requirements. Paradigm shift from closed to open Innovation. Through the development oft OI to Innovation oft Business models and services.	The father oft OI describes his concept oft OI as paradigm shift from closed to Open Innovation. Further development oft Business models and services through OI.	OI as the new paradigm for Innovation with some concrete example oft different companies and industries. An example oft applied science and useful for all industries as well for the automotive industry.To be further developped for PSS and Business model design through OI.	Concept of OI, history of OI
H. Chesbrough	**Bringing Open Innovation to services (2011a)**	To see the business as Service innovation business and not only product driven. Openess in the process oft outside in and inside out flows.	Problem definition oft mature markets to develop service innovation business and the important role of the customer in the process.Focus offers on utility, rather than the product.	Starting to explain the role oft customer to gain his tacit knowledge and to find appropriate business solutions via open ended questions. More possibilities to exploit in this field. Starting point of further investigation.	Open innovation, service innovation, concepts oft OI, cooperation with customer in OI.
H. Chesbrough	**Open Innovation Where We ' ve Been and Where We ' re Going (2011b)**	Support of the thesis from Chesbrough (2011a)	Support of thesis Chesbrough (2011a)	For the services business approach, the value chain must be replaced by a different kind of pattern; creating the Customer's Experience as Services Value Web.	Open innovation, servitizatio n
N. Carroll, M.Herlfert	**Service capabilities within open innovation (2010)**	Design of new business models through OI in immature ecosystems.Process of value co-creation in modern service environment to exploid service capabilities. Sharing business value through collaboration in an ecosystem.	OI environment from a capability perspective, due to further service orientation. New model of Service capability sourcing model (SCSM) through service co-creation and OI to create new service offering.	Service ecosystem is a combination of servitization and OI. Strong focus on the companies capabilities sourcing and matching of processes. The customer/ other partners (Chesbrough) as main stakeholders integration in the OI process is not fully described in the new SCSM model. Customer, suppliers and other partners should be integrated in the OI process and the research to fully understand the external service capabilities	SPP through OI, value creation
Wang, Voss, Zhao and wang	**Modes oft service innovation: a typology (2015)**	Exploring service innovation via three modes of business model innovation, service product innovation and service process innovation. External involvement is necessary to successfully create innovation.	Incorporation of business model innovation into the study of service innovation with support oft service product and/or process innovation. Business model innovation relays on external collaboration.	Understanding of successful service innovation via three modes of innovation. External collaboration of customers and business partners is required to business model innovation. The detailed role of external support should be more in the focus to describe the main part of the external partners. The case studies shows no example of the automitive industry.	Innovation manageme nt, service innovation, business model and open innovation, typology
Walters & Rainbird	**Cooperative innovation: a value chain approach (2007)**	The purpose of this paper is to review contributions to partner/cooperative innovation with the aim of evaluating the concept of a value chain business model	Partner or cooperative innovation combines elements of process and product innovation within a network structure. The creation of a product-service system, which can use its own resources. Extension to the supply chain (upstream and down stream) management and relationship management.	Innovation cooperation means active participation in joint R&D and other technological innovation projects with other organisations. A clear explanation as part of OI with a cost focus for companies. Focus on business partners and R&D cooperations and less on customer cooperation. Cooperative innovation could be a seen as a specific part of OI with a clear focus and value creation.	Cooperativ e/partnersh ip innivation. Processman agement,Fu nctionalma nagement, Virtual organizatio ns,Economi c cooperation

To sum up, the presented tool supports the task to incorporate relevant literature in a structured procedure, including the track history. Furthermore, the tool supports the next stages of data analysis and interpretation.

2.1.6 Data analysis stage

The following section presents the method to summarize the results of the literature review. Data analysis (Kerlinger, 1973) is the categorization, ordering, manipulation and summarizing of data to obtain answers to the research questions and to reduce data to intelligible and interpretable form. Choosing relevant literature and analysing the content is a challenging task.

The researcher is using the same evaluation tool to categorize and organise the different data points to the relevant subject under investigation. The text analysis and the short discussion of the tool supports the comparison and summarizing of data. Trying to find adequate answers out of relevant literature, creating expertise, interpreting the actual stance of knowledge is another focus of the literature review. By these means the investigator is able to shape the basis for further research. Likewise, the analysis and interpretation stage is an effective preparation for the next section.

2.2 The presentation stage

The systematic approach of Cooper's five stage model gives the opportunity to report the presentation stage in order to discuss the outcomes of the literature review. The following sections introduce the presentation stage of the literature review.

2.2.1 Forces of change in the automotive sector

The automotive industry is experiencing a period of rapid change and innovation. The use of alternative powertrain solutions, novel services and alterations in customer behaviour are impacting the automotive sector. To better comprehend this changing environment, it is necessary to discuss and analyse these important forces of change. The literature proposes the technique of environmental scanning to identify forces of change by using relevant information, which impacts organizations.

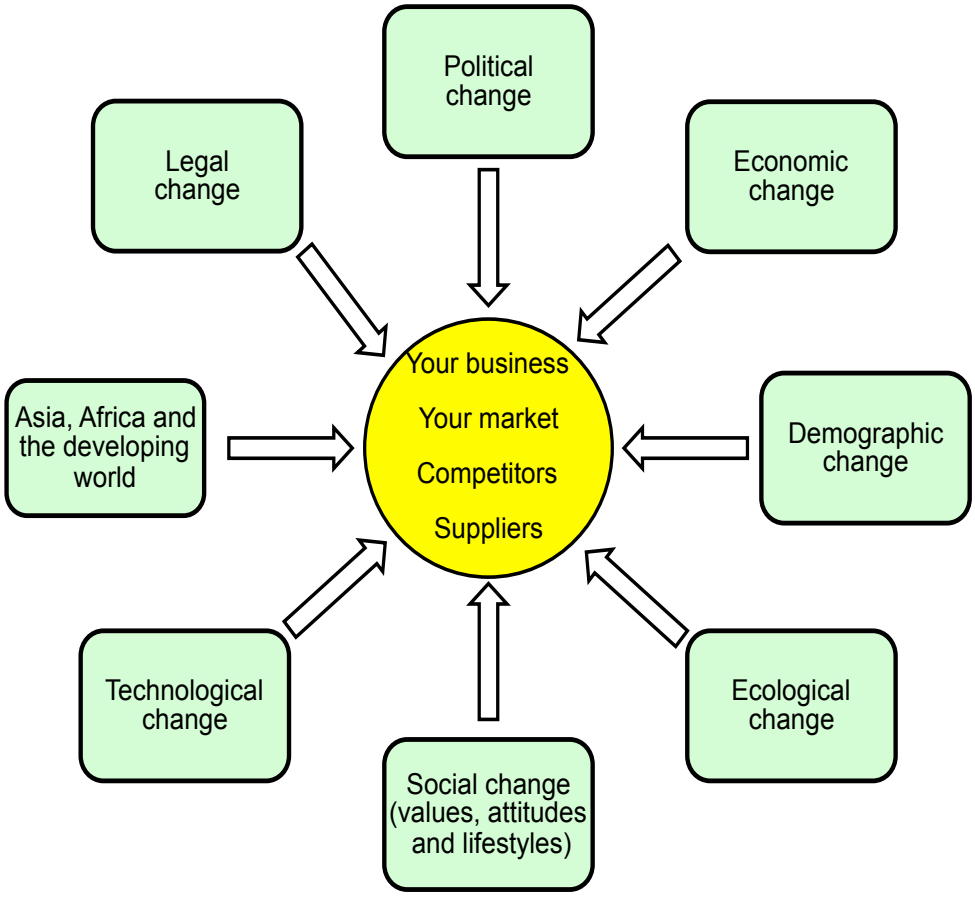
2.2.2 Environmental scanning to identify forces of change

Environmental scanning (Choo, 2001; Reinhardt *et al.*, 2017) is the acquisition and use of information about events, trends, relationships in an organization and its external environment, and about the knowledge of which would assist management in planning the organization's future course of action. Organizations scan the environment in order to understand the external forces of change (Choo and Auster, 1993) so that they may develop effective responses (Liao, 2018; Pryor *et al.*, 2019), which secure or improve their position in the future. As a consequence, organizations should adapt themselves to their external environment, knowing and understanding forces of change. Environmental scanning (Choo and Auster, 1993) includes both, looking at information (viewing) and looking for information (searching).

To scan the actual situation in the automotive environment, the study employs the "**P**olitical, **E**conomic, **D**emographic, **E**cological, **S**ocial, **T**echnological, **A**sia (economic rise of Asia, Africa and other regions in the developing world) and **L**egal" changes.
The literature is using the acronym PEDESTAL (Watts, 2020) to emphasize important forces of change (Shore, 2012; Erwin, 2015). For example, demographic change (Watts, 2020) will dramatically affect the distribution of ages, income and wealth in populations, numbers and types of households, employment legislation, migration patterns and eventually social attitudes to careers, youth and ageing. This change has a direct impact on the procurement behaviour of customers in the automotive sector. An aging population is still very affine to buy cars in a traditional manner, whereas younger generations consume mobility in different ways (car-sharing, renting etc.) and even more service/use-oriented. Another study uses the eternal forces of change for a multi-sectoral analysis (O' Mahony, Zhou and Sweeney, 2012) on different economic sectors, to explain Co2 emissions and their impacts on industries. This study analyses the current forces of change and their impacts on how to comply with governmental regulations. All these global changes impact the automotive industry and they are all interrelated. A change in one area can lead to changes throughout. This analysis of these forces of change (Choo, 2001; Reinhardt *et al.*, 2017; Watts, 2020) will be complemented in the upcoming study to develop effective responses. Political and legal decisions ((European Commission, 2018) to reduce Co2 emissions, the legislative encouragement of using alternative technologies (Spanish Government, 2018) and Diesel bans in inner-city areas have a direct impact on powertrain technology development of OEMs`. Social changes create different behavioural attitudes and impact customers purchase decisions. Consumers are defining nowadays new rules of the industry, such as new mobility service offers, zero emission vehicles and much more. These effects have also an impact on R&D of the OEMs` and their service development. Moreover, these examples demonstrate the interrelation of these forces of changes, which additionally impact the industry. The researcher executed a brief environmental scan in the introduction chapter to explain specific forces of change and challenges of the automotive sector, to better understand the current environment. The study already presented relevant impacts on political, legal, technological and environmental changes, whose effects are very difficult to predict and are often under-estimated (Watts, 2020) or simply missed.

The following figure 2.6 explains the different forces of change in the Pedestal framework.

Figure 2.6. **The PEDESTAL Framework**



Source: Watts, 2020 Forces for change – the PEDESTAL Framework

After the execution of the brief environmental scanning, the main impacts depend, up to now, on political, environmental, social, legal and technological changes in the Spanish automotive environment, as already mentioned in the previous chapter. The study attempts to identify more specific forces of change in the automotive sector to anticipate customer needs and expectations.

2.2.3 General limitations and implications for the research

The literature is still limited and generic on environmental scanning in the automotive business. Thus, the researcher briefly scanned the current automotive business environment to understand potential threats, trends and relationships.

Environmental scanning supported the researcher in the construction of the industrial context and challenges of the thesis.

The literature could partially respond to the first research question about the external forces of change. Nevertheless, the outcome did not fully respond to the expectations of the researcher.

The environmental scan supports the identification of forces of change, which create new mobility trends and services. Only through the expertise and knowledge of these forces of change, empirical research can support the development of future customer-oriented, digital mobility services. Therefore, the researcher will use the body of literature, optimizing the design of the interview guide of the case study to expand the knowledge into the automotive sector. Due to the limitations of the review, the researcher will integrate more specific questions to better comprehend the forces of change in the automotive sector. The study will discuss these main forces of change and their impact on the industry. This method will potentially support the development of mobility services, as effective response (Pryor *et al.*, 2019) to future customer needs.

2.2.4 New mobility trends and environmental awareness

Mobility demand is booming and the mobility landscape is completely reshaped by new trends and the ongoing vehicle connectivity. The massive increase of urban mobility is challenging metropolitan authorities (Audenhove *et al.*, 2018), while consumers are attracted by supplementary but sustainable mobility solutions. Mobility innovation (Vecchio and Tricarico, 2018) recently brought into the market, apps, social networks and sharing economy practices, which impacts upon the economic appeal of urban areas and strongly influences the preferences of individuals. While societies are increasingly mobile and interconnected, new tools are becoming more and more relevant for mobility, accomplishing tasks and creating relationships (Elliott and Urry, 2010). Companies in the automotive industry are in the process of transforming their business from product to service-oriented companies (Dombrowski and Engel, 2014; Wedeniwski, 2015). Tesla Motors (Mahut *et al.*, 2017) is one of the most advanced actors in the automotive sector through the sales of supplementary services with a modular approach and a fully electric powertrain technology. The study analyses the provider platform of Tesla Motors Model S, in which the provider can continuously add additional services to offer them to their customers. Autonomous driving functionalities and other available services can be completed and updated over the air.

This approach requires the company to develop the hardware product accordingly to the functionality of future services.

The study of McKinsey (2016, p. 16) explains that “the Original Equipment Manufacturers (OEM) need to find the right strategy for differentiating their products and services, which largely means evolving their value proposition from hardware provider to integrated mobility service provider”.

Product differentiation (Porter, 1980), as a strategic approach, should be pursued through a digital end-to-end user experience (McKinsey, 2016) with a customer focus similar to software companies keeping products attractive throughout the lifecycle. Currently, boundaries between actors are disappearing, and new entrants are starting to offer core mobility as well as auxiliary services based on consumer needs (Stanley & Gyimesi, 2015). Another study (Athanasopoulou *et al.*, 2019) explores different types of technology-enabled services, which have a significant impact on the automotive industry. The investigation identifies broadly four perspectives on mobility services that affect the industry: personalisation of services and enhanced user experience services, generic mobility services, shared mobility, and Internet of Things-enabled connected cars. These studies underpin the necessity of a service-based oriented technology development in the automotive sector. The increasing consumer demand creates opportunities for the companies to explore more service-oriented mobility. Due to new IT technology, a large variety of novel services are arising in the automotive industry. Besides the core service of mobility, cars can be seen as providing a platform by which to communicate with other objects. New services are emerging (Lengton et al., 2015) based on an interaction between vehicles (e.g. collision-warning systems), between vehicles and road infrastructure (e.g. road information) and between vehicles and devices (e.g. smartphone integration, payment and even commerce opportunities). Shared mobility is moving into the cities with different kind of vehicle offers. People are going for the ostensibly “smart” motorized option (Bienzeisler, 2017) instead of using fixed-route public transportation, riding a bike or walking and a majority of those who avail themselves of shared mobility services actually do so at the expense of public transportation, thereby increasing traffic volume and congestion in the inner-city. These new technologies allow the use of future autonomous mobility with self-driving vehicles. According to recent economic studies (Audenhove *et al.*, 2018) around 50% of self-driving cars in 2040 will be shared, while the portion of the total car fleet will be approximatively 10 to 40 percent, depending on the scenario.

Technologies for automated driving (Schöttle, 2018) might not apply straightforwardly to all markets, but will be integrated in different phases. The study claims that actual transport environment allows already vehicles with more environmentally sustainable drive options such as electric scooters and electric bicycles. Furthermore, air taxis that fly autonomously (Schöttle, 2018) are currently being developed by start-up companies such as “Volocopter” in Germany.

The current business model of most global automotive corporations is based on the improvements of production and technological development in order to realise maximum profits from the manufacture of cars. The trend of renting or leasing a product to a consumer, instead of being sold, is permanently increasing. Manufacturers retain the ownership of the product within a PSS (Williams, 2005) and utility is provided through the sale of customer-oriented services and therefore this approach has the potential to radically change the behaviour of both manufacturers and consumers. Williams (2005, p.176) claims moreover, that “the modularity and upgradeability of products become an important part of the design process”. If individual components or modules of a product can be regularly repaired, replaced or upgraded as part of an on-going contract between producer and consumer, the concept of providing entirely new products and disposing of used ones becomes increasingly obsolete. Product-service systems require a shift from buying products (Williams, 2005) to purchasing services and solutions to minimise environmental effects of consumer needs and expectation. This requires a sophisticated approach of customers and more instruction by the car industry. The responsibility for car producers and service providers (Williams, 2005) in a product-service system is increasing for the complete product life cycle. The study also claims that another important point of a PSS is the expected involvement of consumers in the PSS design process. The actual discussion of a PSS concept demonstrates the ability of an innovative system and the capability to go beyond the traditional innovation process in the automotive industry. New economy corporations are already creating user platforms for mobility services and disconnect the product from the service. This approach establishes an existing threat for the traditional manufacturer, which endangers its profitability. But it also demonstrates the limited automotive research in this field. The body of literature expresses the paradigm shift in the automotive industry by integrating new mobility concepts and services. New technologies and mobility solutions are paving the way into our modern society, providing flexible, efficient, smart and user-oriented mobility services.

From the discussed topics, two different patterns can be derived. The first pattern integrates eco-friendly powertrain technologies and vehicles in different varieties as new mobility solutions. The other pattern indicates new user-oriented mobility trends to satisfy customer demand. Environmental awareness becomes a game changer in the industry, due to the fact that the “Greenness” wave has an influence on the purchasing behaviour of the customers.

The approach suggested by Williams (2005, p. 173) “seeks for a shift away from the manufacture and sale of products towards the delivery of a whole range of products and services”. Companies can in such a way realise profitable new business opportunities at the same time as improving their environmental performance. Moreover, the study (Williams, 2005) explores in detail these types of system-level strategies to transform the automotive industry to a more sustainable one. The investigation of Williams explains five-principle life cycle environmental impacts associated with the manufacture, use and disposal of vehicles. Firstly, automobile production processes are associated with high levels of sometimes non-renewable resource use. Secondly, there are impacts associated with the use of water and energy in manufacturing and the emissions caused as a result of power generation. Thirdly, some elements of vehicle manufacture, particularly during painting and metal finishing, result in the emission of pollutants to air, water and land. Fourthly, the extensive geographical scale of the industry means that it must be supported via global logistics and distribution systems, adding to transport mileages and exhaust emissions; and fifthly, at the end of their life, automobiles also represent a vast waste stream.

The significance (Schöttle, 2018) of electric powertrain technology is replacing combustion-engine-powered vehicles, which will lower carbon emissions in urban centers and the share of energy from renewable sources is on the rise on international markets; electric vehicles will essentially constitute a more sustainable vehicle technology over time. Moreover, the transition to electric vehicles (Schöttle, 2018) is part of a much-needed transition in transportation, which in turn should be coupled with global efforts aimed at transforming our energy sector in terms of sustainability. The study argues that a useful range of vehicles, including small, agile electric vehicles for city use, larger ones with more range or combustion-engine-powered vehicles for long-distance trips, sports coupes for special occasions, and even moving vans to transport large items, complete a future inner-city mobility concept.

The study also claims the advance of IT technology and connected electric vehicles, which helps to make electric vehicles more user-friendly in terms of reservation of charging points. Electric charging (Schöttle, 2018) should become a comfort function and not be classified as a boondoggle. Electric vehicles need a mature charging network to further develop electric mobility. A recent study in the field of eco-friendliness and environmental attitude shows the positive impact on the purchasing intention (Xu, Prybutok and Blankson, 2019) of environmentally friendly cars.
Furthermore, the findings reveal that environmental awareness factors explain less variance than perceived product quality. This element expresses the importance of environmental aspects on the purchase decision. The industry is facing an additional product feature, which is even more important than quality. The aspects of the studies imply that ecological awareness becomes a unique selling proposition (USP) in the sector. The efforts of the industry indicate the importance of consumers' choice and current political and environmental pressure (European Commission, 2018) on the sector as already mentioned in the introduction. Eco-friendliness is an important factor in the purchase decision and has the ability to become a factor of differentiation in the industry. The literature describes current and future mobility services, trends and the importance of connectivity in the automotive sector. The literature establishes a detailed overview on current and future-oriented mobility solutions. Environmental awareness becomes a game changer in the industry and indicates the impact on the industry. Only through the connection of different studies, it is possible to obtain a more holistic picture of the topic. Yet the current literature lacks to establish interactions and correlations between all these different aspects to a fully developed mobility concept. Most of the studies do not take into account the relevance and integration of personal mobility needs.

2.2.5 General limitations and implications for the research

The body of literature on new mobility solutions confirms existing technologies but is still very generic and offers only few concrete examples for the automotive sector. Future mobility solutions and trends were very generally addressed. The body of literature responded to some extent to the first research question about the impacts on mobility solutions and trends.

The gained expertise in this domain supports the empirical research and the study will integrate more precise interview questions and guidance towards internal and external participants to enhance the data quality and know-how regarding current and future mobility needs. Furthermore, the literature review focused on current and future individual mobility needs and connected services. The review supported the current understanding of these topics and will further improve the interview questions for a more specific customer feedback, concerning future mobility needs.

2.2.6 Value creation through innovation

It is necessary to primarily introduce the general concept of innovation before discussing the more specific form of open innovation. Innovation is a key strategic issue for corporations and managers, but it is also of great interest for researchers through a variety of business management themes. The business environment becomes more and more dynamic and creating a competitive advantage through innovation becomes a key success factor for companies to meet customer demand and expectations. Innovation (Schumpeter, 1942; Dosi, 1990) is about learning, ideas, new products, services, processes and competitiveness.

2.2.7 Definitions of innovation

As one of the early pioneers, Schumpeter (1942) introduces innovation as a process of industrial mutation, that incessantly revolutionizes the economic structure from within, incessantly destroying the old, incessantly creating a new one. Schumpeter describes the process as creative disruption. The importance of Schumpeter`s work (Fritsch, 2017) implicates that one of the key drivers for economic growth is innovation. Thus, innovation is required to develop and foster corporations and businesses. Schumpeter (1934) divided the process of structural changes into five types of innovation:

- Launch of a new product or a new species of already known product.
- Application of new methods of production or sales of a product.
- Opening of a new market.
- Acquiring of new sources of supply of raw material or semi-finished goods.
- New industry structure such as the creation or destruction of a monopoly position.

In a complex and dynamic world, Schumpeter claims that the driving force for the quest of profits and competitive advantage remains innovation. Schumpeter`s ideas are still present in the automotive industry and this traditional approach of innovation is still a reference in the hardware-oriented world of Mercedes-Benz. Thompson (1965, p. 2) states that “innovation is the generation, acceptance and implementation of new ideas, processes products or services”. In comparison to the traditional approach of Schumpeter, this definition includes new ideas and services. This definition creates already a link to our study with open innovation and service innovation. Kimberly (1981, p. 108) defines “innovation from a diverse point of view, which describes various forms of innovation with three stages of innovation: innovation as a process, innovation as a discrete item including, products, programs or services; and innovation as an attribute of organizations”.

The definition is an evolution to the former one, due to the fact that Kimberly underlines the importance of process, product, organisational and service innovation. Another definition (Dosi, 1990) demonstrates the transformational process of product creation and the obligatory organisational change, due to the innovation process. Innovation concerns processes of learning and discovery about new products, new production processes and new forms of economic organization. A more evolutionary definition is provided by Baregheh, Rowley and Sambrook (2009, p. 1334); “innovation is the multi-stage process whereby organizations transform ideas into new or improved products, service or processes, in order to advance, compete and differentiate themselves successfully in their marketplace”. This definition explains the process of competitiveness through differentiation. Innovation means creative disruption and it changes the complete business environment for an organisation. This definition underlines the theory of Schumpeter, extending the perspective, but is still focused on closed innovation. Innovation is an essential challenge for the industry, especially for the automotive sector to create a competitive advantage. To capture the voice of the customer, the next section explains a specific form of innovation with an open source approach and an evolution of the actual innovation literature.

2.2.8 Paradigm shift towards Open Innovation

Open Innovation (OI) is a specific model of innovation and of growing interest in different industries. The integration of customers, business partners and other stakeholders to the innovation approach, offers new opportunities for corporations. Through the cooperation with external and internal partners, OI could create additional value for corporations and in particular to capture customer needs and expectations. During the discussion of innovation, the thesis refers frequently to OI and its capability to create additional value through knowledge creation. Open innovation can support different types of value creation, which we discuss in this section. The fathers of Open Innovation (Chesbrough, Vanhaverbeke and West, 2006) explain the historical background, the concept of OI and it`s further potential development. The utilization of diverse business models to define system and process requirements started a paradigm shift from closed to open innovation (Chesbrough, 2003) in research studies and the industry as well.

Open Innovation is a paradigm that assumes that firms should use external ideas as well as internal ideas, and internal and external approaches to the market. The study of Open Innovation (Chesbrough, Vanhaverbeke and West, 2006) argues, that OI has the potential to reach the next level of new research approaches. The OI approach creates additional value via service- and business model innovation as a valid proposal for most industries. The literature review discusses open innovation and sets the focus on service innovation. Business model innovation will be presented in a later stage of the study as outlook for further research. The approach of OI (Chesbrough, 2011) is important to develop a profitable and sustainable business in the future automotive environment. OI as the new paradigm for innovation (Chesbrough, Vanhaverbeke and West, 2006) is described as an industrial success story with concrete business examples. This research represents a tangible demonstration of applied science and useful approaches in a business environment. Google and other new technology corporations are operating successfully in an open innovation approach. The LEGO Corporation (Chesbrough, 2011) have had great success in letting customers create future designs. In LEGO's case, an early example of this phenomenon was LEGO Mindstorms, in which the company included programmable motors with the plastic parts. This allowed consumers to build LEGO designs that could move. An increasing number of firms (Chen, Zhao and Wang, 2015) recognised already the benefit of open innovation to their actual innovation activities.

2.2.9 Value co-creation

The following research (Ili, Albers and Miller, 2010) expresses the need for co-creation, due to increasing innovation and cost pressure in the automotive industry. Corporations need to look outside their own boundaries to escape from this productivity dilemma. This study demonstrates that open innovation proves to be more adequate to achieve better R&D productivity for companies in the automotive industry than a closed innovation model. Open Innovation in the context of the automotive industry (Ili, Albers and Miller, 2010) does not yet seem to have made an impact. This study describes the need for further investigation and supports the appropriateness of OI in the car industry and especially in R&D departments. This study (Ili, Albers and Miller, 2010) identifies global conclusions and recommendations regarding the relevance and the adoption of open innovation in the automotive industry. This is especially factual in the context of strategy, process, methods and culture.

This study is strongly focused on R&D and production activities in the automotive sector. The essential link to cooperation`s and customers is not pronounced in this automotive study and therefore only valid in very generic way. Chesbrough (2011) argues that an important problem for advanced economies is that these markets know much more about development of new products and technologies than the innovation of services, which is potentially the case of Mercedes-Benz. The author argues to move away from Porter's product-oriented value chain (Porter, 1980), thinking about a new approach to the customer and to see the actual business more than a service business. For the service business approach, the value chain must be replaced by a different kind of pattern; creating the Customer's Experience (Chesbrough, 2011) as Services Value Web.

To achieve tangible results in the process of engagement and co-creation, tacit knowledge is stimulated from the customer and the customer learns tacit knowledge from the corporation as well. Through the work on tacit knowledge (Polanyi, 1967), researchers were able to integrate the outcomes of intangible assets into their studies of innovation. To better comprehend the involvement of this knowledge transfer, Nonaka (1991, p. 62) refers to "knowledge conversion as four modes of diverse interactions from tacit to tacit (socialization), from tacit to explicit (externalization), from explicit to tacit (internalization) and from explicit to explicit (combination)".

The investigation of Bozward and Rogers-Draycott (2017) created a programme which uses series of pedagogies, technologies and techniques which have not previously be brought together in one action-based entrepreneurship education programme, in particular learning through value creation. Even in academic entrepreneurship training (Bell and Bell, 2016), value creation and live experience are used to create successful entrepreneurial mentoring and development programs for future businessmen. The study of Chesbrough, (2011) underlines the socialization interaction in the case of open innovation. Providers are asking open-ended questions to diagnose a problem correctly and customers are contributing with additional information about the specific situation and context. This happens to be the instant where tacit knowledge is shared and contributes to open innovation through socialization. Tacit knowledge (Chesbrough, 2011) may only emerge during the innovation process and the close cooperation with customers can help to develop new business solutions. Before explaining the important role of customers, a more specific study (Myhren *et al.*, 2017) demonstrate the competence of internal participants and co-creation of open service innovation groups.

This case study identifies three archetypes for open service innovation: internal group development, satellite team development and rocket team development. This research demonstrates the integration of employees to the process of service innovation through their creativity, professional skills and knowledge. This case study presents the benefits of internal group work as extended part of OI, which could lead to a discussion, if this approach is coherent with the definition of OI. At least it can be concluded that the integration of customers, as an external voice in the process of service innovation and the knowledge and expertise of internal experts could represent added value creation for corporations. Customer co-creation is another important aspect of OI. In a contemporary hyper-competitive marketplace, customer value co-creation (Tommasetti, Troisi and Vesci, 2017) has gained increasingly more relevance as a cutting-edge phenomenon. The study of Gustafsson, Kristensson and Witell (2012, pp. 311-327) describes customer co-creation as a frequent, bidirectional face-to-face communication process supporting creative problem solving. Moreover, the increasing digitalization of services demands new forms of customer co-creations in the future. The integration of co-creation into the innovation process becomes a competitive advantage in an industry.

The main stakeholders of OI, customers, employees, suppliers and other business partners create additional value. Partnership innovation is another important consideration of OI.

2.2.10 Open innovation in the automotive sector

The explorative study of Townsend and Calantone (2014) describes some of the most noticeable topics related to innovation and product management in the context of the contemporary global automotive industry. OEMs` are increasingly turning to their supply chains for help in achieving innovation goals, with relational systems developing a more important role in the process, such as partnership and co-creation strategies. Product life-cycle management (Townsend and Calantone, 2014) is a major point of consideration, not only because of the massive resource and financial costs involved up front, but also due to the importance of product acceptance in the marketplace. In the future, much of the expected innovation will be driven by consumer demand for product features. Due to political, ecological, financial cost pressure and consumer related changes in society, the automotive industry (Townsend and Calantone, 2014) has to adapt to new solutions of co-creation in their innovation strategy.

A change from closed towards open innovation is certainly recommended from the authors. The study expresses further the fact that the automotive industry developed products and technologies for the last decades in a closed environment and actual studies of OI in the automotive sector are still fragmented. Partnership innovation can be seen as another subset of open innovation. The research of Walters and Rainbird (2007) identified patterns and motives for the approaches to partnership innovation and the relationships with suppliers, customers and competitors. The purpose of this paper is to show the contribution to partner or cooperative innovation with the aim of evaluating the concept of a value chain business model. Partner or cooperative innovation combines elements of process and product innovation within a network structure. The Oliver Wyman study of innovation management in car industry argues that, in the future, car manufacturers and suppliers (Dannenberg and Burgard, 2015) will have to examine the chances of success of their innovations much more thoroughly. Companies have to know in advance which ones of the innovations for which customers of which brand are important.

The study of Cano-Kollmann et al. (2017, p. 34) states that “a group of major manufacturers had to explore the new technologies to catch up to the knowledge frontier and market lead amassed by Toyota”. GM, BMW, and DaimlerChrysler joined forces to form the Global Hybrid Alliance, which had the mandate to research hybrid technologies and respond to Toyota’s leadership in the HEV market. Partnership innovation means active participation in joint R&D activities and other technological innovation projects with other organisations. The following section of open innovation explains the design of new business models (Carroll and Helfert, 2010) through Open Innovation (OI) in immature ecosystems and the requirement for service capabilities within open innovation. The process of value co-creation in a modern service environment through OI should support the design of new business models. This research examines the perspective of a company`s service capabilities. Service orientation (Carroll and Helfert, 2010) and the traditional staged capability maturity model need a revision in a changed business environment. The OI concept through internal and external innovation flows (Carroll and Helfert, 2010) and the following value creation involves an extended capability maturity model and the evolution to a Service capability sourcing model. This study proposes a new model of service capability sourcing through service co-creation and OI.

Due to further service orientation and on-going competition in the industry, the OI environment needs certainly a stronger focus on the service capability perspective to create new, enhanced product service offers within a service ecosystem. The definition of an ecosystem and specifically service ecosystem in a business environment is necessary to understand the essence of these studies.

An ecosystem (Weiller *et al.*, 2015) is a business-oriented, three-dimensional strategic framework, with the ability to shape an innovative, competitive and technological advanced ecosystem. The service ecosystem (Carroll and Helfert, 2010) can be defined as a combination of “servitization” and OI. This research demonstrates a strong focus on companies’ capabilities sourcing and matching of processes and systems. The main stakeholders of OI, such as customer, suppliers and other partners could be more assimilated in the research to better understand the external capabilities.

The study of Wang *et al.* (2015) is exploring service innovation via three modes, such as business model innovation, service product innovation and service process innovation.

This study proposes external involvement as necessary to successfully create a 360° degrees innovation. With the aim to reduce significantly costs and limited resources, business model innovation relies extremely on external collaboration. External collaboration with customers and business partners is required to business model innovation and consequently, the role of external partners should be more detailed in this paper to describe their main function. The incorporation of business model innovation into the study of service innovation, with support of service product and/or process innovation is partially discussed in the outlook for further research in this study. Nevertheless, the success of open innovation among corporations (West and Bogers, 2014) is related to its capability to improve the innovation performance. The value and the flow of internal and external knowledge can amplify the success of commercial activities. The current OI research focus in the automotive industry remains mainly on business partners and R&D cooperation's. The critical aspect of partnership innovation, which could be seen as subset of OI shows a clear focus of the industry on these two aspects. Main targets of automotive corporations are the reduction of costs and the value creation in the industrial production process. The actual body of literature portrays the traditional innovation process of the industry as a closed innovation approach. Nevertheless, the literature describes the opportunities of an OI approach and its capability to improve the innovation performance of the automotive sector. The actual stance of investigation gives additional opportunities to explore customer`s integration into the OI process.

By the evaluation of the actual body of literature, it is recognizable that OI has a strong potential to further improve the service innovation in the automotive industry. Customer co-creation has the potential to become the new paradigm in the automotive industry. Customers, as new protagonists in open innovation are yet not in the research focus of the industry. The implication of customers and the specific role in open innovation is worth additional studies to provide special emphasis on the subject. Solutions for actual and future customer needs in individual mobility, offer the opportunity to create additional services around the vehicle. Open innovation relies on external collaboration, business partners and customers, who can support the development in a very efficient way and effectively stimulate innovation in the automotive sector.

2.2.11 Services and the link to OI in the digital era

Generating profits from tangible and intangible services, such as park & recharging apps for electric cars or “pay as you drive” and others will be undoubtedly an important challenge to sustain the value chain in the automotive industry. The integration of services to the conventional innovation process is one of the future automotive challenges. The automotive industry is mainly steered via an engineered and product-centric approach (Räse, 2010). The evolution and the combination of cars and valuable services will be discussed in the following section. In the near automotive future cars will be most likely electric, fully connected and autonomous. Thus, additional services could turn out to become a unique selling proposition (USP). The link between open innovation, hardware and services to a complete mobility system will be discussed in the next section. The discussion will consequently lead to the evolution of services to a complete service system in the digital era. The automotive industry is still dominated by a product centric approach and the profit generation via tangible products. The service culture is entering only gradually into the industry, but external platforms and corporations create most of the actual additional mobility services. Along with the transformation from a car manufacturer to a mobility service provider, the automotive industry has to face new service challenges. With the introduction of a service-dominant logic (Lusch and Vargo, 2004), describing the shift from a product-centred view of markets to a service-led model, a new marketing perspective introduced the service concept. The focus is shifting away from tangibles and toward intangibles, such as skills, information, and knowledge, and toward interactivity and connectivity and on-going relationships.

The business orientation has shifted from a purely producer focused point of view to meet customer needs and expectations. The outcome of this study underpins the necessity for concentrate on service-dominant logic in the automotive industry. The study of Chesbrough (2011) defines services as intangible by nature, so that customers often cannot specify exactly what they want. It is often much harder to measure the services that are delivered, therefor the company should create an openness (Chesbrough, 2011), which means from outside in, where a company makes greater use of external ideas and technologies in its own business and from inside out, in which a company allows some of its own ideas, technologies or processes to be used by other businesses. Chesbrough underlines the importance of service innovation linked to OI as a new innovation standard for the industry.

Another enlightenment to the relation of OI and a concrete product-service response is given by Walters and Rainbird (2007, p. 598); “It follows that partner/cooperative innovation combines elements of process and product innovation management within a network structure to create a product-service response that neither partner could create using its own resources”. Open service innovation is perceived as the ideal prerequisite to develop efficient, digital services for the automotive industry and it is worth to further explore the subject.

2.3 The concept of service innovation

Service innovation has a strong impact on the overall economic development. Service innovation is currently (Snyder *et al.*, 2016) acting as the engine of economic growth and pervades all service sectors and includes Internet services, such as Twitter and Netflix and industrial giants (e.g., IBM and GE), who have revitalized their competitive positions by focusing on customer services by creating new customer experiences. Ostrom *et al.* (2010) suggest that service innovation creates value for customers, employees, business owners, alliance partners, and communities through new and/or improved service offerings, service processes and service business models. The actual body of literature of service innovation is using different terms and definitions; therefore, it is necessary to clarify upfront various terms. Neely (2007) claims that “servitization” is most prevalent in industrial developed countries; there exist different forms of service offering that manufacturing firms can adopt and there is evidence that larger firms, measured both in terms of number of employees and turnover, are more likely to “servitize” their offer.

Larger companies have certainly the potential to offer intangible services in addition to their tangible products. Nevertheless, in today`s business environment, it is no longer a question of size, but a question of speed, sustainability and determination to develop new services. Following terms are considered to be synonyms in the service innovation literature (Tan *et al.*, 2010, pp. 90-97): “servitization” of the products, functional product development, service engineering and “servicizing”. Other terms from the field have emerged (Beuren, Gomes and Cauchick, 2013, p. 227) in the literature: “industrial product-service system, service-based businesses, service-based products, service providing, sustainability contribution, functional sales, functional economy, functional product, leasing, integrated product and service offering, service-dominant logic, and integrated product and service engineering”.

An alternative clarification of terms is given by Baines et al. (2007, p. 4). “Recent years have seen the ‘servitization’ of products and the ‘productization’ of services. Morelli (2003) sees ‘servitization’ as the evolution of product identity based on material content to a position where the material component is inseparable from the service system. Similarly, productization is the evolution of the services component to include a product or a new service component marketed as a product. Subsequently enhancing services to innovation produces new business opportunities. The organisation for economic cooperation and development (OECD, 2005) defines service innovation as launching a new or significantly improved product (good or service) or process, a new marketing method, or a new organizational method in business practices, workplace organization, or external relations. Traditional service innovation categorizations separate radical, incremental and product and process innovations (Gallouj and Savona, 2009). Recent service studies recommend to interrelate categories of service innovations, such as service-product to service-process innovation (Ostrom *et al.*, 2015). Main points of differentiation between service innovation and traditional innovation perspectives result in the changing role of the customer, the Internet use and new business models (Dotzel, Shankar and Berry, 2013; Hsieh *et al.*, 2013). Analysing these different service innovation categories provide a different perspective on the specific service innovation approach and clarifies the importance of service innovation in a business environment. Schumpeter (1934, p. 66) defines innovations as the “carrying out of new combinations”. Taking into account Schumpeter`s work, researchers develop the Schumpeterian view of service innovation (Gallouj and Savona, 2009) as more straightforward evolution of innovation.

The expressed definitions are rather general and explain principal categories, which are underdeveloped to apply service innovation in business practice. An evolutionary step of applied service innovation is the development of a whole system of services linked to a specific hardware product (Morelli, 2003; Baines *et al.*, 2007; Beuren, Gomes and Cauchick, 2013).

2.3.1 The evolution of service innovation

The convergence of these service trends leads to the consideration of a product and a service as a single offering, which defines a complete Product Service-System (PSS). PSS is consequently organizing all other aspects of “productization” and “servitization” in a whole system as a logic evolution of service innovation.

The study sets the focus on the PSS innovation as one of the main evolutionary steps of service innovation. PSS is analysed in the next section as a potential enabler to accompany the automotive transformation through the development of a Service-System and the consequent link to the vehicle in the automotive environment. The body of literature proposes several interpretations of PSS; the most often cited definitions in the literature on the PSS (Beuren, Gomes, Cauchick, 2013) are presented in this review. Goedkoop *et al.* (1999, p. 18) describe a "PSS as a system of products, services, networks of players and supporting infrastructure that continuously strives to be competitive, satisfy customer needs and have lower environmental impact than traditional business models". Aspects of "competiveness", customer satisfaction and "eco-friendly" behaviour are the basis for the business model of a PSS. To satisfy customer needs by transforming them into a system of product and services, is the key value to create future business success.

An evolution of the definition is given by Baines et al. (2007, p. 8), who argue that "a Product Service-System is an integrated product and service offering that delivers value in use". A PSS offers the opportunity to decouple economic success from material consumption and hence reduce the environmental activity. The valuable use of a PSS and economic success, while reducing environmental impact define additional objectives for the automotive industry as mobility services in use. Currently, the automotive industry is selling cars with additional services; In the near future, the automotive sector will potentially sell mobility including a car. The ecological aspect of PSS in the automotive business is undeniable. Customer`s demands and limited raw material (Baines et al., 2007) for electric batteries (lithium and cobalt) should be in the centre of interest of the automotive industry to sustain their value chain. Since a few years, changes in society can be observed; corporation, institutions and consumers are managing limited resources with more sensitivity. Only by supporting these ecological aspects, a corporation like Mercedes-Benz can be a successful competitor in the future.

Therefore, the study of Baines et al. (2008) not only explores PSS development, but underpins the sustainability of a business model. As already mentioned, environmental awareness is becoming very prominent and a key factor of change in the automotive sector.

The definition of Mont (2002) is reflecting these ecological aspects and refers to product service-system (PSS) as a system of products, services, supporting networks and infrastructure that is designed to be competitive, satisfy customer needs and have a lower environmental impact than traditional business models. Added value is created by technological improvements (Mont, 2002), intellectual property, product image and brand names, aesthetic design and styling; all nonmaterial aspects of products. These nonmaterial aspects of a product could represent a unique selling proposition (USP) in the automotive future.

The definition of Manzini and Vezzoli (2003) of PSS goes even further in the interpretation as an innovation strategy, shifting the business focus from designing (and selling) physical products only, to designing (and selling) a system of products and services which are jointly capable of fulfilling specific client demands, while re-orienting current unsustainable trends in production and consumption practices. The combination of a joint product service-system, with regard to sustainable trends in production and consumption behaviour, represents the new paradigm in a modern society. Different terms and phrasings of PSS are used in literature and in the field of business. To facilitate the knowledge exchange (Beuren, Gomes and Cauchick, 2013) between academia and business, it is important to consolidate the terms and their definitions. This research sets the focus on the term “PSS”, due to the fact that this wording describes the automotive environment, with its joint products, the vehicle and valuable services, in the most adequate way.

PSS incorporates three different perspectives (Tukker, 2004, pp. 248-249), the first category are **product-oriented services**, where the business model is still largely associated with the sale of products to consumers, with some additional services. The second category consists of **use-oriented services**, where products remain central, but are owned by service providers and are made available to users in different forms (e.g. leasing, renting or sharing). The third type is **result-oriented services**, where customers and service providers agree on a desired outcome (e.g. mobility services) without specifying the product involved. A common trend for result-oriented services is the outsourcing of catering and office cleaning of most modern companies. Result-oriented services can be considered as a subcategory of service innovation.

Tukker (2004, pp. 252-258) develops through the previously mentioned categories eight archetypes with specific economic impacts on Product Service-Systems:

- Product-related service
- Advice and consultancy
- Product lease
- Product renting and sharing
- Product pooling
- Activity management
- Pay per unit use
- Functional result

It isn't expected that these PSS types result immediately in fundamental gains for a company. PSS development will not automatically cause an environmental and economical win–win situation. Some of the PSS`s, such as product lease, could potentially lead to less responsible user behaviour and thus increase environmental impacts. Product renting, sharing and pooling could in principle lead to higher environmental improvements, due to the fact that the assets are used more intensively. The most promising PSS in environmental terms is the function-oriented PSS. The example of Rolls Royce aircraft engines is presented in PSS study of Tan *et al.* (2010) with the PSS result-oriented contracts of TotalCare ® and CorporateCare ®. In the TotalCare ® offer, the customer is invoiced per hour of flight, rather than for the buying of an engine. The maintenance of the engine is managed by the provider which warrantees a mandatory level of availability and costs for the customer. These contracts are made relevant for the provider by the monitoring of engine conditions in use, which enables a better prevision of maintenance operations and a finer management of resources through the maintenance network of operators, workshops and spare parts. Better information of use parameters and engine conditions allows valuable closed-loop information to design stages of the engines. The Rolls Royce aircraft service management demonstrates the successful implementation of a PSS in the manufacturer industry.

The study of Barquet *et al.*, (2016) shows that a business model could be defined by applying innovative methods. One of the important methods is the development of a PSS Configurator for a sustainable business model. This aspect emphasizes the significance of a PSS in the business environment. Nevertheless, the demand side is very important before operating a PSS, to meet customer expectations and needs.

2.3.2 PSS in the automotive environment

The automotive industry is already developing **product-oriented** services and starting to offer **use-oriented** services with additional potential in the marketplace. **Result-oriented services** are yet in the starting blocks of the industry. Williams (2006) argues, that based on this exercise, most current initiatives do not unify these three key elements of a PSS in a single coherent system, they do not constitute 'complete' versions of PSS, the focus is mostly on technological improvement. Product redesign is largely synonymous with redesign of the artefact. In the case of the automobile industry, this might entail the replacement of an internal combustion engine with a hybrid powertrain or fully electric vehicle. The study of Mahut *et al.* (2017) focuses on the consumers' needs, the limits between tangible and intangible offer, which are challenged through new kind of offers merging products and service under one common offer.

In the case of the automotive industry, "the product side (Mahut *et al.*, 2017, p. 2102) of the industry is mature, whereas service side is currently increasing". The authors claim furthermore, that the automotive industry is confronted with the integration of new constraints of sustainability, economic globalisation and new ways of consumption. This new kind of product service proposal make it possible to respond to this challenge. This study supports the approach of new trends in customer behaviour the opportunity to increase the product and service proposal. Baines (2015) claims that researchers have to identify organizations it will be the most productive to study and yet the automotive industry is one of them. In addition to Mercedes products with high level of environmental compatibility and environmentally friendly production processes, Mercedes (Daimler AG, 2017) also strive to provide innovative mobility services on the road to emission-free driving. To present an actual overview of existing mobility concepts of Mercedes-Benz, the researcher proposes a range of concrete examples. From the car-sharing provider "car2go" and the mobility platform "moovel" to the taxi app "mytaxi" and the participation in the coach company "FlixBus" and the "Bus Rapid Transit "(BRT) system Mercedes-Benz already covers inner-city and overland mobility services. Recent additions to this list are the service portal "Blacklane" and "Croove", a car rental service operated by and for private individuals.

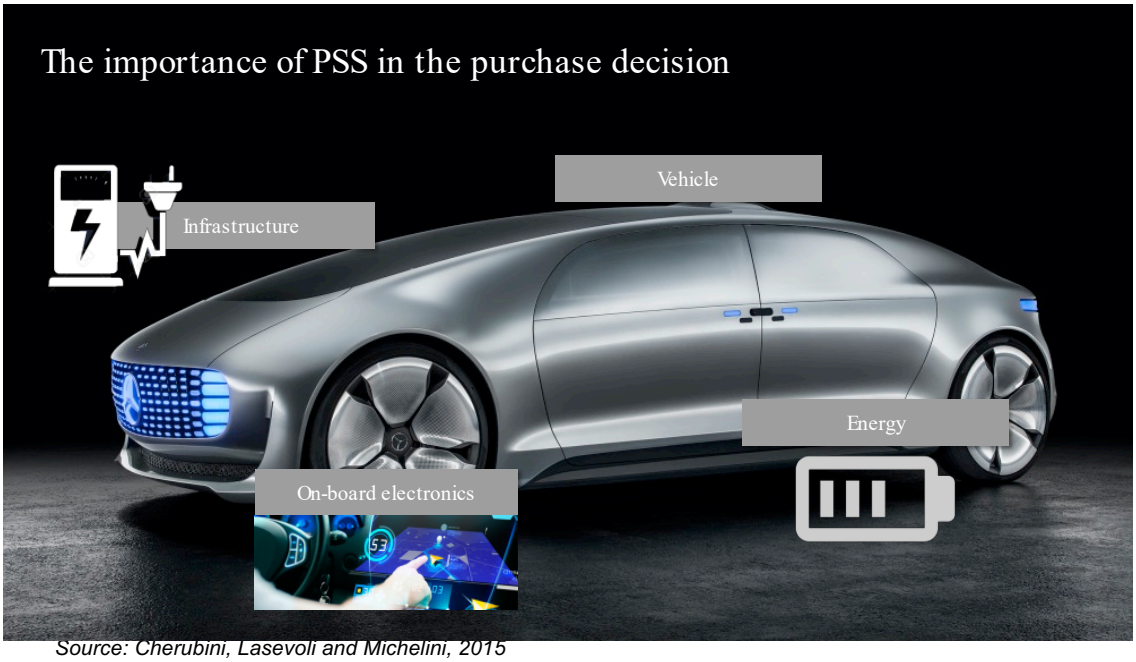
2.3.3 Paradigm shift towards PSS integration in the digital era

Tesla Motors (Mahut *et al.*, 2017) is one of the most advanced actors in the automotive sector and sells supplementary services through their modular provider platform and the McKinsey (2016, p. 16) study expresses the need that the “OEMs` evolve their value proposition from hardware provider to integrated mobility service provider”. These arguments express the need of a paradigm shift in the automotive industry.
The PSS integration and transformation from a traditional hardware provider to PSS designer could be explored with more conviction and determination in future studies. Product-service systems require a shift from buying products to purchasing services and mobility solutions. Hereby, environmental effects of mobility are minimised. The responsibility for car manufacturer and service providers in a product-service system is increasing for the complete product life cycle.
Another important aspect of a PSS is the expected involvement of consumers in the PSS design process. The current discussion of a PSS concept demonstrates the ability of an innovative system and the capability to go beyond the traditional innovation process in the automotive industry. The actual body of literature shows limitations in the research area of automotive PSS and the incorporation of the customer in the development process. The review also demonstrates the delay of the automotive industry in terms of research activities to a fully developed concept. As a relevant factor in the purchase decision, the research (Cherubini, Iasevoli and Michelini, 2015) in the electric car industry assumes considerable importance to a PSS with relevant service components. The study further claims a proper Product-Service System management is essential for the automotive industry. Moreover, the study demonstrates that there is a strongly motivated sector of “green” consumers who are willing to pay more for an eco-friendly car, even if the total cost of ownership compares unfavourably with conventional vehicles. Nevertheless, these consumers are affine to additional services to complete the entire offer. The research discovers four essential sub-systems of PSS in the electric car industry:

- **Vehicle sub-system** is linked to: Car Assistance, Batteries, Leasing, Warranties and specific Car Services.
- **Infrastructure sub-system** is linked to: Public infrastructure, Institutions and Priority access.
- **On-board electronics sub-system** is linked to: Costs info, Route info, Charging info, network info and Access info.

- **Energy sub-system** is linked to: Regular charging, Convenience charging and remote charging.

Figure. 2.7. *PSS for Electric Vehicles*



Source: Cherubini, Lasevoli and Michelini, 2015

The need to follow an approach based on PSS management (Cherubini, Lasevoli and Michelini, 2015) is necessary, especially in new or evolving markets such as the electric car industry, and this means that companies must develop new product-service systems for the market. The study expresses the growing importance of PSS development, yet the academic literature has remained sparse, especially in the field of electric vehicles. This study claims that consumers are willing to accept this new service approach and the challenge of novelty of the products. The findings of the study (Cherubini, lasevoli and Michelini, 2015) highlight the central role of the intangible components in creating an innovative automotive style in which functional and tangible benefits are integrated with symbolic and cultural status meanings. The automotive industry is observing a significant increase of electric vehicles from new competitors such as Tesla. Electric mobility users claim for an expected level of PSS, while purchasing or using an electric car. This study demonstrates the necessity (Cherubini, Lasevoli and Michelini, 2015) of the car industry to incorporate multiple players in this business eco-system and the integration of additional digital services. This approach could also be transferred to the automotive industry in general and shows the need for further study in the field of PSS research.

2.3.4 The concept of a digital PSS

Creating a better understanding of the different PSS conceptions, the inquiry explores the evolution of a PSS to a digital PSS in the automotive environment. Digitalization created an increasing trend towards intelligent, digital systems that allow the products to operate independently (Lerch and Gotsch, 2015) of human intervention and communicate with other machines. This study has dealt with new challenges and impacts of digitalized services, focusing on how they differ from more traditional product-related services. What is missing in the literature (Lerch and Gotsch, 2015), is a complete framework bringing together the emerging trends of servitization and digitalization in one conceptual structure. A digital PSS is a systematic and consequent evolution of digital servitization. The study demonstrates that “digitalization (Lerch and Gotsch, 2015, p. 46) makes it technically feasible to connect products to the Internet and assign them an IP address so that they can communicate and interact, with other components and with remote controllers, thus enabling more advanced services”. In the digital era, new definitions of digitalized PSS (Lerch and Gotsch, 2015) are established as an evolution of service bundles.

Digitalized PSS (Lerch and Gotsch, 2015, p. 47) may be defined as an “integrated bundle of physical products, intangible services, and digital architectures designed to fulfil individual customer needs via automated, independent operation, with the goal to significantly improve customer outcomes”. Manufacturers at this stage not only provide complex PSS to their customers, but also incorporate ICT solutions as a novel component in the product-service bundle, creating intelligent, independent operating systems that deliver the highest level of availability possible and optimize operations while reducing resource inputs.

The study develops three types of digitalized PSS:

- Smart Service Delivery
- Smart Product Optimization
- Digital Brain

The concept of digital PSS brings digitization and PSS together and forces the manufacturers to integrate products, services and the digital architecture to deliver novel digitalized PSS. In this way, the industry could provide highly customer-oriented, highly customized solutions and maintain the business model upright by connecting the car with a complete service ecosystem- a digital PSS.

The success of a product-service combination (Vendrell-Herrero *et al.*, 2017) is determined by the level of understanding of market demand. This study establishes the link between customer needs and a successful, digital product service-system, offered across developed marketplaces. Appropriate resource bundles can then be co-produced, and dialogue with customers can be undertaken to educate partners as to the value of the proposed offer (Vargo and Lusch, 2008). This example demonstrates the partial development of digital PSS through the application of OI. The value of a digital PSS (Vendrell-Herrero *et al.*, 2017) is not only grounded on “value in exchange” of product ownership, but PSS includes also the “value in use” of the provision of digital service offerings.

2.3.5 General limitations and implications for the research

Service innovation in the automotive industry is just at the beginning of researchers` interest and the actual body of literature is still limited to few particular examples. Increasing the knowledge of service innovation in the automotive environment is a challenge. The literature review discussed different concepts of service innovation to better satisfy customer needs and expectations. Understanding service innovation through a digital PSS, as an essential requirement for the future development of a new, adapted SIPM, supports further study in the design of open workshops. As a result of the literature review, the researcher will improve the workshop design, where participants can contribute their knowledge and experience in an open innovation environment to develop a new service innovation process model. Experiencing co-creation and the necessary paradigm change from closed to open innovation, to develop valuable customer services, will be correspondingly integrated into the workshop design.

2.4 Service innovation processes

The high volatility of economic markets increased the competition within the automotive industry. Intense market competition and price pressures drive manufacturing enterprises towards making service innovation (Gebauer, Fleisch and Friedli, 2005) as they attempt to obtain additional income and profits.
A good service can enhance customer loyalty and increase the likelihood of customers buying again (Yang *et al.*, 2009).

Empirical results of the study (Yang *et al.*, 2009) demonstrate that structured service innovation practices positively relate to service innovation performance and more effort and resources need to be committed to the management of the processes and the team that is engaged with the service innovation process. The study (Yang *et al.*, 2009) suggest a structured process management approach and continuous improvement increase of procedures. Indeed, different innovation procedures of diverse companies are used to face the innovation challenges. The study of Yang is discussing a variety of different, unstructured service innovation processes with little consensus of a structured innovation process. Therefore, our following investigation goes beyond process management and will analyse different innovation processes.

The body of innovation management literature grew considerably over the last years and this led to an increasing amount of different models (Eveleens, 2010) of innovation processes. In modern economies (Eveleens, 2010) in which services are getting more important, recent service innovation processes from Tidd, Bessant and Pavitt (2005), from Andrew and Sirkin (2007) and from Hansen and Birkinshaw (2007) are considered as well in business practice, though still with less attention. All these models are using a phase model, with many feedback-loops and cycles (Eveleens, 2010) before proceeding through the process with the same complexity as the Stage Gate Process of Cooper (1990). These models are simplified representations of reality, but only few models are identified for service innovation in the automotive sector. The results of the Eveleens (2010) study is quiet disappointing in terms of real business application and entire components of the different service innovation models, such as strategy, culture, leadership, organisational structure, resources and links to external stakeholders. Currently, the literature review considers service innovation in the automotive environment and discusses different approaches of OI and co-creation.

The new age of innovation started with open innovation and the link to customer co-creation (Bartl, Jawecki and Wiegandt, 2010). New innovation concepts have at least in common (Bartl, Jawecki and Wiegandt, 2010) that they go beyond organizational boundaries (Prahalat and Ramaswamy, 2000) and foster the collaborative exchange and integration of resources and know-how outside the company (Prahalad and Ramaswamy, 2004) into the value chain.

The study of Bartl, Jawecki and Wiegandt (2010) underpins the necessity of open innovation through co-creation as strategic program to develop new products and services in the automotive industry.

Co-creation is defined (Bartl, Jawecki and Wiegandt, 2010, p. 6) as a “continuous collaborative relationship with users consisting of various interactions along the innovation process including iterative internal and external cycles of acquiring and assimilating the users’ value contributions”. Therefore, three major dimensions (Bartl, Jawecki and Wiegandt, 2010) have to be taken into account:

- Developing a co-creation skill set allowing to accomplish excellence in terms of methodologies, tools and experience.
- Continuous co-creation activities with alternating inbound and outbound flows between consumers and the company throughout the whole development process, starting from the fuzzy end to the test and launch of products.
- Organizational structures and routines have to be established not only to acquire external input but also to assimilate, digest and capitalize on the value co-creation within the company.

The BMW Group “Co- Creation Lab” is a valid example to demonstrate co-creation in an open innovation approach for valuable automotive applications. The lab is designed to host several different methods and tools for co-creation (Bartl, Jawecki and Wiegandt, 2010) as well as to constantly feed the whole process of product and service development with consumer input. The literature underpins the importance of open innovation through co-creation of product and service development and the practical relevance for the automotive sector.

Another automotive study (Lenfle and Midler, 2009) claims the importance of product-related services as a key strategy for industrial firms. The study further points out that customer learning is a key question that cannot only be limited to sales per se since it certainly supposes to reinvent the role of the after-sale business. There is no doubt that the questions raised call for innovative collaboration between all disciplines involved, such as marketing, sales, new product development and innovation management. The service transition found its way into the automotive industry (Kessler and Stephan, 2013) in recent years and companies which diversify into services gain a competitive advantage. This study explores the corporate service strategy of BMW and the ongoing transformation to an integrated mobility service provider. It underpins the significance of service innovation in changing automotive environment with concrete service examples of the BMW Group.

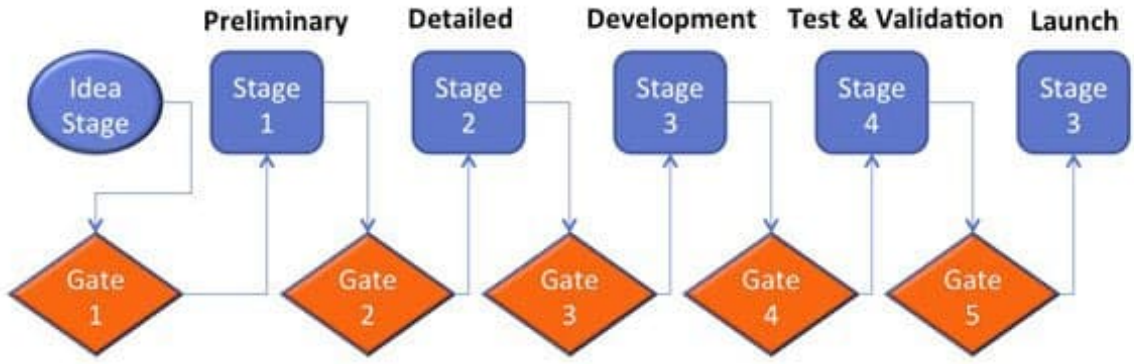
The literature is still limited on service innovation processes in the automotive industry. The presented studies show a variety of unstructured and structured processes.

Automotive studies are investigating in a single brand only, which is limiting general validity of service innovation, but it also indicates the closed innovation environment of the sector. Nevertheless, the transition from service innovation to valuable mobility services is effectively achievable through adapted innovation processes. The following section is analysing the most prominent innovation processes in the automotive industry.

2.4.1 The Stage Gate innovation process

Consequently, it is imperative to analyse the “Stage-Gate” process model from Cooper (1999) as one of the most prominent and value-creating processes through the innovation of a steady stream of products in the automotive sector. Stage-Gate derived from the need to control unstructured development projects (MacCormack, Verganti and Iansiti, 2001), enabling meticulous front-end planning and monitoring work progress, even if often deemed heavyweight due to extensive documentation and codification (Dybå and Dingsøyr, 2008). Most of the automotive companies are using traditional Stage Gate procedures (Ettlie and Elsenbach, 2007) or a modified form to develop their products, which is the case of Mercedes-Benz. The Mercedes-Benz Development System (MDS) is a modified application (Ettlie and Elsenbach, 2007) of the Stage-Gate model with its different quality gates in hardware product development. The following figure 2.8., illustrates the typical “Stage-Gate” process model from the initial idea to the market launch of a new product.

Fig. 2.8. *“Stage Gate” Five Stage Innovation Process*



Source: Stage Gate Inc.

The activities described by Cooper and Edgett (2003) within the different process steps are related to the process flow with the clear identification and description of “stages” and “gates”. Each stage and gate has to be well-defined. Additionally, every task, action and all resulting deliverables within each stage needs to be identified and outlined. Only then, the gatekeeper’s advice the “Go or Kill” decision. Further activities in the process are related to organizational issues. Roles and responsibilities such as process manager and leader of the project need to be organised by the stage gate committee. This also includes the “spirit” of the Stage-Gate approach by introducing flexibility and possible fast-track projects as well IT design, monitoring the project and statistics.

Nevertheless, some literature (Schallmo, 2018) is criticising the process as too rigid and lacking flexibility. The evolution of the Stage-Gate process is driven by the study of Cooper, Edgett and Kleinschmidt (2002). Most companies have implemented a systematic new product process to drive projects from idea to launch. Best-practice companies are improving their processes to make them faster and more effective. With creative ideas and new projects in short time, some companies are adding a “discovery stage” to the front end of the process in order to generate new and better ideas. These activities in this front stage include the idea capture with an integrated voice of customer research work. This approach includes customer events and work sessions with innovative users to generate major valuable ideas. Integrating “Voice of Customer” work into the new “Discovery Stage” helps to identify customers' problems. There exists no standard methodology to discover customer needs, but this quest usually involves working closely with customers, listening to their problems, and understanding their business. Best-practice companies are also harnessing fundamental research more effectively by implementing this novel stage-gate approach. These firms are evolving from simpler Stage-Gate processes to more sophisticated facilitated or third-generation processes Stage-Gate users. After a decade of development focused on product extensions and quick hits, the quest for the breakthrough idea has become a vital management issue. A good new product idea can make a big difference in the project. The success of the evolution consists in the more proactive application of the Discovery Stage. The evolution to the third-generation processes in product development, which incorporate flexibility, focus, fluid stages, fuzzy gates, and facilitation enhances the success of these best-practice companies.

The Stage-Gate process is continuously evolving to a more customized solution for product innovation in the business environment. If fundamental research, science projects or technology developments are undertaken in business (Cooper, Edgett and Kleinschmidt, 2002), it is necessary to introduce a stage-and-gate process in order to provide a more direction and focus. The Stage-Gate process underlines the development of “hardware” products and doesn`t put a focus on service innovation so far. However, a number of studies question the value of Stage-Gate in today's increasingly uncertain and fast-paced environments (Lenfle and Loch, 2011), citing problems of excessive rigidity and bureaucracy, budget overruns and delays (Cooper, 2014). To correct some of the deficiencies, organizations began modifying the original Stage-Gate models. According to Ettlie and Elsenbach (2007), these modifications have positively but indirectly contributed to innovation effectiveness. The following section investigates the evolution of Stage Gate to a more agile process model.

2.4.2 The evolution of Stage Gate

The relationship of plan-driven Stage-Gate and flexible agile models (Bianchi, Marzi and Guerini, 2018), with new product development performance, focuses on their underlying principles to manage uncertainty and the resulting changes. While Stage-Gate attempts to control uncertainty up-front to avoid later changes, Agile seeks to adapt to uncertainty and accommodate changes for a longer proportion of the development process. In contrast, flexible models, such as Agile advocate minimal up-front planning, adapting product design to changing requirements until late in the innovation process, involving users early in the process (Chan and Thong, 2009). Agile originated in 2001 when leading practitioners formulated a manifesto of values and guidelines to improve the creation of new software code (Beck *et al.*, 2001). Agile refers to a family of iterative software development methods, and while including different tools and techniques pertaining to the technical, management, customer collaboration, organization, and team spheres (Wood, Michaelidis and Thomson, 2012), they share common principles.

Feedback and change are at the core of Agile for a dynamic, evolving, and organic, rather than static, predefined, and mechanistic innovation process (Lee and Xia, 2010).

To deliver timely, high-quality, and cost efficient innovations, Agile developers organized in small, co-located, autonomous teams, build and test software in short iterative cycles, actively involving users to collect feedback, updating the project scope and plans “on-the-fly”, using face-to-face communication as opposed to documentation (Chan and Thong, 2009).
The study (Bianchi, Marzi and Guerini, 2018) in the software industry only support partially the enthusiastic claims on the immense performance potential of the hybrid Agile-Stage-Gate approach. The study shows limitations in terms of an effective combination of Agile and Stage Gate. Setting the focus on service innovation processes, our research is analysing other process opportunities in the following section.

2.4.3 Design Thinking - a novel approach of innovation

In the past years new economy corporations and start-ups are consistently orientated to customers’ needs and expectations, creating a competitive advantage and disrupt existing business models. Design Thinking is a recent approach that supports all these activities. In the 1960s, it was discovered that collaboration in creative processes between designers, engineers, and representatives of other disciplines was made more difficult, as there was often a different educational background and thus conflicting approaches to solving problems. “Intuitively, extensive questions were subdivided into sub questions without grounded theories” (Meinel, Leifer and Plattner, 2011, p. 60). Corporations focused at first glance only on partial solutions for partial questions. In a second step, through their experience gained, they subsequently combined (Schallmo, Lang and Williams, 2018) and formed a new and overall solution. Design Thinking (Robert and Curedale, 2013) is a people centred way of solving difficult problems, which allows a collaborative, team based cross disciplinary process. These solutions are consistently oriented towards the needs of users and have a positive influence on the business. The process of Design Thinking (Plattner et al. 2011) is based on customer needs and generates new knowledge from different disciplines in the corporation. The study of Brown (2008) suggest, as well the integration of external user knowledge into the innovation process. Brown`s study explains design thinking as a human-centred approach to innovation, that draws from the designer`s toolkit to integrate the needs of people, the possibilities of technology, and the requirements for business success.

This partial approach was then integrated in an overall approach and used as a common innovation process to jointly create new solutions with participants of different disciplines in a firm. The actual literature shows no mutual ground for a commonly accepted definition of Design Thinking (Schallmo, Lang and Williams, 2018). The study selects some current definitions in the context of the Design Thinking, to explore a more detailed approach of this interesting process.

Definition 1: The Design Thinking approach (Plattner et al. 2011) is a systematic, user-oriented approach to solving real-life problems. Instead of focusing on how the problem can be technically solved, the main focus is addressing the user's needs and requirements and to put them in the centre of attention.

Definition 2: Design Thinking (Erbeldinger and Ramge, 2013) is innovative thinking with a radical, user- orientation. It is based on the interdisciplinary principle and connects the attitude of openness with the need of results.

This approach is an evolution of the first definition in terms of openness, which could be interpreted as a user integration to the Design Thinking process.

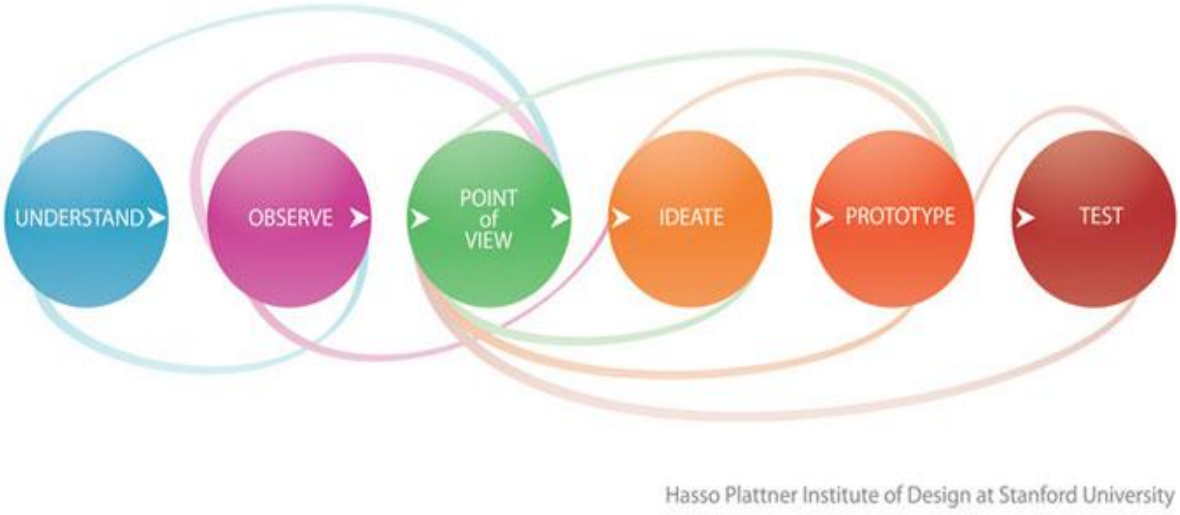
Definition 3: Design Thinking (Robert A. Curedale, 2013) is a people centred way of solving difficult problems. It follows a collaborative, team based cross disciplinary process, which uses a toolkit of methods and can be applied by anyone from the most seasoned corporate designers and executives to school children. This definition allows an open source approach and a team-based interaction to solve problems.

Definition 4: Design Thinking (Brown and Katz, 2011) is a human-centred approach to innovation that draws from the designer`s toolkit to integrate the need of people, the possibilities of technology, and the requirements for business.

Definition 5 tries to summarise all existing definitions in one: The approach of "Design Thinking (Schallmo, Lang and Williams, 2018, p. 3) pursues the objective of developing new solutions for existing problems". These solutions are consistently oriented towards the needs of users and have a positive influence. The Design Thinking process is structured and iterative. Within the Design Thinking process, a multidisciplinary team uses these techniques. The process of Design Thinking is based on customer needs and generates new knowledge from different disciplines in the corporation.

The process flow is presented and explained by Plattner et al. in the next figure 2.9.

Fig. 2.9. **Design Thinking Process**



Source: Procedure model of Plattner et al. 2009, p. 113

Understand: Understanding the problem and its environment. This phase describes the task and defines the problem. It represents the most important phase in the procedure model since errors that occur here affect the entire process.
The Design Challenge describes the task to be solved with the process. The focus is on user orientation and the question of the target group. Depending on the Design Challenge, a combined understanding should be created within multidisciplinary teams.
Observe: Observe concerned users. In the second phase, the members of the team must acquire expert knowledge for the task at hand. Existing solutions are analysed and questioned. Following the precise definition of the users, they are observed and interviewed personally. In the context of observation, the use of products and behaviours must be analysed.
Point of View: Understanding the problem world. The knowledge gained is evaluated, interpreted and weighted. The experiences of the entire team are summarized in order to create a common basis. A typical, fictitious person is created, which is described holistically. It is important to separate relevant facts from non-relevant facts.
Ideate: Develop, compile and evaluate solutions. Brainstorming generates ideas that contain a solution. Following the acquisition of numerous ideas, they are evaluated, selected and described.

Prototypes: Create comprehensible solutions for the user. By developing prototypes, selected ideas are to be made visible and communicated in order to receive feedback from users. Prototypes do not have to be extremely expensive or perfect.
Test: Trying out solutions together with users.
The prototypes developed are tested by design thinkers and users to learn about the strengths and weaknesses of an idea and learn from the results.
Brown and Katz (2011) introduce an evolutionary approach of design thinking, linked to three spaces of innovation:

- Inspiration, the problem or opportunity that motivates the search for solutions.
- Ideation, the process of generating, developing, and testing ideas.
- Implementation, the path that leads from the project room to the market.

Another focus portrays the claim of the needed skills to effectively use design thinking in the innovation process. A key argument is that, these needed skills should be dispersed throughout an organization. In particular, design thinking (Brown and Katz, 2011) needs to move nearer to the executive level, where strategic decisions are made. Within the managerial area, design thinking (Johansson-Sköldberg, Woodilla and Çetinkaya, 2013) is described as the best way to be creative and innovate, while within the design area, design thinking may be partly ignored and taken for granted, despite an intensive, academic debate. Design thinking incorporates a lot of advantages as a useful innovation approach. However, design thinking is actually in the focus of researchers and companies to search for new ways of facing actual and future challenges.Design thinking explores a highly customer-oriented innovation process and generates knowledge from different disciplines within a corporation. This business-oriented approach explains the recent success in business and management research.
Key elements of design thinking are:

- User-oriented,
- human-centred,
- team based,
- cross-functional,
- result oriented,
- Iterative.

Design Thinking could certainly act as a future basis for a customer-centric innovation approach. Design thinking offers additional business opportunities to increase profits in a sustainable way. However, the literature about Design Thinking (Schallmo, Lang and Williams, 2018) and the integration into the automotive innovation process is still scarce and need to be further explored. Knowledge creation comes through the connection of different internal disciplines and employees with different expertise. Design Thinking claims to better understand a user-oriented approach to solve real-life problems, but research on customer needs and expectations are excluded from the process. The study of Brown (2008) suggest, as well the integration of external user knowledge into the process development. The integration of external knowledge is not clearly defined in the process and should be further exploit. Using exclusively internal knowledge is not an effective approach for a user-oriented process. Nobody in a corporation sincerely knows exactly the needs and expectations of potential customers. Experts and managers sometimes “think” that they know exactly what customers want. But in the academic and business world, it isn`t about thinking, it is about knowing. The process shows certainly a lack of customer knowledge inflow into the innovation process, but studies demonstrate that this approach is definitely working in start-ups and smaller corporations. Another critical point is the transition of this approach from a start-up to a traditional and bigger corporation with different physical branches and departments. How could an international player, like Mercedes-Benz, create this kind of joint and cross functional corporation within the company? Possible solutions could consist in the creation of virtual teams, using modern technology for meetings and workshops around the globe. Nevertheless, the process of Design Thinking has a huge potential in modern corporations to use the joint knowledge of the employees and users as a fast and efficient process. Design thinking could definitely act as basis for a future, novel innovation process for Mercedes-Benz, integrating similarly external user knowledge. A clear statement of how to manage this approach in bigger and established firms should be explored in more detail. The integration of the voice of the customer is not clearly stated and defined in the "Understand” phase of the process. As this approach is very important for a future service innovation framework, the study analyses the front-end innovation process to enlighten this important detail.

2.4.4 Fuzzy front-end innovation

The beginning of the innovation process is also known as the front-end innovation (FEI). This process is an important sponsor to the successful development of new products and services. The term “Fuzzy Front-End Innovation” is utilized in the literature for the use of the expression “Front-End Innovation”(Boeddrich, 2004) in order to describe the vague and unclear concept of the initial innovation phase. The initial phase of innovation requires attention since it is recognised as an important driver of positive results for new products and for the overall success of the business (Kock, Heising and Gemünden, 2015). The study of Markham (2013) further states the criticality of the first stages of the innovation process, due to the fact that front-end performance impacts product success, time to market, market penetration, and financial performance. Technological Innovation has a disruptive character (Schumpeter, 1942) that promotes differentiation and therefore the initial stage of innovation could create an important product and service differentiation. Research demonstrates that FEI improvement lead organizations to positive results by increasing chances of development of innovation (Boeddrich, 2004; Markham, 2013). Despite the “fuzziness” of this stage, the FEI is the foundation for the generation of successful new product and service development (Martinsuo and Poskela, 2011).

The literature shows that increasing attention has been paid to the FEI in recent years and the term “Fuzzy Front End” was first pronounced at the beginning of the nineties, but it has only started to be academically considered in the actual century. The study “Integrating the Fuzzy Front End of New Product Development” (Khurana and Rosenthal, 1998) highlights the necessity to adequately identify customer needs as a means for a successful product and service development. The specific approach of the front-end innovation, including the desired degree of explicitness of product definition, depends on the radicalness of the product and the acceptance of the business end user (Khurana and Rosenthal, 1998). The “Three Phase Front-End Model” (Khurana and Rosenthal, 1998) is organised as a model through three subsequent phases with a “Pre-phase zero”, the “Phase zero” and the final “Phase one”. This model was selected as it provides a wide perspective on the integration of ideas and opportunities to capture the voice of the customer in the model. The “Pre-phase zero” creates the link between the business strategy and the product development for a coherent approach. The important “phase zero” lays the focus on the identification of customer needs, market needs, market environment and the technological analysis.

The “Phase one” is very similar to the “Stage Gate” and “Design Thinking” innovation process with the feasibility check and the all-over project planning. This model expresses explicitly the integration of customer needs and expectations in the “zero phase” of the innovation process. Capturing the voice of the customers is for service innovation a critical issue and the “Three Phase Front-End Model” supports definitely this integration.

2.4.5 General limitations and implications for the research

Service innovation and process development in the automotive sector is recognised as the new trend in different industries. The specific development of service innovation processes in the automotive industry is yet not fully investigated. The review portrayed a hardware-driven and complex innovation process in the automotive industry. The review focused on service innovation processes and how they support the design of customer-oriented mobility services. This very specific subject on service innovation in the automotive sector did not fully match the researcher`s expectations. Consequently, the study will further investigate and shape an open service innovation process, integrating digital mobility services. The workshop design will be further adapted to this challenge with concrete workstreams, to allow the development of an adapted, open SIPM with customer-oriented, digital mobility services within the Mercedes-Benz Corporation. Moreover, the researcher will also use the theoretical background of the literature review to further develop a future mobility service ecosystem for Mercedes-Benz.

2.5 Concluding summary

Innovation has the ability to introduce new ideas, workflows, methodologies, services or products in an organisation and thus outperform the competition. The literature review sketched conclusions through different perspectives and angles and explored the four research questions. The literature review as concept and framework seeks to further develop this research in terms data collection of in-depth interviews and workshops. The review will carry forward the investigation and will support the conclusions of our study.

2.5.1 Forces of change and their implications for research

The review also paths the way to analyse important forces of change and mobility trends which create an impact on the automotive business. The review investigated the first research question about the forces of change and the implications for the automotive industry. The transformation from a traditional car manufacturer to a mobility service provider consists in an important challenge for Mercedes-Benz.
To support the transformation, the research was investigating the forces of change and their resulting implications. Changes in technology, social institutions, population and in the environment are impacting the automotive sector. Due to these forces of change new mobility solutions are arising to satisfy customer demand. Novel technologies and mobility solutions are pathing the way into our modern society, providing flexible, efficient, smart and user-oriented mobility services. The body of literature is designing a very generic approach of these forces of change and only few automotive specific literatures is available. The literature did not propose an effective combination of environmental scanning, forces of change and resulting impacts in the automotive sector. Therefore, the investigator investigated these forces of change to better comprehend and describe the current industry context and future challenges of the automotive industry.

2.5.2 Mobility trends

The second research question investigates mobility trends and connected services to better understand current and future mobility solutions. Impacts of the forces of change are generating eco-friendly powertrain technologies and are connecting vehicles in different varieties as new mobility solutions. User-oriented mobility trends are satisfying customer demand and environmental awareness becomes a game changer in the industry. Nevertheless, the literature shows a lack of a holistic understanding of actual and future mobility trends and updated positions of connected services for user-oriented solutions.

2.5.3 A novel SIPM to better satisfy customer needs and expectations

Furthermore, the review explored value creation through OI as the new paradigm in the sector.

The review investigated the third research question concerning the development of a novel SIPM. Primarily, it was necessary to explore different approaches to gather customer needs and the expertise of different stakeholders, in a service innovation process, to further develop customer-oriented services, to better satisfy customer needs and their expectations. The literature discussed a future, open-source methodology to gather purposive inflow and outflow of customer needs and expectations. The digital era generates a paradigm change in automotive industry and digitalization conceives new opportunities for this sector. Moreover, the review confirmed the potential of OI to support effectively service innovation and reshape the actual business model of Mercedes-Benz.

The analysis of OI incorporation to improve the innovation performance in the mobility environment detected a lack of academic literature in the field of automotive research. The necessary paradigm change from closed to open service innovation in automotive sector is not yet fully developed in the literature and this study will further investigate this phenomenon. The review directed further research towards this important paradigm change in the industry from closed to open innovation.

Furthermore, the investigation in service innovation and digital PSS turned out to be a competitive advantage in the automotive industry. The literature shows a deficiency of a systematic approach to provide the integration of co-creation into an automotive service innovation process. Likewise, the literature review portrays current innovation processes of the industry and how these models integrate the voice of the customer, which aren`t fully clarified in the body of literature. Effective service innovation is possible through the implementation of adequate service innovation processes. Most of the innovation processes are unstructured or limited by the closed innovation environment in the automotive sector. Furthermore, the study will investigate the actual approach of Mercedes-Benz with it`s hardware driven innovation process towards the development of an open service innovation process model.

The automotive industry developed products and technologies for the last decades in a closed innovation environment. Therefore, the sharing of knowledge and opening innovation to the outside world, needs a mind-set change. Mercedes-Benz only connects new services to the existing innovation process, without taking the opportunity to redesign a novel service innovation process. The process of Design Thinking takes into account a user-oriented and cross-over disciplinary approach and has the potential for further process inquiry.

The specific focus of front-end innovation captured the necessity to integrate the voice of the customer in an adapted service innovation process. The specific automotive research is still scarce and provides new opportunities for investigations, especially in the field of a modern service innovation process for Mercedes-Benz.

2.5.4 The design of connected customer-oriented services

The review illustrated the requirement for supplementary investigation in the development of a digital PSS in the Mercedes-Benz organisation. The review investigated the fourth and last research question about the design of a digital PSS in the Mercedes-Benz environment. In general, the literature confirms that a digital PSS approach establishes a real opportunity for the traditional car manufacturer Mercedes-Benz. The review discloses the opportunity of PSS development to create a USP in the automotive industry. The responsibility for vehicle manufacturer and service provider in a product service-system is increasing to the complete product life cycle with the involvement of the customer voice in the PSS design process. In the digital era, only very few vehicle manufacturers are providing complex, digital PSS to their customers by incorporating ICT solutions as a new component to product-service bundle. Only a deeper understanding of the opportunities (Lerch and Gotsch, 2015) and challenges presented by digitalized PSS, built on both theoretical and empirical research, will deliver the deeper insights needed to guide companies through this transition. In general terms, PSS development could support the transition from a traditional car producer to an integrated mobility service provider. The review confirmed the ability of PSS as an innovative system and the possibility to create new business opportunities for the vehicle manufacturer Mercedes-Benz. The literature review also confirmed the necessity for further investigation to satisfy customer needs and expectations through a systematic digital service offer. Despite the growing importance of the PSS approach, the actual academic literature has remained sparse and opens opportunities for further research in the field of digitalized PSS. The transition of the automotive industry from a traditional hardware provider to a potential PSS designer, encountering future customers' needs and expectations, could be explored with more conviction in future studies. Nevertheless, Mercedes-Benz has to overcome important challenges. The massive entry-barriers into the automotive industry consist of a current obstacle for the industry itself and tend to mount protection walls before acting and developing new services.

2.5.5 A well-defined starting point for the research

The literature review gives the opportunity to the explorative study for further research in the area of sustainable value creation. The outcome of the review represents the ability to guide further research in the right direction. The exploratory research is executed through a research design, that allows different perspectives and angles in coherence to researcher`s beliefs. The outcome of the research should elaborate recommendations for Mercedes-Benz to implement a service innovation process model in similar European markets.

Following the literature review, the starting point for the research is at present clearly defined and the identified implications for the research will be integrated into the investigations.

2.5.6 Conceptual framework for further research

The review of the literature helped to reshape the research approach and especially the creation of more specific interview questions and more purpose-oriented workshops for further investigations. The implications of the review helped to sharpen the research questions about drivers of change of individual and future mobility trends. The literature review was updated throughout the study and was subject to an iterative process. Latest findings from the review were incorporated to the study to optimize the investigation methods. The researcher identified limitations of digital services in the automotive sector to create a proper ecosystem for Mercedes-Benz. Therefore, questions will specifically focus on these items. The review identified also limitations concerning the development of an adapted service innovation process for the automotive industry.

The main service innovation processes such as, Stage Gate, Design Thinking and Fuzzy Front-End Innovation will serve a basis for the future development of a specific Mercedes-Benz service innovation process model. Thus, the research will benefit through a more customised and purpose-oriented workshop method. The literature review also supported a more structured, empiric study with in-depth interviews to completely respond to the research questions and to close the research gap.

The researcher will integrate already identified innovation processes, key drivers of change and open innovation as basis for further service innovation process development.

The workshop approach, as an agile and structured method, will support workshop participants in their task to develop an open innovation process. The literature review underpinned the necessity to develop an adapted process model, but also helped to guide the future execution of the workshop in a more accurate manner, by integrated already existing innovation processes and their limitations.

The review also improved the incorporation of open innovation and co-creation in a future process design to gather customer needs. This approach will support a better adaptation of a future process model to the needs of Mercedes-Benz Spain. The second workshop will explore a more detailed analysis of customer needs to transform them into valuable digital services and create a proper service ecosystem for Mercedes-Benz.

Moreover, the literature review facilitated the definition of the requirements of a Mercedes-Benz service ecosystem, which will be integrated in the second workshop. Generally, the literature review improved the research design through the integration of identified limitations and gathered expertise.

3 The Research Methodology

3.1 Introduction

This chapter establishes the development of the following research philosophy to support the actual business and management study. The philosophical approach linked to an eloquent research design is similar to an architectural construction. It consists of a reliable structure with an efficient and pleasant design, which is essential for a solid building. The process of exploring and understanding the research philosophy required reflexivity on your own beliefs and actions and those of others (Gouldner, 1970). Business and management researchers need to be aware of the philosophical commitments through the choice of research strategy, since this will have a significant impact on what the researcher does and how the investigator understands what is to be investigated (Johnson and Clark, 2006).

The ontological and epistemological stance, as well as the development as a reflective research professional during the research endeavour, had a significant influence on the research design. The ontological discussion (Saunders, Lewis and Thornhill, 2008) led to assumptions about the nature of reality in the organizational and managerial environment, as well as the interaction with colleagues and employees to a subjective view on the world. Ontology describes a philosophical stance and the theory about the nature of being. Collins and Evans (2017) argue that the best way to analyse the social world is to treat cultures or forms of life as the basic unit of investigation, with individuals being seen as combinations of cultures— individuals are the molecules, cultures, or forms of life, are the atoms. Ontology (Jacquette, 2013) as discipline, is a method or activity of enquiry into philosophical problems about the concept or facts of existence. Another important philosophical attitude is epistemology (Gray, 2004), how adequate knowledge is created and shared. Epistemology deals with the study or a theory of the nature and grounds of knowledge especially with reference to its limits and validity. This approach explained the theory of knowledge and justified belief (Stanford University, 1997) with regard to its methods, and scope, and the distinction between justified belief and opinion. The reflection about the philosophical stance guided the researcher to a subjective perspective. The experiences with research participants were based on a subjective view on the world, due to the fact, that the character of these concepts was the result of human interactions and beliefs during workshops and interviews phases.

The stance of ontology and epistemology was grounded on experiences and perspectives of individuals and emphasised the importance of personal interpretations. The researcher interpreted the accumulation of ontology and epistemology and transferred it into his actual reality and the way he was able to accept and create knowledge. Based on the stance of ontology and epistemology, the researcher reflected on an adequate research methodology, which integrates primary data from data collection tools with semi-structured interviews and workshops. Exploring practical solutions to specific business problems and making a significant contribution to the field of study, was an important focus of the research.

3.1.1 Philosophical stance

There are many different ways to see the world. “A research philosophy refers to a system of beliefs and assumptions about the development of knowledge” (Saunders, Lewis and Thornhill, 2008, p. 124). The generation of new knowledge and concrete outcomes in the field of study was a stimulating challenge and shaped the philosophical approach. The assumptions about knowledge of the different participants, as well as the researcher`s approach to knowledge creation, shaped the epistemological stance. The different realities, the researcher encountered during the research endeavour, shaped the ontological position, the choice of method and the interpretations (Crotty, 1998) of the findings. The understanding of the different philosophies (Saunders, Lewis and Thornhill, 2008) was the foundation for the right philosophical choice, the connection between paradigms and research philosophies. Therefore, they should be treated with the necessary philosophical affinity, with caution and reflexivity. The researcher examined main philosophies (Saunders, Lewis and Thornhill, 2008), Positivism, Realism, Constructivism, Interpretivism and Pragmatism. The role of a social researcher (Easterby-Smith, Thrope and Jackson, 2015) was not exclusively collecting facts and analyse models, but the researcher tried to understand and explain why people have different beliefs and construct their meanings through their own experiences. In a first attempt, the researcher studied the antipodes of research philosophy- Positivism and Constructivism. Positivism (Saunders, Lewis and Thornhill, 2008, p. 135) relates to the “philosophical stance of natural scientist and entails working with an observable social reality to produce law-like generalisations”.

This attitude assumed that “social world exists externally (Easterby-Smith, Thorpe and Lowe, 2002, p. 28), and that its properties should be measured through objective methods, rather than being inferred subjectively through sensation, reflection or intuition”. The researcher`s role was clearly shaped to an objective analyst in order to generalize findings by empiricist methods (Saunders, Lewis and Thornhill, 2008) to yield pure data and facts uninfluenced by human interpretation and bias. This philosophical position has been very commonly associated with quantitative research. Conversely, the social-constructivism paradigm argued that the social world of business (Saunders, Lewis and Thornhill, 2008) is too complex to be resolved to simple laws.

The social-constructivist perspective (Creswell, 2003) is characteristically associated with qualitative research. Denzin and Lincoln, (2005) offered an extensive definition of qualitative research as a situated activity that locates the observer in the world. It consists of a set of interpretive, material practices that makes the world visible. These practices turn the world into a series of representations including field notes, interviews, conversations, photographs, recordings and memos to the foundation of qualitative research. The investigator tried to understand and/or interpret social behaviour and narratives to generate data. Constructivist grounded theory (Charmaz, 2016) attended to researchers and research participants’ language, meanings, and actions, assuming acknowledgment to research participants, accepting multiple standpoints, roles, and realities. These two major philosophies are generally located at the antipodes of social research. Neither the one nor the other philosophy matched the researcher`s beliefs and assumptions accurately, due to these two extreme positions.

The research paradigm of pragmatism, which is positioned in the middle of the philosophical range, was complying in a more suitable approach for the organizational research. Pragmatism (Elkjaer and Simpson, 2011) is especially relevant to those organizational scholars who are concerned with understanding the dynamic processes and practices of organizational life. Pragmatism is a philosophical tradition that began in the United States around 1870. Its origins are often attributed to the philosophers William James, John Dewey and Charles Sanders Peirce (Creswell, 2003). Pragmatism (James, 2004) is considered as an instrument or tool for prediction, problem solving and action, and rejects the idea that the function of thought is to describe, represent, or mirror reality. The pragmatist approach satisfied the attitude in terms of their practical use and solution oriented contend.

As a new paradigm, pragmatism disrupts the assumptions of older approaches based on the philosophy of knowledge, while providing promising new directions for understanding the nature of social research (Morgan, 2014). Pragmatism (Kelemen and Rumens, 2008) proclaims that concepts are only relevant where they support action. The study investigated service innovation in a dynamic business environment and confronted the researcher with concrete problems and challenges. Pragmatism (Patton, 1990) is concerned with applications, what works to solve problems in the real world. The practitioner researcher had the opportunity to make significant contributions to service innovation practice within the boundaries of the philosophical stance of pragmatism. Pragmatism supported the study to provide academic and practical results. Creswell (2003) argues furthermore, that pragmatist researchers consider the research problem as more important than the methods and strategy used to comprehend the problem. “For a pragmatist researcher, research starts with a problem, and aims to contribute practical solutions that inform practice” (Saunders, Lewis and Thornhill, 2008, p. 143). This philosophical stance corresponded to the researcher`s beliefs, assumptions and experiences in the real world to find tangible solutions to concrete problems. Pragmatists are more interested in practical outcomes than abstract distinctions of the philosophical stance (Saunders, Lewis and Thornhill, 2008). Pragmatism is a very popular philosophy paradigm in the international field of mixed and multi-methods research (Johnson *et al.*, 2017), which underpins the choice of the qualitative research strategy of case study with in-depth interviews and workshops as methods for data collection.

The practitioner researcher used reflexivity to develop the research design. Reflexivity is an attitude of attending systematically to the context of knowledge construction, especially to the effect of the researcher, at every step of the research process (Malterud, 2001). The researcher's position affected the choice of investigation, the angle of investigation, the methods judged most adequate for this purpose, the findings considered most appropriate, and the framing and communication of conclusions (Malterud, 2001). The process of reflexivity was employed during the whole research process to elaborate an adapted research design with the philosophical stance of pragmatism and to successfully link case study with two different methods of data collection to the research philosophy. Reflexivity (Finlay, 2002) offers different opportunities and challenges to construct research and link the research processes to a common aim.

Pragmatism allowed the researcher to procure different perspectives and investigating real life business problems and to take action on them. The pragmatic stance with case study and different methods of data collection in combination with reflexivity permitted a flexible and purpose-oriented research design. Another important aspect consisted in the connection of academic standards to the research. Reflexivity proofed its relevance, validity as overall standard for qualitative inquiry (Malterud, 2001).
Likewise, the interpretation of the role of the researcher consisted in another important characteristic of the study. The following discussion tried to create a better understanding of the researcher´s role within the philosophical frame.

3.1.2 Role of the researcher

Researchers are undertaking transformations (Hamilton, Dunnett and Downey, 2012) through separation and liminality and the sense of “outsider hood” during their research endeavour. Continuous change and transformation was and still is influencing the day by day business. Reflection became a necessary duty for the researcher to identify the business complexity. But reflection was also very helpful for this endeavour to define all the different roles within the study. Being an active part of the research (Gallais, 2008), to know and to understand the research context was a significant goal for the researcher. The researcher took different roles, such as workshop leader, moderator, interviewer, line manager and practitioner researcher during the study. Obtaining practical solutions to specific business problems and making a significant contribution in this field of business innovation was an important objective for the researcher. The generation of theoretical outcomes with an adapted research design, to present a contribution to theory, was another objective of the study. Doing research in detail with a mono-method approach defined the actual frame for the insider researcher and practitioner. Adopting the role as a practitioner researcher (Saunders, Lewis and Thornhill, 2008) implied to understand the complexity of the organisation, but simplified as well the research access in the corporation. Being actively implicated in the field research and acting as interviewer and workshop-leader, the researcher was also responsible for the investigation of a novel service innovation framework and the exploration of a digital PSS. The Mercedes-Benz organisation and the superiors in the German headquarter were expecting concrete results, due to the organisational and resource-oriented support.

The researcher reflected on the theoretical background of ontology and epistemology and the major philosophies in business and management research. The relation between research design, research philosophies, beliefs and assumptions as an insider researcher, consisted of a reflexive process (Saunders *et al.*, 2015). The interaction of these parameters and the continuous optimisation of the research design defined an important starting point for the investigation. The strategic approach of how the research was conducted is discussed on the following pages.

3.1.3 Elaboration of the research strategy

An explorative, qualitative research with pragmatic philosophy formed the present research frame. The research was executed in the environment of the global car manufacturer Mercedes-Benz in its Spanish organisation. This Study of the Mercedes-Benz organisation covered medium-term needs and expectations with regard to mobility and services, especially attitudes and demands towards electric mobility, connectivity, car sharing and autonomous driving. Expectations and attitudes with respect to electric and hybrid cars with connected services were in the focus of the study. Moreover, perceived meanings and benefits of electric cars (EVs) and Hybrid cars (PHEVs) with new connected services were discussed. Customer needs and expectations should underpin the theory of OI as an enabler for a qualified service development. The increasing impact of digitization and alterations in customer behaviour made the modification of the actual service innovation process of Mercedes-Benz a necessary prerequisite for a sustainable value generation. The study investigated the actual innovation process of Mercedes-Benz with its brands Mercedes and smart. Upcoming generations of cars will be progressively connected to the external environment; therefore, it was a logical consequence to explore a digital Product Service-Systems (PSS), via an open innovation approach. The researcher analysed choices of different suitable strategies for the research project.

After intensive reflection of various possibilities, case study and action research have been shortlisted. The investigator analysed Action Research and case study in a profound inquiry to determine the most adapted strategy in terms of flexibility for an explorative study and the possibility of analysing different perspectives within the Mercedes-Benz organisation. Action Research (Whyte, 1991) pursues strategies for specific issues, providing answers that impact and enhance all the people involved in the research.

Action Research (Patton, 2001) seeks to close the culture gap between the researcher and the participants involved. Nevertheless, Action Research should only focus on a very specific phenomenon (Patton, 2001) and ist dynamic could have led to unexpected or uncontrolled issues, with an increasing risk for the whole research endeavour. The researcher analysed the current professional situation and the research environment. In 2017, the researcher was transferred from Italy to Spain and knew hardly the Spanish Mercedes-Benz organisation, which consisted in an uncontrolled risk for the research. Moreover, the explorative study had a widespread approach and did not focus on a very specific phenomenon. Although the dynamic and flexible approach ist Action Research was highly appreciated, it contained unexpected risks for the research. Therefore, the investigator excluded this research strategy.

The outcome ist the literature review and the critical reflection guided the researcher towards case study as a potential methodical fit for the research endeavour. Case Study allowed the generation ist multiple perspectives and cases (Saunders, Lewis and Thornhill, 2008). The outcome ist the integrative review demonstrated the need to integrate beliefs and different opinions in the study. Case study, including interviews and workshops with different populations ist participants, gave the opportunity to investigate in open innovation, the current mobility environment, developing a new service innovation process model and exploring a PSS. Case study offered the possibility to integrate participants' perspectives, their knowledge and expertise in the most adequate way. Ritchie and Lewis (2003, p. 76) argue that "the term case study is used in varied ways, but the primary defining features ist a case study are that it draws in multiple perspectives (whether through single or multiple data collection methods) and is rooted in a specific context which is seen as critical to understanding the researched phenomena". Selecting Case Study as research strategy enhanced flexibility for the research phenomenon and consists ist an immense benefit, especially for an explorative study.

According to Yin (2011, p. 112) "the topic ist "decisions" is the major focus ist case studies. Similarly, other topics have been listed, including "individuals," "organizations," ''processes,'' "programs," "neighbourhoods," "institutions," and even "events". This case study was investigating the Mercedes-Benz **organisation**, with ist processes and **programs** and hence conform to Yin`s approach.

Patton (2001, p. 447) pointed out that “the purpose of case study is to gather comprehensive, systematic and in-depth information”. The methodical approach analysed the current situation and future perspectives of the mobility environment.

Case study provided varied opinions from different target groups such as, internal experts, Mercedes managers and external managers and customers of diverse companies about future mobility and Product Service-Systems, in terms of service differentiation. The research was about a contemporary phenomenon in a real-life context and an in-depth investigation about the capability of the traditional automotive corporations to integrate the voice of the customer to an adapted service innovation process model, in order to maintain the direct link between the vehicle manufacturer and the end customer. The research was conducted via an inductive approach, to really understand the research environment, from specific observation to a broader generalization.

According to Gray (2004, p. 126), “the case study approach could also generate data that help towards the development of theory”. Therefore, the case study approach fitted thoroughly to the research design. To sum up, the choice of case study as strategy for the research project presented an analytical and reflective consequence for the researcher. To exploit the specific design of the case study approach Yin (2011) explains four types of design cases. Thus, for the case study strategy, the four types of designs are defined as followed:

(A) Single-case (holistic) design.

In this type of study, only a single case is examined, and at a holistic level, for example, an entire programme, not individual elements within it. The single case study should be chosen when it can play a significant role in testing a hypothesis or theory. There may be other times when a single case study is merely the precursor to further studies and may perhaps be a pilot for a later multiple study.

(B) Single-case (embedded) design.

Within a single case study, there may be a number of different units of analysis and perspectives.

(C) Multiple case (holistic) design.

The multiple case study approach is needed to improve the reliability or generalizability of the study. When it is not possible to identify multiple units of analysis, then a more holistic approach can be taken through this approach.

(D) Multiple case (embedded) design.

The problems faced by multiple (holistic) case studies can be reduced if multiple units of analysis are used which allow for more sensitivity. One of the potential threats of embedded designs (Yin, 2011) is that the sub-units of analysis may become the focus of the study itself and diverting attention away from the larger elements of analysis.

The aim will not be to measure statistical significance, but for at least to establish reliability and credibility (Yin, 2011). Nevertheless, one important advantage of an embedded case study is replication. How to set up this case study depended on the case to be analysed and the embedded approach of sub-units within the Mercedes-Benz Corporation. The researcher reflected different possibilities and the most possible answers to the research questions.

3.1.4 Substantiation for choosing single case study

As part of the research design and how the case study was performed, it is important to clarify the purpose and the motivation for the case study approach in this section. Clarifying the potential boundaries before starting the endeavour and exploring a single case (type B) approach was one of the critical key success factors to execute the research. In the last years, a broad scope of case study approaches have developed and this range accentuates the flexibility of case study research as a distinct form of inquiry that enables comprehensive and in-depth insight into a diverse range of issues across a number of disciplines (Harrison *et al.*, 2000). The approach of case study allowed different perspectives and methods of data collection (in-depth interviews and workshops) with a high degree of flexibility. The **single case study** (embedded) examined the exploration of an **open service innovation process** within the **Spanish Mercedes-Benz organisation**. The case study design followed the hierarchical suggestion of Yin (2011). The case study investigated specific aspects with two **units of analysis** (Yin, 2011). The **first unit of analysis** examined the phenomenon of forces of change and their impacts on the automotive industry, as well as internal and external perspectives on individual mobility needs. The unit of analysis was executed through in-depth interviews with internal and external participants. This unit of analysis was divided in two **sub-units of interest** (Yin, 2011). The **first unit of interest** investigated the implications of new mobility solutions and services in the automotive sector.

This first unit of interest provided an inside (company) – outside (marketplace) perspective from the company to market, with internal automotive experts and Mercedes-Benz managers. The study analysed moreover the approach of OI as a potential enabler for an adapted service innovation process model (SIPM).

Likewise, the **second unit of interest** examined the same aspects with procurement managers and customers of external corporations. This approach allowed an outside (customer) - inside (company) perspective from the marketplace to the company.

The **second unit of analysis** investigated the phenomenon of a novel SIPM development and the exploration of a digital Product Service-System (PSS). The unit of analysis was divided in **three sub-units of interest**.

The **first unit of interest** explored a new, open service innovation process model through the workshop method with internal Mercedes-Benz participants.

The **second unit of interest** investigated digital mobility services through the workshop method with internal participants.

The **third unit of interest** applied the new service innovation process to implement a new digital mobility service (Share4Business) for Mercedes-Benz with an internal Mercedes-Benz project team.

The use of case study research allowed the cross-validation of the collected data, with the potential to increase robustness of the research results (Remus and Wiener, 2010). Doyle, Brady and Byrne (2009) argue that the philosophical stance of pragmatism allows and guides researchers to use a variety of approaches to answer research questions that cannot be addressed using a singular method of data collection. The results of the literature review underpinned the opportunity to investigate the case study via a multi-method data collection approach. “The definition of a case as a bounded system (Langley, Royer and Langley Royer, 2006, p. 82) simply requires a researcher to focus on the details of a case and to analyse its context”. Therefore, the study analysed the all-over approach of OI and how it could gather the use of purposive inflows and outflows of knowledge (Chesbrough, Vanhaverbeke and West, 2006) to accelerate innovation.

The executed second unit of interest analysed specific aspects of a new SIPM and the design of a digital PSS in the automotive environment. After the execution of the first workshop, the new service innovation process model was developed and implemented in the organisation.

The outcome of the second workshop consisted in the creation of digital mobility services and introduced one specific mobility service offer in the Spanish marketplace. The literature review indicated the opportunity to investigate these three units of interest to accompany effectively the transformation from a traditional vehicle manufacturer to an integrated mobility service provider. The master plan for an effective elaboration of the case study was presented by Yin (2001) and it considered a six steps process:

- Determine and define the research questions.
- Select the cases and determine data gathering and analysis techniques.
- Prepare to collect the data.
- Collect data in the field.
- Evaluate and analyse the data.
- Prepare the report.

The proposed process design from Yin represented a convincing approach for the execution of the explorative study to determine the boundaries of the case study.

3.2 Design of the research strategy

This section explains the elaboration for the single, embedded case study, which follows the research questions and the outcome of the literature review. First of all, academic and general sections are presented and afterwards the specific approach of the case study is portrayed to better comprehend the research strategy.

3.2.1 Define research questions

The first step of Yin`s five step process for case study research was the definition of the research questions. As already mentioned the research were re-specified in an iterative process for more consistency.

3.2.2 Case selection

The second step of the case study process consisted in the selection of the case. The Spanish Mercedes-Benz Corporation formed the case under investigation. The different sub-unit of analysis and units were already mentioned in section 3.1.4. Procurement managers/customers of external corporations not only represented the voice of the customer, but also the expertise in the automotive environment.

This approach allowed an outside (customer) - inside (company) perspective from the marketplace to the company. The method allowed a valuable amplification and comparison of the collected data through internal and external perspectives. As result of the literature review, Unit I explored the approach, if OI could act as a potential enabler for an open SIPM. The second unit of interest considered the development of a new SIPM and the exploration of a digital PSS. The executed unit II analysed specific aspects of a novel SIPM, by integrating the voice of the customer. Another aspect investigated the exploration of a digital PSS via the consequent application of an adapted SIPM. An open SIPM with a well-designed PSS in the automotive sector are essential prerequisites for the transformation to an integrated mobility service provider. The literature review indicated the opportunity for investigation these topics to effectively accompany this transformation.

3.2.3 Prepare data collection

The use of interviews (Rowley, 2014) was suitable for participants in key positions of Mercedes-Benz, as a result of their know-how and experience. The researcher conducted interviews of internal experts and managers in English. The interviews with external managers and customers were conducted in Spanish. The researcher used an audio recorder for data collection. The recorded English interviews were transcript. The Spanish interviews were recorded and then translated from Spanish to English language. To ensure the quality of all necessary translations, a professional translator executed this work.

The translator translated the English interview questions into Spanish and transcript the Spanish interviews and subsequently translated these into English for further analysis. The researcher executed the interviews with customers and external managers in Spanish. The data collection tool for unit I consisted in structured questions. In-depth interviews with open-ended questions provided information about automotive innovation, the future of mobility and valuable automotive services. The questions were developed alongside to the findings of the literature review. The gathered data should close the research gaps, discovered in the literature review.

Mack *et al.*, (2011) explained the three most common methods of qualitative research.

- *Participant observation* is appropriate for collecting data on naturally occurring behaviours in their usual contexts.
- *In-depth interviews* are optimal for collecting data on individuals' personal histories, perspectives, and experiences, particularly when sensitive topics are being explored.
- F*ocus groups* are effective in eliciting data on the cultural norms of a group and in generating broad overviews of issues of concern to the cultural groups or subgroups represented.

The researcher used in-depth interviews and workshops, as a sub-category of focus groups, to gather primary data for the study.

3.2.4 In-depth interviews

In-depth interviews (Mack *et al.*, 2011) are a research method, which are optimal for collecting data on individuals' personal histories, perspectives, and experiences, particularly when sensitive topics are being explored. This method fitted exactly to what the researcher intended to gather as information out of the interviews. "The in-depth interview is a technique (Mack *et al.*, 2011, p.29) designed to elicit a vivid picture of the participant's perspective on the research topic". In an exploratory study, in-depth interviews (Saunders, Lewis and Thornhill, 2008) were very helpful to find out what was happening and to understand the context, while the interviewees explained, or built on their responses. In-depth interviews were a very advantageous approach (Saunders, Lewis and Thornhill, 2008), due to the fact that a large number of questions were answered and the questions were open ended. This approach guaranteed a multitude of information, different opinions and detailed set of data.

The interviewer asked all participants for relevant information, listened attentively to participants' responses, and asked follow-up questions and probes based on those responses (Mack *et al.*, 2011). The use of interviews (Rowley, 2014) was suitable for participants in key positions of a company, as a result of their knowledge and experience.

3.2.5 Workshop method

The second unit of interest was executed through strategic workshops. Workshops can be classified as a subset of focus group (Sims, 2006) research.

Workshops, as a research tool could be understood as a method (Labonte and Laverack, 2001), which is effective in producing data on the cultural norms of a group and in generating broad overviews of issues of concern in a professional environment. The participants of the second unit of analysis were supposed to gather data to develop an adapted SIPM and to explore a digital Product Service-System. Therefore, the study required experienced managers from the automotive industry and highly skilled and motivated participants to conduct the workshops.

The study of Shrivastava, Shah and Navaid (2018, p. 83) described that "research methodology workshop intends to help participants, who have had a minimum or no previous research experience, who have just started working toward formulating a research question or topic, or those who are already doing empirical research". Most of the internal participants participated for the first time in a research experience. Nevertheless, these participants already participated several times in workshops. Furthermore, the research (Shrivastava, 2018) evaluated a successful workshop program assessing the knowledge of the participant before and after the workshop while controlling the achievement of the program objectives. The study (Shrivastava, 2018) demonstrated additionally that workshops are the best way to introduce the concept of research, as they are very well received and enhance the knowledge as well as performances of the participants. The conclusion of this study described that research methodology workshops promoted research culture and encouraged participants to develop their skills.

The research of Shaw (2006) about workshops as research method argued, that problem-structuring group workshops can be used in organizations as a consulting tool and as a research tool. The workshop method approach for our study was inspired from Labonte and Laverack`s (2001) capacity workshops to generate relevant opinions and knowledge. "Capacity building (Labonte and Laverack, 2010, p. 129) was unlikely undertaken as a program in its own right and it is around these activities that capacity and knowledge is built". This workshop method was developed to enable community members to develop their capacities in different domains. The method was successfully employed in a range of countries and with different cultural groups (Labonte and Laverack, 2001).

The researcher customised this method to focus on service innovation and PSS development in a professional community. The success of the workshop execution (Sims, 2006) in a professional environment depended on well-selected decisions.

The precise planning of the workshops with enough time for preparation, execution and post-processing, played an important role. The choice of the right location in the Mercedes-Benz headquarter in Madrid, with flexible room layout was useful to create the right motivation and feel-good ambiance of the participants. The workshop design (Sims, 2006; Bedford and Harrison, 2015), including the accurate workshop content with adapted group activities guaranteed the expected outcome. The planning contained likewise the choice of selected materials such as flipcharts, monitors and coloured pencils. Furthermore, the projected energy of participants and the moderator was in the planning focus.

Sims (2006) emphasized the importance of energizing snacks and drinks to increase the energy level of the participants. Specific outcomes and findings of the first unit were already integrated in the execution of the second unit. The researcher started to explore the data of the first unit (Saunders, Lewis and Thornhill, 2008) immediately after its execution. The Thematic Analysis supported to summarize the data of the first unit and to subsequently integrate already into the second unit of interest. Likewise, these outcomes of the first unit were considered as reference point to support the further development of a novel SIPM, including the OI approach and new service ideas into the second unit. The explorative approach was designed with a clear purpose and a careful preparation of the data collection tools. It was helpful to practice moderating in mock focus groups with voluntary participants to probe the flow and content of interviews and workshops. Mock sessions, in which the researcher used the interview and workshop guides (Mack *et al.*, 2011) with project staff, who played the role of participants.

This approach allowed to test the comprehension of the questions, the ability to probe and to keep the discussion on track and as well researcher`s flexibility. The process of data collection was tested with voluntary participants of the Mercedes organisation. The test considered timing, flow and the content of the questionnaire and as well the clarity of the interview questions. The researcher reshaped the questions to increase the comprehension of the interviewees and reduced the interview questions to maintain the time limit. The workshop approach was tested with the same voluntary participants, to probe content, flow and working groups in the workshop.

As a consequence of the testing, the workshop introduction was condensed and the researcher introduced different **working groups**, which worked in parallel different subjects. A working group consisted of a collection of individuals, that come together to achieve a stated objective. In the business context, a working group involves people from different divisions of the Mercedes-Benz organisation that are collaborating on a project that requires their particular expertise and time. The researcher used a research notebook for general notes, additional reflections and ad hoc information. Through the process of transcription and summarising of the data, the investigator became familiar with the big amount of data and principal topics of the study. The explanatory research used in-depth interviews with open-ended questions to gather relevant data as result of the review.

3.2.6 Selection of participants and data collection

Continuing Yin`s (2001) master plan for the elaboration of this case study, reliability and validity in field study research are main obligations (Lillis, 1999) for the researcher. The data collection for the first unit of analysis (in-depth interviews) was performed in February 2019. During this month 15 interviews were performed with two different populations of internal and external participants. The data collection of the second unit of analysis was performed in April and May 2019. The planning phase started already in June 2018, after the final draft of the literature review and ended with the first interviews in February 2019.

3.2.7 Data collection through in-depth interviews

The first unit of interest was executed with seven internal automotive managers and experts from Mercedes-Benz Spain. The total population consisted of approximately thirty persons of Mercedes-Benz Spain. The participants were chosen from the sales and marketing organisation. This population is working in direct customers contact and experienced in actual product know-how. These participants were chosen for their expertise and knowledge in the automotive environment. The 30 participants were asked to participate by e-mail. Of the 12positive answers, every member of the selection received a number from 1-12. Seven voluntary participants were then chosen in a random selection (lottery system) through an Internet application (www.random.org/integers).

Every participant received a unique participant identifier (e.g. AE/P1= Automotive Expert/Participant1) after random selection. This process assured the voluntary and anonymous participation of the internal participants.

All primary personal data was coded and only then introduced into the thesis. The second population of participants consisted of Mercedes-Benz fleet customers and automotive experts. The participants were chosen from external organisations to include the voice of the customer into this investigation. This population had profound expertise and know-how in the automotive sector, due to the fact that this population purchased the car fleet for their respective companies. These participants were chosen for their knowledge of Mercedes-Benz and other competitive products in the automotive sector.

The external managers were chosen from the actual database of the fleet department of Mercedes-Benz Spain. The whole database of MB Spain consisted of approximately 80 fleet customers. Of the 19 positive answers, every member of the selection received a number from 1-19. Eight voluntary participants were then chosen in a random selection (lottery system) through an Internet application (www.random.org/integers). Every participant received a unique participant identifier after random selection.

This process assured the voluntary and anonymous participation of the external participants. All interviews had a length of approx. 90 minutes. The interviews were audio recorded and afterwards transcript. The following figure 3.10 introduces all interview participants with their respective interview schedule.

Figure. 3.10. Participants list and interview schedule

Company	Department	Participant	Interview
		Unit I	
Mercedes-Benz Spain	Training Academy	AE/P1	11.02.19
			10:00H
Mercedes-Benz Spain	Sales passenger cars	AE/P2	13.02.19
			14:00H
Mercedes-Benz Spain	Customer Services	AE/P3	15.02.19
			09:30H
Mercedes-Benz Spain	CASE department	AE/P4	12.02.19
			09:30H
Mercedes-Benz Spain	Product Management	AE/P5	11.02.19
			14:30H
Mercedes-Benz Spain	smart Sales	AE/P6	14.02.19
			15:00H
Mercedes-Benz Spain	Fleet sales department	AE/P7	12.02.19
			14:30H
ALD	Procurement	PM/P8	20.02.19
			12:00H
General Electric	Procurement	PM/P9	19.02.19
			09:00H
Europcar	Fleet department	PM/P10	25.02.19
			11:00H
Cableados y Conexiones	BoM	PM/P11	27.02.19
			10:00H
Calcats Mallorquins SA	BoM	PM/P12	21.02.19
			17:00H
Elecnor	Fleet department	PM/P13	22.02.19
			15:00H
Inet	Procurement	PM/P14	01.03.19
			16:00H
ROVI	Procurement	PM/P15	28:02.19
			16:00H

3.2.8 Data collection with workshops

The two workshops were likewise prepared through several topics and work packages to gather necessary information about service innovation and digital services. The workshops were performed in April and May 2019. The first workshop was performed on the 09th and 10th of April 2019 and all invited participants attended. The same participants performed also the second workshop on the 07th of May 2019.

Correspondingly, all invited participants attended to the second workshop session. All participants were “anonymized” for summaries, without any personal statement.

The second unit of analysis involved 14 automotive managers and experts**.** The participants were part of the Mercedes-Benz Spain organisation. The members consisted of senior managers, managers and experts from Sales & Marketing, After-Sales, Network, Finance & Controlling, HR, IT & Process, Press, Legal, Financial Services and the CEO/researcher. These participants were chosen for their explicit product know-how and expertise in the automotive sector. All primary personal data was coded and only after the anonymous transformation introduced into the thesis, according to the following participants list (Fig. 3.11.).

Figure. 3.11. Participants of the second unit of Analysis

Company	**Position**	**Department**	**Participant**
			Unit III
Mercedes-Benz Spain	Manager	Process Management	WG/P1
Mercedes-Benz Spain	Manager	Case department	WG/P2
Mercedes-Benz Spain	Director	Finance & Controlling	WG/P3
Mercedes-Benz Spain	Manager	Fleet sales	WG/P4
Mercedes-Benz Spain	Manager	Used Car Sales	WG/P5
Mercedes-Benz Spain	Director	Financial Services	WG/P6
Mercedes-Benz Spain	Expert	Press department	WG/P7
Mercedes-Benz Spain	Senior Manager	Customer Services	WG/P8
Mercedes-Benz Spain	Senior Manager	Network department	WG/P9
Mercedes-Benz Spain	Senior Manager	Mercedes Sales	WG/10
Mercedes-Benz Spain	Senior Manager	Legal department	WG/P11
Mercedes-Benz Spain	Manager	smart Sales	WG/P12
Mercedes-Benz Spain	Senior Manager	HR department	WG/P13
Mercedes-Benz Spain	Manager	IT department	WG/P14

As part of their daily work, participants were invited via e-mail to the strategic workshops, including the identical information letter than the participants of the interviews.

The total population consisted of approx. 25 managers and experts of Mercedes-Benz Spain. Of the 18 positive answers, every member of the selection received a number from 1-18. Fourteen voluntary participants were then chosen in a random selection (lottery system) through an Internet application (www.random.org/integers). Every participant received a unique participant identifier after random selection. All primary personal data was coded and only then introduced into the thesis. This process assured the voluntary and anonymous participation of all participants. The random selection was available as long as the selection process was completed, to allow new participant to join, in case of withdraw of one of the selected participants**.** The participants of the workshops didn't receive any compensation. To increase the energy level of the participants (Sims, 2006), Coffee, energizing drinks and snacks, were offered during the pauses.

3.3 Critical aspects and quality of the case study

The weaknesses of the case study were commonly the reliability and the academic rigour. Yin (2011, p. 37) critically stated that, "in the past, case study research procedures have been poorly documented, making external reviewers suspicious of the reliability of the case study". To counteract these tendencies, the researcher used different data collection tools; a data collection tool for interviews, a workshop summary tool, and a research notebook for general notes, additional reflections and ad hoc information. All collected data and additional information were methodically summarised for further analysis. To use case study as a research strategy implicated many advantages, but the researcher needed to accept an in-depth research with an adapted documentation and academic rigour. The four criteria proposed by Lincoln and Guba (1985), credibility, dependability, confirmability and transferability, formed the framework for determining the academic rigour and quality of this research. The definition given by Lincoln and Guba (1985) of credibility, as confidence in the truth of the findings could be achieved by different techniques. The researcher set the emphasis on diverse aspects to develop credibility for this research study.

- Prolonged Engagement

As employee and actual CEO of Mercedes-Benz Spain, the researcher spent over 25 years in the company, to learn, to understand the culture, social settings and the phenomenon of interest. This aspect involved the researcher in spending adequate time observing various aspects, speaking and developing relationships with employees.

- Persistent Observation

The purpose of persistent observation was an important aspect for the researcher to identify those characteristics and elements that are most relevant to the research problem for the last three years. If prolonged engagement provides scope, persistent observation provides depth (Lincoln and Guba, 1985). The daily observation as manager and researcher in the corporation shaped the study approach and clarified important issues of the research. Moreover, the researcher identified suitable and qualified persons to invite for the research.

- Peer debriefing

Every interview and workshop participant received an introduction of the research purpose and the actual automotive environment of approx. 10 minutes. Credibility (Saunders, Lewis and Thornhill, 2008) was promoted through the supply of relevant information to every participant before interviews and workshops.
The exploration of the material (Sims, 2006) actively involved the participants through discovery, creativity and improved the quality of the collected data.

- Member-checking

The researcher tested the data, flow, analytic categories, interpretations and conclusions of questions and the workshop content with mock groups of the Mercedes Corporation. The researcher tested how long the questions took to answer, the clarity of instructions and if the respondent felt uneasy about answering some of the questions. The preparation of the workshop flow and content were analysed and optimized with the support of employees of the organisation.

Moreover, the aim of these probe participants for elaboration (Mack *et al.*, 2011) of their responses, was the sharing about their knowledge of the research topic and to integrate these experiences in the questionnaire and the workshop design. The feedback of the test persons concerned also their opinion about topic omissions and any other of their comments. Typically, member checking is viewed as a technique for establishing validity of an account.

- Transferability of findings

Transferability refers to the degree to which the results of qualitative research (Lincoln and Guba, 1985) can be generalized or transferred to other business environments and sectors. From a qualitative perspective, transferability (Lincoln and Guba, 1985) was primarily the responsibility of the practitioner researcher to generalize the study, by doing a systematic work of describing the research context and the assumptions of the interview round and both workshops. The researcher proceeded in a very detailed description of the case study to guarantee the potential transferability to other business environments. The findings of in-depth interviews represented narratives and opinions of automotive experts and customers. The systematic approach of structured, open-ended questions guaranteed the effectiveness and congruence of interviews with similar research experiences (Conklin, Weiss and Bucuvalas, 1982). The answers to the interview questions may vary, depending on the maturity of the automotive market, in terms of future technologies and mobility needs. Nevertheless, individual adaptation to specific market and service needs should be tested or further investigated. However, in general terms, the findings are potentially transferable to the entire automotive industry and other mobility service provider sectors. The findings of the research confirmed the significance of an open source SIPM, from the identification of customer needs to the transformation into service solutions and introducing them to the market. The findings also reinforced the necessity to integrate the open innovation approach to gather the voice of the customer. The later integration of the process model into the Spanish Mercedes-Benz organisation demonstrated the practicability of the theoretical model in a real-world business environment. The successful application of the new “DOING” process proved the potential transferability to the entire automotive industry and other hardware-driven industries, to develop a coherent connection to a more service-oriented business model.

Furthermore, the new process defined the starting point of the digital PSS development in the Mercedes-Benz ecosystem. The second workshop created a valuable product service portfolio with different digital services. With regard to these customer needs, the second workshop elaborated a diversified mobility ecosystem with the exploration of seven core, digital services. The participants worked along the first three stages of the “DOING” Process. The result of the different stages “Discover, Organize and Initiate” consisted in the creation of a coherent product-service ecosystem and the conception of a new product service portfolio. Furthermore, the study outcome elaborated the specifications of the MVP, including the specifications for the IT-application for the most promising “Share4Business” service. The later integration of the project into the Mercedes-Benz “DOING” process organisation confirmed the practicability of the process via the successful creation of the final “Share4Business” service proposal. This workshop was conceived to deliver a particular result and to explore a first approach of a service ecosystem. The fully executed “Share 4Business” project proved the workability and the effective transformation of customer needs into valuable services. Therefore, the findings matched the expectations and could be introduced to other OEMs`, integrating specific mobility needs of diverse automotive brands in the “discover” stage of the “DOING” process. To conclude the understanding of transferability of our findings, the elaborated research design and study reporting improved the potential transferability to the entire automotive industries and other mobility business environments (Burchett, Umoquit and Dobrow, 2011).

Dependability is important to trustworthiness (Lincoln and Guba, 1985) because it establishes the research study’s findings as consistent and repeatable. The researchers aspired to verify that the findings are consistent with the raw data. Other researchers could potentially replicate similar findings in a similar study.

Confirmability in qualitative research tends to assume that each researcher brings a unique perspective (Lincoln and Guba, 1985) to the study and refers to the degree to which the results could be confirmed or corroborated by other researchers. Through the consequent documentation, description of procedures, data checks and the description of potential subjectivity, the researcher created sufficient documentation that another researcher could replicate the findings.

The **personal involvement** in the embedded case study approach was an important issue for the researcher. Case study was a suitable research design, which was also appropriate to the research philosophy of pragmatism, according to Saunders, Lewis and Thornhill (2009). Another focus revealed the potential limitations of the personal involvement and the subjectivity (Simons, 2009) of the researcher with his beliefs, assumptions and the validity of the findings. The researcher tried to limit these effects through a systematic preparation, planning and execution of the case study. Nevertheless, the researcher had to admit, that interventions in the real world created their own dynamics. The uncontrolled intervention that case study research (Walker, 1983) is in the lives of others, the distorted picture of the way things are, and its essential conservatism – the case study is locked in time while people moved on. Interviews and workshops were executed in a brief and limited time window to catch all relevant information in the same technological period, to better understand and compare the collected data. The research strategy was prepared with the best knowledge of the researcher and conducted with the support of the actual Case Study literature.

3.3.1 Data analysis technique

Thematic Analysis (Braun and Clarke, 2006) offered a systematic and flexible approach to analyse qualitative data, weather for large or smaller data sets, which led to solid description, explanations and theorising of the collected data. It was used to analyze classifications and present themes or patterns, which are related to the collected data. Thematic Analysis as an independent qualitative descriptive approach is mainly described as a method for identifying, analysing and reporting patterns within data (Braun and Clarke, 2006). It has also been introduced by Brown and Clark (2006) as a qualitative descriptive method that provides core skills to researchers for conducting many other forms of qualitative analysis. Another convenient point was, that Thematic Analysis applied minimal description to data sets, and interprets various aspects of the research topic (Braun & Clarke, 2006). Likewise, the flexibility of Thematic Analysis allowed the use of both inductive and deductive methodologies (Hayes, 2000). Thematic Analysis (Alhojailan, 2012) is considered the most appropriate for any study that seeks to discover using interpretations.

Moreover, qualitative research requires understanding and collected data, Thematic Analysis (Yardley, 2007) gave an opportunity to understand the potential of any issue of the data collection process more widely. Thematic Analysis (Saunders, Lewis and Thornhill, 2009) involved the researcher coding the qualitative data, defining and naming themes, reviewing themes, and searching for themes, to identify patterns for further analysis. The qualitative outcome of the questions and workshops themes was coded in relation to the different subject areas. This method corresponded in an adequate manner the researcher`s philosophical stance to explore diverse answers and interpretations within the different themes. The study used the three stages process model of Miles and Hubermann (1994) to execute the data analysis.

The first step considered data reduction (Miles & Huberman, 1994) through summaries and patterns to sharpen the data. The second step represented the data display. This step involved the understanding and the organization of the data. The third step of the Miles & Huberman Model comprised data drawing and conclusions, which included the relevance of statements, the notation of patterns, correlations among factors and variables as well as the conceptual coherence and consistency. The researcher reflected to compare and amplify the interviewed data from internal and external perspective. The method allowed furthermore the comparison between different working groups and the succeeding, common discussions of outcomes within the whole workshop group.

The researcher used Excel-tools to analyse narratives and patterns in the different subject areas. The use of Excel was the most convenient method for the researcher to analyse, compare and summarise the findings. Thematic Analysis is a flexible tool as Braun and Clarke (2006) referred to it as foundational method for qualitative analysis to seek to understand factors underpinning human attitudes (Saunders, Lewis and Thornhill, 2008) and actions. As one of the prerequisites, the outcome of Unit I was integrated in advance in Unit II to better analyse customer needs and expectations with regard to a future SIPM and a digital PSS development. The objective of Unit I was to demonstrate that OI could act as a potential enabler for an efficient SIPM, through the use of internal and external ideas (Chesbrough, Vanhaverbeke and West, 2006). The results were explicitly outlined and served as a basis for further research on the digital PSS exploration. Subsequently, the qualitative data from interviews and strategy workshops was systematically evaluated. Analyses was undertaken during the collection of data (Saunders, Lewis and Thornhill, 2008), as well after it.

The inductive, interactive approach of data collection and analyses allowed the consequent comparison with diverse databases. Recorded audio data was systematically transcribed and successively compressed in summaries. Narratives and patterns were identified through analytical themes, subsequently the evaluation method of investigations was analysed via thematic narrative analysis (Saunders, Lewis and Thornhill, 2008), which was used for individual and multiple, related narratives in the subsequent findings.

3.4 Execution of the case study

3.4.1 The inside-outside perspective

The interview questions focused on opinions about the future of mobility and services in the automotive sector. Those issues were not linked to sensitive, internal corporation issues. Interviews were executed in an open-minded environment, where the researcher considered new ideas and suggestions in an unprejudiced way. The interviewer tried to create a stimulating and stress-free environment. After the introduction about the focus of the research, the researcher and interviewer clearly stated that participants` opinion were important and that they will not be judged neither the interviews would have an impact on their daily work. The participants felt free to express their personal opinions about future automotive mobility and services. The researcher explained his role as researcher and interviewer to the participants. Moreover, he expressed, that no judgment will be taken, or pressure will be put on the participants. The interviews should provide information about innovation, the future of mobility, future valuable services and as well customer needs and expectations from an inside – outside perspective from the corporation to the market. The researcher conducted all interviews with the Mercedes-Benz automotive experts in English language.

3.4.2 The outside-inside perspective

The interviews with external participants allowed an outside - inside perspective from the market to the company. The researcher conducted these interviews in Spanish language.

Due to some weakness of the Spanish language, the English-speaking assistant to the CEO was ready to intervene in eventual queries and ambiguities during the interviews.

The researcher used the identical questionnaire for both units of interest and for all 15 participants. The researcher wanted to explore the point of view of the customer about service needs and expectations. The outcome of all interviews were compared and amplified the findings of the different themes.

3.4.3 Design model for interviews

To warrant that essential data was collected, structured questions were created with the support of Saunders' design model for questions. To gather relevant information, the researcher used this method (Saunders, Lewis and Thornhill, 2008) of data requirements. Proceeding along this model, supported the creation of central questions. The researcher developed open questions, sometimes referred to as open-ended questions (Carter, 2010), that allowed the respondents to give answers in their own way. The researcher clarified the data requirements beforehand (Saunders, Lewis and Thornhill, 2008) and designed the questions. Nevertheless, the questions were tested previously to capture all necessary data in order to reply the research questions. The event started with a short introduction of the research purpose and ended with a last opportunity to mention important issues.

Saunders` design model

- Decide whether the main outcome of your research is descriptive or explanatory.
- Sub-divide each research question or objective into more specific investigative questions about which you need to gather data.
- Repeat the second stage if you feel that the investigative questions are not sufficiently precise.
- Identify the variables about which you will need to collect data to answer each investigative question.
- Establish the level of detail required from the data for each variable.
- Develop measurement questions to capture the data at the level of data required for each variable.

For an improved display of the design approach, the method will be explained in the next section along the interview questions.

3.4.4 Introduction to the interview method

The explanatory investigation used in-depth interviews with open-ended questions to gather relevant data. The research questions supported the design of the interview questions. Moreover, the literature review supported the development and the specificity of the interview questions. All participants answered the entire 31 interview questions and every participant received the identical introduction of the research purpose and the automotive background. The researcher proposed to the participants an imaginary picture, allowing the projection into the near future: “We put on some Virtual Reality glasses, which allows us to see what our life is going to be in 5 years’ time”. All participants accepted this imaginary approach to better visualise a potential future and respond to the questions. The following section explains the detailed design and organisation of the interview questions.

3.4.5 Design and organisation of in-depth interviews

Short input of actual Mobility Services:

Following existing content was explained to all participant in a 10 minutes introduction to the mobility environment. The researcher introduced some automotive trends and services as a warm-up for the interview.

- Comprehensive electric mobility. Car sharing, Car2Go.
- Parking assistance in big cities.
- Pay-per-use Cars.
- Change of vehicle in case of need.
- Pick-up and delivery service for repairs and maintenance.

Leisure and entertainment:

- Access to multimedia content in the vehicle: Netflix, Spotify.
- Listen / answer (via voice) emails, WhatsApp, etc.

Time management:

- Parking solutions.
- Cleaning service while the vehicle is not in use.
- Charging service (electrical) while the vehicle is not in use.

The researcher sub-divided the research questions (Saunders, Lewis and Thornhill, 2008) into more specific questions about future technology and entertainment to gather relevant data. The researcher reshaped the questions after the mock sessions to more specific and investigative questions. The researcher identified the main topics from the research questions (Saunders, Lewis and Thornhill, 2008) and integrated them into the interview questions. Furthermore, the investigator used the literature review to identify important topics for analysis. The conduct of new technologies, future mobility and services were not extensively discussed in the literature. Likewise, the analysis of current factors of change in the automotive industry were only discussed in a very general way in the literature. The concept of PSS and the creation of a specific Mercedes-Benz ecosystem consisted in a prerequisite for the future development of mobility services.

- Future conduct in terms of new technologies.
- Future mobility and services.
- Factors of change.
- Product service-Systems.
- The Mercedes-Benz ecosystem.

To gather relevant data and detail-depth the researcher developed short and precise measurement questions, such as:

- How will people use mobility during the week? On the weekend? At work? And for holidays?

The interview started with four "**Questions about the Future conduct"** in terms of new technologies with the following identification in the subsequent thematic analysis.

Identification: 1-QF 1-4

These questions should partially respond to the first research question about the implications of future technology.

1. What will be your relationship with technology in the future?
2. How will you communicate in 5 years' time and how are you going to relate to your friends and family?
3. What will happen to leisure and entertainment and how will you enjoy your free time?

4. What types of new services or products will companies or brands offer?

The second part of the questions consisted in eight "**Questions about future Mobility"** and services with the following **identification: 2-QM 1-8**
These questions gathered information for the first research question (Saunders, Lewis and Thornhill, 2008) about future mobility and service solutions in the Mercedes-Benz ecosystem.

1. How will mobility change in the next 5 years and will customer act in a different way? What is new? What has disappeared?
2. What will be exciting in terms of mobility and what will be worrying?
3. How relevant will mobility be in general and will it increase or decrease?
4. What are you seeing through the VR glasses and how will mobility be experienced?
5. How will people use mobility during the week, on the weekend, at work and for holidays?
6. What will be the role of private owned vehicles? Of public transport? And what about electric bikes, electric scooters?
7. How will car-sharing or similar services evolve in the future? What do they offer as services?
8. When are these services used?
9.

In the third part of the questions, the researcher asked nine "**Questions about drivers of Change"** in terms of mobility with the following **identification: 3-QC 1-9**
This part collected correspondingly data for the first research question. Likewise, this question should partially gather data for the second research question about methods to stimulate the voice of the customer.

1. What will be the factors to shape these new mobility options? What will be future trends of mobility?
2. What will happen with the traffic in big cities? What will be enhanced? What will the regional government of Madrid / Barcelona as a consequence do?
3. What do you see in terms of change in vehicle technologies?
4. What will happen to combustion (petrol and diesel) engines?

5. Do you think that the future car technology will be purely electric? What will be the impact in 5 years' of individual mobility?
6. What will be the role of plug-in hybrids?
7. Do you see vehicles that operate with other technologies?
8. What do you think about connected cars? What will they provide as additional services? What will be the advantages for OEMs` and users?
9. What do you think about autonomous vehicles? How do you imagine this technology?

The next part included five "**Questions about Product-Service Systems"** with the following **identification: 4-QP 1-5**

The questions collected data for the second research questions.

1. What other kinds of services or features, technology, entertainment, innovations, charging options etc., will vehicles offer in the next 5 years?
2. What kind of digital applications will link services to the vehicle?
3. What kind of products and services from other industries might be interesting to offer in the automotive industry?
4. By looking through the VR glasses, how will consumers' purchase vehicles in 5 years? Do customers still own cars? Will cars be rented or Payed-per-use?
5. What could be the ideal mobility system for consumers?

The last part of the questionnaire introduced five "**Questions about the automotive Ecosystem"** with the following **identification: 5-QE 1-5.**

This part of the questions collected partially data for the first research question in terms of future mobility and service solutions in the automotive ecosystem. Similarly, the question gathered data for the fourth research question about the design of an open PSS.

1. Which companies or brands may execute these ideas in 5 years and from which industries? Are there brands that fit to these ideas more than others?
2. What should each company/brand provide as new services offer in this environment?
3. What could be the advantage for the company to offer these types of services?

4. What are the distinguishing factors of a brand?
5. How will MB compete with its long-standing competitors (BMW, Audi, Mini and Toyota)? In addition, with new technological players (Google, Apple, Amazon, UEBER etc.)?

The interviews closed with an open question for all participants, to give the opportunity to address important issues, which were not already mentioned. All 15 participants answered the entire and identic 31 interview questions. A complete interview compilation with five different Participants is available in **appendix A**. For a better understanding, the researcher presents a compilation of two internal and three external participants for each of the five thematic themes.

3.4.6 Evaluation and analysis of data

Understanding qualitative data to analyse the meaningfulness and to make sense of the subjective and social constructed meanings (Saunders, Lewis and Thornhill, 2009) of the participants, the technique of Thematic Analysis (TA) supported this challenge. The researcher identified, analysed and reported patterns and themes out of the interviews and the two workshops. The literature review helped to sharpen the interview questions and supported the design of the workshops by the already mentioned limitations of the literature. The researcher defined, reviewed and searched for themes, to identify patterns for further analysis (Braun and Clarke, 2006) of the collected data in the field. The aim of Thematic Analysis consisted in the identification and interpretation of data features, guided by the four research questions (Clarke and Braun, 2017), by producing rigorous and high-quality analysis. Thematic Analysis (Clarke and Braun, 2017) was also used to identify patterns within and across data in relation to different populations of interview participants. Thematic Analysis identified lived experience, views, perspectives, behaviour and practices of customers and automotive experts.

3.4.7 Transformation of the interview data

For the first unit of analysis, all interviews were transcript from audio recorded data. The researcher transcripted all interviews in English language. A translator transcripted the Spanish interviews and translated them subsequently to English language. The researcher read carefully all interviews, particularly the Spanish transcript interviews, to become familiar with the collected data.

The transcript summaries of all interviews were compared and amplified the findings of the different themes. Summaries facilitated the identification of themes that have emerged from the interviews (Saunders, Lewis and Thornhill, 2009). The researcher carefully read all interviews responses and reflected all thoughts to sharpen the data. The researcher used the three stages process model of Miles and Hubermann (1994) to execute the data analysis. In a first step, all responses were clustered into the already defined five topics of interview design to better understand and compare the data. The researcher then clustered all interview questions into the five following topics with the corresponding identification to facilitate further analysis.

1.	**Future conduct in terms of new technologies**	**1-QF 1-4**
2.	**Future Mobility and services**	**2-QM 1-8**
3.	**Drivers of Change in terms of mobility**	**3-QC 1-9**
4.	**PSS needs and ideas**	**4-QP 1-5**
5.	**The automotive Ecosystem**	**5-QE 1-5**

The researcher also added his field notes to the topic summaries. Afterwards, the researcher analysed all collected data of each question and summarised and compared the data. Subsequently, topic summaries were established to refine the data. Likewise, the researcher analysed and compared different perspectives, from the inside-outside and the outside–inside perspective from different interview participants. Theoretical and reflective thoughts were documented and first thoughts about potential codes and themes were integrated in the summaries. In a second step, the researcher involved the understanding and the organization (Miles & Huberman, 1994) of the data and generated initial codes and themes. The collected data was used to generate various themes for analysis and interpretation. Through the transcript summary, the investigator identified seven different themes and connected them to the following codes:

1.	**Mobility Trends**	**Code: MT.1.0**
2.	**General Attitudes towards the Future**	**Code: AF.2.0**
3.	**Mobility and Product Services**	**Code: PS.3.0**
4.	**Drivers of the change in terms of mobility**	**Code: DC.4.0**
5.	**PSS needs and key ideas**	**Code: NI.5.0**
6.	**The Ecosystem and the value of premium**	**Code: VP.6.0**
7.	**Nuances between the two different perspectives**	**Code: DP.7.0**

The researcher took different perspectives and data sources, integrated reflexive thoughts and created a coding framework with main themes and sub-themes.

All identified themes, sub-themes and patterns were included in the code framework alongside the following logic and hierarchy (Lincoln and Guba, 1985). The whole coding framework was developed in three hierarchical levels, as shown in the following figure 3.12. The **first level** consisted in the seven main themes; the **second level** consisted of important sub-themes. The **third level** included detailed patterns, which were linked to the sub themes.

The complete code framework is available in appendix E, for a holistic understanding of all themes and hierarchical levels.

Fig. 3.12. Extract of Code Framework/ Interviews

Thematic Analysis		
Code Framework		
Code	**Theme**	**Definition**
MT.1.0	Mobility Trends	Increasingly consolidated mobility trend towards hybrids (PHEV) and full electric cars (EV).
MT.1.1	MT	Legislation in the short to medium term is tending to increasingly benefit PHEV and electric cars
MT.1.2	MT	New ways of acquiring and using cars.
MT.1.3	MT	Ecological aspect have an important impact on the choice of the technology.
MT.1.4	MT	Future possibilities of connectivity and services is also changing client's behaviour.
AF.2.0	General Attitudes towards the Future	Major changes in future,due to new technology
AF.2..1	AF	Fundamental changes in life style
AF.2.1.1	AF	Human relations and all forms of communication.
AF.2..1.2	AF	Education and health.
AF.2.1.3	AF	Work: new professions and telework.
AF.2.1.4	AF	Experiential context: changes in cities versus suburbs.
AF2.1.5	AF	Consumption: online versus physical channels
AF.2.2	AF	Dual way, uncertainty and expectations
etc...		

The researcher organised the code framework, including diverse themes and detailed definitions of different themes and sub-themes.

The important process issue of data collection, coding, organizing, and analysis was described in sufficient detail to enable the reader to judge whether the final outcome is rooted in the data generated (Coughlan, Cronin and Ryan, 2007). The third step of the Miles & Huberman model comprised data drawing and conclusions, which included the relevance of statements, the notation of patterns, correlations among factors and variables as well as the conceptual coherence and consistency. For this reason, the researcher revisited the raw data of the interviews, themes and sub-themes for common patterns and coherent logic. The researcher used the code framework as guidance to create a coherent story, while preparing the data collection. The investigator integrated direct quotes from participants as an essential component of the final report (King, Cassell and Symon, 2004). Moreover, he embedded extracts of raw data into the report to illustrate the complexity of the data, going beyond a description of the data and convincing the reader of the validity and merit of the analysis (Braun and Clarke, 2006). The next section explains the workshop design of the second unit of analysis.

3.5 Execution of the workshops

To capture important data from the participants during the workshop sessions, the researcher proceeded in a similar mode to the first unit of interest. Instead of preparing questions, the study used workshop sessions to gather data. The workshop sessions were prepared through different topics and the participants had to respond to different questions in working groups. Most of the sessions were organised as team challenges. A team is a group of people with a full set of complementary skills required to complete the workshop task. The team members operated with a high degree of interdependence, shared the authority of the researcher and moderator. The team was responsible for self-management and their collective performance. The team members had a strong sense of mutual commitment and generated a greater performance than the sum of its individual members. Nevertheless, the design of a workshop with 14 participants at the same time needed a structured approach to maintain control and the creativity level of the members. The researcher followed the workshop design model of Sims (2006). The workshop design consisted of three building blocks:

1. Preparation and organisation of the Who, What, Why and where.
2. Design of the workshop.
3. Performing the workshop session.

The workshop followed the agenda of Sims` model. The first step defined the preparation and the organisation of the workshop. This building block described the participants, aim, objectives as well as the location of the workshop. This detailed information was already presented in the previous “prepare for data collection” section. The second model step (Sims, 2006) expressed needed knowledge and creativity of the researcher to design an interactive and dynamic exercise with participants. The “whole-brain learning” approach of Sims (2006) proposed the use of the whole brain, instead of the traditional “left brain” use for learning and creativity. This learning approach (Sims, 2006) actively involved the participants through discovery, creativity and exploration of the material, to use both sides of the brain. The “whole-brain learning” (Sims, 2006) tool supported a better information flow between the participants and they were able to faster process new information and enjoyed more the whole learning and information process. A structured background information and the clarification of the purpose and objectives of the workshop enhanced the “whole-brain learning” approach of the participants. The researcher had already several years of experience and knowledge in this field of workshop execution. Sims (2006) proposed to maintain the control of the workshop with an open-minded spirit, a well-designed workshop agenda and offering advice and guidance during the workshop. Even in case of loss of control, the workshop leader could easily manage this situation by adapting a more facilitative mode (Sims, 2006) to regain the control of the workshop. The researcher took the advice very serious and applied the instructions in the best possible mode, but still with an authentic attitude. The explanatory investigation used the workshop method to gather relevant data. All participants received an introduction of the research purpose and information about the automotive background. Multi-disciplinary teams of the workshops delivered important information out of the different working groups. The researcher introduced diverse topics in order to give important background information which were useful to update all participants. The background information created a common baseline and opened their mind for the workshop and introduced the “whole-brain learning” tool.

3.5.1 Workshops as method for data collection

To explore and create a new SIPM by meeting customer needs and explore a digital PSS, workshops were planned with several topics and work tasks to gather relevant data.

The second unit of analysis integrated managers and experts from the Mercedes-Benz organisation. This population was already conscious about the actual paradigm change towards integrated mobility services. The workshops of the second unit of interest were performed through two workshops during the working week. Mercedes-Benz Spain embarked this journey to reach a new harbour, developing a new SIPM and exploring new service products connected to the whole Mercedes-Benz vehicle range. The workshops were based on following prerequisites:

- Not continuing developing services from a purely inside approach
- Delivering services which meet customer expectations
- Creating an open innovation environment
- Creating an adapted steering model

The workshops were designed with the following objectives to answer the research questions:

- Developing a new Service Innovation Process Model (workshop I)
- Creating an efficient framework for Mercedes-Benz Spain (workshop I)
- Exploring a digital PSS (workshop II)
- Implementation a service product portfolio within MB Spain (workshop II)

The researcher designed the workshop strategy along SIMS (2006) workshop design model to ensure an appropriate execution with concrete outcomes. Overall, two workshops in April and May 2019 were organized in the Mercedes-Benz Headquarter in Madrid. The topics were clearly and precisely defined, and the focus laid on enabling and creating interactive discussions between participants to gather relevant information. The workshop content was also tested with employees of the corporation to ensure the flow, content and the performance of the different working groups. The working group consisted of automotive managers and experts. During the Workshops, notes were taken, and flipcharts were used, as well an I-phone to take pictures of written outcomes. The data collection tools for the second unit of interest consisted of a working paper with an agenda and summary tool. The researcher also used a field notebook to take notes and record information. The findings were summarized in presentations, content protocols and summaries for data collection. The researcher already had several years of experience, performing working groups and leading workshops. He took the role as workshop leader and moderator in the workshops.

Both workshops were executed in the regular business environment of Mercedes-Benz Spain in English language.

3.5.2 Design of the first workshop

The researcher proposed the following workshop design and agenda for the first investigation:

Title of the Workshop

"Workshop to explore a new Service Innovation Process Model for Mercedes-Benz"

The researcher used the introduction for the open innovation approach to demonstrate the necessity of a new innovation model. (The complete workshop 1 agenda is available in appendix B).

Following topics were presented as background information to the participants:

1) Social, political, environmental and technological challenges.
2) Endangered Profitability and Business Model
3) Concept of Open Innovation and fuzzy front-end innovation
4) Main findings of the first research unit in terms of Open Innovation approach
- General shared discussion

The researcher introduced for the first two topics a summary of the first chapter of this study. The introduction of topic three and four represented mainly a summary of the literature review. The focus laid on the inflow of internal and external ideas to develop a new SIPM. The purpose of this workshop included data collection in order to reply to the third research question about an open source framework to better satisfy customer needs. Customer needs and expectations were in the centre of the concerns and the cross-functional capabilities of the participants enriched ideas and opinions of the workshops. Moreover, the introduction improved participants` creativity for the group work sessions (Sims, 2006).

After the introduction, the members had the opportunity to debate implications for Mercedes-Benz in the general discussion of the main findings of the first unit of analysis. The researcher established two different working groups of seven participants to elaborate the workshop questions. Two different groups worked in parallel and presented solitary their ideas, approaches and models consecutively. Afterwards, the group leaders presented the outcomes in front of all participants with a succeeding discussion, which clarified the all-over information.

Ultimately all participants discussed the complete outcome and integrated the best ideas and approaches in each stage of the framework. The first working group consisted in the response of how to integrate an open source approach to identify customer needs. Two groups presented their ideas and the final discussion closed the first session. The next workshop step introduced a common working group, which discussed different innovation processes as basis for a future new service innovation framework. The researcher presented the outcome of the literature review in a summarised form, introducing different innovation processes to prepare the path for a future framework for Mercedes-Benz. He introduces also the limitations of the existing innovation processes to increase the flexibility of a future process and the creativity of the participants.

1. Presentation of Stage Gate Process
2. Presentation of the Mercedes-Benz Development System
3. Presentation of Design Thinking approach

➢ General shared discussion

The introduction of the different innovation processes was useful to create a common understanding and a foundation of the possibilities of a novel SIPM. This approach paved the way for the next working group to adapt a new framework to the needs of Mercedes-Benz. The participants elaborated the question with the same method then the first working session.

- What are important parameters/building blocks for the workability for each process step?

The final group presentations and common discussion closed this session. The third session defined the first process step of the SIPM for Mercedes-Benz. Two groups worked on the following question:

- How to identify customer needs and the integration in a process stage?

Afterwards the group leader presented the outcomes in front of all participants with a succeeding discussion, which clarified the all-over outcome of a first process stage. Group work IV defined the second process stage with the subsequent question:

- How to organize and prioritize customer needs?

The final group presentations and common discussion closed session IV and the first workshop day. The second day offered the possibility to further develop and discuss a new SIPM.

Agenda for Day Two

The researcher wrapped up and summarised the conclusions of the first workshop day. The participants adapted their process model to the concrete needs of Mercedes-Benz. Working group V defined the third process stage and elaborated the validation of customer needs, analysing the business model and the feasibility of needs? Subsequently, each group leader presented the outcomes in front of all participants with a succeeding discussion, which clarified the all-over outcome of the second process stage. Working group VI discussed the definition of the fourth process stage and the launch of a service product that satisfies customers' expectations. The groups discussed and presented their outcomes in front of all participants. The succeeding discussion clarified and improved first conclusions of each group. The next working session defined the fifth and last process stage and answered following question:

- How to consolidate initiated services and integrate them into the operational business?

The global discussion finalized the five process stages of the service innovation model. Furthermore, the succeeding discussion led to the necessity to define key roles in the process. Working group VIII defined Key roles in the different process stages. The following session VIIII worked on the needed resources and metrics for each stage. The two groups elaborated the following two questions.

- Which resources in terms of resources, data, reports, money are needed to guarantee the quality of each stage?
- What kind of standard measurement is needed to guarantee the validity of each stage?

Afterwards the group leader presented the outcomes in front of all participants with a succeeding discussion, which clarified the all-over outcome of needed resources and metrics. The last working sessions discussed the necessity of quality gates to guarantee process excellence. The participants elaborated following question:

- What kind of Quality Gate is needed and after which stage to guarantee the all-over process standard?

The final discussion gave the opportunity to review the all-over framework, the quality gates, key performance indicators and needed resources. The researcher wrapped up and summarised the outcome of the two days' workshop.

3.5.3 Design of the second workshop

The workshop followed a precise agenda and the researcher used the same workshop methodology as in the first workshop to explore the design of a digital PSS in the Mercedes-Benz Corporation. The second workshop was designed as a one-day session. The complete agenda of workshop 2 is available in appendix D**.**

Title of the workshop

"Workshop to explore the design of a digital PSS for Mercedes-Benz"

Agenda

The researcher introduced diverse topics in order to give important background information, creating a common mind-set for the second workshop. The researcher used the introduction to increase the awareness of a digital PSS and the requirements of a future Mercedes-Benz ecosystem. The focus of the second workshop laid on the exploration of valuable, digital services. Moreover, the introduced topics improved participants` creativity for the sessions in a similar mode to the first workshop. After the first workshop, the researcher analysed and evaluated the data to introduce it in the second workshop. Introduction of the study background with following topics:

- Presentation of the novel service innovation model of the first workshop.
- Main findings of the first unit of analysis
- Identified Needs
- Requirements of the future Mercedes-Benz Ecosystem

The introduction of these topics was useful to update the participants and prepare them for the workshop challenges. The participants worked along the first three process stages of the already developed new service innovation model. The first working group introduced the first stage and the description and qualification of the already identified customer needs.

The researcher established seven working groups with two participants. Each working group elaborated one identified need out of the seven total needs. The working groups qualified each need and described the context, the task and customer “pain points” of each single customer need. The groups integrated each of the seven identified needs into a three-dimensional meta-planer with the context, the task and the “pain points“. The researcher prepared the meta-planer beforehand and introduced it to the workshop members. Each group argued for the qualified need and the final, common discussion helped to clarify each customer need. The second session worked on the prioritization of customer needs of the second stage of the new process model. The participants integrated the already qualified needs into a meta-planer according the opportunity size, the strategic fit and the “right to play” as described in the new process model. This exercise allowed the creation of the Mercedes-Benz ecosystem with a core Service-Product portfolio. The third working group consisted in the validation of “PRIO I” desirable needs and enquiry of specification of a minimum viable product (MVP). The groups worked according to the new process model on the “Initiate” stage. The researcher asked the following two questions:

- What are the specifications of the MVP for “Share 4 Business”?
- What about the IT-system environment of “Share 4 Business”?

The researcher replaced the approach and changed for two groups of seven participants. The participants elaborated the specifications of the MVP and the IT environment for the “PRIO One” project with the naming of “share for business”. In each of the groups, one IT expert was integrated to support the session with their competence and IT-knowledge. The main support was the translation of general specification to a concrete IT requirement. The mobility service “Share for business” was designed in the first workshop. This service was an identified need for corporate car sharing with smart cars and incorporated the voice of the customer in the most adequate way. The participants chose this special need to the priority they gave it in the first workshop.

The succeeding and final discussion clarified and improved an elaborated PSS model and the creation of a product service portfolio for future projects. The introduction of the PSS concept was a prerequisite, creating a common understanding of a potential PSS exploration within Mercedes-Benz. All groups presented and discussed their outcomes in front of all participants.

The researcher wrapped up and summarised the outcome of the second workshop. This session closed the design of the different methods of data collection of our study.

3.5.4 Applying Thematic Analysis for the second unit of interest

The researcher applied TA for the second unit of interest, which consisted of two separated workshops. To better understand the approach and the logic, the researcher integrated the explanations and frameworks of the TA. Elementary topics of the working groups, different analytic themes and code frameworks were directly linked to the findings. Therefore, the approach to apply TA seemed to be consequent and should facilitate the comprehension of the “Finding and Discussion” chapter. Subsequently, the qualitative data from the first and the second workshop was systematically evaluated through Thematic Analysis (TA). Workshop summaries and field notes were carefully analysed and helped to detect themes and patterns. The researcher took the similar methodical approach as for the TA of the interviews and used the three stages process model of Miles and Hubermann (1994) to execute the data analysis. In a first step, the researcher developed ten topics for the first workshop and clustered them into different working groups. Afterwards, all collected data was clustered into the ten working groups to simplify further analysis.

Working Groups (WG)	**Topic**
WG One	Exploring a framework through an open source approach
WG Two	Creating a service innovation framework
WG Three	First process stage, identification of customer needs
WG Four	Second process stage, organizing customer needs
WG Five	Third process stage, validation, analysing and feasibility of needs
WG Six	Fourth process stage, service product to satisfy customers
WG Seven	Fifth process stage, initiate services and integration in business
WG Eight	Key roles in different process steps
WG Nine	Resources and measurement to guarantee quality
WG Ten	Quality gates, which kind of quality gates for process standard

The analysis of workshop one and two were always executed in a disconnected routine to guarantee the quality of the final report. For the second workshop, the investigator developed three working groups of the workshop and clustered the collected data along the three themes.

Working Group (WP)	**Theme**
WG One	Qualification of customer needs, description and qualification
WG Two	Prioritization of needs
WG Three	Validation of “Prio one” need, specification of MVP and IT

The inductive, interactive approach of data collection and analyses allowed the consequent transition and identification of themes and patterns to develop a coding framework for the two workshops. Relevant data of “workshop one” was analysed by the researcher and several themes and sub-themes were identified. The researcher identified eight different themes with the following codes.

1. General process Framework	**Code: PF. 1.0**
2. Design of Framework	**Code: FW. 2.0**
3. Discover needs – First stage	**Code: FS. 3.0**
4. Organize needs – Second stage	**Code: SS. 4.0**
5. Initiate solutions – Third stage	**Code: TS. 5.0**
6. Incubate solutions – Fourth stage	**Code: FS. 6.0**
7. Grow and scale opportunities- Stage five	**Code: SF. 7.0**
8. Steering model	**Code: SM. 8.0**

The same method applied to the second workshop and the researcher identified the following eleven themes:

1. Main description of customer needs	**Code: MD. 1.0**
2. EQ Easy Mobility	**Code: EQ. 2.0**
3. EQ Energy Boutique Parking	**Code: EB. 3.0**
4. EQ Ready App	**Code: QR. 4.0**
5. EQ Swap	**Code: ES. 5.0**
6. EQ Charge Solutions	**Code: CS. 6.0**
7. EQ Ready Tariff	**Code: RT. 7.0**
8. Share4Business	**Code: FB. 8.0**
9. Prioritization of Customer Needs	**Code: PR. 9.0**
10. Core Mobility Service-Product Portfolio	**Code: PP. 10.0**
11. Incubate Share4Business	**Code: IS. 11.0**

The researcher used again triangulation and reflexive thoughts to create a coding framework with main themes and sub-themes. All identified themes, sub-themes and patterns were included in the coding the following two framework of the workshops. The first level consisted in the main themes of both workshops. The second hierarchy level consisted of important sub-themes and patterns of the outcome of the working groups. The third level contained detailed pattern of the outcome of the working groups, which were linked to the sub themes. This approach was performed for both workshop analysis.

Fig. 3.13. **Extract of Code Framework/ Workshop 1**

Thematic Analysis

Code Framework Workshop 1

Code	Theme	Definition
PF. 1.0	Process Framework	Exploring a new innovation Framework
PF. 1.1	PF	OI approach
PF1.2	PF	Identification of customer needs
FW. 2.0	Framework	Design of Framework
FW. 2.1	FW	Goal of each stage
FW. 2.2	FW	necessery input
FW. 2.3	FW	task to accomplish
FW. 2.4	FW	desired output
FW. 2.5	FW	needed resources
FW. 2.6	FW	Metrics to measure
FW. 2.7	FW	needed stakeholders
FS.3.0	FS	Discover needs
FS. 3.1	FS	Find, gather and qualify needs
FS.3.1.1	FS	Comprehension of needs
FS. 3.2	FS	Input
FS. 3.2.1	FS	List of needs, Open source
FS. 3.2.2	FS	Internal, external research and sponsor
FS. 3.3	FS	tasks
FS. 3.3.1	FS	Opp. Size , market fit, right to play
FS. 3.3.2	FS	Pre -priorization and prepare proposal

The code framework of the first workshop permitted an improved understanding of the qualitative data and a clear organisation of the data collection.

Fig. 3.14. Extract of Code Framework/ Workshop 2

Thematic Analysis

Code Framework Workshop 2

Code	Theme	Definition
MD. 1.0	Main Description	Main description of needs
MD. 1.1	MD	Expressing custumer pain points
MD. 1.2	MD	Understanding the subject
MD. 1.3	MD	Definition of future service tasks
EQ. 2.0	EQ	EQ easy Mobility
EQ. 2.1	EQ	Pain Points
EQ. 2.1.1	EQ	Car not ready, no parking, polluting cars
EQ. 2.2	EQ	Need context
EQ. 2.2.1	EQ	Change car when needed
EQ. 2.2.2	EQ	other mobility solution
EQ.2.3	EQ	Task description
EQ. 2.3.1	EQ	Mobility voucher, Car2Go, MyTaxi
EQ. 2.3.2	EQ	alternative e-mobility solution
EB. 3.0	EB	EQ Energy Boutique parking
EB. 3.1	EB	Pain Points
EB. 3.1.1	EB	Parking is a pain

Thematic Analysis supported the understanding of the collected data and improved the analysis of comments, meanings and narratives. The transition of the coding framework and the summarized data allowed a clear interpretation of the workshop outcome. TA helped also to make sense out of the subjective and social constructed meanings (Saunders, Lewis and Thornhill, 2009) and supported the systematic elaboration of the data collection.

3.6 Implementation of the “DOING” process

After the two workshops, the Mercedes-Benz executive board nominated the entire “DOING” project team, the project sponsor and the steering committee.

The project team implemented the “DOING” process in the Mercedes-Benz Spain organisation and developed the “Share4Business” mobility service solution. Afterwards, the digital service solution was introduced to the Spanish market. The next section introduces ethical approach of the research in relation to participants of the study.

3.7 Ethical considerations

The Ethics of research according to Gray (2004) concern the appropriateness of the researcher`s behaviour in relation to the subjects of the research or those who are affected by it. The research incorporated access to primary data through workshops and person-to-person interviews. The data collection and ethics were critical aspects (Saunders, Lewis and Thornhill, 2008) for the success of the research. The insider researcher was looking for “intrinsic good” and “truth-telling” (Oliver, 2010) as fundamental qualities of the qualitative study. Costley, Elliott and Gibbs (2010) are pointing out that your practice as researcher involves meaning and intention and the data you collect will be interpreted according to your own experiences and knowledge as a practising professional. Therefor it was important as an insider researcher to gather personally, whenever possible, primary data by executing interviews as primary instrument (Gallais, 2008). Discussing innovation, future technologies and services in the automotive sector with customers and experts, via face-to-face interactions, could have potentially exposed the participants to diverse sensitivities. Personal opinions of focus group members were exposed in the group, power relations within the organisations of the experts and the researcher represented further potential sensitivities of the participants. All Mercedes-Benz and smart experts were employees of Mercedes-Benz Spain and therefore, in a dependent power relation with the researcher and interviewer. This caused a critical situation for the research and a potential misuse of power. Having been aware of this situation, the approach to the participants was executed in a very sensitive and controlled manner to avoid any harm or deception for the experts and also for the researcher. Although the researcher was head of the company Mercedes-Benz Spain and the automotive expert of Mercedes were in a dependent power relation, the focus of the research were questions and opinions about the automotive future and were not subject to sensitive internal corporation issues. The misuse of power was not an issue for this specific study about the automotive future.

All external interview participants were chosen from existing customer database. The process assured the voluntary basis and all participants were informed about the details of the research beforehand. These interviews were tape-recorded, and the outcome of the intervention translated to English with the consent of all participants. The questions were translated from English to Spanish for the interviews by a professional translator. The translator transcript the interviews and subsequently translated them into English. The researcher was supported by Mercedes-Benz Spain in his research activity and according to Oliver (2010, p. 115), “this is acceptable when ethical standards for both sides are ensured”. There were ethical issues in the various aspects of the design of the research, in soliciting and in dealing with the participants (Meltzoff, 2005), and in analysing and reporting the data. Therefor it was necessary to follow ethical principles, such as the Ethical Principles in the Conduct of Research with Human Participants (EPR) from 1982. The types and severities of risks associated with human research (British Psychological Society, 2014) ranged widely; from innocuous, anonymised at source data gathering on non-sensitive topics, to research carrying multiple high-level risks that demand very detailed ethics protocols and close attention to risk obviation, minimisation and management, along with adequate liability cover. In this spirit the research followed the four main ethical principles (Gray, 2004) to protect the participants.

- Avoid harm to participants.
- Ensure informed consent of participants.
- Respect the privacy of participants.
- Avoid the use of deception.

The research pursued the ethical standards of Worcester University and followed the ethical approval procedure of the institute. All participants were invited to take part in the research on a voluntary basis and were informed about the details of the research project through a signed form to ensure informed consent. Information about the use, anonymity and the confidentiality of their data was explained in advance in a written form and via voce. The right to withdraw, during and after the intervention (up to two weeks after taking part) protected the research participants from information imbalance, inability to hedge, inherent uncertainty, and untoward bodily invasion. Information about the use, anonymity, the confidentiality of their data and the right to withdraw their participation was explained before every intervention.

The researcher gave all necessary information about the use, anonymity, and the confidentiality of their data. The right to withdraw their participation was also explained before every intervention. The study respected the EUI's (European University Institute, 2016) Data Protection Policy and was compliant with the new EU General Data Protection Regulation (GDPR) from May 2018 onwards, which replaced the Data Protection Directive 95/46/EC. The researcher guaranteed and complied with data protection regulations, one's right to privacy, anonymity and confidentiality. The research fulfilled the technical framework and security measures to guarantee that personal data are safe from unforeseen, unintended or malevolent use. All necessary measures concerning access to data, processing, communication and conservation of data were installed. All primary personal data was coded and only then introduced into the thesis, according to examples already mentioned. Only the researcher controlled and managed the operating system with the personal database (authentication & access control). Passwords to access electronic files of the operating system were installed. All relevant documents were password protected. The researcher stored all relevant personal data and relevant research data offline on an external hardware, which was and still is stored in a secured location (in a safe at the researcher`s home). Personal data will not be stored longer than it is required for DBA purposes and will only then be destroyed. Anonymized data will be kept until the implementation of the research outcome, but for a minimum of ten years, according to Worcester University ethical guidelines.

4 Findings and Discussion

4.1 Introduction

The literature review outlined the important requirement to incorporate OI into the innovation activities of the automotive industry. The findings of the literature review demonstrated that the paradigm change from closed to open innovation could effectively support a PSS development in the automotive industry. Attitudes and demands towards electric mobility, connectivity, car sharing and autonomous driving were included in the study, as well the expectations and attitudes with respect to EVs and PHEVs and their associated service profiles. The discussion incorporated elements, which constitute the ideal customer proposition to better comprehend the service-product proposal, such as recharging options, range, price, financing, environmental issues, sustainability, parking in cities, inner city access, toll free driving. The study took also a closer look at additional services, such as connectivity, car-sharing, internet access and mobile apps. As one of the prerequisites, the findings of the first unit of interest were subsequently integrated in the workshop sessions, to successfully analyse customer needs and expectations with regard to future mobility services. The discussed concepts of the “Stage-Gate” process and design thinking were correspondingly included in the first workshop session as basis for a new service innovation framework. The outcome of the first workshop was subsequently incorporated in the second workshop session. The pre-processing and preparation of the study background, the literature review and the case study, were effectively employed to develop a new service innovation process model and to explore the design of a digital PSS in the second workshop. The new SIPM was successfully implemented in the Spanish Mercedes-Benz organisation and the project team developed a digital mobility service solution.

The study will reveal, if the findings matched the expectations and answered the research questions. Likewise, findings and limitations of the study will be discussed at the end of each section. The section 4.2 will present the findings of the interview round with internal and external participants and respond to the first and second research question. The section 4.3 discusses the Daimler innovation strategy with the current innovation process and section 4.4 will introduce the findings of our service innovation process workshop. Both sections will respond to the third research question.

Section 4.5 will reveal the findings of the PSS workshop with internal participants. Section 4.6 will present the implementation phase of the new SIPM. Both sections will respond to the fourth research question. The findings will scrupulously address the four research questions in the in the section 4.7.

4.2 Findings of the interview round

The findings of internal and external interviews were summarised under the umbrella of different themes after being processed in the Thematic Analysis by themes and patterns. Interview rounds collected data from Mercedes-Benz managers and external automotive experts. Interviews with open ended questions were an adequate method to capture meanings and narratives (Saunders, Lewis and Thornhill, 2008; Clarke and Braun, 2017) of automotive experts and incorporate the voice of the customer.

4.2.1 Mobility trends

The first unit of analysis showed an increasingly consolidated mobility trend towards hybrids (PHEV) and full electric cars (EV). Furthermore, legislation in the short to medium term is tending to increasingly benefit these types of vehicle in the EU. On the other hand, the relationship with vehicles is currently changing to new ways of acquiring, using vehicles and the possibilities of connectivity services. Mercedes-Benz launched its first PHEV models in 2014 and has already introduced another eight models in the Spanish market. And new generation of full electric Mercedes-Benz cars (EQ brand) was launched in May 2019. The smart brand is entirely manufacturing 100 % electric cars with its two and four-seater models. The current market showed an increasingly consolidated trend toward PHEVs and EVs. Furthermore, legislation in the short to medium term is tending to increasingly benefit these types of vehicles in the EU. On the other hand, the relationship towards vehicles is currently changing to new ways of acquiring and using cars. **The impact of actual and future possibilities of connectivity and services is also changing client's behaviour and supported the development of a mobility service portfolio.**

Medium-term needs and expectations with regard to mobility in bigger cities have an influence on the procurement decision. Likewise, the important role of legislation and ecological aspect have an important impact on the choice of the technology. **These new mobility trends and technological choices underpinned the importance of external forces of change and their impact on the mobility environment.**

4.2.2 General attitudes towards the future

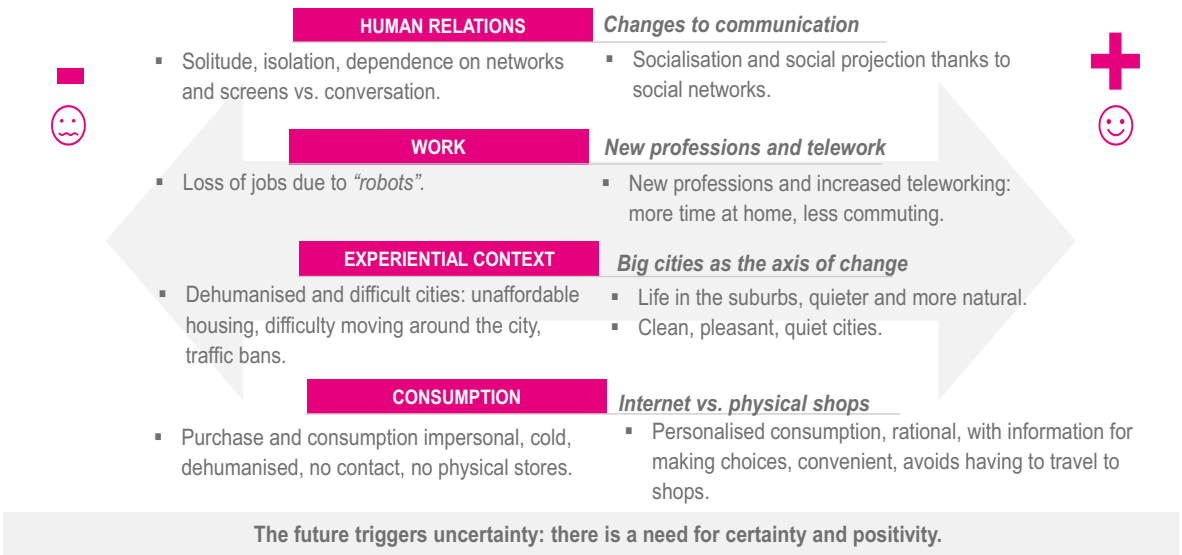
Participants projected major changes in the future, due to new technology trends. The development of technology is seen as the root cause of changes. Participant AE/P6 stated, "We are facing a paradigm shift" and participant PM/P9 said, "*The rate of change is going to be exponential in the coming years*".

These changes affected fundamental aspects of life:

- Human relations and changes in communication.
- Work, new professions and teleworking.
- Experiential context: Changes in cities versus suburbs.
- Consumption: Online versus physical channels.

Consumers have more or less knowledge and interest about technology, but the majority perceived these changes as inevitable and these inevitable changes are experienced with anxiety and polarisation. These inevitable changes in communications, professional approach, living in big city centres and purchase decisions were expressed with a mixture of fear and excitement as shown in the next figure 4.15.

Fig. 4.15. **Inevitable Changes**



The technological development affected all aspects of life, although with different speed. The future was always experienced in a dual way; on the one hand with uncertainty and fear and on the other hand with expectations.

However, these forces of change are being experienced progressively and are not having such a strong impact on some people, depending on their personal circumstances. For more experienced and established participants, these impacts were less important, but these changes led to more uncertainty for younger participants. Changes were accepted or rejected on the basis of personal freedom. Mobility stood out spontaneously in this context of change and participants felt something is going to happen right away. **Heading towards these forces of change in important decisions, such as the place of residence and choice of a vehicle, impacted actual buying decisions of the participants and supported further study to identify customer needs.**

4.2.3 Mobility and product services as a protagonist of the change

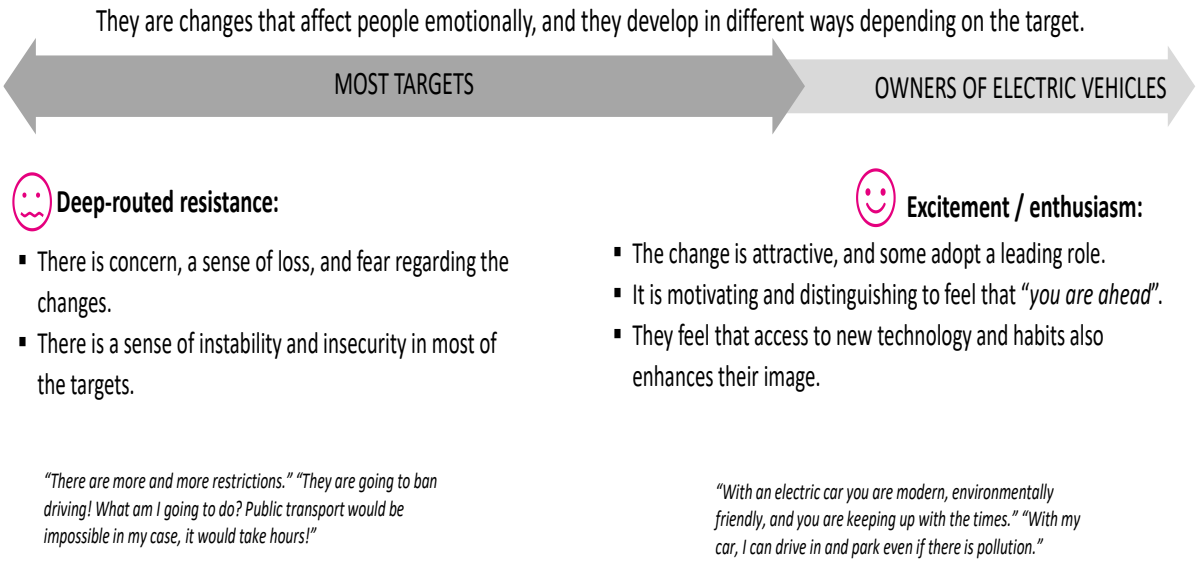
Mobility played a key role in the context of change. The participants shared a common and unified position about the key role for future mobility. In a first step, the major part of the participants agreed on the fact that there will be noticeable changes in mobility in bigger cities. Further legal traffic restrictions, which were already experienced as something tangible, concerned the interviewees. Political and environmental restrictions were already applied, due to events of inner-city pollution, as well as sanctions for certain technologies (diesel and older polluting vehicles). This approach was recognised by a spread of restrictions in major cities around Spain. Hybrids were perceived as a perfect equation for the present day. The participants appreciated electric cars as a green, a new-silent-driving-sensation and less stressful. The perception of the participants was that these changes are going to be noticeable and fast. Participants described their attitudes towards future mobility through the value of technology in terms of safety and quality of life and aspired to improve their quality of life with less commuting and more video conferencing versus travel. In general, they felt like having no choice, but to move forward and follow the technological trends. But one of the basic principles remained unchanged. The participants had still a strong desire for ownership. Interviewees were very sceptical about public transport and didn`t find car sharing very appealing. Participants were aware of car sharing and considered it as a future trend. But they defended ownership for a rational and an emotional reason. First of all, the own car is always available and it is perceived as a private and personal space. Most of the external interviewees, but all internal participants were passionate drivers and preferred individual mobility.

Participants advocated the power and sensation of petrol engines, but little by little they were more open to the new hybrid technology. However, they were more motivated by driving experience than by fuel savings. Most of the internal participants were still very sceptical about electric vehicles. This fact was explained by the missing charging infrastructure, minor autonomy and a higher price in comparison to a conventional vehicle. Nevertheless, participants identified strongly themselves with a premium product and defined differentiation also through services to enhance their quality of life. A major part of the external participants privileged a sustainable approach in mobility and expected a faster progress than today. **The changing utilisation of mobility in combination with political and environmental forces of change created additional support for our study to develop enhanced mobility services.**

4.2.4 Drivers of the change in terms of mobility

The participants were divided by the resistance to change and the enthusiasm towards change. Most internal participants anticipated change as a threat for their jobs, an increasing insecurity and instability. External interviewees reacted with more excitement and enthusiasm to change. This population searched for concrete applications of new mobility solutions and connectivity in their professional domain and were very motivated to apply new technology. Anxiety in the face of mobility changes generates different responses, presented in the next Figure 4.16.

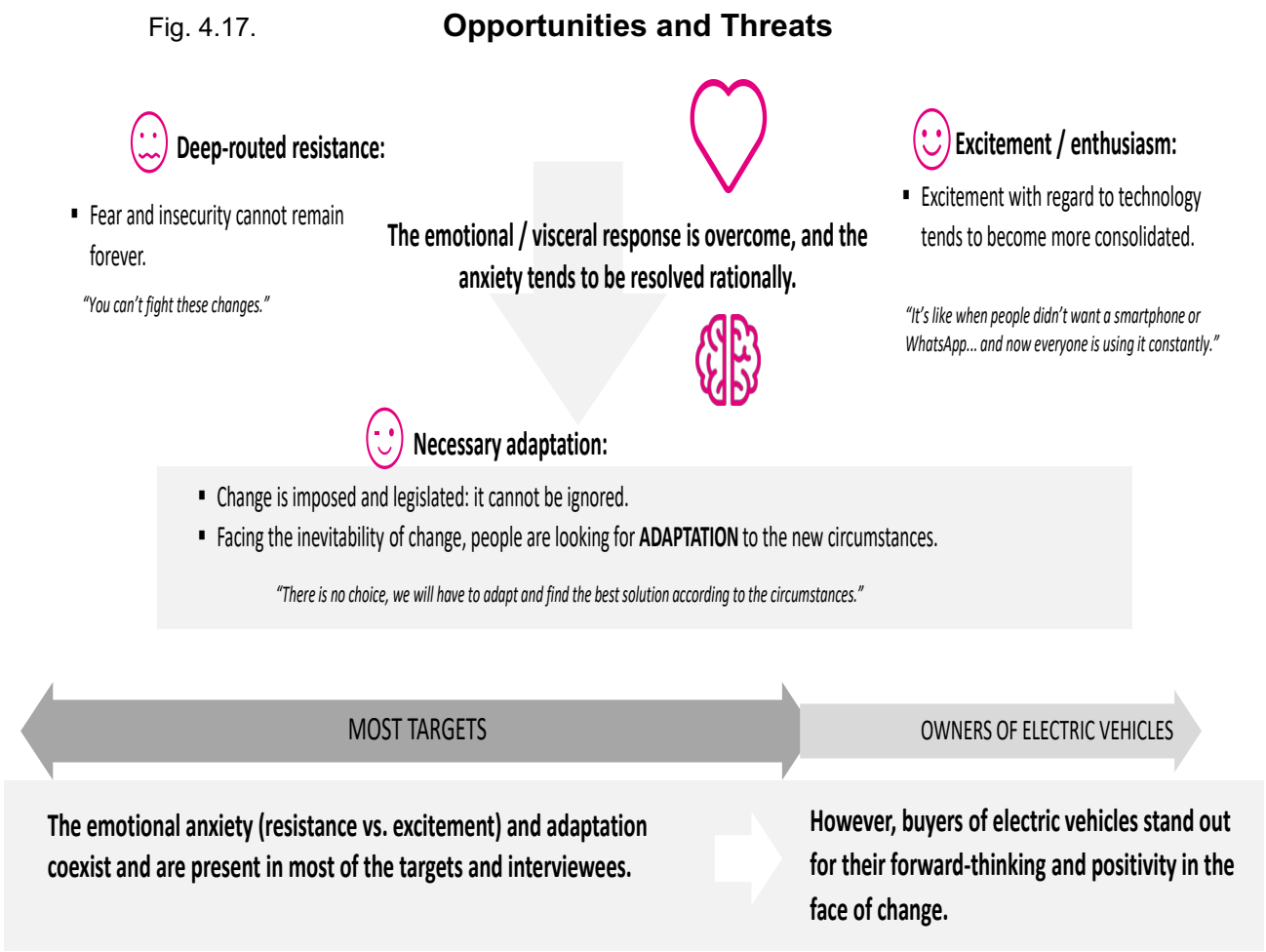
Fig. 4.16. **Duality of Changes**



Participant AE/P4 stated that, "*there are more and more restrictions! What am I going to? Public transport would be impossible in my case, it would take hours*"! Participant PM/P12 said that, "*with an electric car you are modern, environmentally friendly, and you are keeping up with the times. With my electric car, I can drive and park even if there is pollution alert*". The changes were often transformed into a political discussion. Some interviewees spoke with a certain indignation about authorities and their decisions, which increased insecurity, as for example participant AE/P2. "*The authorities deceive us in whichever way they want, according to their interests. They told us diesel was the best, as consumption is lower, so it is less polluting and more long-lasting*.

And now diesel is the devil". As illustrated in in the next figure 4.17., participants were aware of the potential threats, but had to accept the change, due to the fact that political institutions imposed this transformation. Some interviewees affirmed that human beings always adapted to their new environment.

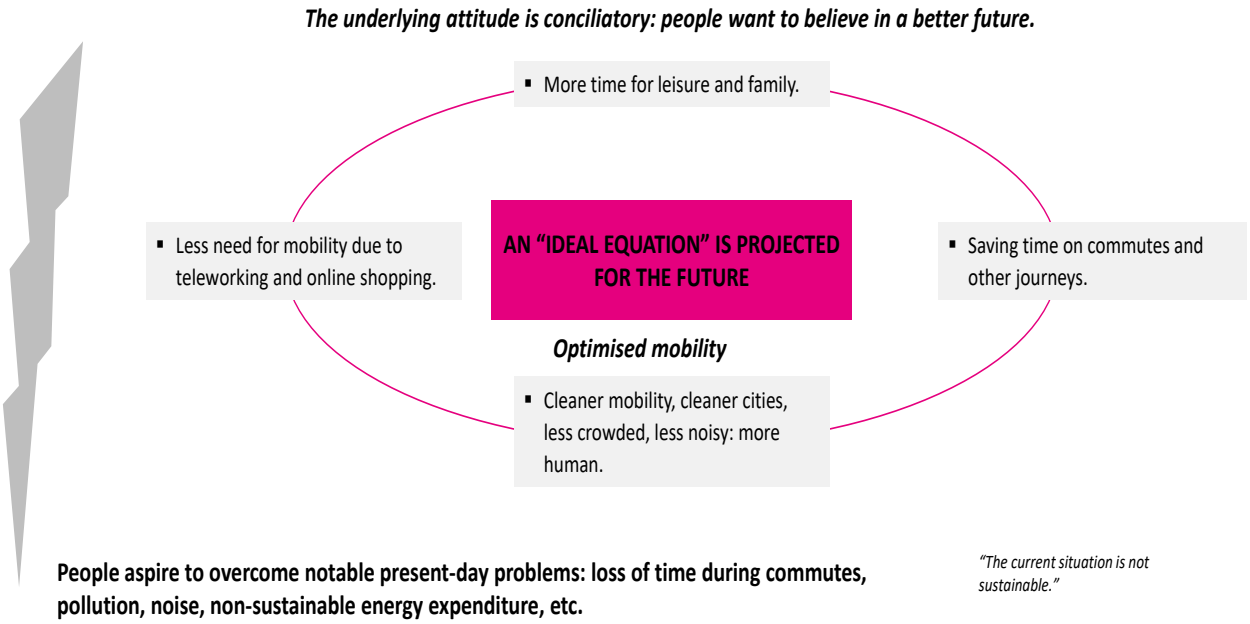
Fig. 4.17.



Participants explained their point of view mostly in a dual approach. They explained their fears, which was expressed in resistance, but also realised opportunities of new technologies. AE/P6 expresses that "*You can`t fight these change and there is no choice, we will have to adapt and find the best solution according the circumstances*". Participant PM/P 15 said that "*It`s like when people didn't want a smartphone or WhatsApp… and now everybody is using one*". Nevertheless, most participants were confident to adapt to the new circumstances. The anxiety in the face of mobility changes is eventually resolved positively. Participants underlined the fact that they will overcome actual problems and believed in a better future.

They admitted positive effects of technology such as more leisure time, homeworking, cleaner mobility and cleaner cities, less stress and more time for family.

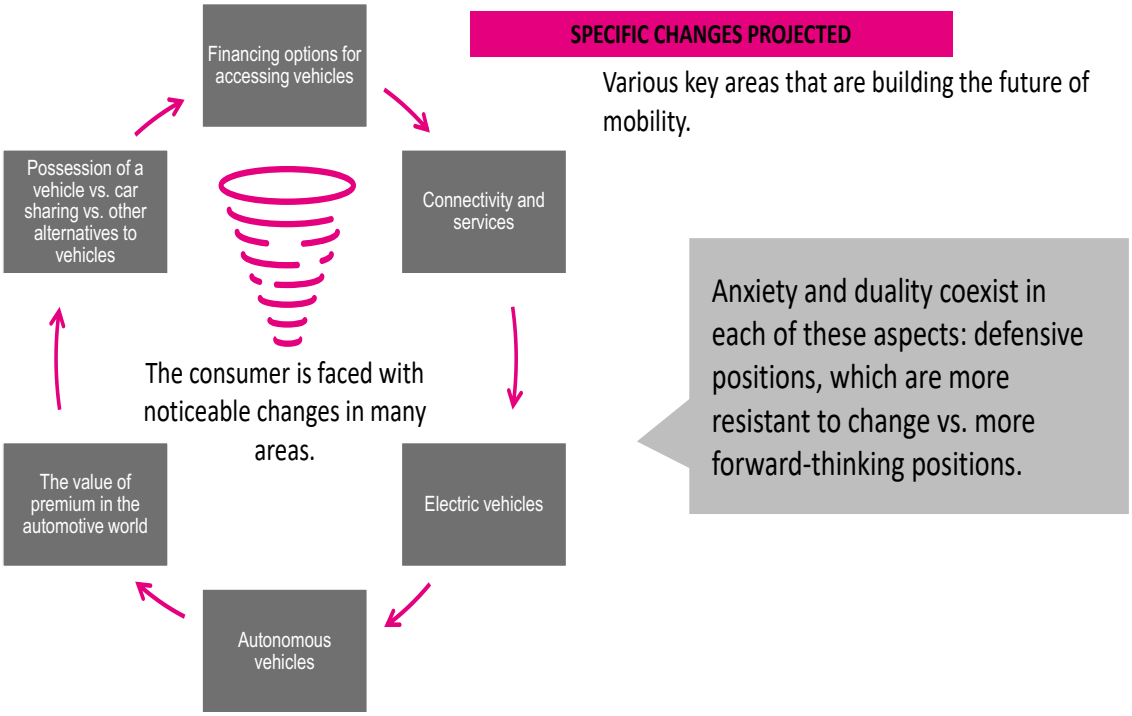
Fig. 4.18. **A better Future**



Participants were also convinced of an optimized mobility in terms of cleaner cities, less noise and a more human approach of technology. Technology is perceived to enhance the quality of life, but on the other hand, participants expressed less need for mobility due to teleworking an online shopping. Participant PM/P10 stated clearly that "*The current situation is not sustainable*". Although several different key aspects converged in this anxiety, this leads to more uncertainty. However, the coexistence of a defensive and a future-oriented thinking created a sense of uncertainty in the interviewed population.

The vision of mobility was linked to new services and connectivity, flexible finance solutions, electric cars, premium product-services and alternative mobility solutions. New technology leads to a new use of mobility, including car-sharing, autonomous vehicles and pay per use, which was useful to further guide our study. Participants were divided in their opinions, due to the fact that some evolutions would have a negative impact on their jobs or personal circumstances.

Fig. 4.19. **The Future of Mobility**



Participants described **forces of change** with the following aspects: Participants were aware of sustainability and proactive in the search for **green solutions**, such as clean energy for the houses (solar panels, etc.) and they made sustainability “activism” a fundamental motivation in their lives. Being “ahead of the wave” of new sustainable solutions was very motivating for them and they experienced a potential future as something that is very close and they felt that progress is going to be faster and faster. Participants also added an ideological component; they had the impression that **political and economic powers are slowing down the actual progress potential**.

Nevertheless, participants were also aware of the potential danger and impacts of technology.

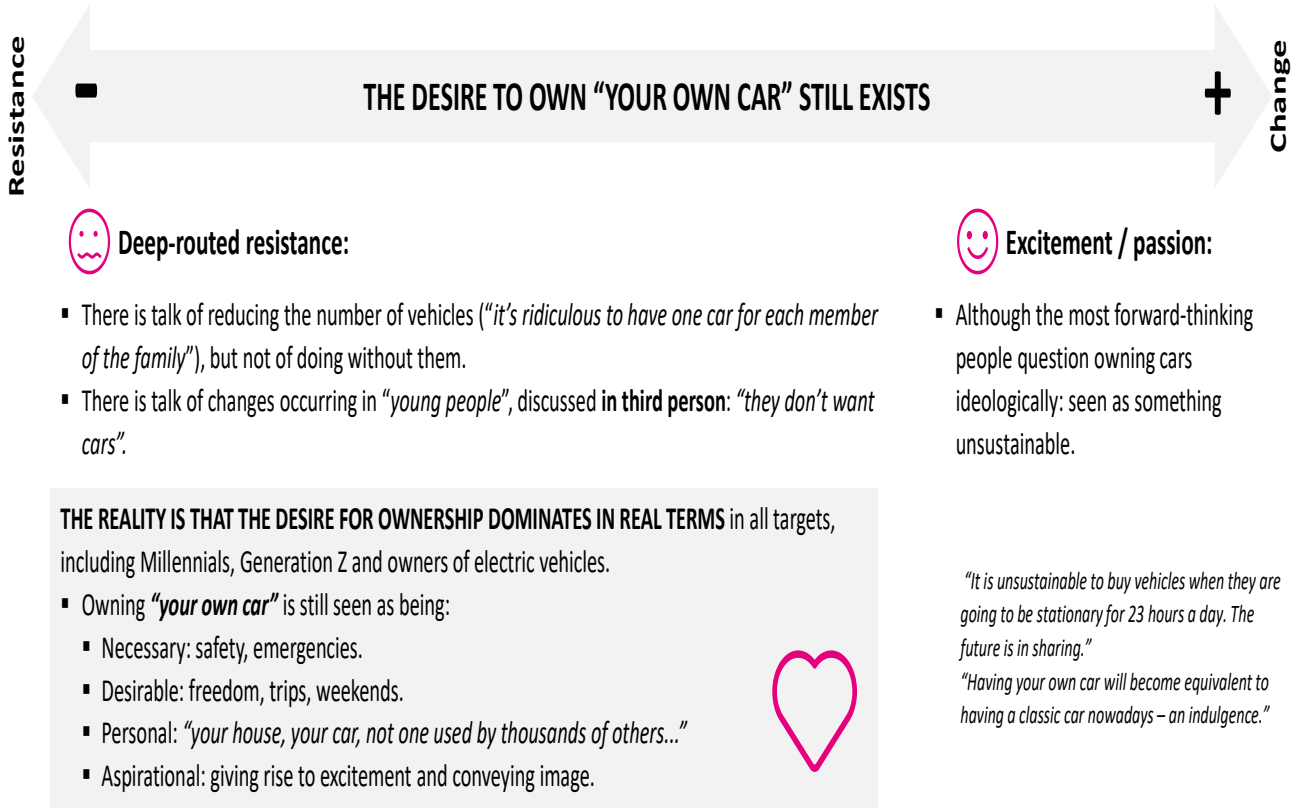
These above-mentioned findings underpinned the importance of the different forces of change and their impact on the automotive industry and specifically for the car manufacturer Mercedes-Benz and influenced strongly further investigation in the following workshops.

4.2.5 PSS needs and key ideas

New options for accessing vehicles complement but will not replace vehicle ownership. Participants with a higher resistance to change still had the desire to own a car for several reasons: Safety, emergency cases, the availability and the personal image played a prominent role for this aspect. Participants expressed their need for freedom and comfort to own a car. Although the forward thinking-oriented participants still want to own a car. They predicted that issue as unsustainable in the future. Participant PM/P1 declared that, „*it is unsustainable to buy vehicles when they are for 23 hours a day and having your own car will become equivalent to having a classic car nowadays – an indulgence".*

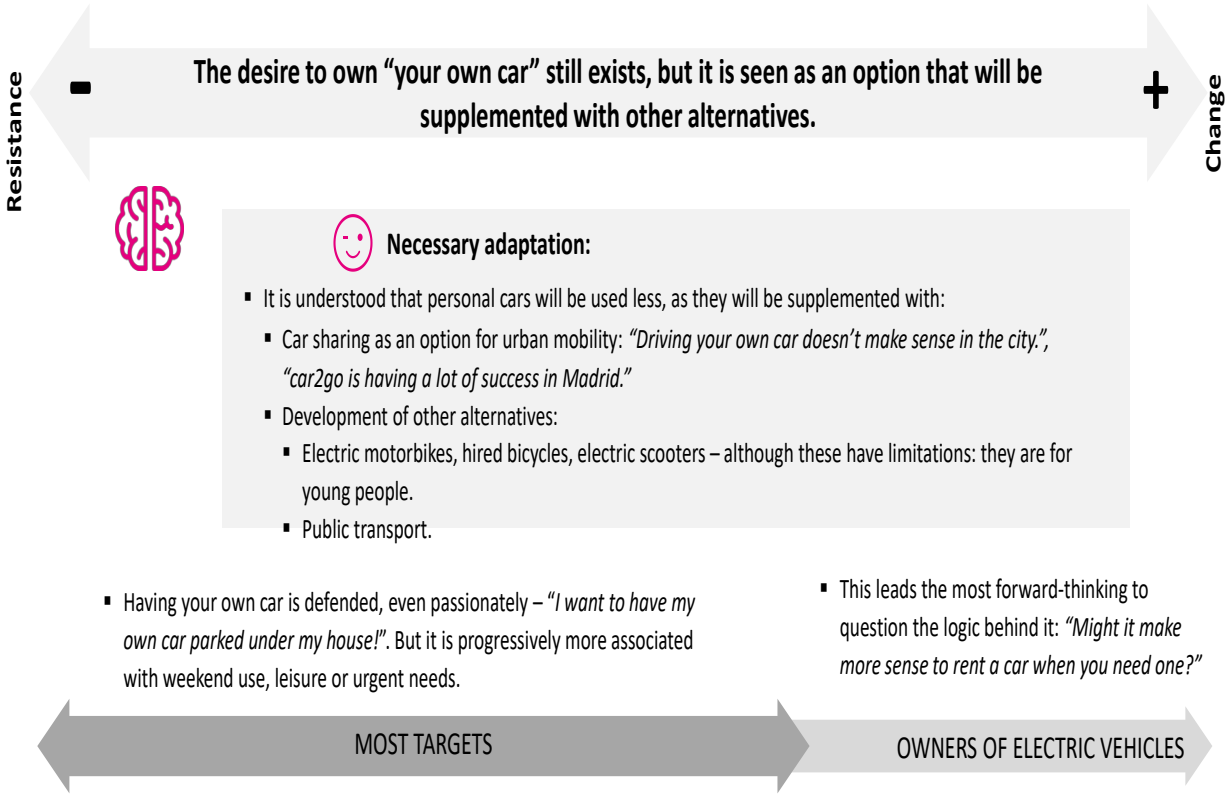
The interpreted the progress of future mobility solutions with a careful use of resources and ideological aspects, as shown in the figure 4.20.

Fig. 4.20. **Owning your Car**



The **range of mobility services** becomes more complex. Most interviewees still desired to own a car, but were aware of the accessibility of alternative mobility solutions. Car-sharing, electric scooters, e-bikes and public transport in combination with car rental will solve mobility issues in the future. Forward-thinking participants were questioning the ownership of a car, due to the fact to use other mobility alternatives. Most of the internal participants expressed the need to combine ownership with adapted mobility solutions.

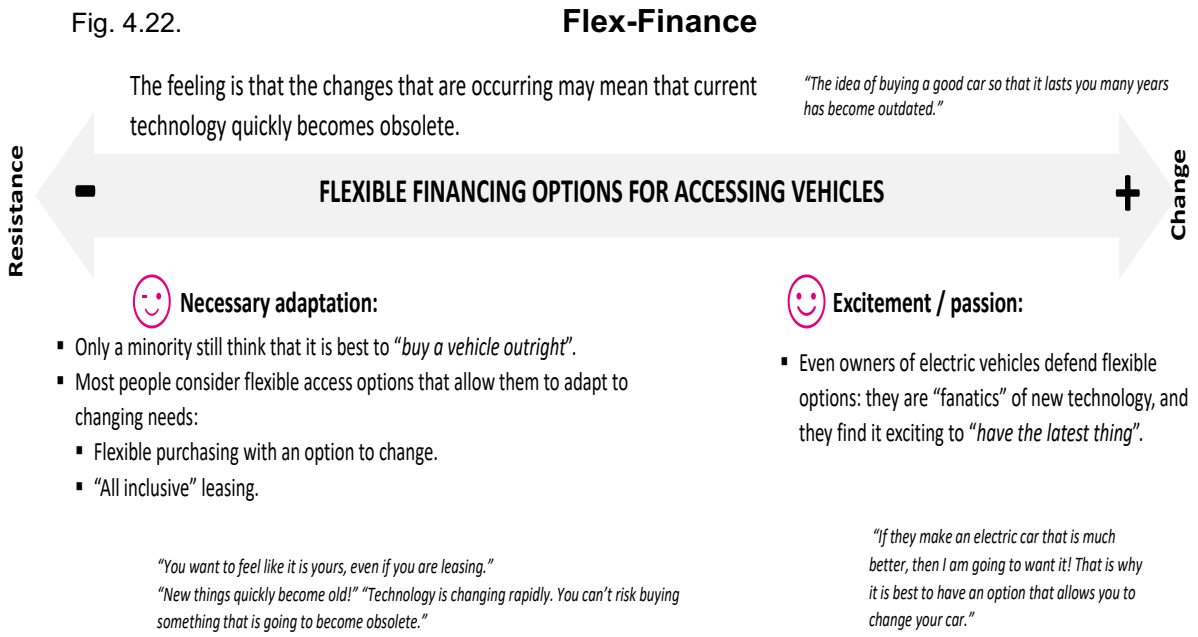
Fig. 4.21. **Using Mobility**



Participant AE/P1 defended his position in using mobility, "*I want to have my own car parked under my house*" and participant PM/P9 declared that, "*it might make more sense to rent a car when you need one, driving your car doesn't make sense in the city, Car2Go is having a lot of success in Madrid*". The use of mobility is constantly changing, and owners of electric cars expressed a more future-oriented vision of mobility. The rapid development of technology favoured the emergence of new **financing options**. All-inclusive leasing with flexible financial offers, to switch the car whenever necessary was one of the immediate requirements.

Participants also demanded the possibility to change the vehicle when new technology is available as presented in the next figure 4.22.

Fig. 4.22.



Participant PM/P14 expressed his vision of flexibility, "*you want to feel like it is yours, even if you are leasing. New thinks quickly become old and technology is changing rapidly. You can`t risk buying something that is going to become obsolete*". Even owners of electric cars saw the advantages of flexibility. Participant PM/P10 said that "*if they make an electric car that is much better, then I`m going to want it. That is why it is best to have an option that allows you to change your car*". Flexibility was interpreted to fallow the current technological evolution and changing the vehicle whenever desired. **Via the expressed ideas of participants, the researcher identified seven needs and ideas for a future PSS development.** During the interviews, participants developed several ideas for valuable services. These ideas were expressed several times and defined valuable needs in the current mobility environment. The interviewees mentioned following seven needs and expectations:

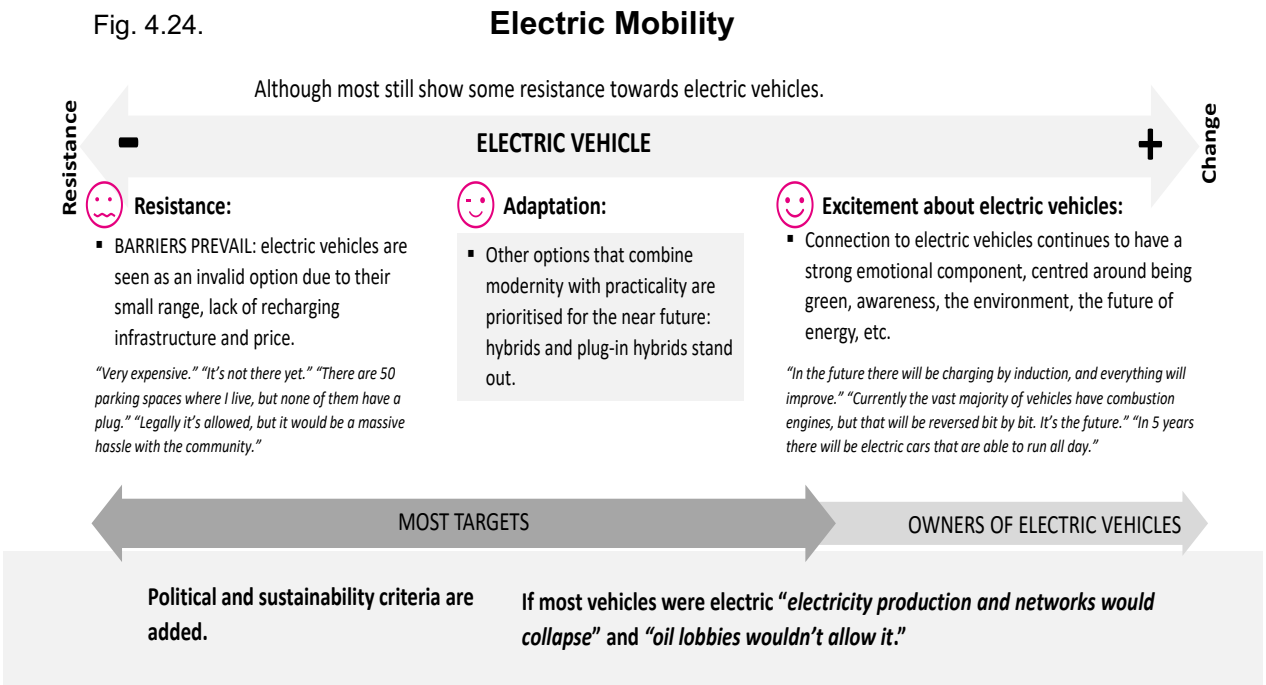
- Switching the car whenever needed or desired
- Parking is a pain in the bigger cities
- Polluting cars are not welcome in city centres
- How to change my combustion engine to an EQ car when needed
- Charging solutions for electric cars (where? When? How much?)
- Do I get a special pricing offer as Mercedes customer for charging an EV?
- Internal corporate car sharing services for employees (smart EV)

Most of the participants suggested these valuable needs and ideas during the interviews. Moreover, external participants (procurement managers) were demanding a special corporate rental service for smart EQ. The interviewees claimed to offer this service as additional value to their employees. Participants expressed these needs in a very convincing way as additional value, connected to a Mercedes-Benz. The researcher integrated these ideas in the later workshops to transform needs into services. **Connected cars** were attractive in the short term and participants privileged a **multi-connected car**. All participants identified advantages of connectivity and the interaction between driver, car and external networks. The interviewees claimed three main areas for connectivity. The practical aspects, which enhances the quality of life, safety aspects to distress while driving and interaction with work, home and other external networks as illustrated in the following figure 4.23. Participant AE/P7 explained that "*nowadays, any mobile phone can do anything*" and Participant AE/P2 said that "*connected vehicles will soon be considered a basic essential for any car with voice control; the car talks to you*". Participants perceived connectivity as additional value and comfort to increase quality of life.

Fig. 4.23. **Alternative Solutions**

Clean vehicles were conceived as an unavoidable, future development. Most of the external participants were enthusiastic about "clean vehicles" and stipulated the environmental positive impact and other future green energies. Another joint approach consisted in the awareness of the practicality and user-friendliness of hybrids and plug-in hybrids as early adapters of this technology, as presented in the next figure 4.25. Few of the internal managers showed still resistance towards electric cars, due to the small range, lack of recharging infrastructure and the actual higher prices, as for example participant AE/P1, who declared that "*Very expensive, it`s not there yet and electricity production and networks would collapse, and oil lobbies will not allow it*". Participants AE/P7 argued "There are 50 parking spaces where I live, but none of them have a plug (recharge structure). One the other hand participant PM/P12 stated that "*In the future there will be charging by induction and everything will improve. Currently the vast majority of vehicles have combustion engines, but that will be reversed bit by bit. In five years there will be electric cars that are able to run all day*."

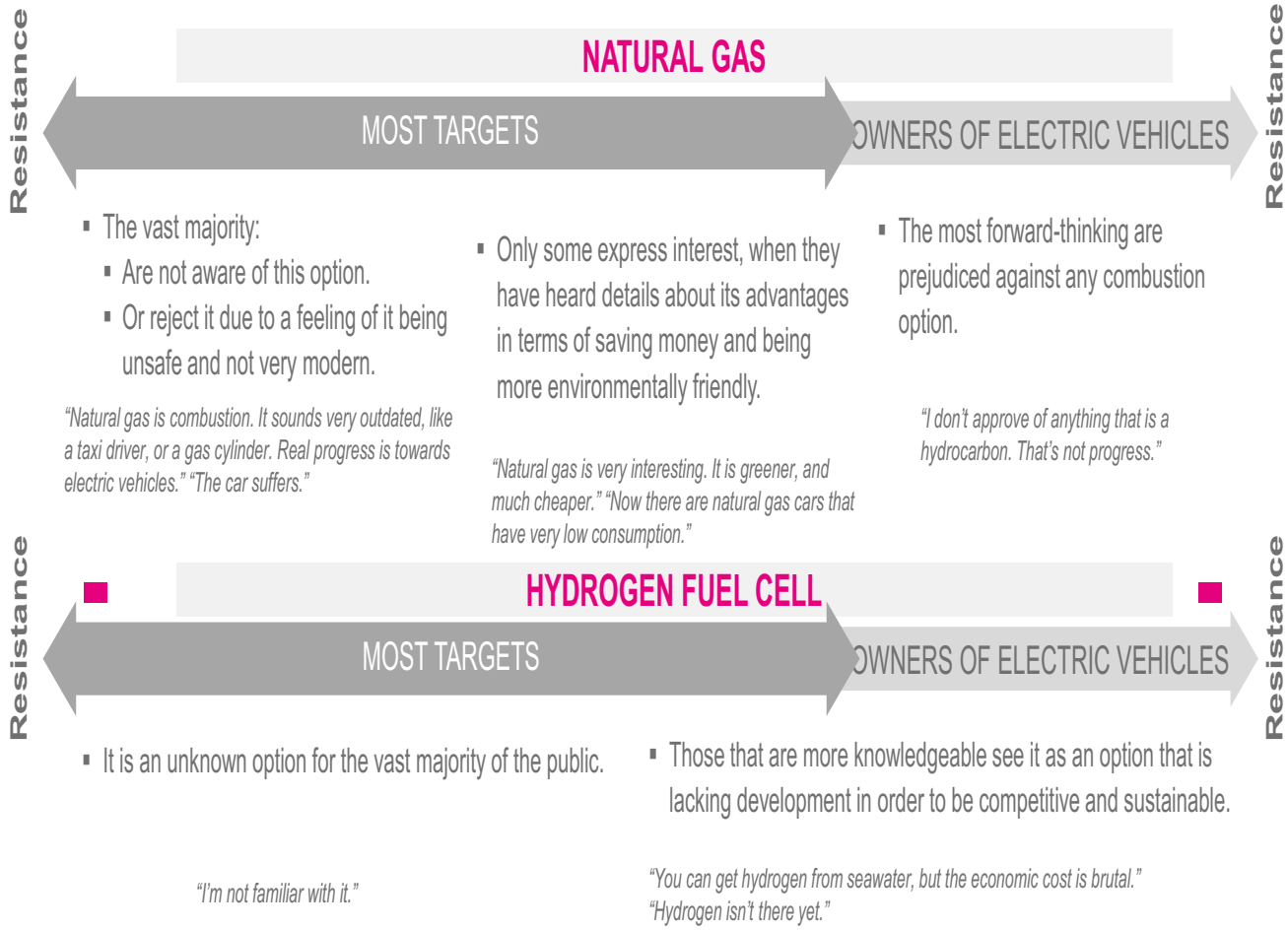
Fig. 4.24.



Environmental awareness, limited resources were having an important impact on participants to choose a green technology. Participants with a stronger resistance expressed the liming factors of the green technology. Nevertheless, the combination of modern technologies, such as plug-in hybrids and practicality was suggested by most participants.

However, the path towards **zero emissions** becomes more established and dominates the future. A minor part of the internal participants discussed two other technologies, natural gas and hydrogen fuel cell as potential alternatives to battery electric vehicles. Most of the external participants were not aware of these green technologies, as for example participant PM/P8, who said that "*I´m not familiar with it*". Mercedes-Benz experts knew this technology and also see a potential future instead of electric or simultaneously. Participant PM/P11 declared that "*you can get hydrogen from seawater, but the economic cost is brutal. Hydrogen isn`t there yet*."

Fig. 4.25. **Alternative Solutions**

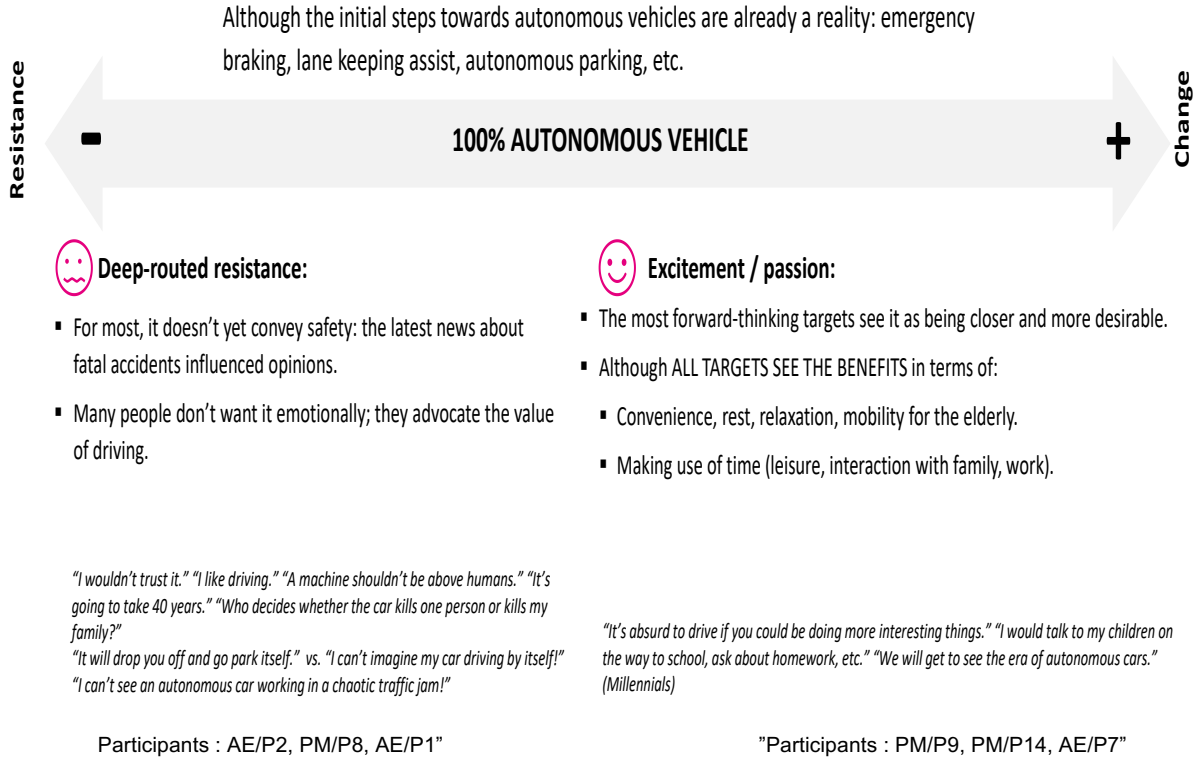


PM/P8 answered that "*Natural gas is combustion. It sounds very outdated, like a taxi driver, or gas cylinder. Real progress is towards electric vehicles. The car suffers*". A more balanced response was given by AE/P1 "*Natural gas is very interesting. It is greener and much cheaper. Now there are natural gas cars that have very low consumption*".

Interestingly, the external participant PM/P13 expressed a clear statement "*I don't approve of anything that is a hydrocarbon. That's not progress*". A full autonomous vehicle is expected in a distant future. Autonomous driving is seen as the most adapted mobility service in the future, due to convenience, relaxation and the use of time (internet access, working, free time organization and full connectivity). The fully connected car will only be available with various service offers, when the autonomous vehicles becomes reality. Nevertheless, a majority claimed the lack of safety and others still prefer to actively drive their vehicle, as shown in the following figure 4.26., including the voice of six participants.

Fig. 4.26. **Autonomous Vehicles**

4.2.5.1.1.1



The voice of the participants were divided in terms of safety aspects, such as "*I wouldn`t trust it" and "a machine shouldn`t be above humans*". The other part of participants expressed the advantages of this technology in a more progressive manner; for example, "*It is absurd to drive if you could be doing more interesting things" and "we will get to see the era of autonomous cars*".

Similarly, the entire range of resistance and enthusiasm was expressed in participants` opinion. Autonomous driving still is an unknown technology and the participants never experienced it so far.

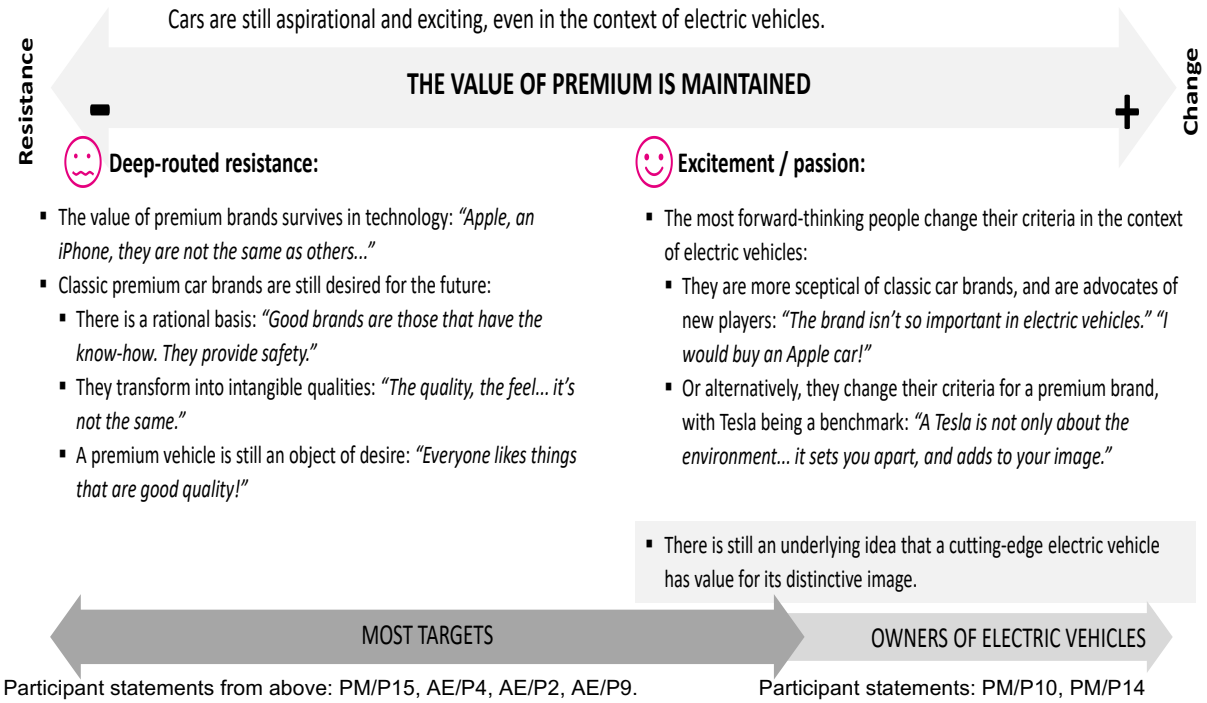
To sum up, the above-mentioned findings clarified the internal, external perspectives and provided useful mobility needs and connected services to better satisfy future customer needs.

4.2.6 The ecosystem and the value of premium

Participants still wanted to preserve the value of premium.

The questions about the ecosystem divided the opinion of internal and external participants. Internal interviewees still believed in the power of the traditional car brands. These brands will be able to transform their qualities into valuable services and maintain the status of desire. The outside-inside perspective indicated another approach towards new technology corporation, which they perceived already in a leading position of services and a strong brand management as trend-setters as illustrated in Fig. 4.27.

Fig. 4.27. **The Value of Premium**



Participant statements from above: PM/P15, AE/P4, AE/P2, AE/P9.

Participant statements: PM/P10, PM/P14

In general, participants still attributed a strong brand image to Mercedes-Benz, but expected new technologies, such as hybrids and more connectivity in the model range. Mercedes demonstrated a leap in design for younger customers.
Interviewees perceived Mercedes models very aspirational, due to the dynamic styling but expect more technology-oriented innovation. In general terms, they were anxious about mobility issues in city centres. Participants tended to advocate electric smart cars as a potential solution for inner city mobility. External participants advocated the cutting-edge technology of electric vehicles as a distinctive brand image.

- **They represent a leap in open attitudes toward technology and dynamic styles within MB.**
- **But they have a high level of excitement / passion for cars in general and MB in particular.**
- **They expect superior technological development from MB.**

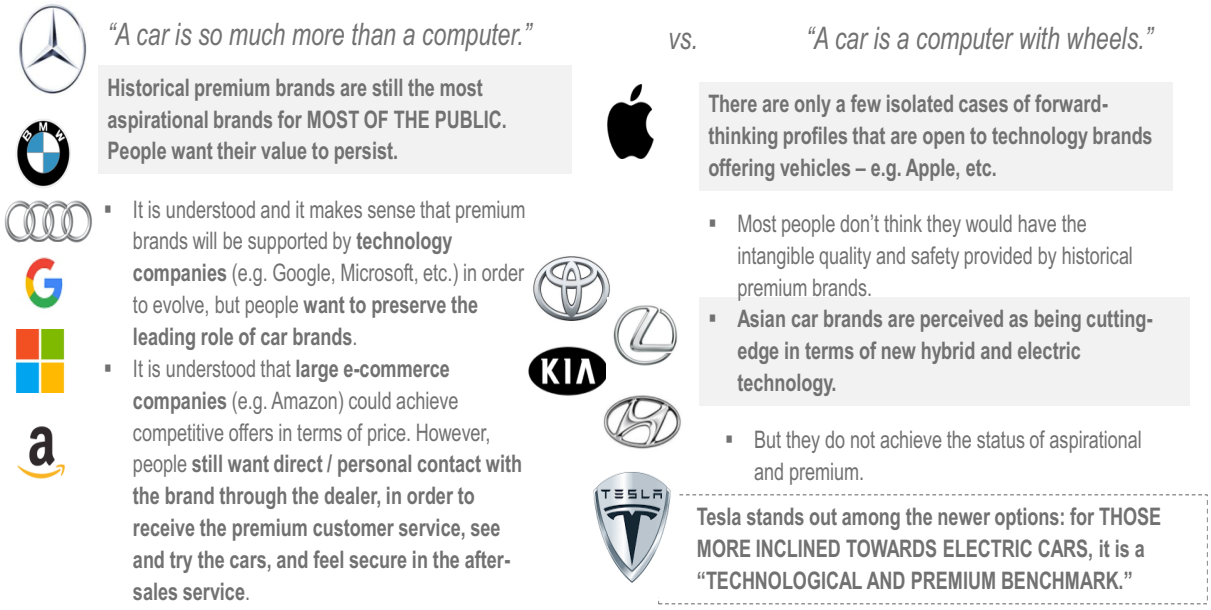
The smart was perceived as a young, unisex, cool, modern and urban brand and the relationship with Mercedes-Benz consisted in an additional value. The congruence of smart in the electric environment was recognized, but there exists some other barriers towards the brand as too small and a more versatile car was preferred. Participants had doubts about the electric range and the higher price of the electric smart.

They see smart's imminent move towards becoming exclusively electric as a problem and a loss: the range is considered insufficient, and they understand that it will lead to a repositioning towards an exorbitant price that would alienate them from the brand.

New players in the automotive environment emerged as a result of the paradigm shift. Technological progress involved changes, but the value of classic car brands is still resistant to change. A major part of the participants claimed that traditional brands should cooperate with new technology corporations in order to preserve their leading role. External participants claimed also the personal and direct customer contact with dealers in order to receive a premium service. The Tesla brand is perceived as a premium benchmark for electric cars and services. However, Tesla did not offer enough security yet, due to recent accidents with the automated driving assistance. Some external interviewees mentioned the fact that a car is a mobile device on wheels.

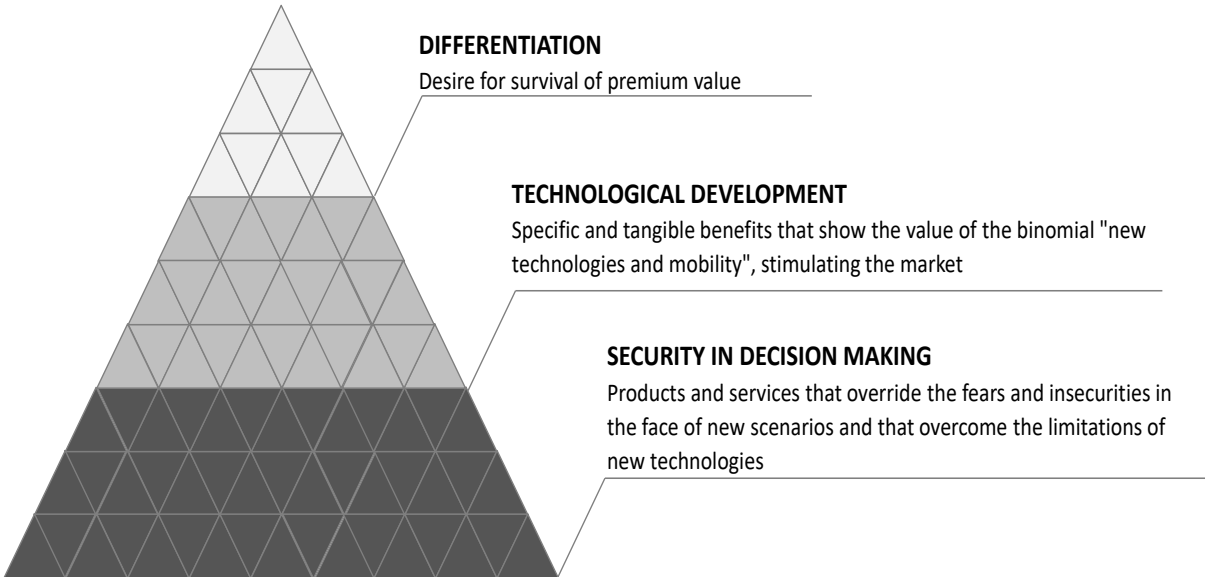
The interesting point of the statements was the fact that technology corporations (Google, Apple, Amazon and Microsoft) were perceived as automotive competitors. The roles of the participants were more or less divided in interpreting the paradigm shift from participant AE/P4 "*A car is so much more than a computer*", to participant PM/P14"*A car is a computer on wheels*".

Fig. 4.28. **The Paradigm Shift**



Interviewees argued moreover, that products and services had to overcome fears and insecurities while introducing new technologies. Participants claimed for valuable coherence of technology and mobility, which created market opportunities. A premium service was still desired and made the important difference between brands. The **Mercedes-Benz ecosystem of services** is built in response to customer needs. Differentiation through premium value, technological development with tangible customer value and security through high quality products built progressively three fundamental levels as shown in the following figure 4.29. Participants demanded security and stability to take decision. A convincing product and service range supported this process. Technological progress was perceived as a tangible benefit for the user and premium value through differentiation was still appreciated. **A holistic approach to create customer value through these three factors allowed the creation of an improved Mercedes-Benz ecosystem.**

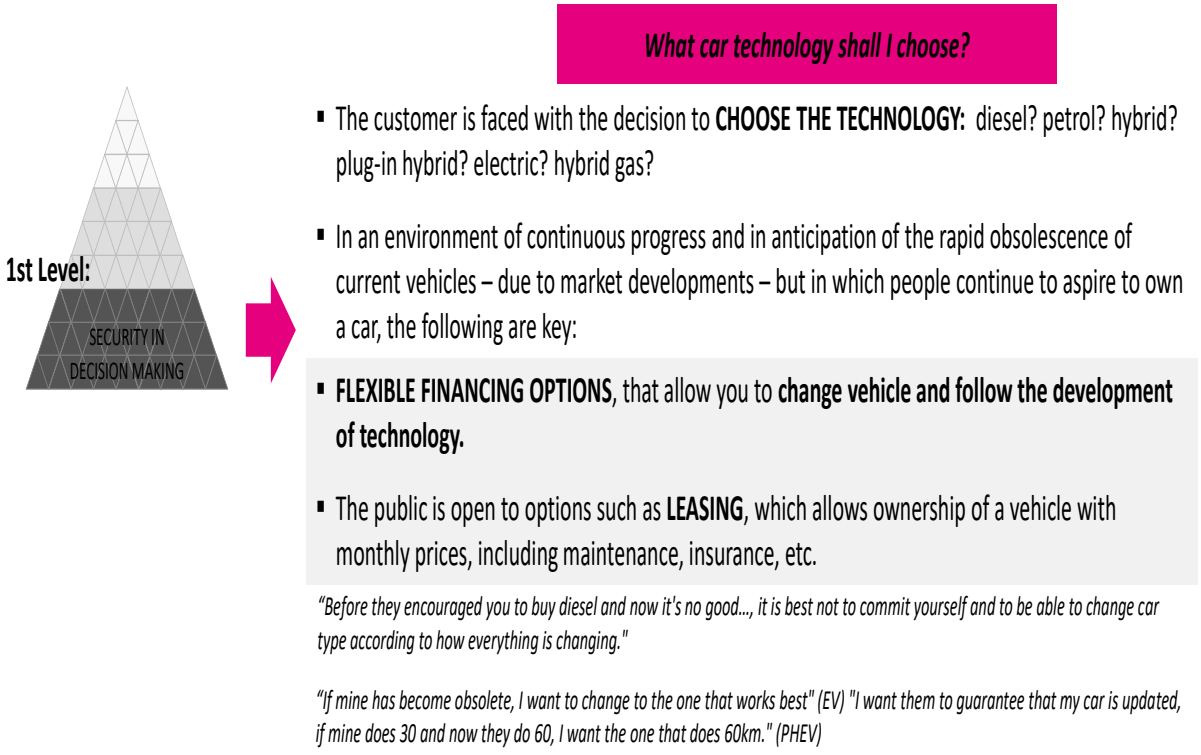
Fig. 4.29. **The new MB Ecosystem**



Participants explained their future way of choosing a vehicle. The choice of technology with flexible financial offers to switch a car when necessary and desired. However, the technological choice was presented as difficult, due to the actual uncertainty and the political discussion. The interviewees argued that they were looking for a secure and flexible mode of buying the right vehicle with adapted services to follow technological progress. Flexible financial offers with all including monthly rates were key for a secure busing decision, as shown in the next figure 4.30.

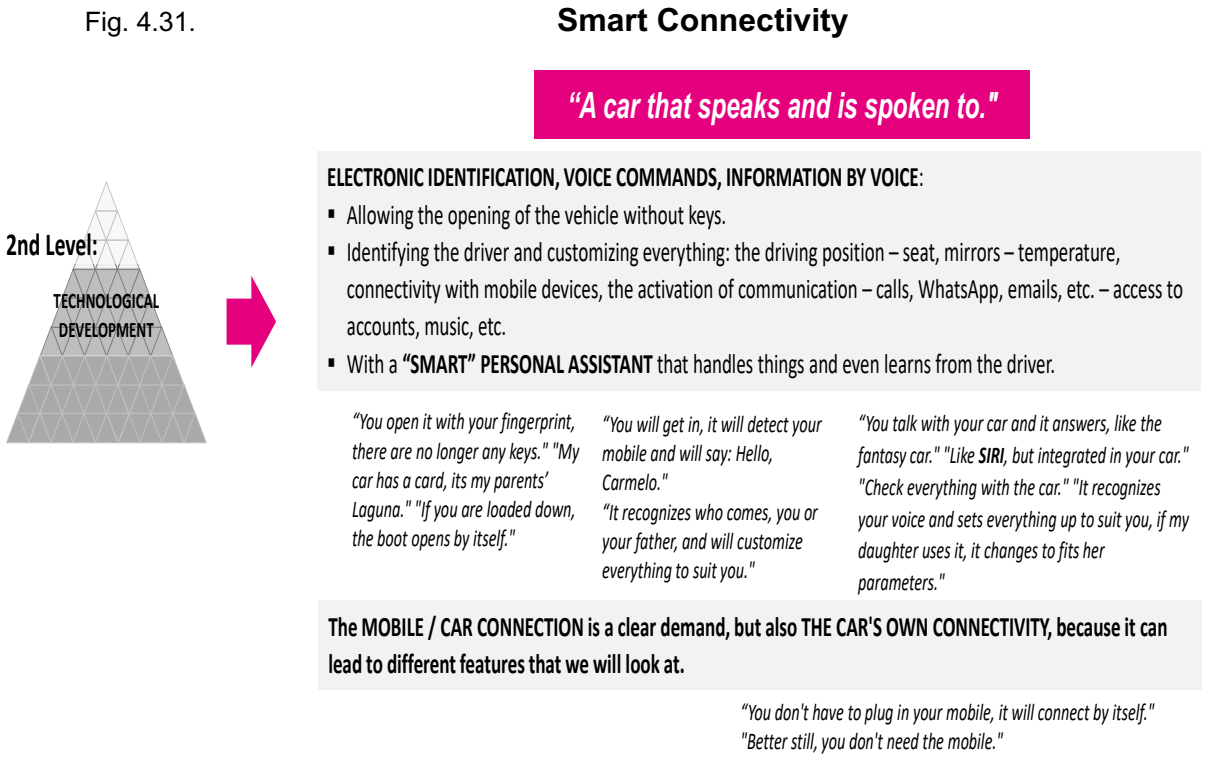
Fig. 4.30.

The Technological Choice



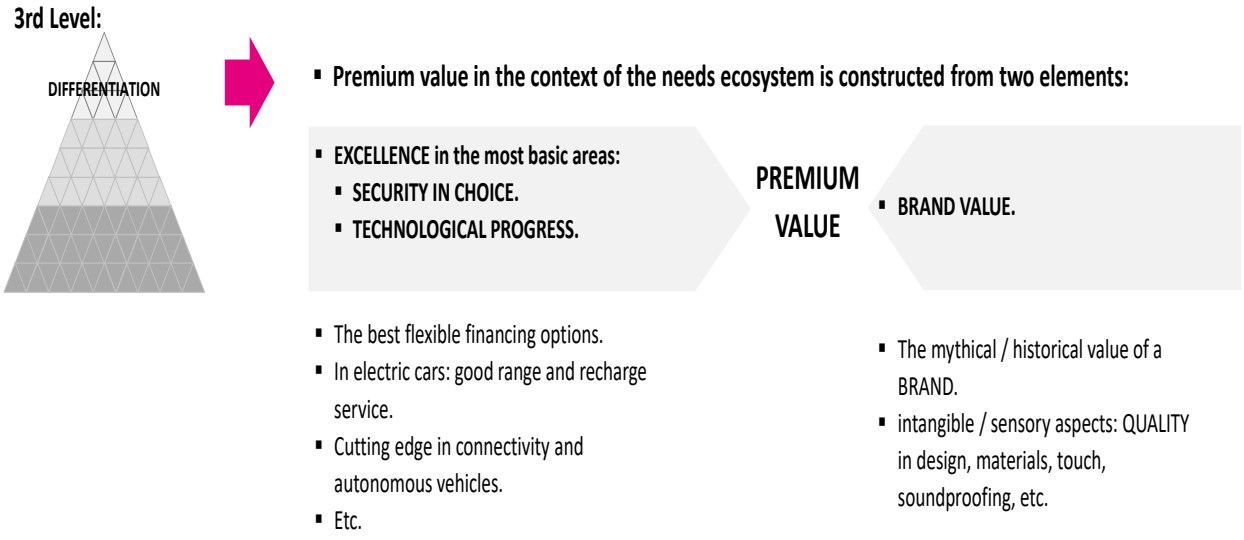
Participant PM/P8 was directly introducing flexible solutions, "*Before they encouraged you to buy diesel and now it`s no good…, it is best not to commit yourself and to be able to change car type according to how everything is changing*" and participant PM/P 11 stated that "*if mine has become obsolete, I want to change the one that works best and I want them to guarantee that my car is updated, if mine does 30 and now they do 60, I want the one that does 60*" (km of autonomy). The second level expressed technological expectations from a vehicle with a "state of the art" connectivity and personal assistance. Technological progress needed specific, useful and tangible benefits. The value of technology converted progress in values of comfort and utility, related to the "SMART CONNECTED CAR" as illustrated in the following figure 4.31.

Fig. 4.31.



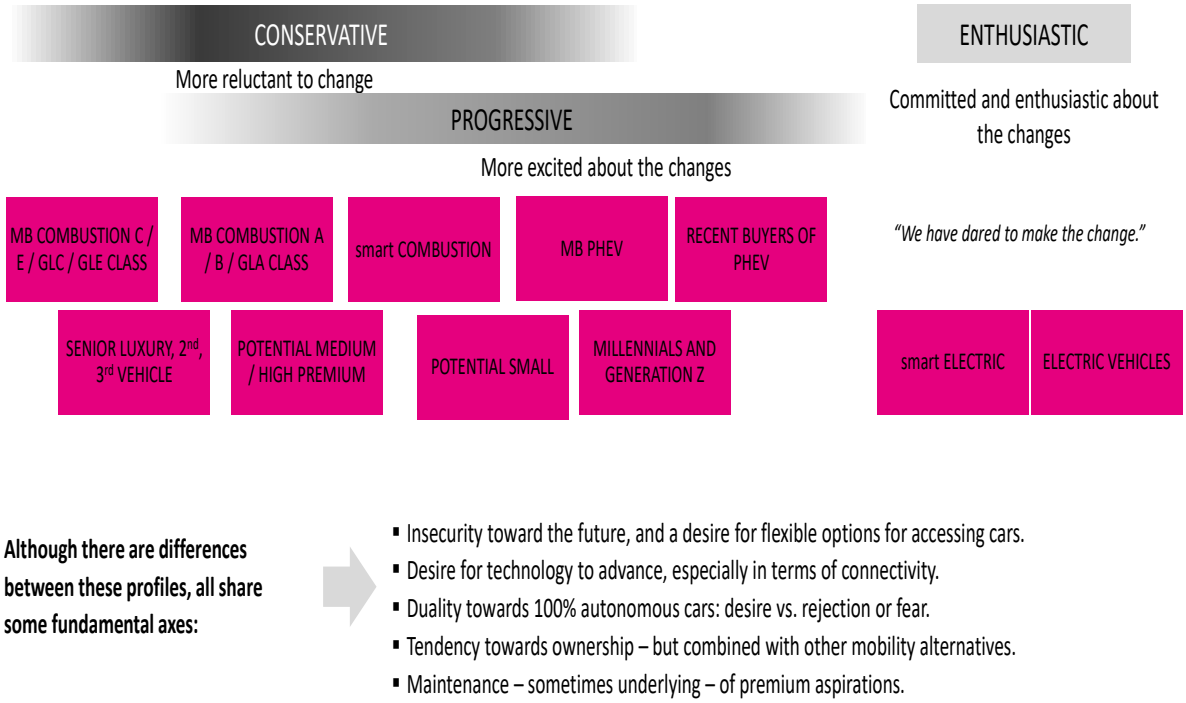
Participants expressed the desire of a fully connected vehicle, compatible with the mobile phone or even replacing it. Participant AE/3 stated that "*You don`t have to plug in your mobile, it will connect by itself. Better still, you don`t need the mobile anymore*." The third layer consisted of the persisting desire for product and service differentiation. As a result of the service and product differentiation, the participants suggested the creation of a premium ecosystem for Mercedes-Benz. The desire to own a vehicle along with other options for access to mobility still persisted in the approach of most of the participants. In an increasingly complex, technological scenario, where the importance of services played a prominent role, the premium approach still maintained its value and makes the difference. Differentiation was similarly constructed through services.Excellent services (flexible finance, long range and recharge service, cutting edge in connectivity and autonomous driving) reinforced the sense of exclusivity and of *"ALWAYS HAVING THE BEST"* as expressed of some participants. These services combined with the Mercedes-Benz product created the brand value, including quality of the product, great design and high-end materials.

Fig. 4.32. **A Premium Ecosystem**



The interviews outlined distinctions between **two divided Perspectives**. The findings discovered additionally important distinctions between the outside-inside perspective of external mangers and the inside-outside perspective of Mercedes-Benz managers, regarding changes in mobility, connectivity and services.

Fig. 4.33. **Distinctions about Changes**



Although there are differences between these profiles, all share some fundamental axes:

- Insecurity toward the future, and a desire for flexible options for accessing cars.
- Desire for technology to advance, especially in terms of connectivity.
- Duality towards 100% autonomous cars: desire vs. rejection or fear.
- Tendency towards ownership – but combined with other mobility alternatives.
- Maintenance – sometimes underlying – of premium aspirations.

External managers valued technology, as it provided safety and quality of life; they aspired to improve their quality of life with less commuting and more video conferencing versus travel. External managers still had classical anchors, but were more connected and open for new trends. In general, external managers moved forward and followed actual and future trends in a proactive way. Internal managers still had traditional attitudes as the desire for ownership, the passion for driving and recreational use of the car. They were also open to other options in future times to more practical aspects, as the evolution of electric vehicles, car sharing and other new mobility solutions. Internal managers were very sceptical about public transport and didn`t liked car sharing. Internal participants advocated the power and sensation of petrol engines, but little by little, they are more open to the new hybrid and electric technology. However, internal managers are more motivated by experiences than fuel savings and identified themselves strongly with a premium product and premium service differentiation.

4.2.7 Discussion of the interview rounds

New trends in customer behaviour are setting the path for new mobility solution. These inevitable changes are experienced with anxiety and polarisation and a mixture of fear and excitement. In general, these important changes in technology are recognised as potential threats. External interviewees reacted with more excitement and enthusiasm to these changes. Technology is perceived to enhance customers` quality of life. On the other hand, internal managers indicated more resistance and fear to these important changes in mobility. However, the coexistence of a defensive and a future-oriented thinking creates a sense of uncertainty in the interviewed population. The future of mobility is linked to new services and connectivity, flexible finance solutions, electric cars, premium product-services and alternative, cleaner mobility solutions in the Mercedes ecosystem. The following section will lively discuss, state, support, explain and defend the research findings of the first case unit. In general terms, premium services and new mobility solutions created an alternative, more progressive mind-set. Moreover, these findings underpinned the “Fuzzy Front End” innovation approach (Khurana and Rosenthal, 1998) and the necessity for further investigation to adequately identify customer needs for successful service innovation. The study also identifies advantages of multi-connectivity and the interaction between driver, car and external networks.

The additional value of technology converts progress in comfort and utility. The actual focus of the industry is still on hardware optimisation and the current “Diesel-gate” debate essentially supports technical powertrain solutions. The unit findings refer to service innovation and integrated mobility solutions. The research outlines the voice of the customer with detailed service ideas and additional customer value. Likewise, the findings are coherent with the actual body of literature and complete the understanding of mobility solutions, trends and connected services. The study expressed the findings of internal and external managers and customers. Williams (2006) expects the replacement of internal combustion engines with a hybrid powertrain technology. Our study confirmed these changes in powertrain technology towards hybrids and fully electric vehicles. The study was limited to the current mobility environment and only few comments concerned future technology. Participants simply developed actual technology to a future mobility deployment. Tesla Motors is already one step ahead (Mahut *et al.*, 2017), as one of the most advanced actors in the automotive sector. Due to the fact, that they already sell supplementary services through a modular platform on which the provider can add additional services connected to the fully electric vehicle. Tesla already created its own ecosystem, which links the hardware to their services. The study confirmed Tesla`s path towards connected services. Nevertheless, the study investigated further, concrete service needs. These findings also demonstrated the significance of an open source approach to gather the voice of the customer and valuable customer needs. Participants identified seven main mobility needs in the current mobility environment. The study will use these seven identified needs to further develop them in the subsequent workshops. Manzini and Vezzoli (2003) perceive a shift in the business focus from selling physical products towards a system of product and services, which are jointly capable of fulfilling specific client demands, while creating sustainable trends in consumption practices. This approach goes hand in hand with the findings of the study and the quest for sustainable solutions. With regard to sustainable trends, Tukker (2004) expects product-oriented, user-oriented and result-oriented categories. The main focus of the study lays on product- and result-oriented service solutions. Use-oriented services were more unfamiliar to the participants. Another result-oriented services is given by Tan *et al.* (2010) with the example of Rolls Royce aircraft and the two service contracts of TotalCare ® and CorporateCare ®.

This example demonstrated the new approach of pay per use in a mobility environment, which was confirmed in our study through the identified result-oriented needs of “switching the car whenever needed or desired”, “How to change my combustion engine to an EQ car when needed”, “Charging solutions for electric cars and do I get a special pricing offer as Mercedes customer for charging an EV”. The statements of the literature review and the study findings demonstrate the coherence of a similar development in terms of technology and service trends and underpin the outcome of the first unit. Another intention of Unit I is the creation of service ideas and concepts for Mercedes-Benz via the method of open innovation in the Mercedes-Benz ecosystem. The study discovers several customer needs by using internal and external sources. These needs will also be integrated in the later discussion of PSS exploration. Meanwhile, the reason for the investigation of future mobility trends is also given by Mahut *et al.* (2017). In the case of the automotive industry, the product side of the industry is mature, whereas service side is currently increasing and therefore the study took the opportunity to further investigate the subject as the basis for the exploration of a PSS and the development of a new framework. To summarize the interviews of unit I, it is important to work on the distinguishing features between internal and external participants and their different perspectives during the interviews. The important differences between internal and external participants were unexpected in their significance. These inevitable changes are experienced with anxiety and polarisation and a mixture of fear and excitement. In general, these important changes in technology are realized as potential threats for internal participants. External interviewees reacted with more excitement and passion to these changes. The study payed also great attention to the outside-inside perspective. Different attitudes emerged from the analysed data of the customer point of view. There exists a progressive gradient among this population in relation to attitudes towards technology, changes and services. These participants were more open to behavioural change and technology. They welcomed flexible mobility solutions, fully electric cars with a premium aspiration and future connectivity. Overall, these participants were more enthusiastic and fearless about change than the internal participants. Internal participants were more sceptical about social changes, environment development, sustainability and connectivity in general. External interviewees reacted with more excitement and enthusiasm to these changes. Technology is perceived to enhance customers` quality of life.

But some of the internal managers demonstrated a certain resistance and fear to these important changes in mobility. They were potentially reluctant to this transformation, as they perceived it as a threat for their jobs. However, the coexistence of a defensive and a future-oriented thinking created a sense of uncertainty in the interviewed population. The first research question wanted to capture the actual mobility environment and new service trends. Knowing actual and future mobility trends was the basis for this explorative research. The intention of the first research question was the creation of expertise and the elaboration of the main understanding of mobility solutions and connected services in the Mercedes-Benz ecosystem. The first unit of interest also covered partially the integration of co-creation into a future service innovation process. The study captured the voice of the customer and the expertise of automotive managers by identifying seven potential service needs. The actual unit under investigation could entirely answer the first research questions and show how the findings support the research answers. In summary, new trends in customer behaviour are setting the footprint for new mobility service solutions. The researcher interviewed exclusively Mercedes-Benz and automotive experts with vast sectorial expertise. Future study could also involve average consumers to capture the voice of the customer in a wider perspective and render the study available for the whole automotive sector.

4.3 Main findings of the current Daimler service innovation approach

4.3.1 Introduction

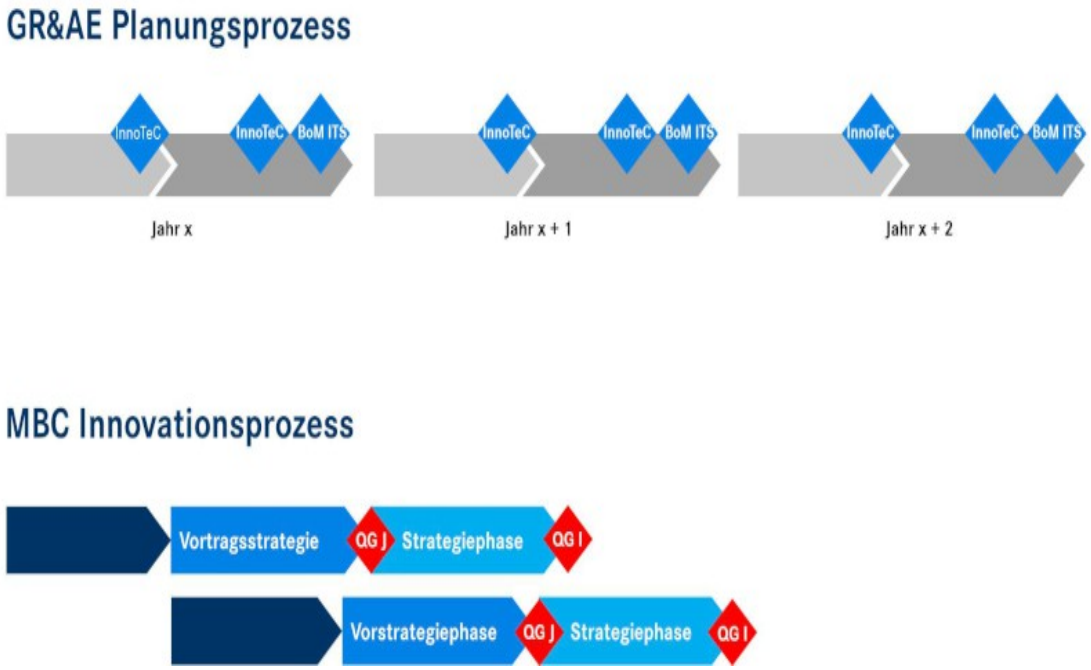
It is critical for the automotive industry to anticipate future trends and provide mobility solutions. Car manufacturers recognize the need for service innovation and the development of new business models. In an industry, where the main focus is still on vehicle and technology improvement, a systematic approach for service innovation is required. The development of a novel service innovation process was based on the “Stage-Gate” process and Design Thinking approach. The Mercedes Development System was analysed through the Intranet source of Daimler AG and turned out to be very complex and inadequate for service innovation.

The main objectives of the workshop were the creation of a systematic process to identify, gather and qualify customer needs and to transform them into valuable services in the Mercedes-Benz ecosystem. The workshop teams delivered information about a step by step approach to craft a new service innovation process model. Furthermore, the findings defined a starting point to design a digital PSS and prioritise potential new services for further implementation. The following sections introduce the analysis of the innovation strategy of Daimler, the Mercedes-Benz Development System (MDS) and the main findings of the second unit of analysis with two separated workshops.

4.3.2 The innovation strategy of Daimler AG

To better understand the possible exploration of an open and digital PSS in the Mercedes-Benz Corporation, the researcher took a closer look at the actual innovation strategy of Mercedes-Benz. The service innovation framework is mainly responsible for the integration of a PSS in the organisation. The following section examines the general innovation strategy and the innovation process of Mercedes-Benz. Potential alternative innovation processes are presented to discuss an effective service innovation framework within the corporation. Daimler AG and the Mercedes-Benz brand (Intranet of Daimler AG, 2018) have always set the standard for technological innovations in the automotive industry. Innovation is also the engine for the daily work of the Mercedes-Benz employees. An independent department within the Daimler R&D organisation is responsible for the control processes with a group-wide function. This department is the central point of contact for the various business units in the early phase of vehicle development. In particular, this concerns the management and coordination of the cross-divisional strategy and planning process of Daimler Research and Advanced Development (**G**roup **R**esearch & **A**dvanced **E**ngineering **GR & AE**).

Fig. 4.34. GR & AE Strategy and Planning Process



Source: Daimler AG, Intranet (2018)

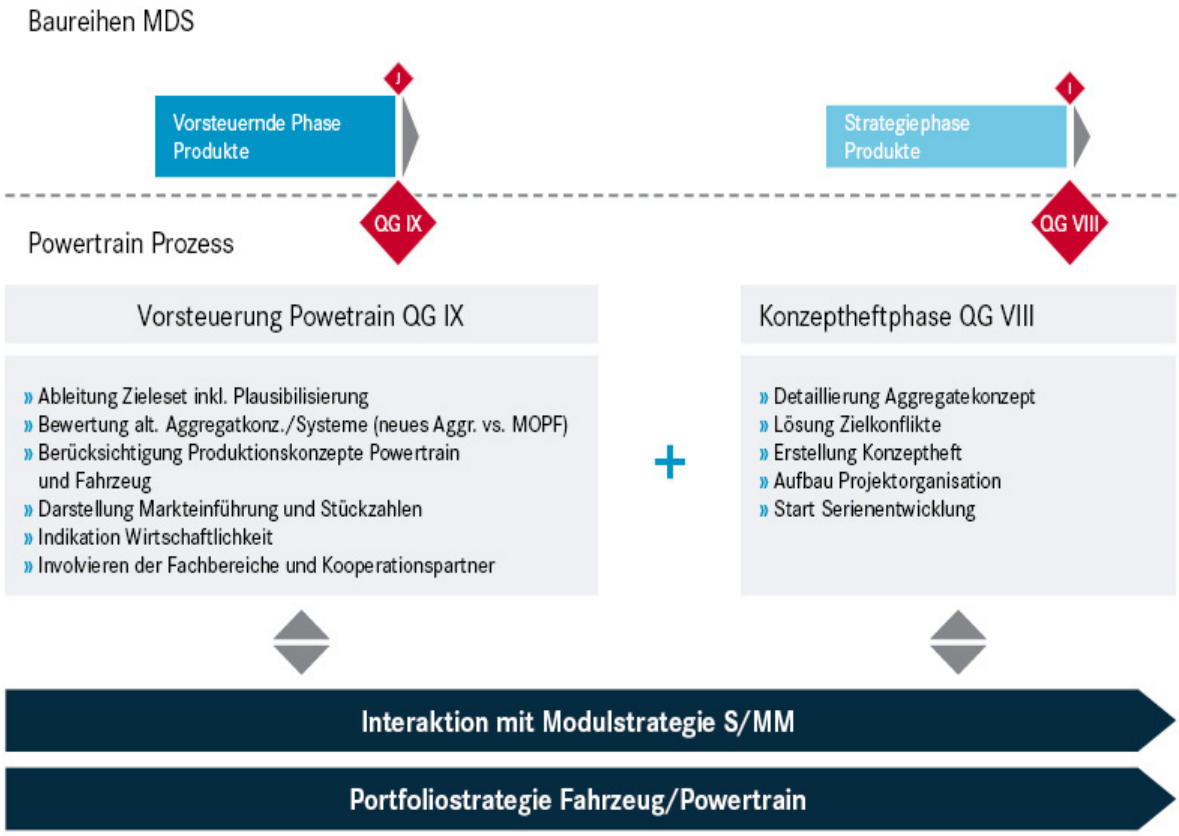
The strategy and planning process of Daimler Research and Advanced Engineering (GR & AE) are responsible for all innovation topics within Daimler AG. Product innovation is exclusively concentrated in the R&D department. In the first six months of the process, the departments revise their thematic field strategy, taking into account of technological developments as well as relevant environmental conditions and the needs of the operational business units. All departments in sales and after sales with important customer touch points are excluded from innovation activities. Only business requirements are taking into account. This process allows only a closed innovation process. In the second six months of the strategic process, the need for action derived from different areas, are integrated into the GR & AE project portfolio of the following year. The Daimler executive board decides the final GR & AE project portfolio and related funding.

4.3.3 Mercedes-Benz innovation process

Let us take a closer look at the innovation approach of the manufacturer Mercedes-Benz, which is described in the internal network (Intranet Daimler AG, 2018) of Daimler AG.

Fig. 4.35. Mercedes-Benz Development System (MDS)

Source: Daimler AG, Intranet (2018)



The Mercedes-Benz Development System (MDS) is an engineered driven hardware process (Räse, 2010), which is designed around tangible products such as engines and other car components. This process describes the traditional car manufacturer innovation process from the creative idea to the final product and market launch as a closed innovation approach with its diverse quality gates. The MDS is based on the Stage-Gate model of Cooper with its different quality gates before each next process phase.

4.3.4 Analogy of Stage Gate process and MDS

Consequently, it was important to analyse the overlap of the “Stage-Gate” process from Cooper (1999), as a value-creating process through the innovation of a steady stream of products and the MDS. Most of the automotive companies are using traditional Stage Gate procedures (Ettlie and Elsenbach, 2007) or a modified form to develop their products, which is the case of Mercedes-Benz.

The MDS is a modified application (Ettlie and Elsenbach, 2007) of the Stage-Gate model with its different quality gates in hardware product development. The “Stage-Gate” process model is a typical step by step approach from the initial idea to the market launch of a new product with feedback loops and quality gates. The activities described by Cooper and Edgett (2003) within the different process steps are related to the process flow with the clear identification and description of “stages” and “gates”. Each stage and gate has to be well-defined. Additionally, every task, action and all resulting deliverables within each stage needs to be identified and outlined. Only then, the gatekeeper’s advice the “Go or Kill” decision. Further activities in the process are related to organizational issues. Roles and responsibilities such as process manager and leader of the project need to be organised by the stage gate committee. This also includes the “spirit” of the Stage-Gate approach by introducing flexibility and possible fast-track projects as well IT design, monitoring the project and statistics.

Nevertheless, some literature (Schallmo, 2018) is criticising the process as too rigid and lacking flexibility. The evolution of the Stage-Gate process is driven by the study of Cooper, Edgett and Kleinschmidt (2002). Most companies have implemented a systematic new product process to drive projects from idea to launch. Best-practice companies are improving their processes to make them faster and more effective. With creative ideas and new projects in short time, some companies are adding a “discovery stage” to the front end of the process in order to generate new and better ideas. These activities in this front stage include the idea capture with an integrated voice of customer research work. This approach includes customer events and work sessions with innovative users to generate major valuable ideas. Integrating “Voice of Customer” work into the new “Discovery Stage” helps to identify customers' problems. There exists no standard methodology to discover customer needs, but this quest usually involves working closely with customers, listening to their problems, and understanding their business. Best-practice companies are also harnessing fundamental research more effectively by implementing this novel stage-gate approach. These firms are evolving from simpler Stage-Gate processes to more sophisticated facilitated or third-generation processes Stage-Gate users. After a decade of development focused on product extensions and quick hits, the quest for the breakthrough idea has become a vital management issue. A good new product idea can make a big difference in the project. The success of the evolution consists in the more proactive application of the Discovery Stage.

The evolution to the third-generation processes in product development, which incorporate flexibility, focus, fluid stages, fuzzy gates, and facilitation enhances the success of these best-practice companies. The Stage-Gate process is continuously evolving to a more customized solution for product innovation in the business environment. If fundamental research, science projects or technology developments are undertaken in business (Cooper, Edgett and Kleinschmidt, 2002), it is necessary to introduce a stage-and-gate process in order to provide a more direction and focus. The Stage-Gate process underlines the development of “hardware” products and doesn`t put a focus on service innovation. Furthermore, the MDS model contains even more complexity than the Stage-Gate process, due the different layers and processes within the innovation model of Mercedes-Benz. The MDS process still creates a gap between the systematic hardware innovation and the downstream service innovation. The vehicle model development process is driven in parallel to the module strategy and the portfolio strategy of Mercedes-Benz. In this way, the process allows all possible synergies between powertrain technology and different car models. In this phase exists an intensive exchange with pre-production to allow the effective integration into the production lane. Digital technologies are entering increasingly in the production process of the carmakers to control and support more efficiently the production process on an industrial level. Ensuring basically cost and timing targets in the development process, the approach of innovation should be reconsidered and opened to other stakeholders in the Mercedes-Benz development system. To better understand the innovation approach, we discuss in more detail the actual innovation process of Mercedes-Benz.

4.3.5 The Mercedes-Benz Cars innovation process

In the early phase of the innovation process (Intranet Mercedes-Benz, 2018), the organisation provides orientation for project creation and prioritization in different subject areas by developing innovation search fields (future innovation requirements from the point of view of our target groups). Through the continuous survey and analysis of the MBC innovation level, the process ensures the transparency of innovation projects across all model series.

Innovation process – pre-strategy phase

Once the innovation portfolio is realised, the organisation controls innovation activities for all different car and engine architectures to ensure an attractive portfolio of innovations. Different quality gates ensure the assessment in terms of architectural relevance, assurance of maturity level, development of the business case, cascading on subsequent series, analysis of the innovation level, derivation of action requirements, comparison with competitor analysis, patent management and the module strategy.

Innovation process – strategy phase

The clear goal in the strategy phase is to ensure the concept validity of all innovations, including the authorization of the business cases. This is done in cooperation with the innovation project managers from pre-development and operational areas.

Innovation process – across all production lines

In addition to the hardware innovation process, the innovation management drives specific innovations in individual cases (such as system innovations/airbags, light systems and navigation systems, etc.).

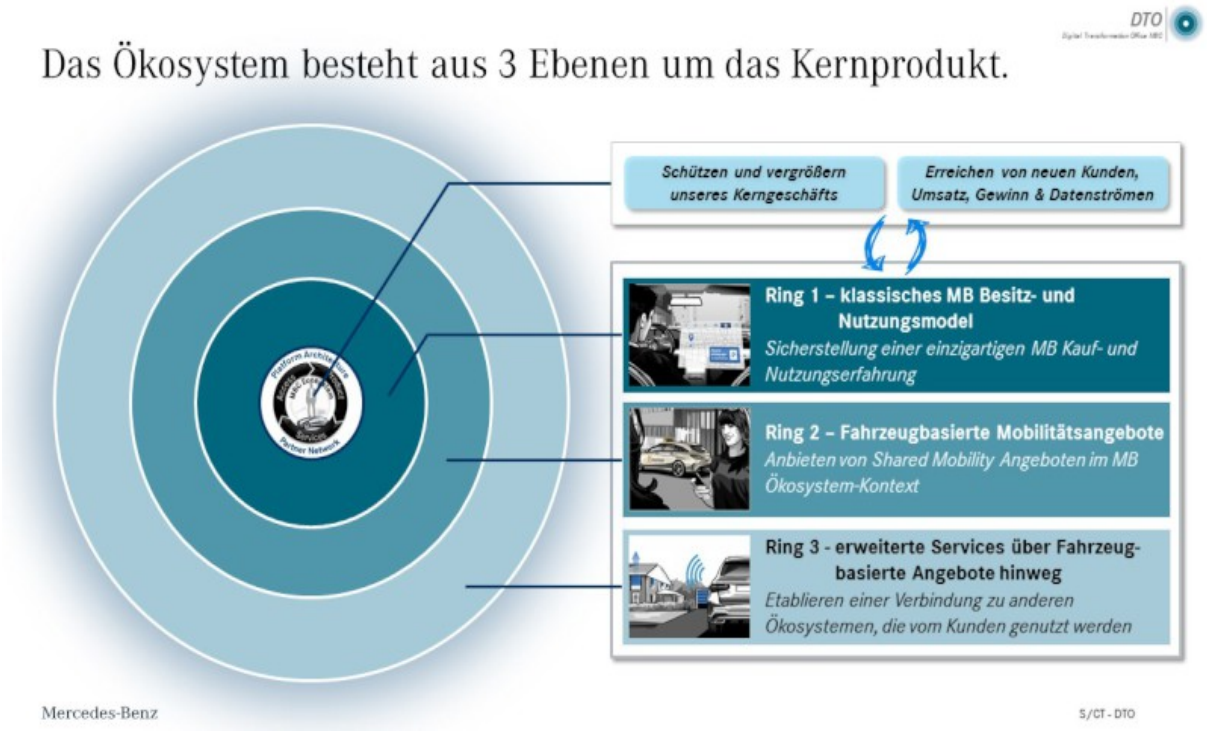
Modular strategy process

In parallel to the innovation process, Mercedes-Benz is developing a module strategy to exploit synergies between all model architectures.

Mercedes-Benz ecosystem

The regulatory framework for the MB ecosystem includes initiatives that are directly visible from the customer's perspective. Crucial for the customer is the seamless integration of MB products and services into his digitally shaped world. The aim of the ecosystem is to strengthen our core business, attract new customers and tap new sources of revenue, as shown in figure. 4.36.

Figure. 4.36. The Mercedes-Benz Ecosystem



Source: Daimler AG, Intranet (2018)

The regulatory framework divides customer needs into three parts:

- MB ownership: The initiatives in this part are designed to make the purchase and use of a Mercedes Benz an outstanding experience.
- Car-based mobility services: These initiatives serve other vehicle-related mobility needs of customers, such as: Car sharing or co-ownership.
- Services beyond car-based mobility: these initiatives look at other lifecycles of the customer - such as Health - and their connections with the first two parts to create multi-valued services for the customer.

The study investigated the current innovation approach of Mercedes-Benz as an engineered driven hardware process. The MDS process turned out to be a highly complex hardware innovation process, where the simultaneous integration of services would be impracticable. The investigation indicated the rigidity, the complexity of an automotive innovation process and the lack of flexibility for service integration. Co-creation and the capacity of knowledge transfer through open innovation within the company consists of an obvious weakness in the Mercedes innovation process.

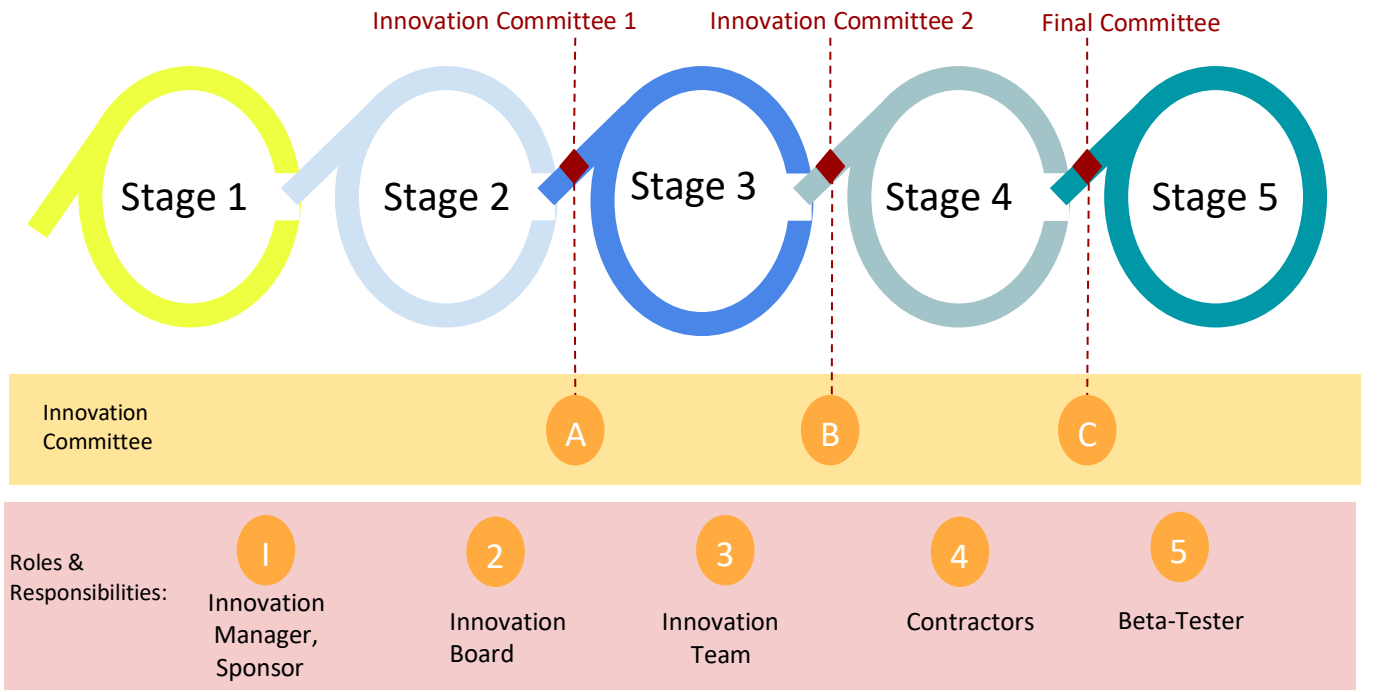
The company still operates in a closed innovation environment without taking into account purposive inflows and outflows of knowledge to accelerate innovation. Moreover, the Mercedes-Benz innovation process creates a disruption between the systematic hardware innovation and the posterior downstream service innovation. This inquiry demonstrated the necessary paradigm change towards open innovation through a systematic service innovation framework within the Mercedes-Benz Corporation. The research also the necessity for further research in this field. After the analysis of the current innovation framework of Daimler AG and Mercedes-Benz, the researcher planed the second unit of interest. To better understand the analysis and the approach, the study presents the Thematic Analysis of the second unit of interest with its two workshops.

4.4 Main findings of the service innovation workshop

Through the introduction and background information during the workshop, the participants had an improved understanding of customer needs and co-creation. Two different teams followed the workshop and delivered useful information for a new innovation process model to meet and satisfy customer needs. Transforming customer needs to valuable services through the creation of a new service innovation process model was the focus of this investigation. Based on the evidence of the existing process models of MDS, the “Stage–Gate” process model and Design Thinking, the investigation gathered data for a stage by stage design for a future service innovation process model. The findings introduce a five-stage approach including important roles and responsibilities and the respective control committees to apply the framework in the Mercedes-Benz business environment. The service innovation process model introduced new roles, formalized project stages and defined a clear decision-oriented methodology. Different groups worked in parallel and presented solitary their ideas, approaches and models consecutively.

Ultimately all participants discussed the total outcome and integrated the best ideas and approaches in each stage of the process, as shown in the over-all approach in figure 4.37.

Fig. 4.37. Implementation of a process model



The five stages process model will be explained in detail in the following sections. The study will describe the stage by stage in a detailed and comprehensive manner.

4.4.1 The “DISCOVER” Stage

The goal of the first stage consisted of a deeper comprehension of customer needs and the integration of co-creation. In a first step, the different working groups identified customer needs and expectations on the basis of Unit I. The inflow of internal and external sources was detected as key issue to better comprehend real customer needs. The working groups explored diverse steps to identify customer needs as shown in the following figure. To find the needs in an open source approach, through focus groups, interviews and internal sources was an important concern for the participants. Gathering different needs through internal and external sources completed the whole picture of customer needs. In a further step, the study realized the prerequisite to qualify and prioritize these needs.

Using the outcome of case study / Unit I, was especially helpful for the participants to work with seven already identified and concrete customer needs. The comprehension of “real-life” customer needs created an additional stimulus, developing a new service innovation process. The researcher discovered the necessity of the inside and outside perspective and the cross-check of required needs. The first step was entitled as “Discover” stage and it was all about finding, gathering, and qualifying customer needs. The participants also required the necessity for responsible roles and sponsors within each stage of the process to successfully manage the future framework in a “real world” business environment. Participants suggested that a Mercedes-Benz expert should obtain the role of responsible “innovation manager” to drive the first stage of the process. This innovation manger played a pivotal role in the discover stage. His task consisted to sustain the “Find-Gather-Qualify” process in a structured and open approach. Participants further required additional tasks for the innovation manager:

- Supervise the complete framework phases.
- Gather learnings and guarantee a structured approach.
- Be aware of projects being developed in other companies.
- Coordinate all cross-functional activities.
- Represent “customers” and collaborate with leaders in different areas.
- Interpret business strategy and determine innovative solutions to support the business strategy.

The participants described the innovation manager profile with “*cross-functional vision, a well-organised mind-set and strong conceptual skills*”. The use of internal sources, such as Mercedes-Benz employees, the dealer network and Mercedes market research to discover needs defined the first, main task of the innovation manager. The second task consisted in the use of external sources, for instance, the outcome of unit I and the routine to exploit permanent customer focus group and interviews as method to gather external needs. Participants also suggest that an experienced manger should receive the role as “*sponsor of the project*”. This function should give advice and challenge the innovation manager in the development and prioritization of customer needs. The next task for the two working groups consisted in the creation of criteria to define and prioritize the customer needs.

The groups developed a three-factor matrix with the following criteria:

- **Opportunity size**
  (Growth potential, potential as a future, valuable and profitable service)
- **Strategic/Market fit**
  (New services, automotive environment, fit to the Spanish culture and market)
- **"Right-to-play" for Mercedes-Benz**
  (Fit into the MB ecosystem, compatible with MB technology)

At this stage, the responsible innovation manager should organize a meeting with the sponsor to be challenged with his executed analyse. The participants baptized this role of an experienced expert as "*innovation manager*" to remember the challenge of service innovation. The workshop participants divided the discover stage into seven main parts, as shown in the following figure. This "seven main parts stage logic" (Goal, input, task, output, resources, metrics and stakeholders) was used for all further stages of the innovation process. Sustaining this logical frame throughout the different stages created a high-quality approach in the all-over process design. The definition of the goal was an important starting point for the first process stage. The working groups then divided the necessary input of needs from the main working tasks and the defined the expected output. They defined required resources, such as market research, focus groups and interviews. Participants defined a metrics to evaluate and measure key parameters of the selection. Likewise, main stakeholders for this precise stage of the process were defined. The created project environment played a key role for a successful use of the process in the Mercedes-Benz business milieu. The next figure 4.38 shows the complete "Discover „stage with the general goal to find, gather and qualify needs for a deeper comprehension of the "real" customer needs. The innovation manager is the responsible person to execute the first stage, which is similar to Design Thinking and "Fuzzy-Front-End" practice (Boeddrich, 2004; Plattner, 2011).

Fig. 4.38. **Discover Stage**

Goal:

Find, gather, and qualify needs in order to have a deeper comprehension of our customers' real needs on basis of Unit I, II. Innovation manager as responsible manager challenged by the sponsor (manager).

Stage 1

INPUT

- List of needs identified during the Discover Stage.
- Open source approach
- Internal sources
- External research, customer Focus Groups and interviews to identify customer needs
- Sponsor required.

TASKS

- Define criteria to compare and prioritize the needs:
  - Opportunity Size
  - Market Fit
  - MBE´s "Right-to-play"
- Organize a pre-prioritization session with Sponsor:
  - Challenge the Innovation Manager´s analysis.
  - Bring out new criteria not taken into consideration.
- Prioritize outstanding needs with received criteria and feedback to prepare proposal for next stage.

OUTPUT

- Selected needs to present for next stage.
- Keep needs updated with insights from the pre-prioritization discussion.

RESOURCES

- Outcome Interviews Unit I and II.
- Permanent customer Focus groups, interviews.
- Actual market research.

METRICS

- # define and prioritized need matrix

STAKEHOLDERS

- Innovation Manager
- Sponsors

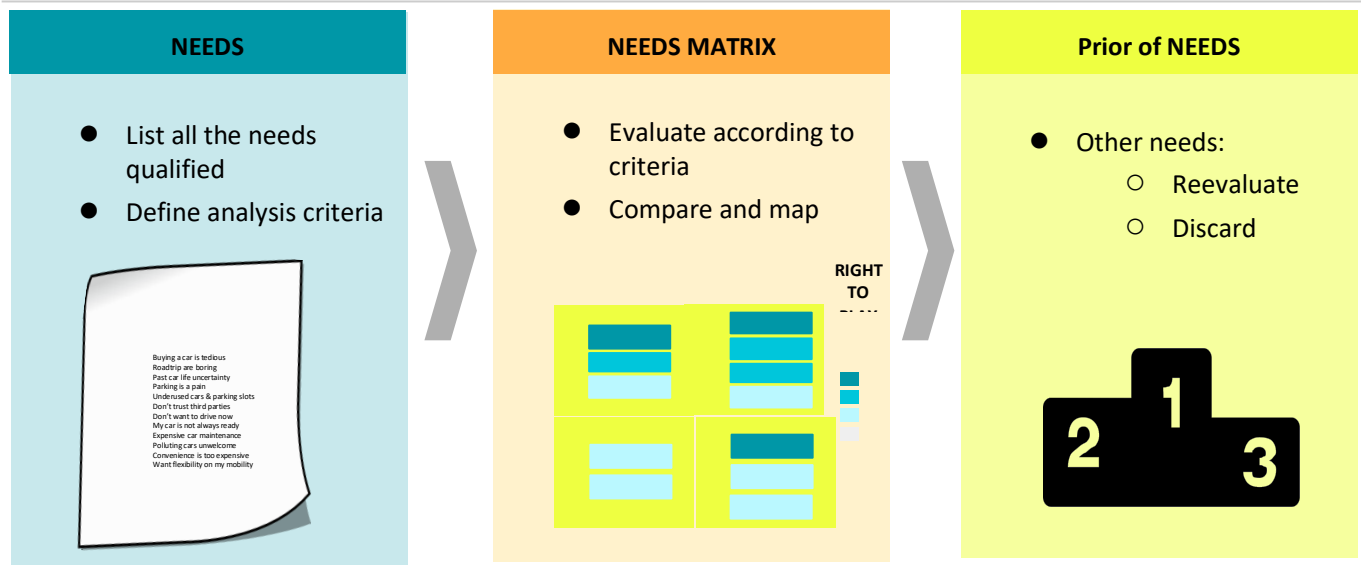
The input consisted in listing of all identified needs during the Discover Stage through an open source approach with internal sources and external research, customer Focus Groups and interviews to identify customer needs. The tasks defined criteria to compare and prioritize the needs via, opportunity size, market fit, MBE´s "Right-to-play", organize a pre-prioritization session with Sponsor to challenge the innovation manager´s analyses. Bringing out potential new criteria, which were yet not taken into consideration. Prioritizing outstanding needs with received criteria and feedback to prepare the proposal for the next process step. Needed resources were defined with the outcome of the interviews. Permanent customer focus groups and interviews were installed, as well as actual market research.

The definition and prioritization of a matrix was executed and the stakeholders, the innovation manager and the sponsor were identified. The output of this stage consisted in the selection of needs to be presented for next stage.

4.4.2 The “Organize” Stage

After the “Discover” stage, the study realized the opportunity to organize the second process stage, which was defined as the “Organize” stage. The workshop routine maintained the same process logic of the main seven parts (Goal, input, task, output, resources, metrics and stakeholders) throughout all stages of the service innovation process model. The main goal of the second stage consisted in prioritizing the qualified needs and prepare the first innovation committee for project decisions. The input was based on internal and external, already selected needs by the innovation manager. His task involved the preparation of the first innovation committee and the detailed presentation of the already mentioned “Find-Gather-Qualify” selection process. The innovation manager had to prepare a complete list of needs. Additionally, this function had to prepare and present the selection matrix with the opportunity size, the strategic/market fit and the “Right-to-play”. With the applied matrix, the innovation manager then evaluated a priority list of needs. Customer needs which did not enter into this logical approach, were ether re-evaluated or discarded as shown in figure 4.39.

Fig. 4.39. ***Find and gather Needs***

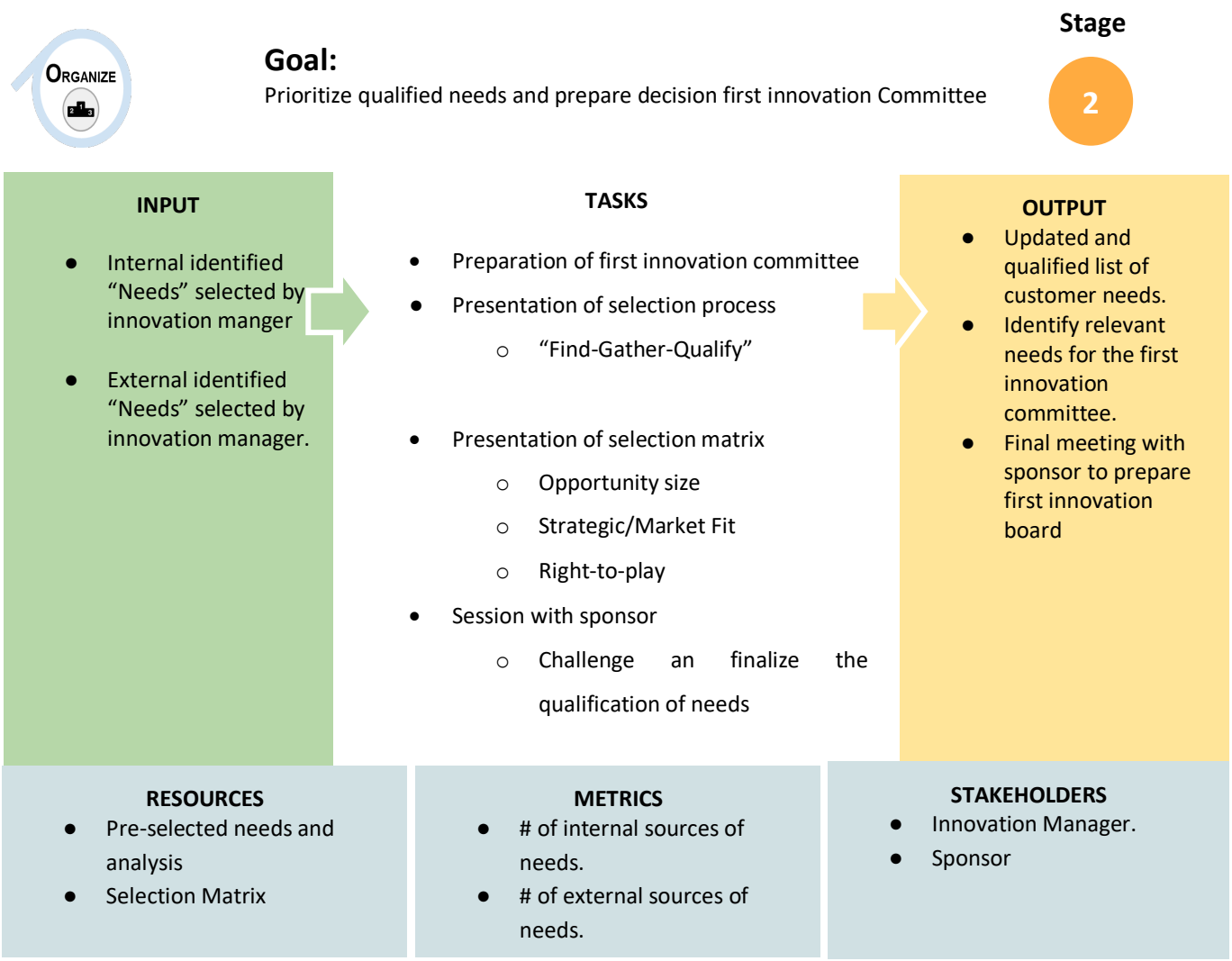


Afterwards, the innovation manager organised a meeting with the sponsor to challenge and finalize his selection and prioritization of needs. The sponsor had the task to challenge the innovation manager with following questions:

- How long from need to service in the market?
- Does the need have a future opportunity as a potential service?
- What other projects are currently being developed in Daimler or other companies?
- Do we have enough budget to cover the development of this service?
- What else should we consider?

Nevertheless, the sponsor as experienced manager should also give advice and support the innovation manager in his approach. The task of preparation and presentation was very important for the later stage of the innovation committee to better comprehend the whole selection process and the intensive preparation. The output of the “Organize” stage consisted in an identified and qualified list of customer needs to be presented in the first innovation committee. The innovation manager used the pre-selected customer needs and the already developed selection matrix as resources. He applied the already defined metrics to evaluate and measure key parameters of the internal and external sources of needs. A stakeholder meeting with the sponsor finalized the selection and the presentation of the selection of customer needs as shown in the next figure 4.40. The organize stage consisted of a mix of the initial FFE process (Markham, 2013; Schallmo, 2018) and the DT step of observation to acquire expert knowledge. However, only the “Organize Stage” included a systematic approach to identify and prioritize relevant needs.

Fig. 4.40. **Organize Stage**

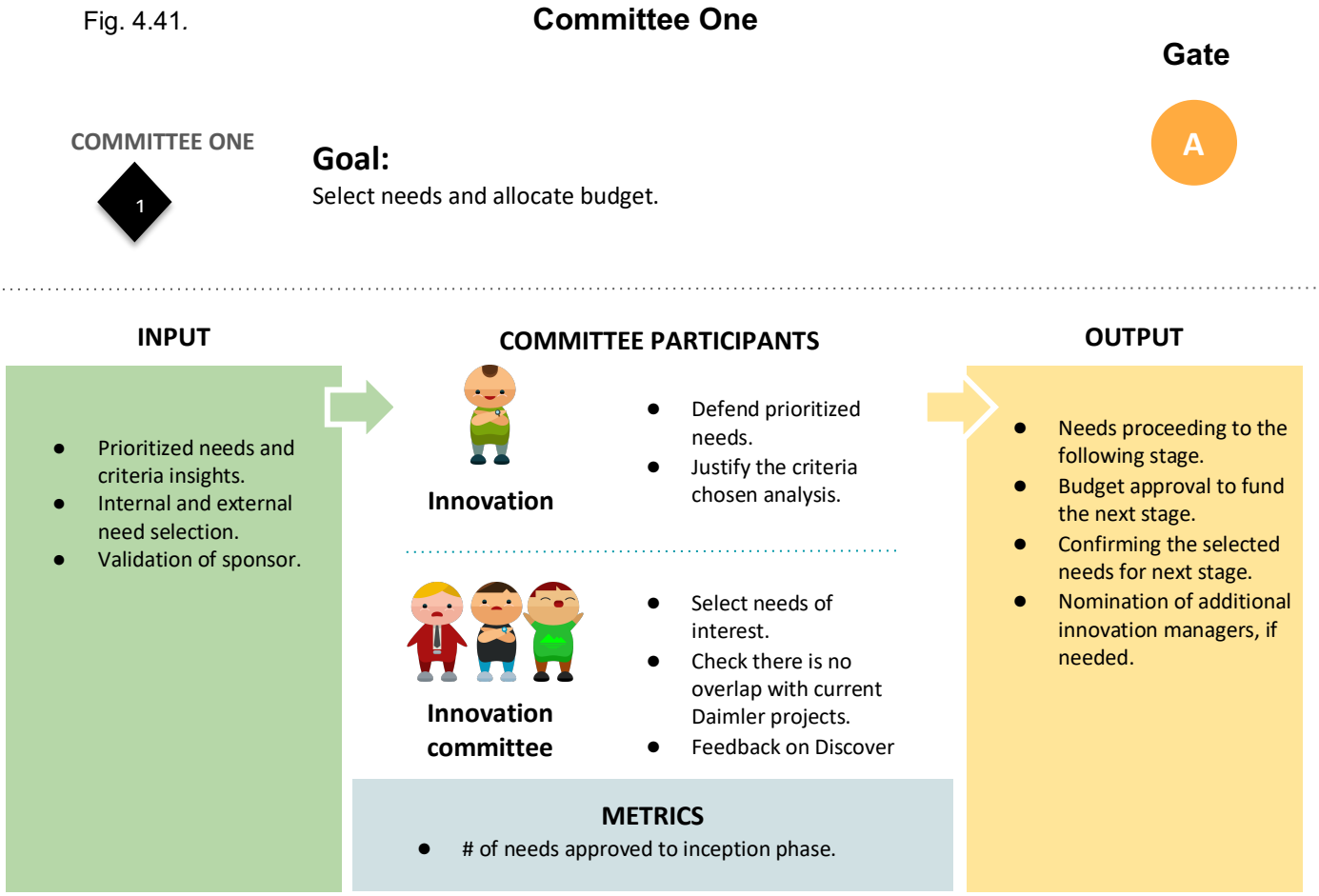


4.4.3 The "Committee ONE" Gate

The investigation developed on basis of the "Stage-Gate" process a similar quality gate after the "Organize" stage to secure the process excellence. The goal of the committee one gate was to select identified needs and to allocate the adequate budget one the different service projects. The "committee One" gate worked with the already identified seven needs of the first unit of interest, as concrete approach to develop this gate. The workshop participants had already the experience and the knowledge to select the accurate customer needs. The function of the innovation manager presented internal and external selected projects to the committee. He defended the prioritized needs and revealed the method for the criteria and analysis to the committee.

The innovation committee gave feedback on the selection, checked with already running Daimler projects and confirmed or discussed the selection. In case several projects were chosen, additional innovation managers needed to be nominated. The final selected needs moved on to the next stage. Figure 4.41., shows the complete committee one gate as already mentioned.

Fig. 4.41.



4.4.4 The “Initiate Stage”

The participants entitled the third stage the “Initiate Stage”. The goal of the “Initiate Stage” was the validation of desirable customer needs, the enquiry of the business model and the feasibility of the project. The function of the innovation manager was in charge to lead this stage. The innovation committee allocated the budget and selected the final needs to go further in the service innovation process. This stage expected third parties participation, where allocated Mercedes-Benz employees lacked the necessary skills. The innovation manager had to ideate possible solutions and a solid value proposition.

He had to develop the customer journey and a desirable customer experience. The project team had to define the whole customer journey and desirable customer experience and had to visualize developed prototypes and tested them with real customers. The validation of a cross-area feasibility assessment was in the focus of the output of this stage. Moreover, the innovation manager created a forum of internal and/or external skills to provide a prototype of the service, as shown in the next figure 4.42.

Fig. 4.42. **Initiate Stage**

Goal:
Validate customer desirability, analyze business viability, and assess feasibility.

Stage 3

INPUT
- Needs proceeding to the Initiate stage.
- Budget approval to fund the Initiate stage.
- Innovation manager is leading the process for selected needs.

TASKS
- Set up team and appoint third party contractors in those areas, where MBE lacks the necessary skills.
- Ideate on possible solutions that could satisfy the customer needs to reach a value proposition and a new service.
- Create a visual prototype of the product.
- Iterate the solution with customers in order to reach desirability.
- Arrange a cross-area forum to validate the feasibility.
- Generate business model.
- Complete the appropriate documentation to pitch the solution to Committee 2.

OUTPUT
- Validated customer desirability for a specific need: customer segments, volumes, etc.
- Defined customer journey and desirable customer experience.
- Developed value proposition.
- Visual prototypes developed and tested with real customers.
- Cross-areas feasibility assessment.
- Preliminary business model.

RESOURCES
- Tentative roadmap for the initiate stage.
- Beta tester pool for ideation process.

METRICS
- # of inceptions completed.
- € Money spent per inception.

STAKEHOLDERS
- Innovation manager.
- Project team appointed by innovation manager.
- Third-parties' contractors.

The innovation manager had also the responsibility for the development of the business model with the support of the finance and controlling department. The development of this stage demanded great efforts of the workshop participants to design this stage, due to the complexity of the different tasks and outcomes.

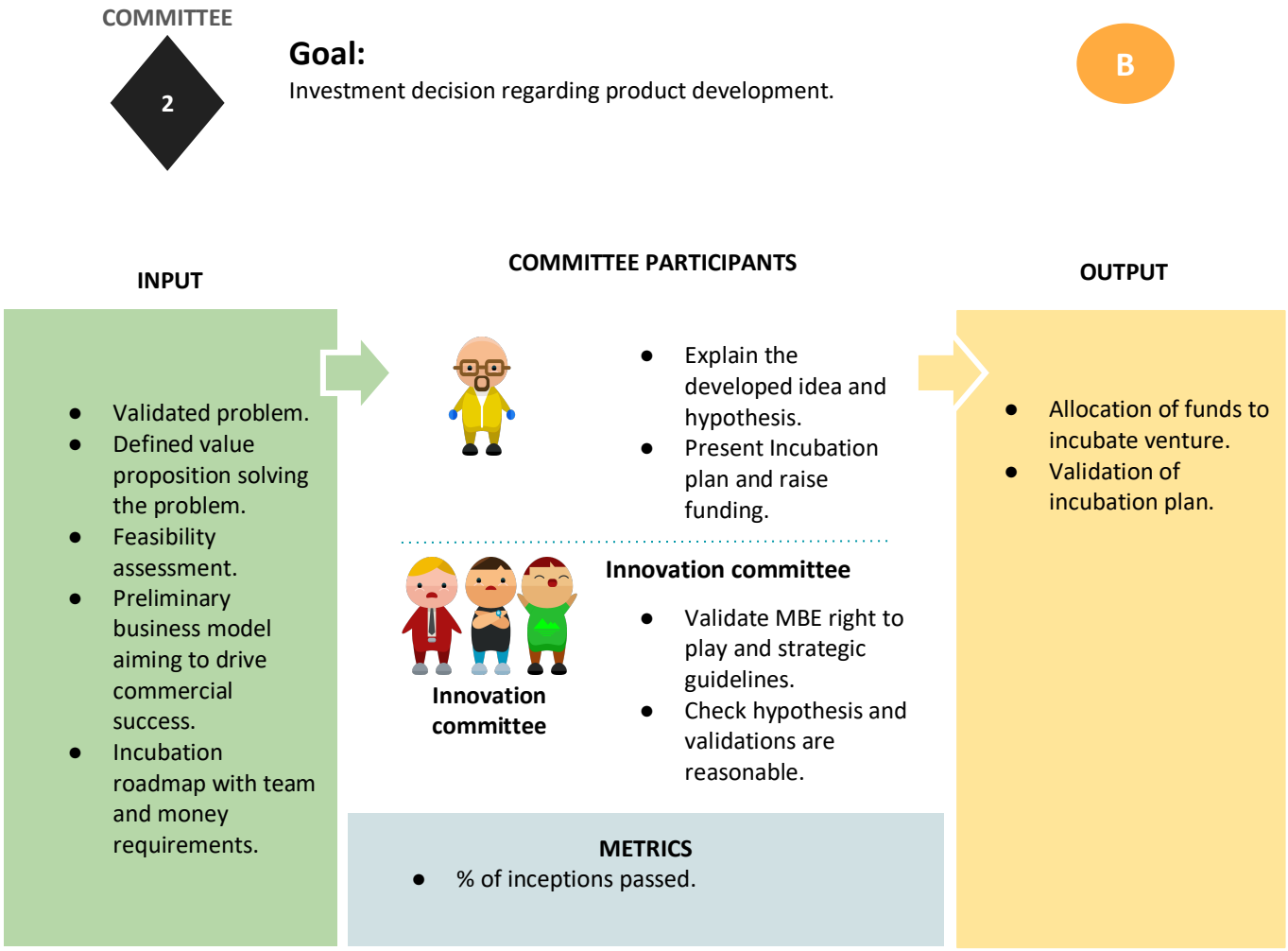
Only the detailed description of the complete process, allowed the progress of the SIPM development. The outcome of this stage was focused on the validated needs and the additional value for the customer. At this point, the transformation from customer needs to the value proposition consisted of a great challenge. The creation of a valid prototype of the service was a key factor for the team. The team had to organize a “beta tester pool” of selected customers. Subsequently, the innovation manager and his team had to test the prototype with beta testers in a real-life situation. Only the extensiveness of the outcome guaranteed the positive assessment of the next process step. The innovation manager had to convince the innovation committee in the next stage to fund further development steps.

4.4.5 The “Committee TWO” Gate

The workshop flow defined at this stage the next quality gate with the second innovation committee. The “committee two” gate had a clear decision-making goal. The committee had to decide upon the persistence or the rejection of the project. The problem validation, the business case, the testing outcome with beta-testers and the required resources were presented at this gate to the committee. The innovation manager together with his team explained the already achieved results and presented their findings. All relevant information regarding the project was displayed to the committee members. The role of the committee was to validate the project, the business case and the fit into the Mercedes-Benz ecosystem. The expected output consisted in a clear decision about the project with the accurate budget allocation and the definition about the duration of the next stage.

The next figure 4.43., shows the all-over “committee two” process description.

Fig. 4.43. **Committee TWO**

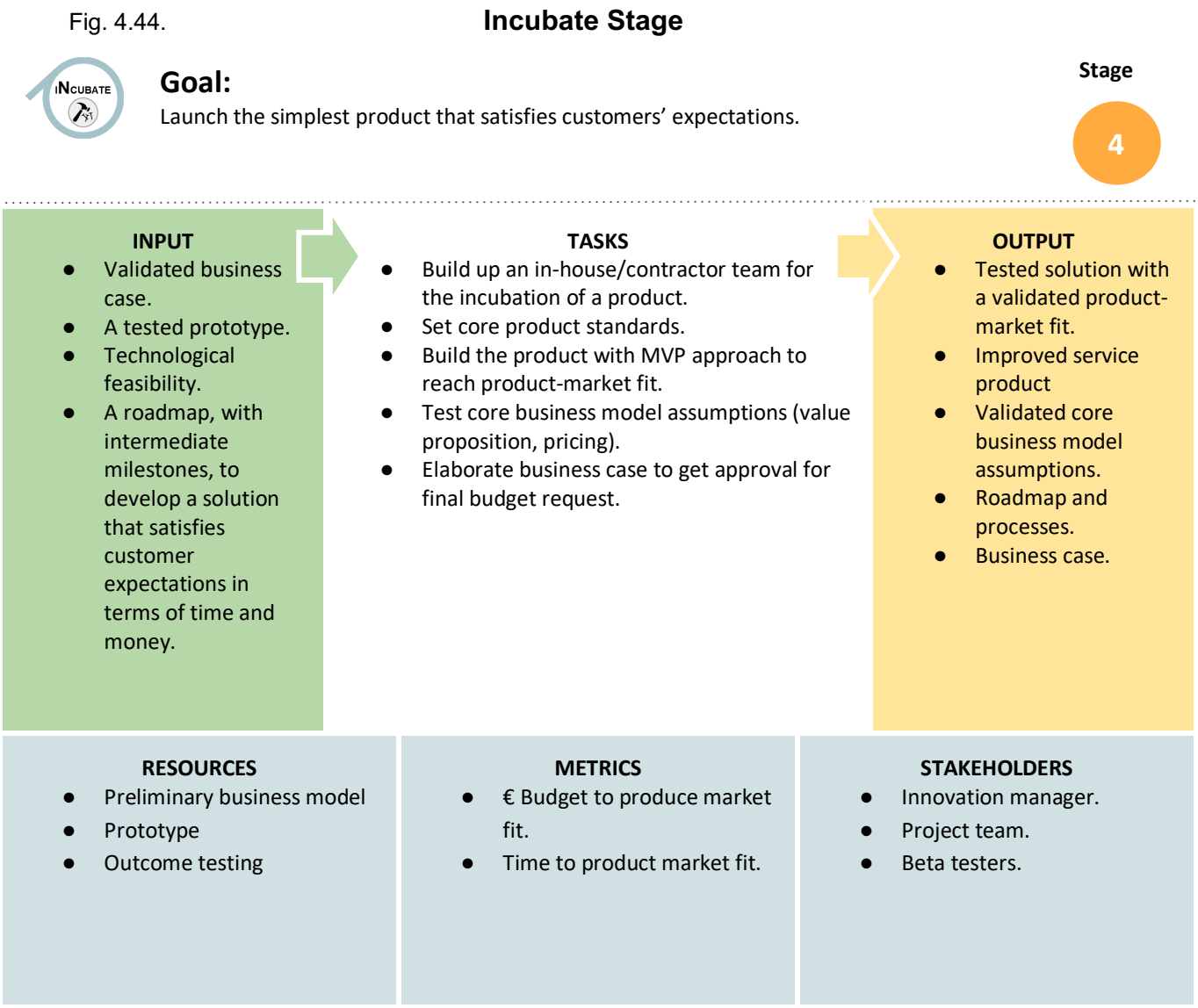


4.4.6 The “iNcubate Stage”

The incubate stage was created on the stimulation of the design thinking process (Schallmo, 2018). This stage was created with the goal to develop a minimum viable product (MVP) of the service proposal to satisfy customer needs and their expectations. But not only the MVP development was an important matter, likewise the improvement of the core business model was in the focus of the workshop participants. Therefore, they entitled this process step, the “incubate stage” to mature the service product and the financial aspects. This process step was based on the input of a validated business case, the already tested prototype and a roadmap with intermediate milestones in terms of MVP and financial matters. The different tasks consisted to build up an in-house and external specialist team to incubate the MVP. Thus, the innovation manager with his complete team had to set the core standards and specifications of the service product and create the MVP. The MVP had to be tested with beta-testers in a real-life market environment to detect errors and enhance the product to reach market fit. The financial teams developed key assumptions for the business model to get the approval for the final budget request. The workshop groups defined the detailed outcomes of this stage, due to his importance for later market success. The tested MVP should meet customer expectations and reach market attractiveness. This stage also allowed the technical improvement of the service product. During the incubate stage, the participants valued the importance of the core business model assumptions and the actual business case for later financial success.

They defined also the roadmap and processes for further steps in this process frame as shown in the following figure 4.44.

Fig. 4.44.

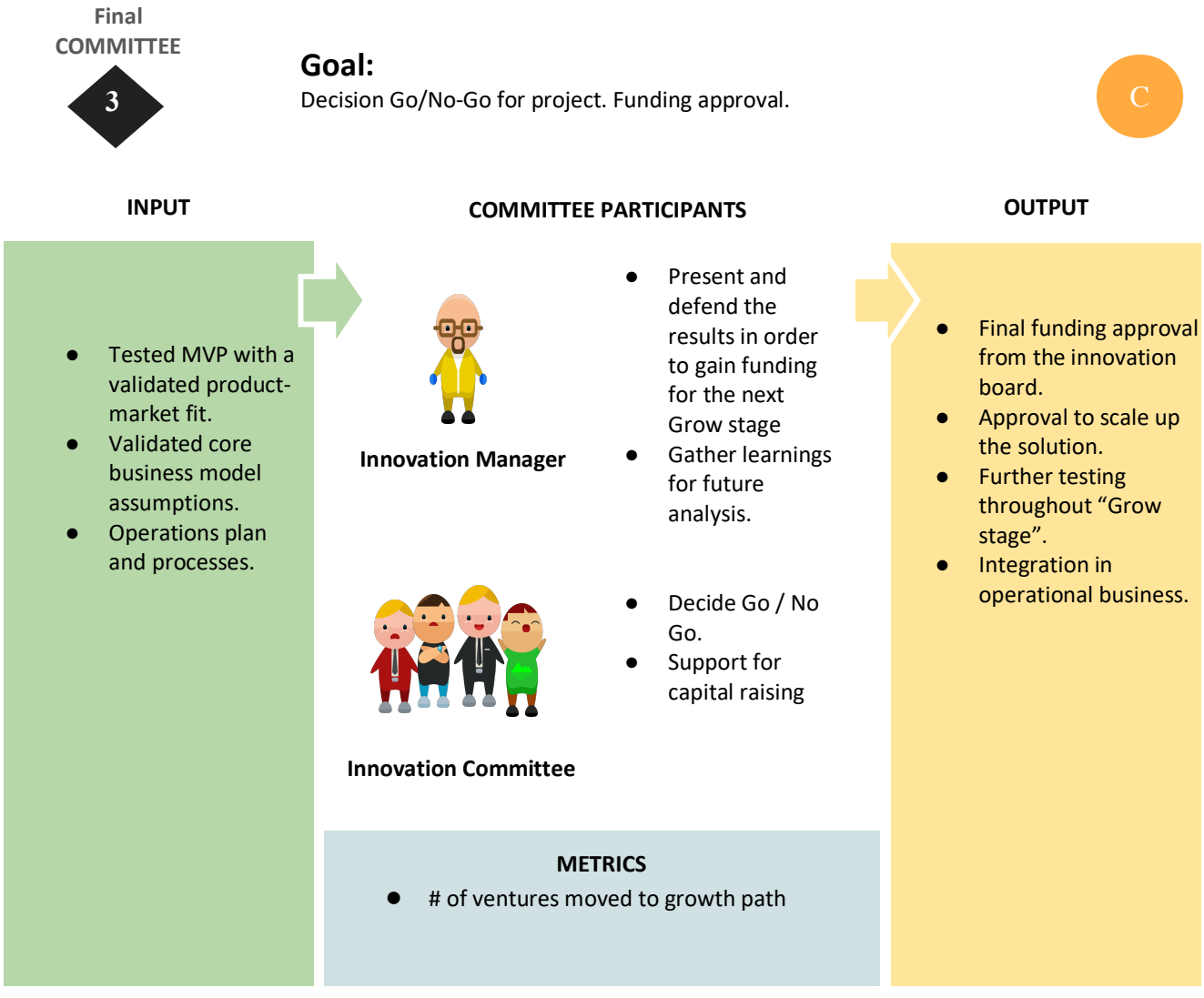


4.4.7 The "Final Committee" Gate

The participants perceived the obligation to integrate an ultimate quality gate after the important stage of incubation. The innovation manager presented the results of the tested MVP and its market fit. The committee discussed the status quo of the business model and the assumption on basis of the operations plan. All the information was given as a basis for further discussion in the final innovation committee. The testing period in a real-life environment and the final business model needed to be challenged in the innovation committee. The goal of this gate was to decide the "go or no-go" for the project.

The innovation manager presented the results of the incubate stage to the innovation board. He defended the project in order to gain further funding for the next process stage. The role was likewise to explain learnings out of the testing phase and improve the service product. The tested and improved service product should achieve the validated market fit from the committee. Once this hurdle was overcome, the innovation committee had to approve the final budget allocation, before going life in the market. The expected output of the final innovation committee was the all-over approval and the integration of the new service product into the operational business of Mercedes-Benz Spain. All committee stages had a similar approach as the Stage Gate (Cooper, 1999) control instance. Immediately after the release, the project reached the final "Grow Stage" of the service innovation process as shown in the next figure 4.45. The roll-out of the project within the Spanish marketplace would be released in the final committee.

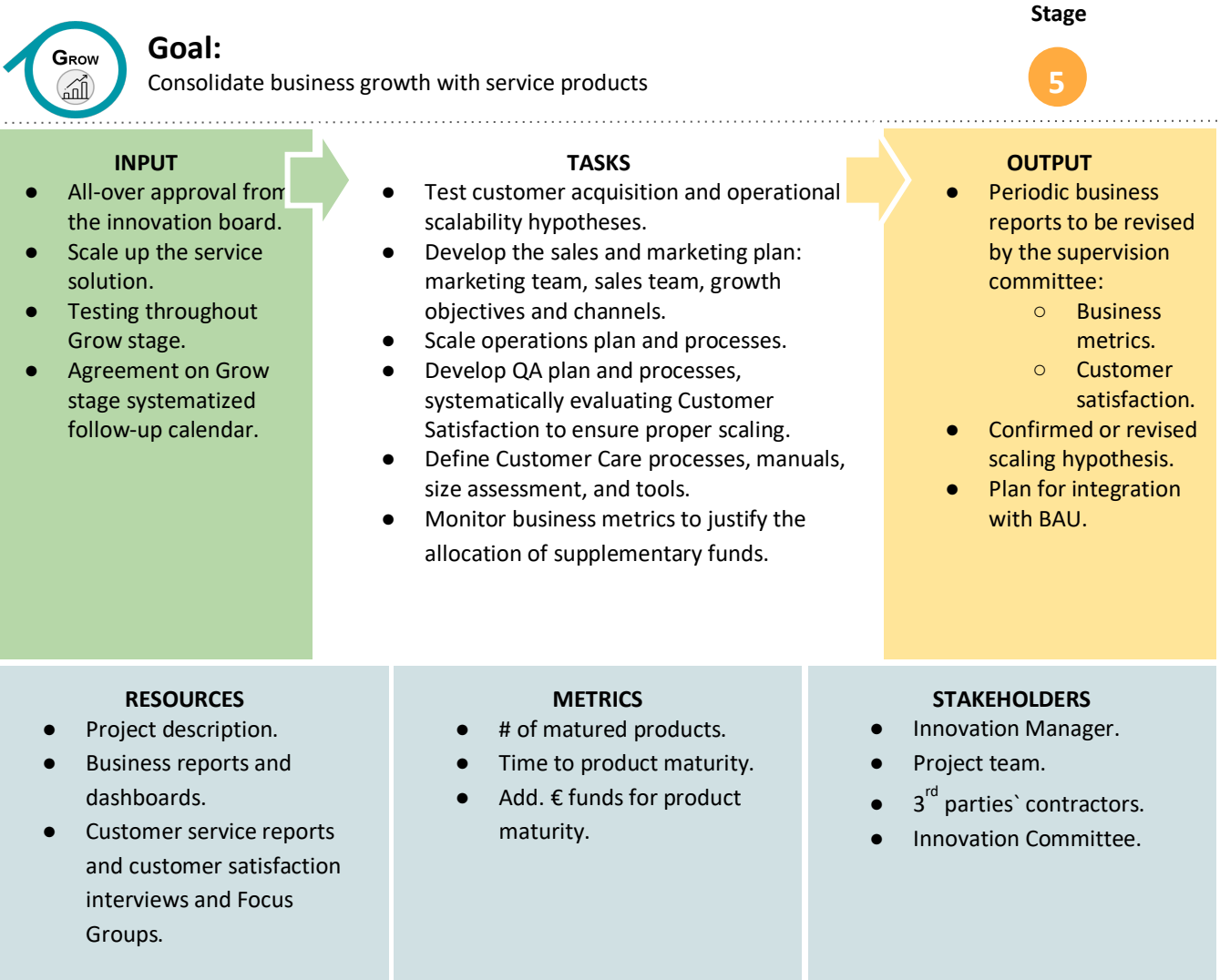
Fig. 4.45. **Final Committee**



4.4.8 The “GROW Stage”

The final process phase was baptised “Grow stage”. The goal of this process step was clearly defined by the two workshop groups. During this process stage the consolidation and the integration in the operational business of Mercedes-Benz Spain was in the focus of the working groups. Following the process methodology with its seven parts, the all-over project approval was an important prerequisite for the input of this process step. The scale opportunities of the project, the testing during the incubate stage and the agreement on a follow-up agenda of the project defined the input of this stage. The main task of this stage was the execution of the business model and the acceptance of the offered service product in the marketplace by developing the sales and marketing plan, the customer care process and all necessary sales activities, which are explained in the following figure 4.46.

Fig. 4.46. **The Grow Stage**



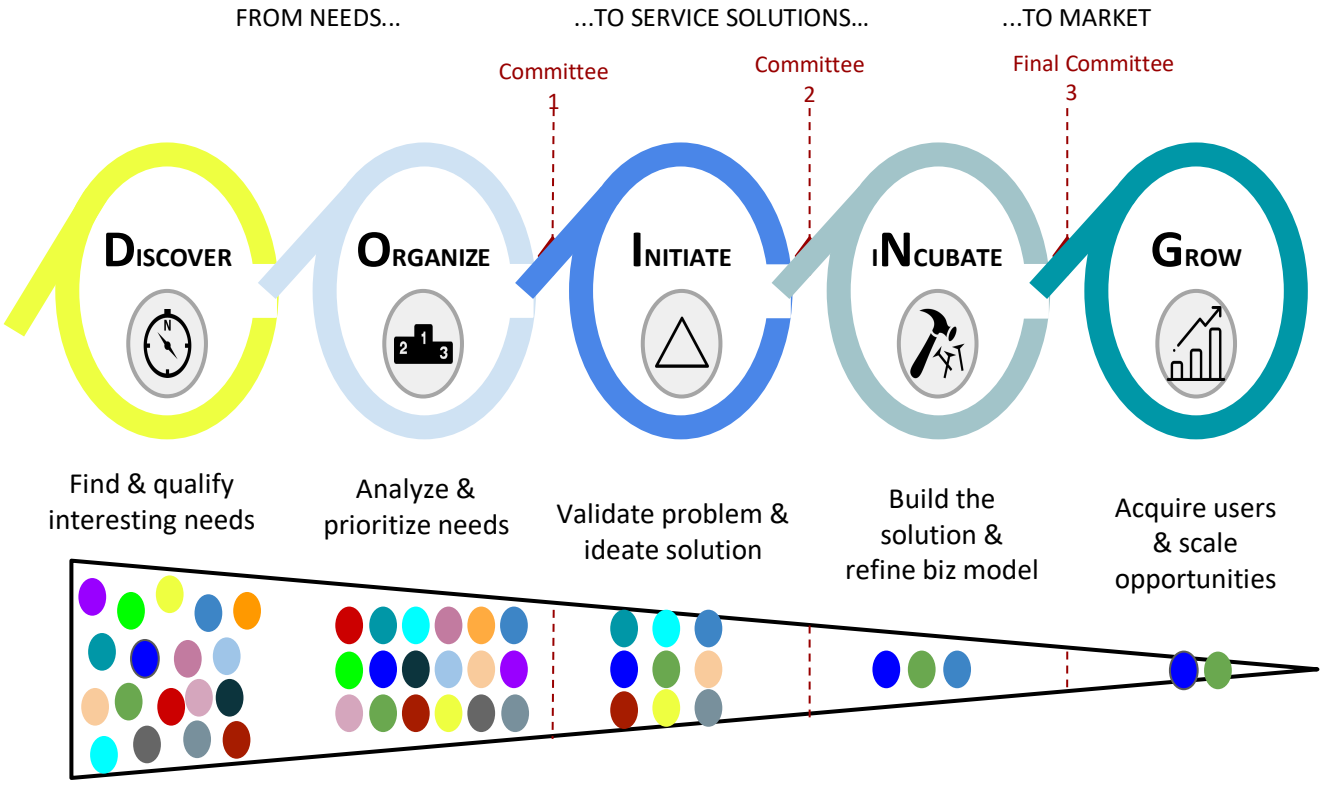
Further tasks of the last process stage consisted in testing customer acquisition behaviour and operational scalability of the service product. The innovation manager and his team had to develop a communication plan to reply to eventual questions of customers or official press demands. Likewise, an action plan had to be installed to systematically evaluate customer satisfaction and business monitoring to ensure and enhance the quality of the product.

4.4.9 The “DOING” process

The creation of this new service innovation process model, with the nomenclature of “DOING”, was delivered by the workshop methodology, the flow and the creativity of the working group participants. The participants developed a positive and healthy competition in their working groups. The conception of this “creative competition” between the two working groups was very supportive for the development of the “DOING” Process. Participants were focused and motivated, creating this new service innovation process. They fully understood and shared the necessity and the future need for this paradigm change within Mercedes-Benz. The result of the workshop consisted in a process model with an open innovation approach, the identification of customer needs, delivering service solutions and introducing them to the marketplace. On the basis of the “Stage Gate” process the members developed three innovation committees to secure the quality of the future service product across the various process stages. Design thinking in combination with the “Stage Gate” process were useful sources and a prodigious inspiration for the five different stages of “Discover, Organize, Initiate, Incubate and Grow”. The creativity of the groups and the power of innovation, coupled with the two mentioned processes, which were adapted to the Mercedes-Benz environment, allowed the development of a novel service innovation process model. The participants insisted on the practicability and the workability of the whole process in order to face the actual business environment and the organizational realities within Mercedes-Benz Spain. The five stages defined a complete, new process model from the identification of customer needs to concrete service solutions until the market introduction. The description of the respective goals defined the concrete content of each stage. The input description summarised the baseline for each stage and the tasks defined the work to be done by the different stakeholders. Likewise, the needed resources were mentioned in order to guarantee the effective execution of each stage.

The deployment of diverse metrics allowed measurable values, which showed the progress and the achievements of the different stages. This method was consequently applied during every single process stage to create a common, suitable frame for Mercedes-Benz Spain, as shown in the following figure. The detailed method of the seven building blocks guaranteed a similar and effective process frame to face the actual service challenges in the automotive sector, as shown in the figure 4.47.

Fig. 4.47. **The Framework of the "DOING" Process**



4.4.10 Discussion of the service innovation workshop

The intention of the first workshop consisted in the structured transformation of customer needs to service solutions. The outcome of the investigation contains a novel service innovation process model with an open innovation approach, which identifies customer needs, delivering service solutions and introducing them to the marketplace. To summarize the findings of the first workshop, a brand-new service innovation process model was developed for Mercedes-Benz. Correspondingly, this fact consists also in a limitation of the research. The process framework is exclusively developed for the Mercedes-Benz business environment through data collection by internal managers. The study exclusively examined current business challenges of the car manufacturer Mercedes-Benz. It could be potentially used for other OEMs`, but this should be investigated in further research or tested in a "real world" business environment. The main objective of the investigation is the creation of a systematic process to identify, gather and qualify customer needs and to transform them into valuable services in the Mercedes-Benz ecosystem. The practicability and the workability of the whole process were in the focus in order to face the actual business environment and the organizational realities within Mercedes-Benz Spain. The five stages define a complete, new framework, from the identification of customer needs, to concrete service solutions, until market introduction. Nevertheless, the SIPM was based on DT, Stage Gate and FFE processes (Cooper, 1999; Plattner, 2011; Kock, Heising and Gemünden, 2015) and influenced the participants to develop a specific SIPM for Mercedes-Benz. A mind-set change in the automotive industry is required to put the same importance on service innovation than on hardware innovation. Only through the integration of open innovation (Chesbrough, Vanhaverbeke and West, 2006) into a complete new framework, with the use of purposive inflows and outflows of knowledge, the acceleration of internal and external innovation is possible for Mercedes-Benz. The approach of open innovation acts as an enabler for new service solutions. Correspondingly, the reviewed literature indicated that open Innovation is a paradigm (Chesbrough, 2011a) that assumes that firms can use internal and external ideas for product-service innovation. The open innovation approach in a corporation represents a structured way to motivate customer-oriented and valuable services. The approach of open innovation and co-creation (Chesbrough, Vanhaverbeke and West, 2006) should help to discover customer needs and transform these into valuable services.

Therefore, the integration of OI into a new innovation framework was mandatory and the literature review underpinned the findings of the study. Likewise, customer value co-creation (Tommasetti, Troisi and Vesci, 2017) gained increasingly more relevance as a cutting-edge phenomenon in competitive markets and the approach of open innovation and co-creation (Chesbrough, Vanhaverbeke and West, 2006) should help to discover customer needs and transform these into valuable services. Moreover, the initial phase of the "Fuzzy Front-End Innovation" requires attention, since it is recognised as an important driver of positive results for new products and services (Kock, Heising and Gemünden, 2015). The new model gathered the voice of the customer and the expertise of automotive experts in terms of new mobility solutions immediately during the first stage (Discover stage) of the process. Therefore, the study developed methodologies to gather the voice of the customer and the expertise of employees in terms of mobility services. Design thinking in combination with the "Stage Gate" process were useful sources and a prodigious inspiration for the five different stages of "Discover, Organize, Initiate, Incubate and Grow" of the new "DOING" process. The Mercedes-Benz Corporation is working with an extremely complex hardware innovation process. The actual Mercedes-Benz Development System (MDS) is an engineered driven hardware process (Räse, 2010), which is designed around tangible products such as engines and other car components. The MDS is a modified application (Ettlie and Elsenbach, 2007) of the Stage-Gate model with its different quality gates in hardware product development. Due to its complexity, the MDS process was considered unsuitable for service innovation. Based on the evidence of the existing process models of the "Stage–Gate" and Design Thinking, the study developed a stage by stage design for the new innovation framework. The actual body of literature confirmed the approach of "Design Thinking" (Robert and Curedale, 2013; Schallmo, Lang and Williams 2018) and "Stage Gate" (Cooper, 2008) as vastly suitable for service innovation. Nevertheless, these two processes are inconsistent in terms of future service development through open innovation and co-creation. The intention of the third research question consisted in the structured transformation of customer needs to service solutions and how the Mercedes-Benz organisation can modify their current hardware innovation process to an open source framework, to better satisfy customer needs and expectations in terms of digital PSS. The result of the investigation consisted in a novel process model with an open innovation approach, which identified customer needs, delivering service solutions and introducing them to the marketplace.

In conclusion, the outcome of the study, as well as the actual body of literature confirmed the need for a new service innovation process model for Mercedes-Benz to achieve a competitive advantage in the automotive sector.

4.5 Introduction of the PSS workshop

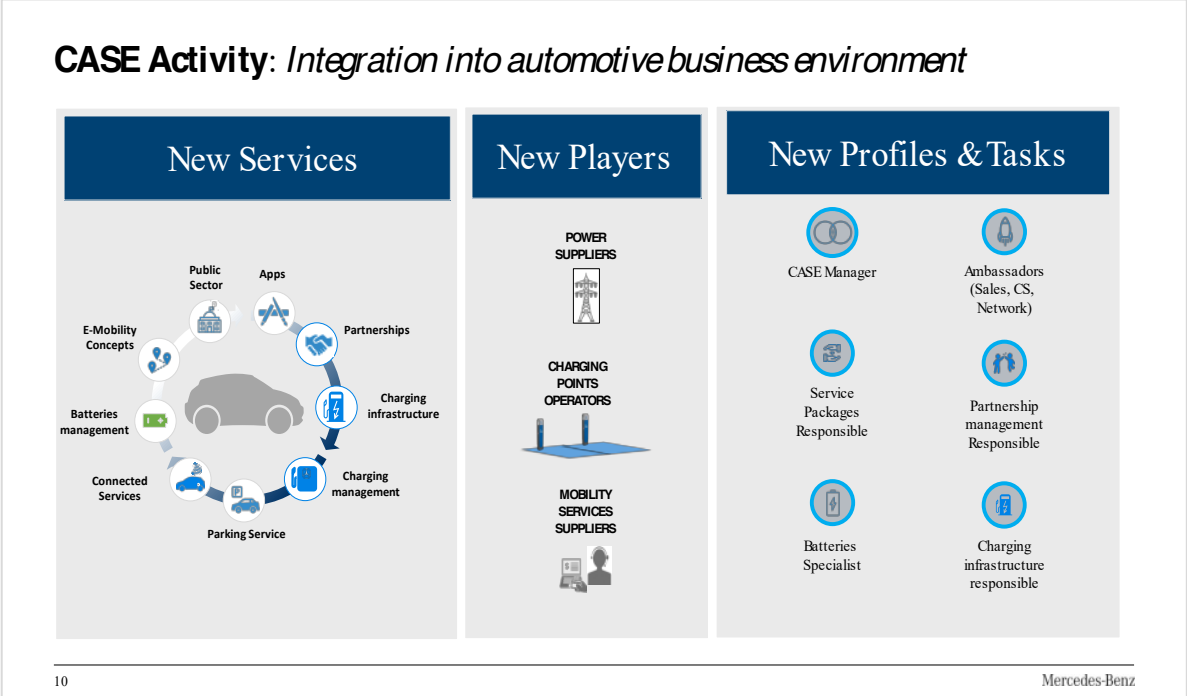
The world is changing more rapidly than ever before. New trends in mobility solutions are evolving and customer behaviour is changing promptly. Automotive companies have to satisfy this new demand for mobility services, connected to the vehicle and demonstrate, that the industry is prepared for this transformation. With regard to these challenges, the starting point of the second workshop was the creation of a diversified mobility ecosystem with the exploration of core digital services. The objective of the workshop was the exploration of a coherent product-service ecosystem and the conception of a new product service portfolio. The researcher introduced the already discovered customer needs of Unit I, as reference point, to incorporate these interesting needs into the second workshop. The guiding principles of the workshop were the identification, analysis and the transformation of needs into valuable services. The multi-disciplinary teams of workshops II explored a digital PSS development along the first three stages (Discover, Organize and Initiate) of the “DOING” process. The participants of workshop II were focused on customer needs and expectations to create the future Mercedes-Benz ecosystem. All workshop participants of the first workshop participated again, creating the necessary grip on the project. The working groups performed the first stages of the “DOING” process, qualifying, analysing, prioritizing needs and ideated first solutions. The workshop supported the immediate development of use-oriented service solutions and proved the workability of the “DOING” process. Likewise, the “DOING” process developed the potential as a novel methodology for service innovation in the Mercedes-Benz environment. The following section introduces the main findings of unit II and workshop II of the case study.

4.5.1 The current PSS status at Mercedes-Benz

Likewise, Mercedes-Benz is already developing new mobility services. At this point of the review it is necessary to analyse the actual status of PSS development at Mercedes-Benz. The research investigated current mobility services through the Daimler Intranet and official publications.

In addition to Mercedes products with high level of environmental compatibility and environmentally friendly and efficient production processes, Mercedes (Daimler AG, 2017) also strive to provide innovative mobility services on the road to emission-free driving. That is why Mercedes has developed a range of pioneering mobility concepts and are forging ahead with innovative approaches; from the car- sharing provider “car2go” and the mobility platform “moovel” to the taxi app “mytaxi” and the participation in the coach company “FlixBus” and the “Bus Rapid Transit “(BRT) system. Recent additions to this list were the service portal “Blacklane” and “Croove”, a car rental service operated by and for private individuals. The Mercedes-Benz strategy CASE (**C**onnected, **A**utonomous, **S**hared & Services, **E**lectric) is preparing the path for connection (Daimler AG, 2017) of all the future-oriented CASE areas. Daimler is on the way to transform itself from an automaker into a provider of mobility services. In the car segment, Mercedes will introduce at least ten fully electric models by the end of 2022. With “Mercedes me” in the car segment, “Mercedes PRO” in vans, and “Mercedes-Benz Uptime” in trucks, Daimler offers comprehensive access to brand worlds and services. And with the new “MBUX” infotainment system Mercedes has taken the theme of connectivity to the next level. Nevertheless, the new “CASE” organisation and other additional services within the Daimler group are starting to create valuable services. Categories of product- and use-oriented services will be available in future scenarios. Result-oriented services, such as car2go, which are already available in some major cities, are developed in the smart department of the corporation. The following figure presents examples of future, additional services, such as leisure time planning and concierge services, TV and media concepts, delivery services and autonomous refuelling.

Figure. 4.48. **Future Service Trend within CASE**



Source: Mercedes Benz Marketing & Sales/CASE (2018)

This example of Mercedes-Benz Case demonstrates that Product Service-Systems with integrated digital services do not unify all key elements (Williams, 2006) of a PSS in a single coherent system. The approach is a creative and a non-systematic innovation approach in post-sales activities. Connected vehicles and digital services are already an important purchasing criterion today. The development of these services is integrated in the Sales and Marketing area of Mercedes-Benz and not concentrated in the R&D department. Thus, three different development streams are responsible for automotive innovation. The R&D department is responsible for core product development, the CASE within the Marketing & Sales department and finally Financial Services for all mobility innovations. The innovation process as a whole is uncoordinated and not integrated under one roof in a complete Product Service-System development of Mercedes-Benz.

4.5.2 Main findings of the PSS workshop

The main challenge consisted in the reform of the traditional automotive ecosystem into a diversified mobility ecosystem to satisfy customer expectations and to explore the PSS development.

The participants submerged into the outcome of Unit I, especially into the identified needs and ideas of a PSS and the subject of a future Mercedes-Benz ecosystem. The aspiration of the first group work was the qualification of the seven already discovered needs and requirements for a MB ecosystem of Unit I.

Already identified needs of Unit I:

1. Switching the car whenever needed or desired!
2. Parking is a pain in bigger cities!
3. Polluting cars are not welcome in city centres!
4. How to interchange combustion engine and EQ car when needed?
5. Charging solutions for electric cars? (Where? When? How much?)
6. Special pricing offer as Mercedes customer for charging an EQ?
7. Internal corporate rental services for employees (smart EQ)!

Requirements of the future Mercedes-Benz Ecosystem of Unit I:

- Buying the right vehicle with adapted services
- State of the art connectivity and personal assistance with useful and tangible benefits for a “smart connected vehicle”.
- Persisting desire for product and service differentiation.

The desire to own a vehicle along with other options for access to diverse mobility functions a significant feature, as shown in next figure. Importance of services played a prominent role; the premium approach still maintained its value and makes the difference. Differentiation was similarly constructed through services and reinforced the sense of exclusivity and of ″ALWAYS HAVING THE BEST".

Fig. 4.49. **Example of Mobility App Bundles**

4.5.3 Qualification of customer needs

Seven working groups of two participants described and qualified the seven customer needs, incorporating the requirements of the future automotive ecosystem. The working groups applied the newly developed "DOING" process to transform customer needs into relevant services. The researcher assigned customer needs to seven teams in order to describe and qualify all seven identified needs.

Fig. 4.50. Seven need clusters Seven teams

Switching the car whenever is needed or desired!	WG/P1, WG/P5
Parking is a pain in the biggest cities!	WG/P2, WG/P4
Polluting cars are not welcome in city centers!	WG/P7, WG/P3
How to interchange combustion engine and EQ car when needed?	WG/P8, WG/P14
Charging solutions for electric cars (Where? When? How much?)	WG/P10, WG/P13
Special pricing for domestic EQ charging!	WG/P9, WG/P6
Internal corporate rental services for employees! (smart EV)	WG/P11, WG/P12

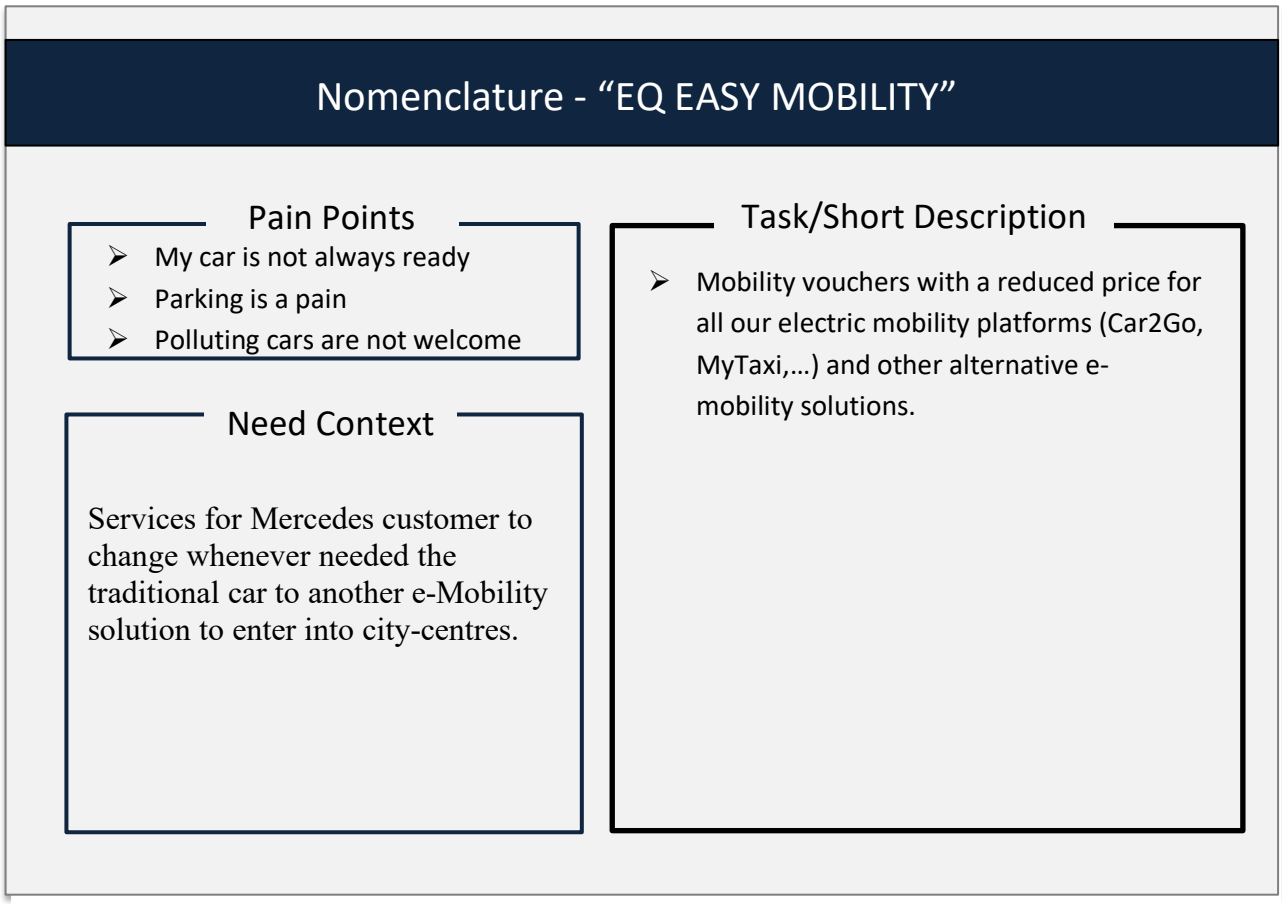
Corresponding to the “DOING” process, the researcher proposed this time a “three main parts logic” for all descriptions of the different needs. The researcher used a common frame to explain customer “pain points”, the need context and the final task of the potential, future service. In a first step, the groups explained the “pain points” of the customer. In a second step, they expressed the context of the need to better understand the subject. In a third step, they described the tasks and defined the content of the future service. After the qualification step, the working groups defined the nomenclature of the future service. Maintaining this logical frame throughout the identified seven needs, guaranteed a high-quality approach and an easier comparison for the later prioritisation. This exercise consisted of the first stage of the transformation from a customer need to a valuable service. The first group presented the need of “switching the car whenever needed or desired”, as a future, potential service solution. The participants labelled this service as “EQ Easy Mobility”, rendering instant, electric mobility solutions possible. EQ is the brand name of the new, electric Mercedes-Benz.

The main customer “pain points” were described as follows:

- My car is not always ready to drive, due to technical problems or other mechanical issues.
- Sometimes, it is not possible to park the car in the already saturated city-centres.
- The municipality of Madrid and Barcelona already banned combustion engines from their city-centres. Therefore, customers expressed the need for an interim solution to access to city-centres or introduce an immediate mobility solution.

The working group defined the need context as potential new services for Mercedes customers, changing the actual car towards another mobility solution, whenever needed or desired. The task of the future service was portrayed as a fast and easy solution, such as supplying mobility vouchers with reduced prices for already existing Mercedes-Benz mobility platforms (Car2Go, MyTaxi, Moovel). The second task consisted of the possibility to change the actual car for an EQ Mercedes, as shown in the following figure 4.51.

Fig. 4.51. **1. “Switching the car whenever is needed or desired”**

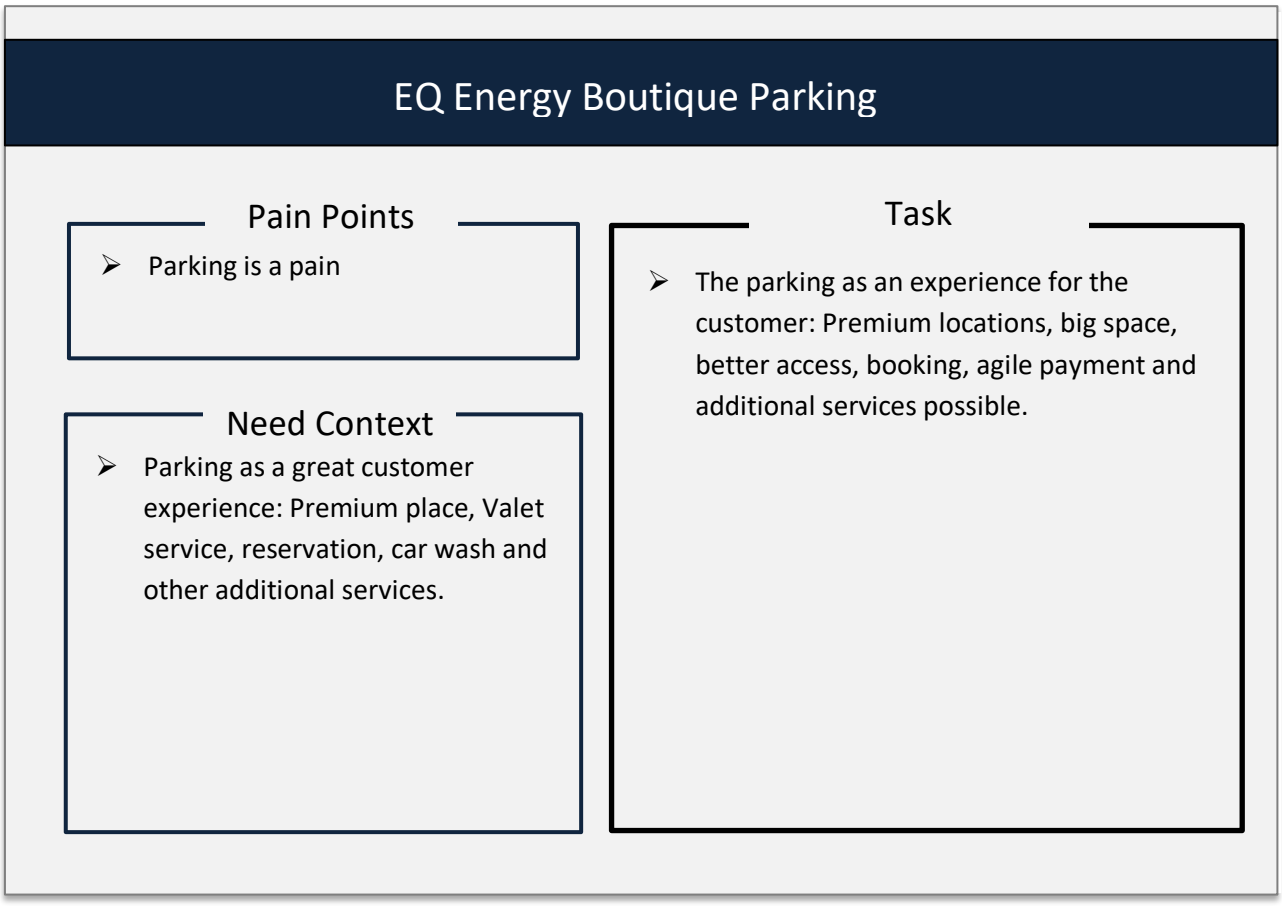


The second working group presented the need of “parking is a pain in bigger cities”, as another potential service option. The group baptized this service as “EQ energy boutique parking”. This approach resulted in converting a customer “pain point” (not finding a parking) in an excellent and unexpected customer experience. The main customer “pain points” were described as follows:

- Arriving in saturated city centres and exasperating to look for a parking was acknowledged to be a real pain and a stressful situation.

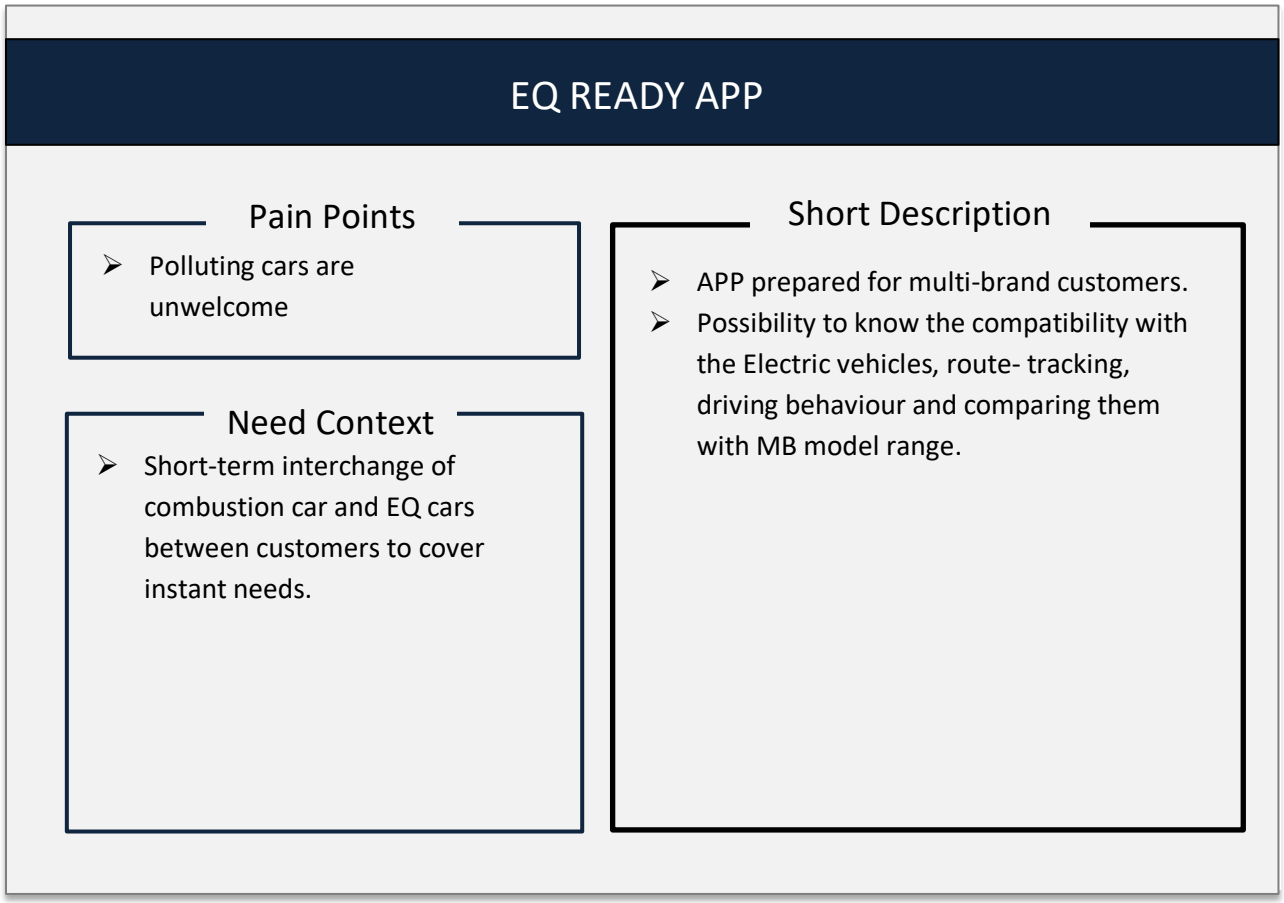
The working group defined the need context to transform a parking trauma into a great customer experience. Giving the possibility of pre-reservation of a premium car slot with valet parking-service. Other services, such as car wash, vehicle fill-up and other additional services were proposed from the group. The task of the future service was designed as a parking experience for the customers in premium locations with bigger spaces, better access, easy-booking service, agile payment and other additional services (see next figure 4.52.).

Fig. 4.52. **2. “Parking is a pain in bigger cities”**



The third project was presented as the need of “polluting cars are not welcome in city centres”, which at the same time was the essential “pain point”. The participants labelled this service as “EQ Ready App”, rendering an instant, electric mobility change possible. The group defined the need context as a short-term interchange of combustion cars and EQ vehicles between customers to cover instant, but different mobility needs. The participants described this exchange of vehicles between customers with the following example. A customer (A) needs to go for a few days downtown for business (need for an electric car), customer (B) needs to go for a business trip in a far-away town (more than 250 km). Via an application, multi-brand customers could interchange their vehicles for a sustainable mobility solution. The task of the future service (see Fig. 4.53.) was defined as a platform prepared for multi-brand customers. This application would give the possibility to recognise the compatibility with Mercedes-Benz electric vehicles. Other features would be a permanent route-tracking, driving behaviour and comparing them with the EQ model range as an extended test drive.

Fig. 4.53. **3. “Polluting Cars are not welcome in City Centres”**



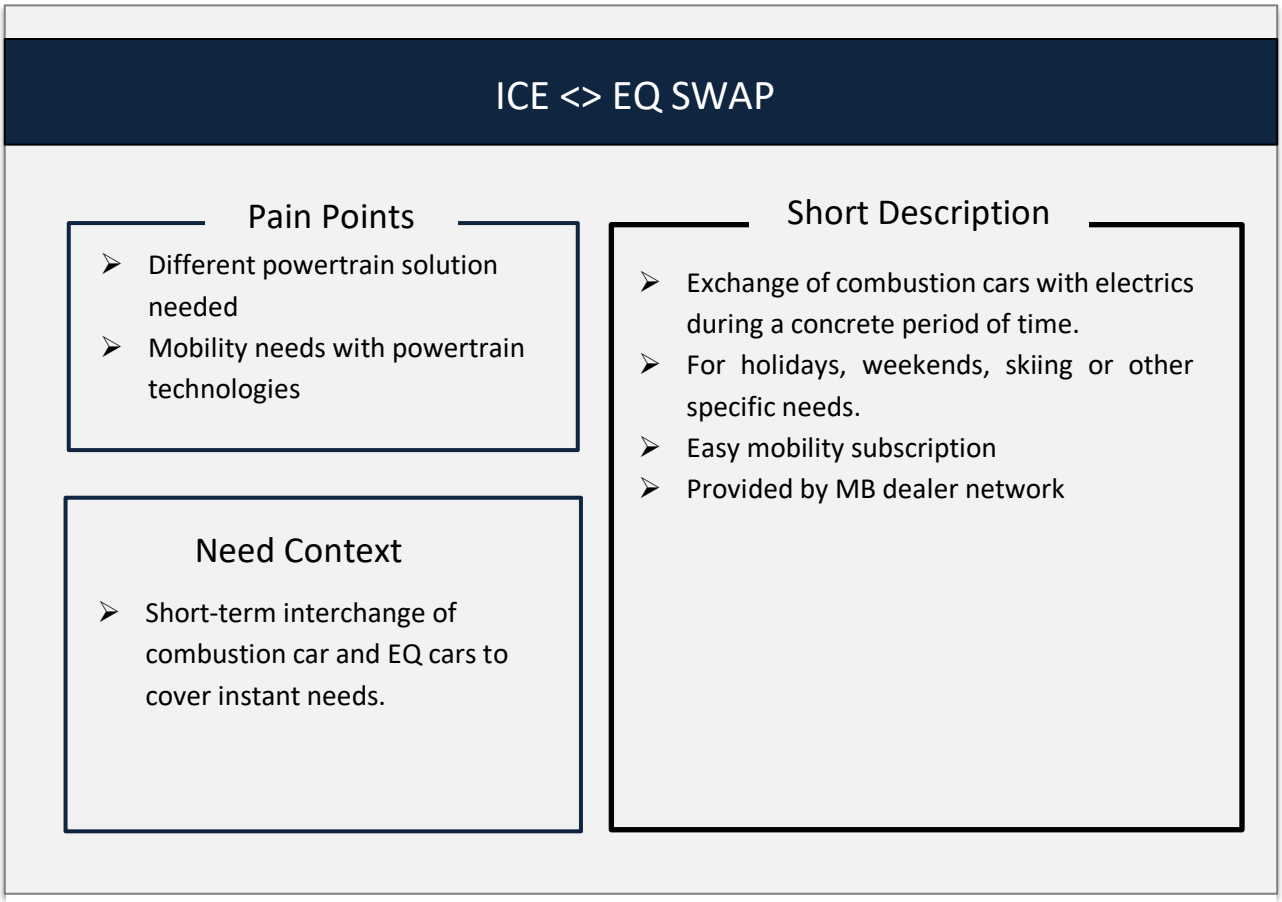
The fourth group portrayed the need of “how to change a combustion engine Mercedes for an EQ vehicle when needed and vice versa”. The participants categorized this service as “ICE (Combustion engine) - EQ (electric vehicle) Swap”. The main customer “pain points” were described as follows:

- The powertrain technology is not always adapted to the potential mobility need.
- Therefore, customers expressed the need for an interim solution with a different powertrain technology.

Changing the combustion engine to an EQ or vice versa, taking in account business trips, week-end tours and other short-term mobility needs. The working group defined this need context as a short-term interchange of combustion car and EQ cars to cover instant mobility needs, due to powertrain requirements. The task of the future service was portrayed as a fast and easy mobility solution via a digital user platform. Customer could change combustion and EQ cars during a concrete period of time with customer-friendly subscription costs as shown in the next figure 4.54. These mobility solutions were provided by the nearest Mercedes-Benz dealer.

4. **“How to change my combustion engine for an EQ vehicle** ”

Fig. 4.54.



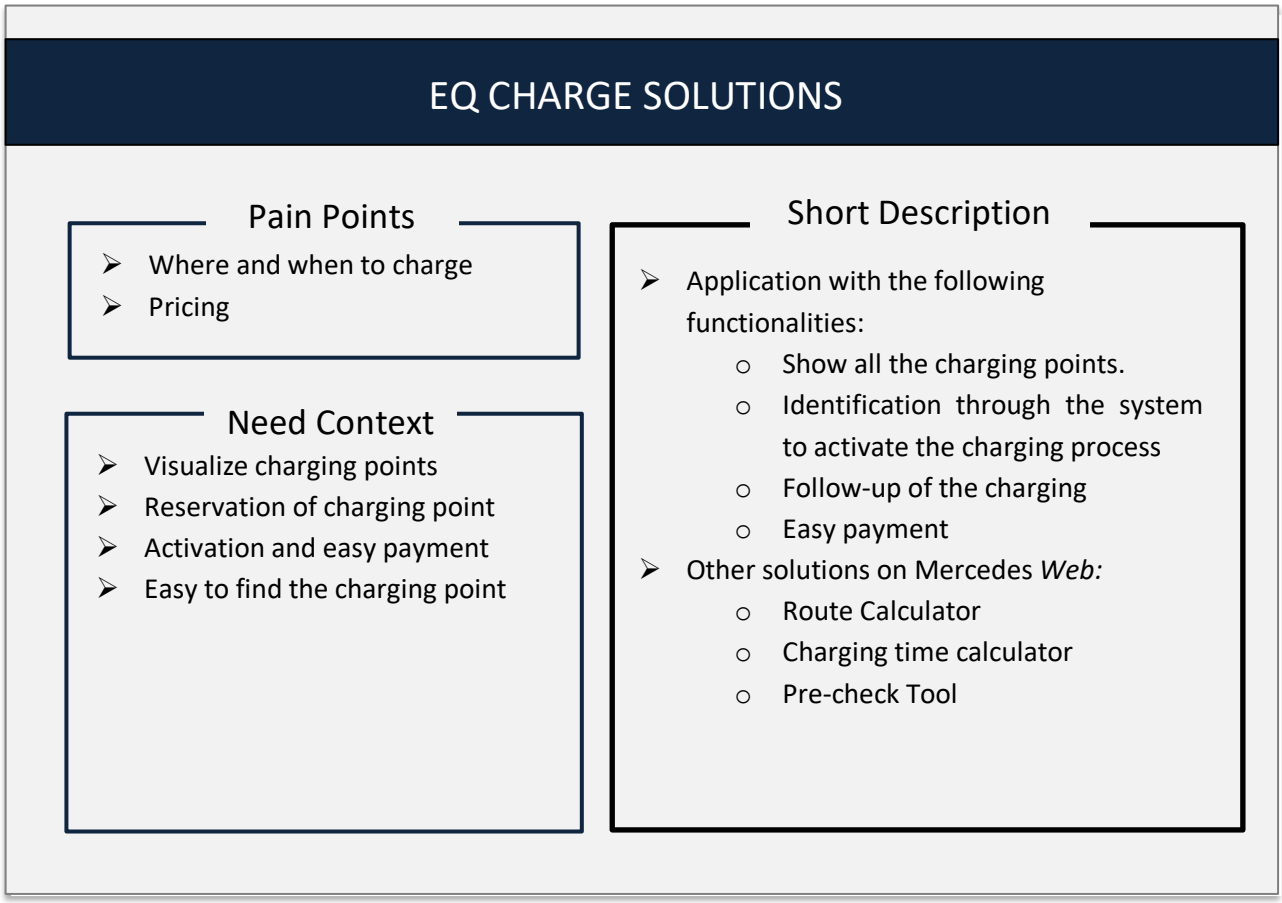
The fifth project was presented as a need of “charging solutions for EQ cars (Where? When? How much?), as a potential service solution with instant consumer advantages. The participants labelled this service as “EQ Charge solutions”, providing a convenient service for electric mobility. The customer “pain points” were described as follows:

- Easy approach and information about charging infrastructure for EQ vehicles with available electricity pricing.

The need context was defined as new services for Mercedes customers, visualizing and reserving charging points, enhancing the process of recharging, paying and finding the nearest charging point. The task of the future service was designed as an application to show all available free charging points. A service application including an easy activation and payment via customer ID. Additional Information about charging status, time calculator and route planer should also be incorporated as shown in the next figure 4.55.

5. “Charging solutions for EQ cars”. (Where? When? How much?)

Fig. 4.55.



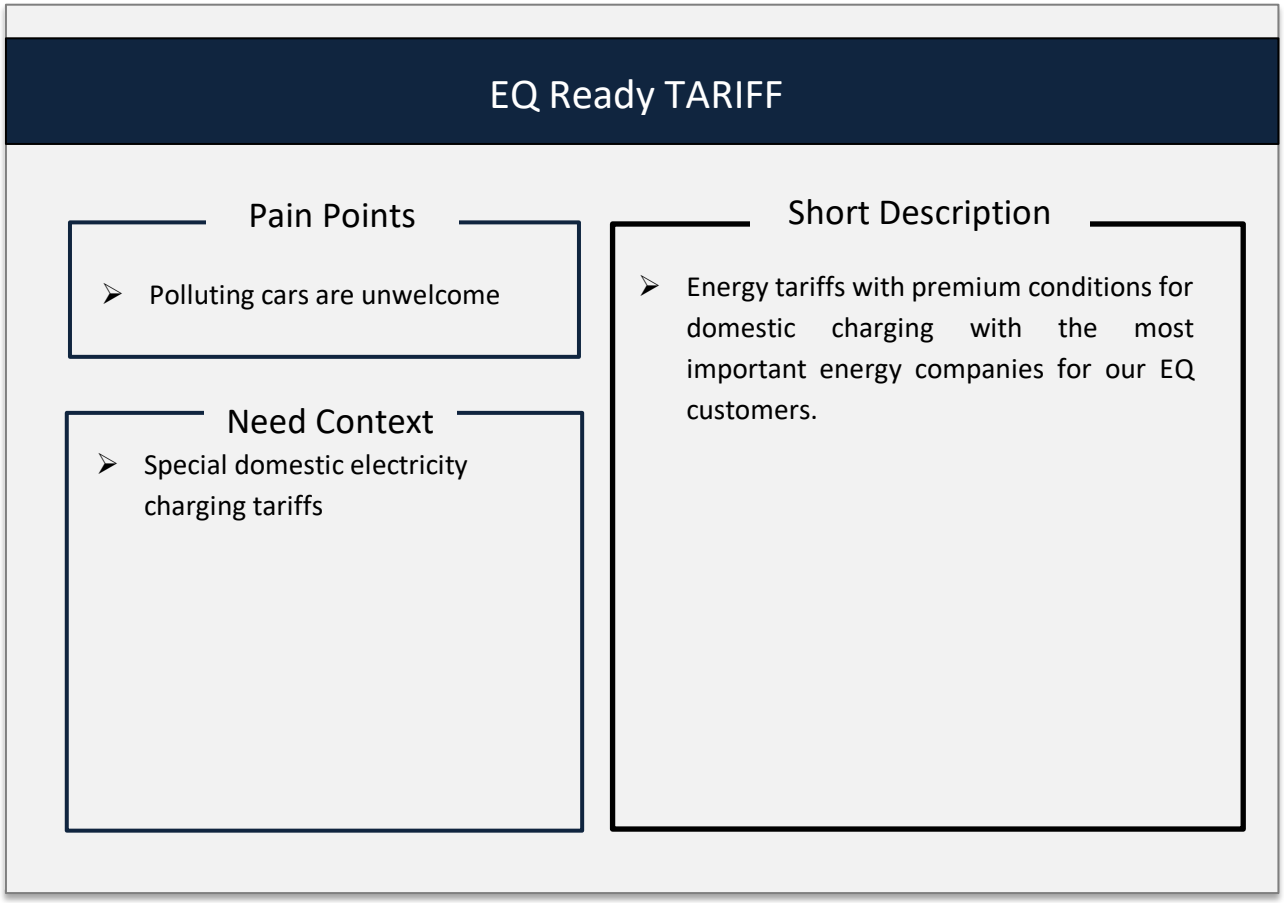
The following project was presented as an extension of the EQ charge solutions for domestic needs. The project was baptized as “EQ Ready Tariff”, providing a convenient domestic charging service. Actual customer choice for buying electric cars was mainly analysed for the advantage to access freely city centres. Therefore, the “pain points” were described as follows:

- Polluting cars unwelcome in city centres.

The need context was designed as a convenient service for EQ customers, expecting a special price offer for domestic charging. The task of the future service was designed as special energy tariff for domestic charging with the most important energy providers in Spain, as shown in the next figure 4.56.

6. **“Special pricing offer for domestic EQ charging”**

Fig. 4.56.



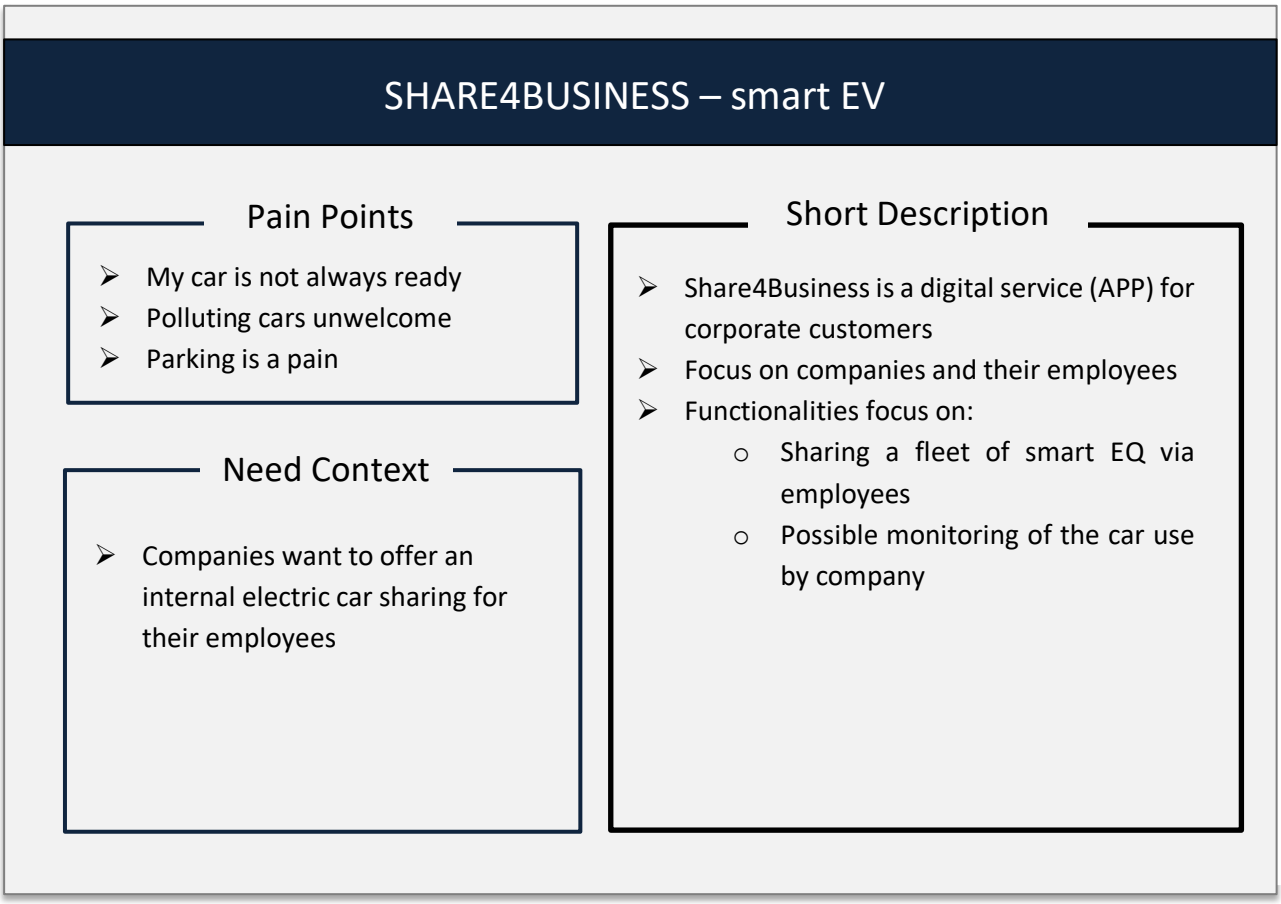
The last group presented the need of an “Internal Corporate Rental Services for employees”, as a future mobility service solution for corporations. The participants labelled this service as “Share4Business”, providing electric mobility solutions for companies. The main customer “pain points” was described as follows:

- It is not possible to park the car in the already saturated city-centres
- Combustion cars have no access.

The working group defined the need context as mobility services for companies. These companies expressed the need for an easy mobility solution linked to a car-sharing model for employees with an electric car fleet. The task of the future service was portrayed as an instant mobility solution, via an application service for corporate customers and their employees. Several functionalities were required to focus on fleet car sharing for smart EQ to enhance the efficiency in a corporation. A possible monitoring of the car use by company was also required, as shown in the following figure 4.57.

7. “Internal Corporate Rental Services for employees” (smart EV)

Fig. 4.57.

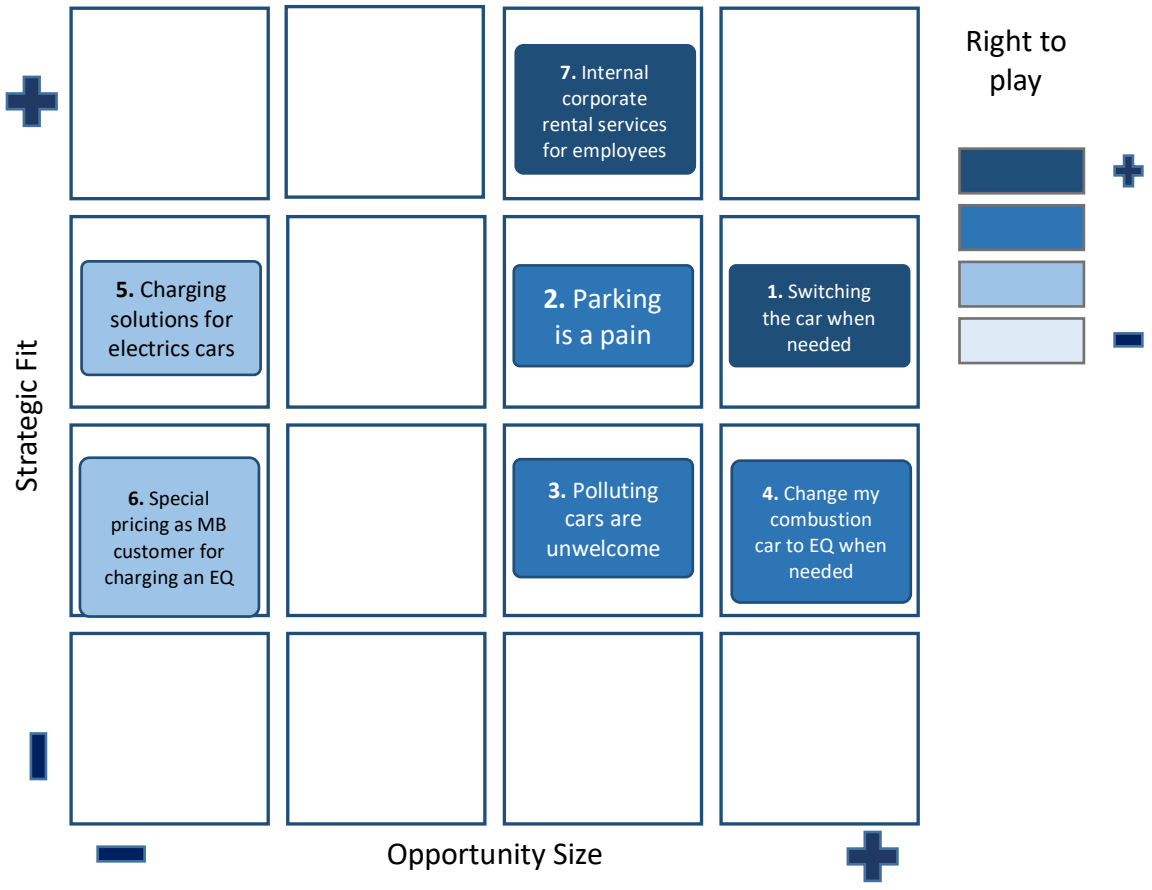


4.5.4 Prioritization of customer needs

The second group work was designed to elaborate on the second stage of the "DOING" process. The seven groups worked on the "Organize" stage in order to prioritize the seven qualified potential services. The researcher proposed the integration of the qualified needs into a three-dimensional meta-planer, as shown in the next figure. The "opportunity size" was transferred on the x-axes, the "strategic/market fit" was transmitted on the y axes. The different blue tones, as third dimension expressed the "right to play". All groups had to present in a five minutes "pitch" their reasoning for each qualified need.

8. Qualified needs by assessing the "opportunity size", the "strategic fit" and "right to play".

Fig. 4.58.



The following common discussion determined the place of each need in the coordinate system. All groups evaluated each of the seven needs according to the following parameters:

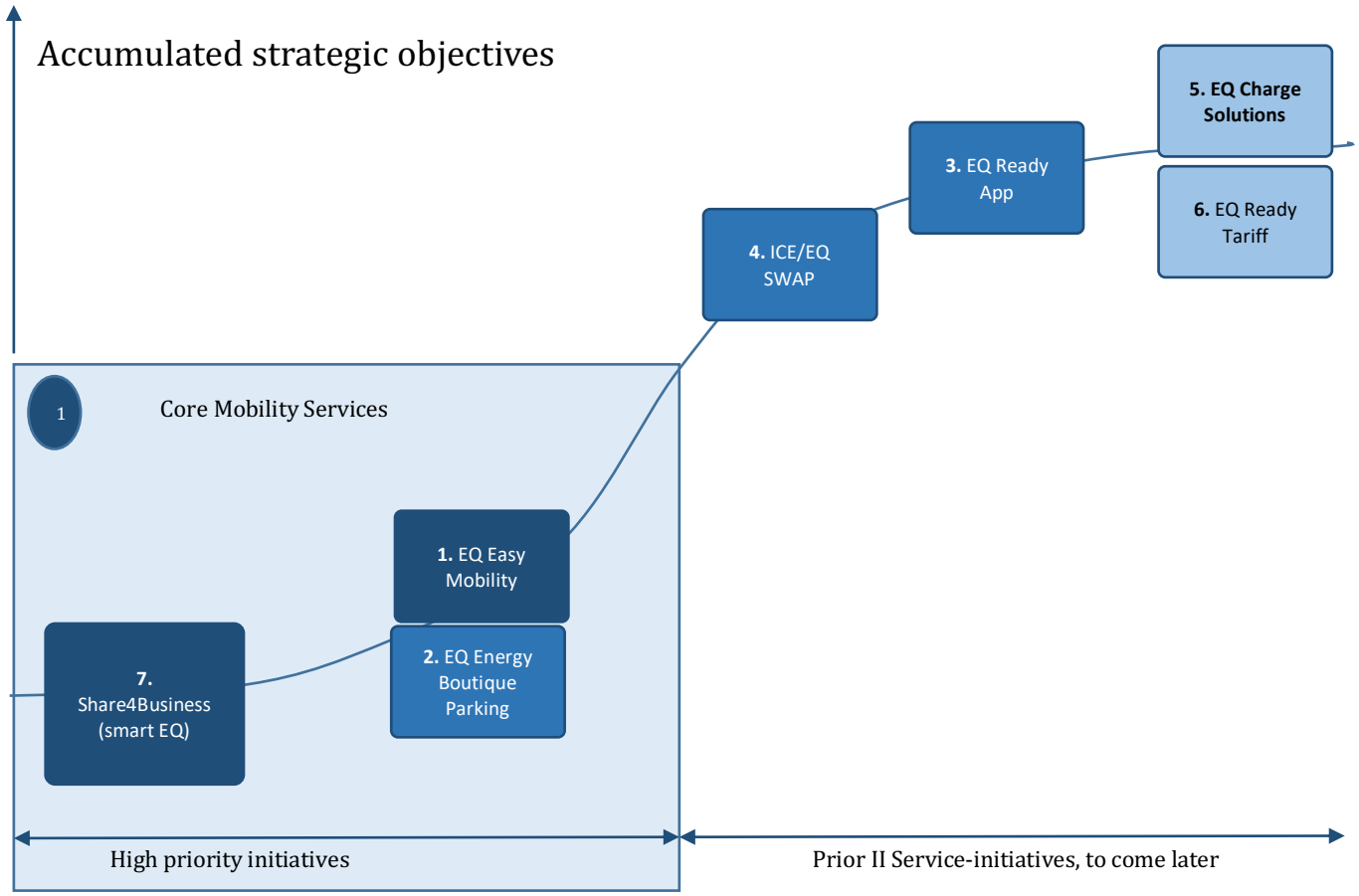
- **Opportunity size**
  Valuable and profitable service, growth potential, potential as a future
- **Strategic/Market fit**
  New services, automotive ecosystem, fit to the Spanish culture and market
- **“Right-to-play” for Mercedes-Benz**
  Fit into the MB ecosystem, compatible with MB technology

The discussion of the second working group determined the ranking of potential services in two clusters. All participants debated the ranking between the three strategic objectives and the decision of “Prior I” or “Prior II” of a future project launch. The first cluster indicated the high priority mobility services, such as Share4Business, EQ Easy Mobility and EQ Energy Boutique Parking. The second cluster determined the “Prior II” mobility services, such as ICE/EQ Swap, EQ Ready App, EQ Ready Tariff and EQ Charge solutions. The participants divided high priority services and other service initiatives, in order to start with one concrete service project and the third stage of the “DOING” process. The service project “Shared4Business” was chosen unanimously to be the most promising project to launch. Likewise, this exercise initiated the creation of the Mercedes-Benz ecosystem with a core Service-Product portfolio of seven potential new mobility services, as shown in the following figure 4.59.

The starting point to create the Mercedes Ecosystem:

"Core Mobility Service-Product Portfolio"

Fig. 4.59.



The third and last group work elaborated the third stage of the "DOING" process. Therefore, the researcher changed the composition of the groups to two groups of seven participants, in order to operate the last working group. The two groups worked on the "Initiate" stage to define the specifications of the MVP for the "Share4Business" service project. The main outcome of this high-level approach was the starting point of a future IT-application with the following specifications:

- Employee of a corporation, the user validates the reservation of the smart EQ.
- A 7/24 operator gives assistance when needed (accident, inoperative, etc.)
- Corporation has all control and reporting (tracking, accident, ticket/fine, etc.)
- Lock and Unlock via mobile (technology from Car2Go)

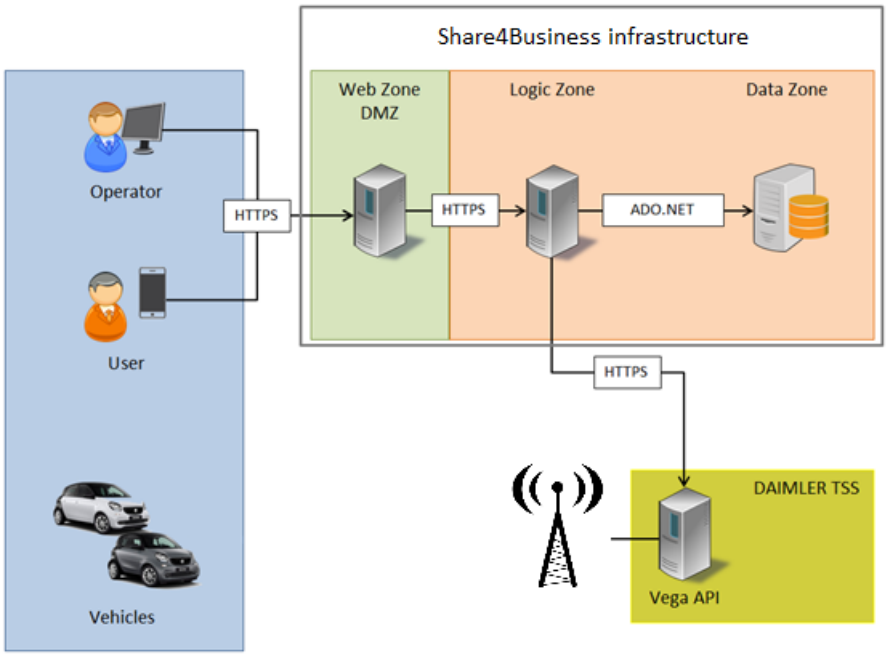
The second part of this working session consisted in the specification of the IT-system for the project. The main outcome of this session was the beginning of the subsequent IT specifications:

- Three applications: 2 for mobile devices (IOS, Android) and one web for operators
- Connection with the car through the mobile network
- Share use of the APP by companies with a physical separation of the data
- Flexible, with the possibility of customization of one layer by the company
- Modular, following the last design patterns
- Scalable system, ready for a deployment plan for high availability
- Secure system, with an ethical elaborated by specialists

The following figure 4.60., represents a simplified illustration of the specification of the “Share4Business” service.

INCUBATE PHASE: “SHARE4BUSINESS”

Fig. 4.60.



Source: Mercedes-Benz Spain, S4B Project Team

As a final result of the workshop, the study introduced the finalized specifications for the “Share4Business” minimum viable product (MVP) application. Moreover, the workshop outcome introduced a new service-product portfolio for the creation of a Mercedes-Benz Spain ecosystem.

4.5.5 Discussion of the PSS workshop

The result of the second workshop involved the elaboration of a diversified mobility ecosystem. Another outcome of the investigation consisted in the starting point of a core mobility service-product portfolio with several initiatives. The findings presented the concrete implementation of the first three steps of the new “DOING” process framework until the elaboration of the specifications of an MVP for the “Share4Business” application. The MVP elaboration consisted in a vital step for the exploration of a digital PSS. Following the different stages of the “DOING” framework with the “Share4Business” project, the study introduced the creation for a PSS development in a proper Mercedes-Benz ecosystem. To summarize the findings, a core mobility service-product portfolio was created and the “DOING” process model was applied in the automotive business with the creation of a valuable mobility service within Mercedes-Benz Spain. Correspondingly, this outcome consists in the same limitation then the outcome of the first workshop, which is the limitation to the Mercedes-Benz environment. The “DOING” SIPM and the mobility service-product portfolio were exclusively elaborated for Mercedes-Benz Spain and only further research and/or testing could demonstrate the usefulness for the whole automotive sector. The main objective of the investigation was the reform of the traditional Mercedes-Benz ecosystem towards a diversified mobility ecosystem. Through the development of a diversified mobility ecosystem, Mercedes-Benz would be able to gain a USP in the marketplace. This newly developed product-service portfolio stands for a diversified and customer-oriented PSS. Likewise, the practicability and the workability of the new “DOING” framework in the actual business environment proved the validity of the novel SIPM. Moreover, the findings of the literature review confirm the relevance of a PSS approach (Cherubini, Lasevoli and Michelini, 2015) as a relevant factor for the purchase decision. The challenge and impact of digitalization in the automotive industry consists of a lack of a complete framework of emerging trends of “servitization” in one conceptual digital structure (Lerch and Gotsch, 2015).

The literature review also showed the evolution of service bundles to a digitized PSS (Lerch and Gotsch, 2015). The findings of the workshop went even further than the actual body of literature, which discussed so far digital PSS developments. The actual study showed the necessity towards a diversified mobility service ecosystem in the automotive environment. The development of a Mercedes-Benz owned PSS, based on digital services in a proper ecosystem, defined the starting point for the development of a competitive advantage in the sector. The study demonstrated the necessity of the application of a new service innovation process model and the design of a digital PSS in the Mercedes-Benz organisation. In conclusion, our investigation, the actual body of literature are both coherent and underpin the necessity for a diversified mobility ecosystem for the automotive business.

4.6 Implementation phase of the “DOING” process model

4.6.1 Introduction

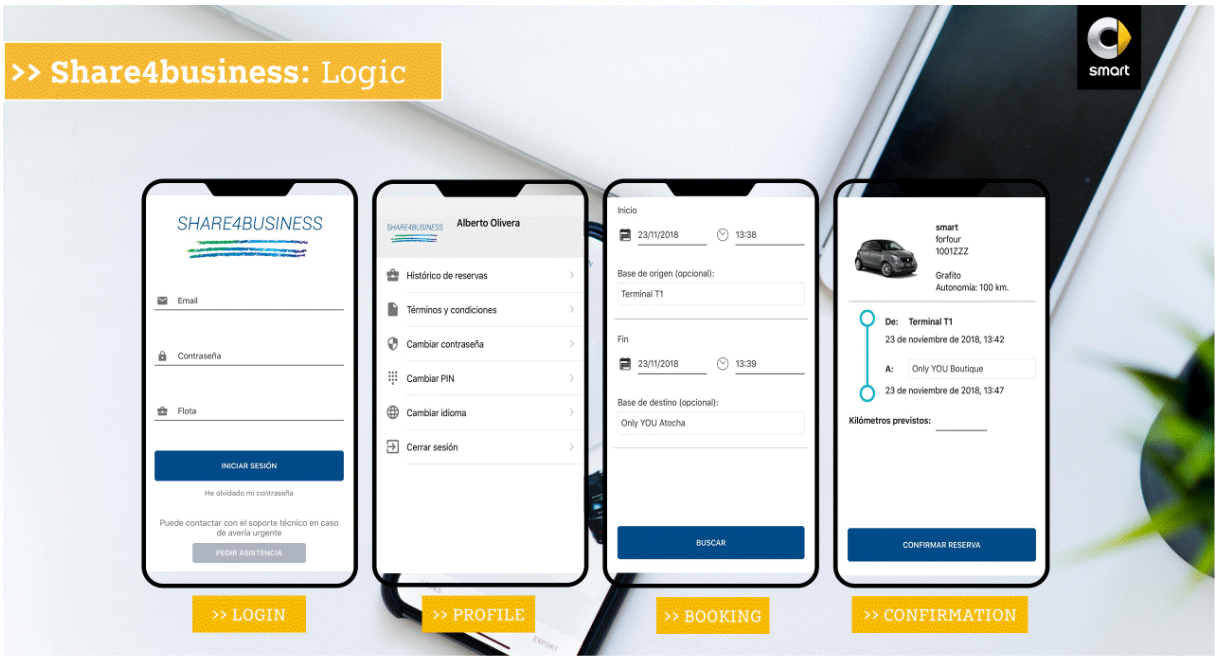
After the execution of both workshops, the “Share4Business” service project was integrated in the official “DOING” project team of the Spanish Mercedes-Benz organisation in the real-world business environment. Consecutively, the executive board of Mercedes-Benz Spain appointed the project team of the “DOING” process organisation.

4.6.2 Implementation and governance of the process

The newly appointed project team executed the “Incubate and Grow” stages according to the process. The main challenge of the “Incubate” stage consisted to build the final service solution and to refine the business model of the “Share4Business” application. This challenge was executed in the Mercedes-Benz organisation from end of May 2019 to September 2019. Due to the importance of the project for the company, the committee members of the “DOING” process consisted of the current executive board of Mercedes-Benz Spain. The researcher and CEO enlarged his role to the function of project sponsor. This approach and the sponsor function allowed the researcher and CEO formal and informal discussions with the innovation manager and the project team. The sponsor was in the position to give guidance, share experiences, discussing important matters and to further guide the research. The implementation consisted in a very important aspect of the research and the company.

The technical development advanced promptly with concrete outcomes and by the end of September a finished product was presented to the project sponsor, according to the “DOING” process stages. The application was developed with an intuitive customer approach in a four “click” design of login, entering the profile, booking and confirmation. The user had to login the application and create his profile. In a next step, the user could already reserve an electric smart from his company fleet and confirmed the travel in the application, as shown in the next figure 4.61.

Fig. 4.61. **“Share4Business” LOGIC**



Source: Mercedes-Benz Spain, S4B Project Team

The innovation manager and his team designed a high-quality service product with a 100% electric smart fleet, a sustainable inner-city mobility approach, compliant with regulations in Spanish metropolitan areas, an efficient vehicle utilization within the corporation and an efficient monitoring of vehicles and business travels of the employees, as presented in the next figure 4.62.

Fig. 4.62. **Unbeatable Proposal**

Source: Mercedes-Benz Spain, S4B Project Team

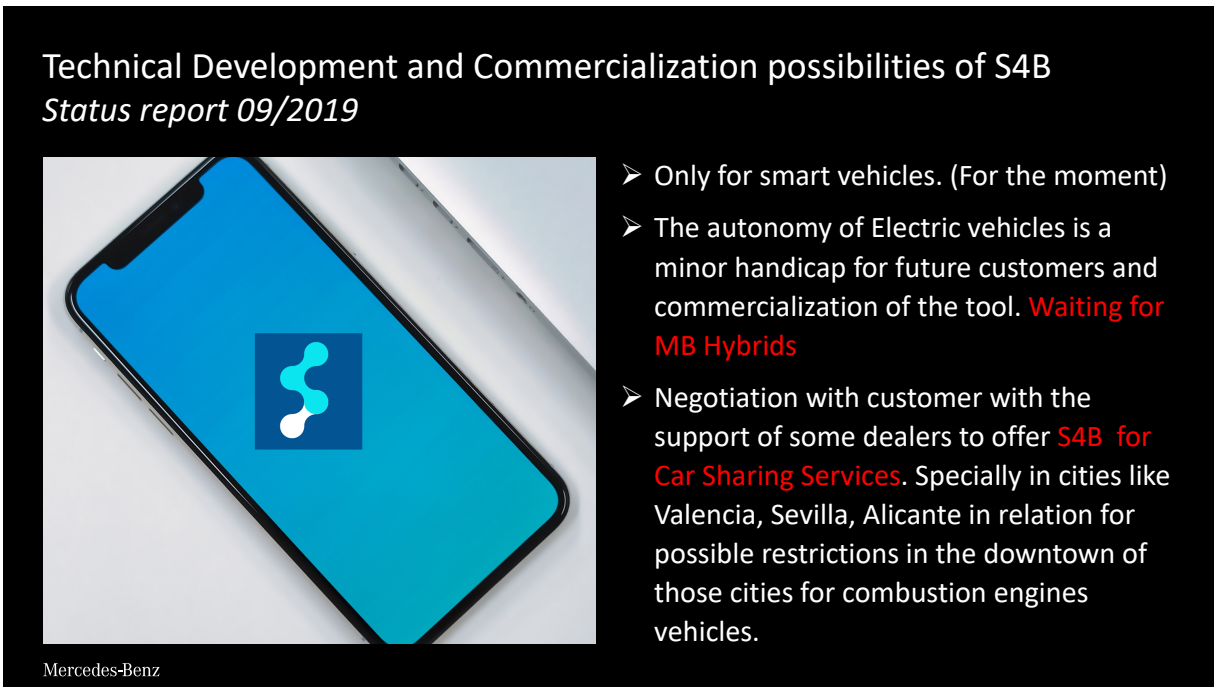
Moreover, the team developed a personalized but competitive market proposal with an attractive margin model for the dealer network, which is the exclusive sales partner for the service product, as shown in the next figure 4.62. The proposal consisted in a vehicle option of 1000€ per smart. This offer could be chosen like any other vehicle option from the pricelist; undeniably an easy and customer-oriented approach. The license cost and the 24/7 technical support were remunerated in a monthly fee of 30 euros. From the very beginning, the customer could choose between the basic and premium package, which consisted basically in a different reporting tool, customised for individual company needs. The dealer, as responsible sales force received a 200-euro commission per vehicle, as shown in the following figure 4.63.

Fig. 4.63. **Revenue Model**

Source: Mercedes-Benz Spain, S4B Project Team

The innovation manager regularly presented the project development to his sponsor and to the "final committee" members in September 2019, as shown in next figure 4.64.

Fig. 4.64. **Status Report September/ Final Committee**



Source: Mercedes-Benz Spain, S4B Project Team

After the successful presentation in the final committee, the next project phase was initiated. The “Grow” stage consisted in acquiring customers and scaling all possible opportunities. From October onwards, the project team acquired the first company from Madrid with a smart fleet of ten cars, equipped with the “Share4Business” service application. The service went live in a pilot phase with a Spanish company called “Unidad Editorial”. This editorial company is based in Madrid and has several offices in the city-centre. The company used the car fleet for internal car-sharing, in and around of Madrid. The company has several locations in the area of Madrid and the employees used our “Share4Business” service mainly to drive to other company locations or for meetings in the city-centre. The project team had the opportunity to monitor the results out of the pilot and applied corrective measures to increase the service level, as presented in the following status report to the sponsor in figure 4.65.

Fig. 4.65. **Status Report November**

Source: Mercedes-Benz Spain, S4B Project Team

The results of the pilot phase were very promising, and the application found the appreciation of our customer. The customer was satisfied with the general service and the utilisation, which decreased internal travel cost of the company. Moreover, the employees were convinced by the easy approach and the immediate availability of the smart vehicles. The project team analysed relevant data and customer feedback to further improve the service application.

Interesting recommendations were presented in the last status report in December 2019. The team strived for the technical integration of the “Share4Business” service into all Mercedes-Benz vehicles, which could have a huge potential in terms of fleet business for the brand. A customer feedback argued an automated analyse tool for vehicle booking, city-centre parking reservations and integrated payment. The team reflected also the possibility of a vehicle tracking tool to allow the anticipation of future customer needs according to their travel behaviours. To summarize, the pilot phase was very successful and new ideas were generated to improve the digital application. The “DOING” process was tested in a real-world business environment with an authentic customer and proved its practicability. The genuine service application “Share4Business” found its way to the customer and his appreciation.

Fig. 4.66. Status Report December

Source: Mercedes-Benz Spain, S4B Project Team

4.6.3 Discussion of implementation phase

The implementation phase of the research and the integration of the service project into the “DOING” project team allowed the development of a coherent mobility service offer. The implementation phase of the “Share4Business” service project supported two main key findings.

Likewise, the practicability and the workability of the new “DOING” innovation process in the actual business environment and the organizational reality of Mercedes-Benz Spain proved the validity of the novel SIPM. Secondly, an identified customer need was transformed in a concrete service proposal and the “Share4Business” application found its way to the customer. The transformation from a need to a valuable service obtained the appreciation of the end customer (Unidad Editorial), who was willing to remunerate a valuable mobility service solution. The researcher enlarged his role model to the function of sponsor. By these means, the researcher could guide further research and maintain a close relationship to the project team and the study. The switch of different roles in the final phase of the study, from researcher to CEO and sponsor was challenging but interesting. The professionalism and speed of the project team was unexpected in its results. The team was highly motivated to participate in the study and with his open and agile approach, the team achieved concrete results. The setup of the project team, according to the “DOING” process, was efficient. Nevertheless, the choice of the right people was an important aspect for the success of the project team. Few members of the team were exchanged during the implementation phase, due to the lack of competence or capabilities.

4.7 Summary of key findings and responding the research questions

The following section will present key findings, their stimulus and link to the responses of the four research questions. Similarly, these findings present the important correlation to contribution to knowledge in the subsequent conclusion chapter. The summary concludes the outcome of the entire investigation, from in-depth interviews and both workshops.

4.7.1 Forces of change and the impact on the automotive industry

Via the first research question (**how do external forces of change impact the automotive industry?**), the study aspired to understand external forces of change (Choo, 2001; Reinhardt *et al.*, 2017; Watts, 2020) and how they were impacting the automotive industry. The world is constantly changing and with these changes new risks arise. To anticipate these potential risks, organisations scan the environment in order to understand these external forces of change and react in an appropriate manner. The researcher executed a brief environmental scanning (Choo and Auster, 1993; Reinhardt *et al.*, 2017) of the current business area of Mercedes-Benz Spain.

The main outcome of the interview rounds, in combination with the brief scanning, identified political, environmental, social, legal and technological forces of change, in the Spanish automotive environment. The forces of change (Watts, 2020) created important impacts on the automotive business and additionally, these changes were interrelated. The research investigated political and legal changes (European Commission, 2018) and the impact of emission free driving and the trend towards "eco-friendliness" (Schöttle, 2018; Xu, Prybutok and Blankson, 2019). These trends had a direct impact on the technological development of OEMs`. Social and demographic changes indicated a new approach in using mobility. The changing customer demand created new mobility trends (Vecchio and Tricarico, 2018) and alterations in purchase decisions. Based on a qualitative analysis on the key drivers of change (Watts, 2020), it can be concluded that several external forces of change are impacting the technological development of the automotive industry and the future of mobility solutions. The body of literature discussed environmental scanning and immanent changes in a broader form but could not respond to a specific scanning in the automotive environment and their resulting forces. Thus, the researcher executed a brief scan of the automotive environment. The environmental scan (Choo and Auster, 1993) could be executed in a more focused way to gather further potential threats and trends. Nevertheless, the scanning allowed the identification of different forces of change, which are impacting the current mobility environment. **Due to the spotted forces of change, the study identified the correlation of new mobility solutions and the link to digital services as main impact on the automotive sector.**

4.7.2 Internal and external perspectives on individual mobility

The second research question (**what are the internal and external perspectives on individual mobility needs and connected services in the automotive industry?**) investigated internal and external perspectives on individual mobility needs and connected services in the automotive industry (Audenhove *et al.*, 2018; Vecchio and Tricarico, 2018). The researcher analysed the internal perspective of Mercedes-Benz managers and the external perspective of automotive experts and customers. The desire of car ownership still remained authentic, but technological progress and new mobility trends are currently changing the attitude towards individual mobility.

The integration of services to the hardware (vehicle) proposal was identified as the main response to current customer needs (Mont, 2002; Manzini and Vezzoli, 2003).

Only through the integration of valuable premium services, automotive brands, such as Mercedes-Benz, will maintain the status of desire and a strong brand image. Technology corporations were perceived as automotive competitors, due to their professional service approach (Mahut *et al.*, 2015). The findings sketched a picture of future mobility, which is linked to new services and connectivity by integrating valuable services and flexible finance solutions. The findings underpinned the reasoning of creating a successful product-service proposal by incorporating valuable services in a broader perspective (Tukker, 2004). Likewise, new mobility services convinced even passionate car drivers to utilize mobility in a different manner. Inevitable changes in society create new trends in customer behaviour, which are setting the path for new mobility solutions (Dombrowski and Engel, 2014; Mahut *et al.*, 2017). Demographic alterations affect distribution of ages, income, wealth and customer behaviour towards individual mobility. The findings confirmed these inevitable changes in communication, in the professional environment, also ecological aspects, living in megacities, online behaviour and the use of mobility, as protagonists of the change. These changes polarised and were experienced with anxiety and enthusiasm. The future mobility environment is fully connected (Athanasopoulou *et al.*, 2019) and new mobility services with flexible finance solutions, premium product-services and alternative, cleaner powertrain technologies are finding their way into our society (Lengton et al.,2015). Technology is perceived as an instrument to enhance well-being. The added value of technology converts progress in comfort and utility for customers (Bienzeisler, 2017). Mobility was identified as converter to improve customers´ quality of life. Individual mobility was recognized as an integrative and flexible approach linked to alternative services. Digitalisation enhances mobility service solutions through connected and autonomous vehicles (Lerch and Gotsch, 2015). Moreover, environmental awareness (Xu, Prybutok and Blankson, 2019) was perceived as the main driver towards clean vehicles, such as electric or hybrid cars. The findings outlined the importance of the customer`s voice with the definition of clear service needs and their future expectations. Understanding these tremendous changes and anticipating future service solutions could establish a competitive advantage. Likewise, the findings completed the understanding of future mobility solutions, trends and connected services.

The external perspective supported the relevance of future mobility services, through the creation of service ideas and concepts for Mercedes-Benz via the method of open innovation (Chesbrough, Vanhaverbeke and West, 2006). The external point of view turned out to be more progressive and future-oriented in contrast to a more conservative attitude towards future mobility and an increased fear of the future of the internal perspective. External participants demonstrated an open technological approach. Unfortunately, no really new genuine service solutions could be identified. Nevertheless, participants only fostered current technologies and mobility solutions. **However, seven important customer needs** (Williams, 2005; Baines, 2015) **were identified for further mobility service development.**

Moreover, internal participants evinced a "hidden" anxiety of job losses, which sometimes impacted their negative behaviour towards new technologies and service solutions. Nevertheless, all participants were very cooperative and open-minded and developed different main service ideas for a future Mercedes-Benz ecosystem. In general terms, the different perspectives were coherent in terms of a common vision of individual mobility. **It can be concluded that future mobility is linked to new services, connectivity, flexible finance solutions, electric cars, premium product-services and alternative, cleaner mobility solutions** (Lerch and Gotsch, 2015a; Mahut *et al.*, 2015; Schöttle, 2018)**.**

Likewise, the findings revealed the relevance of OI (Gassmann, Enkel and Chesbrough, 2010) as a methodology to introduce new ideas in the automotive sector, which in general still operates in a closed innovation approach (Chesbrough, Vanhaverbeke and West, 2006). Similarly, the literature review confirmed the research findings and the benefits of OI (Chesbrough, 2003; Ili, Albers and Miller, 2010; Chen, Zhao and Wang, 2015). The concept of OI as a relevant methodology in the automotive sector was recognised, but the literature revealed only few very generic studies with a concrete OI approach in the automotive industry. **The application of an open innovation approach** (Chesbrough, 2011) **was relevant to capture internal and external service ideas. Internal and external expertise gathered valuable customer needs and this approach consisted in a significant revelation of the research.**

4.7.3 The completely new service innovation process “DOING”

The third research question (**how can Mercedes-Benz develop a novel service innovation process model to better satisfy customer needs and expectations?**) dealt with the development of a novel service innovation process model to better satisfy customer needs and expectations. A main emphasis of the automotive sector is still on hardware and powertrain improvement (Räse, 2010). Nevertheless, the car industry is starting to recognize the necessity of service innovation and a paradigm change towards new service-oriented innovation models (Vargo and Lusch, 2008). The actual Mercedes Development System (MDS) was analysed and evaluated as too complicated and not suitable to integrate additional services into the traditional innovation process (Daimler AG, 2017).

The findings also indicated the necessity of a mind-set change in the industry to propose an open innovation approach (Chesbrough, 2006), creating customer-oriented products and services (Mont, 2002; Manzini and Vezzoli, 2003; Tukker, 2004; Tan *et al.*, 2010) for successful service deployment. The discussion of open innovation and co-creation (Tommasetti, Troisi and Vesci, 2017; Gustafsson, Kristensson and Witell, 2012) turned out to be an essential key driver of change in the automotive sector. Moreover, the study detected this necessary paradigm change from closed to open innovation (Chesbrough, Vanhaverbeke and West, 2006; Ili, Albers and Miller, 2010) explicitly for Mercedes-Benz. The findings revealed the significance of open innovation and co-creation and enhanced the importance of open innovation as relevant method to gather internal and external service ideas. Expertise and knowledge from managers, customers and other stakeholders were essential to collect valuable service needs. Open innovation and co-creation (Ili, Albers and Miller, 2010; Chesbrough, 2011) in the automotive environment consisted in a significant revelation of our research. OI and co-creation discovered future mobility needs and supported the development of a digital service portfolio. The findings indicated that co-creation (Walters and Rainbird, 2007; Townsend and Calantone, 2014) with customers, automotive experts and other stakeholders, makes it possible to encounter new valuable customer-oriented services. The current closed innovation approach (Chesbrough, Vanhaverbeke and West, 2006; West and Bogers, 2014) no longer delivers convincing results in terms of valuable and future service solutions.

Only through a paradigm change (Chesbrough, Vanhaverbeke and West, 2006) **Mercedes-Benz will be in a position to face this significant transformation to an integrated mobility provider with a focused service orientation** (Vargo and Lusch, 2008)**.**

The first workshop revealed a structured approach to transform customer needs into service solutions. The main finding consisted in the development of a new service innovation process model. The existing MDS process was considered as too complex to integrate services into this closed hardware innovation process of Mercedes-Benz (Räse, 2010). Nevertheless, participants further developed and combined these processes, but additionally integrated open innovation and co-creation to gather the voice of the customer. The result of the workshop involved the development of the novel "DOING" process model. The model introduced an open source approach to identify customer needs and to transform them into digital services. The process model only concluded with the market introduction of the selected mobility service product.

The new service innovation process model turned out to be a key success factor to satisfy future customer service demands. The study put the emphasis on the development of a new process model and its practicability in the automotive environment. The body of literature underpinned that customer requirements demanded an open innovation approach (Gustafsson, Kristensson and Witell, 2012; Myhren *et al.*, 2017) to better satisfy their needs and expectations. **The first workshop focused on a customer-centric and open innovation approach to develop the novel "DOING" process model**. The development of this brand-new service innovation model was based on the "Stage-Gate" process (Cooper, 2008), Design Thinking (Brown and Katz, 2011; Plattner, 2011; Robert A. Curedale, 2013) and FFE (Boeddrich, 2004; Martinsuo and Poskela, 2011; Markham, 2013) approach.

The literature did not propose any automotive specific service innovation process so far. Only the combination of different processes, such as "Stage Gate" and DT were identified as pragmatic but not as an entire and consistent process solutions. **Through the development of a specific Mercedes-Benz process model, which partially integrated stages from the above-mentioned processes, it was possible to generate a service-focused innovation model** (Vargo and Lusch, 2008). The "DOING" process model combined distinct process approaches of Stage Gate, DT and FFE, but the dynamic of the workshop participants allowed the development of a completely new process model.

The expertise of the participants was an enrichment for the process, due to their experience and knowledge. Likewise, the workshop method (Sims, 2006) provided valuable data to create this new innovation model. This method was ideal to gather substantial information and participants` creativity supported significantly the development of the process model (Shrivastava, 2018). Using workshops as research method is still scarce but proved to be a very efficient and agile tool for this category of explorative research. Due to the prodigious data of the participants, the findings of the workshop described a five stages process model: The complete "DOING" process consisted of "**D**iscover, **O**rganize, **I**nitiate, i**N**cubate and **G**row" stages. **The outcome of the workshop created a structured model to transform customer needs into valuable services for Mercedes-Benz.**

4.7.4 An improved mobility service ecosystem

The fourth research question (**how might this novel service innovation process model support the design of customer-oriented services connected to Mercedes-Benz vehicles?**) emphasised the creation of a mobility service ecosystem for the Mercedes-Benz Corporation. The second workshop integrated the creation of a diversified mobility service ecosystem (Carroll and Helfert, 2010; Wang *et al.*, 2015). The investigation started with the exploration of a core mobility service-product portfolio (Goedkoop *et al.*, 1999; Baines, 2015) with seven initiatives. The "DOING" SIPM proved its validity and workability in a real-world business environment by the creation of "Share4Business" service. Following the entire stages of the "DOING" framework, the study introduced the creation of a digital PSS development (Beuren, Gomes and Cauchick, 2013) in a proper-owned Mercedes-Benz ecosystem with coherent mobility service proposals. The study identified customer needs, which were transformed in service offers and found their way to the end-customer. A core mobility service-product portfolio was created and the "DOING" process model was applied in the automotive environment within Mercedes-Benz Spain. The main objective consisted in the reform of the traditional Mercedes-Benz ecosystem towards a diversified mobility service ecosystem (Carroll and Helfert, 2010). Through the development of a diversified mobility service ecosystem, the "DOING" framework proved its practicability and workability in the organizational reality of Mercedes-Benz Spain.

The development of a new service innovation process model is only beneficial and contributes to practice, when the model demonstrates its workability. To do so, the case study participants applied the new SIPM “DOING” to transform customer needs into a portfolio of mobility services. The second workshop carried onwards the design of customer-oriented services, connected to Mercedes-Benz vehicles (Goedkoop *et al*., 1999). In order to face the actual business challenges and the organizational realities within Mercedes-Benz Spain, the practicability and the workability of the model were confirmed through the outcome of the workshop. Likewise, the investigation reinforced the useful integration of digital services to the product offer and this led consequently to a systematic PSS development (Goedkoop et. al., 1999; Beuren, Gomes and Cauchick, 2013). **The intention of the fourth and last research question focused on the design of a digital PSS (Cherubini, Iasevoli and Michelini, 2015) through the application of the novel “DOING” SIPM to create an improved mobility service ecosystem for Mercedes-Benz**.

4.7.5 The difficulty to create a sustainable business model

The development of an adequate business model (Amit and Zott, 2001b; Chesbrough, 2010) turned out to be very fragile. Transforming valuable services into sustainable profits, needs to be further investigated. The “DOING” process is quiet generic in the design of this new business model. The project organisation executed the business model design with their current knowledge and experience. The challenge consists in creating the right approach for “value for money”. **Thus, the “DOING” project organisation used a traditional approach, which did not fit to this new reality.** Therefore, further intensive investigation is needed to generate important profits from service innovation in the future. Only via the design of an adapted business model (Casadeus-Masanell and Ricart, 2010; Visnjic Kastalli and Van Looy, 2013), the industry will be in a position to generate additional profits through service innovation, along their entire value chain.

4.7.6 A competitive advantage

Moreover, the findings are going beyond the discussed body of literature, due to the fact that the outcome of the study confirmed the necessity of digital PSS in a Mercedes-Benz ecosystem with proper owned digital platforms.

These digital platforms could potentially create a sustainable competitive advantage in the automotive industry, which could be enhanced for Mercedes-Benz in the near future (Porter, 1980).
The workshop also demonstrated the workability and the contribution to practice with the application of the “DOING” SIPM. In the meantime, the “Doing” process organisation is working on two other service projects “EQ Charge Solutions” and “EQ Ready Tariff” in cooperation with the national energy provider “Iberdrola”. The energy provider was successfully integrated in the early stage of the “DOING” process.

4.7.7 Seven key mobility needs

Participants identified seven main mobility needs in the current mobility environment and the importance of a proper-owned service ecosystem. The study identified seven main mobility needs to improve customers` quality of live:

1. **Switching the car whenever needed or desired**. A service for Mercedes customers to change temporary the current combustion car for an electric car.
2. **EQ energy boutique parking**. Parking as a great customer experience with additional services.
3. **EQ ready app**. An interchange platform for MB customers to change combustion cars and electric cars to cover instant needs.
4. **EQ swap**. A short-term interchange service for combustion and electric cars.
5. **EQ charge solutions**. A service for Mb customers to visualize charging points with additional services.
6. **EQ ready tariff**. A service for special domestic electricity tariffs for MB customer.
7. **Share4Business**. A service for companies to create their proper electric car sharing for the employees.

These services were identified as a starting point for a future Mercedes-Benz mobility service ecosystem.

4.7.8 Main limitations of the study

The explorative investigation encountered some principal, conceptual limitations. Participants merely developed further current technology to a future-oriented mobility vision. Real visionary thoughts towards future mobility solutions were limited to few participant comments.

Internal participants were exclusively chosen from the Spanish Mercedes-Benz organisation and external automotive experts and customers were chosen due to their vast sectorial expertise. The study admitted only a limited number of external participants; for a more representative structure and more potential service ideas, it would be useful to integrate more ordinary customers and focus groups in the "Discover" stage for a wider perspective and render the study available for the entire automotive sector. The participation of more ordinary consumers, with less automotive background would be useful for future study, to gather the voice of the customer in a more holistic way. Moreover, the early integration of potential providers and other relevant stakeholders would be beneficial for future study. The SIPM was exclusively developed for the Mercedes-Benz organisation through data collection by internal managers and the study exclusively examined solitary Mercedes-Benz business challenges. The second workshop presented the same limitations then the outcome of the first one. The "DOING" process, the mobility service-product portfolio and the "Share 4Business" mobility solution were exclusively elaborated for Mercedes-Benz Spain and only further research would demonstrate the usefulness for the entire automotive sector. The investigation and the SIPM development had some limitations in the approach and content. The model was exclusively developed for the challenges of Mercedes-Benz Spain, but it could be recommended for similar European Mercedes-Benz markets. Another limitation of the study was certainly the fact that the Spanish Mercedes-Benz organisation could only focus on service innovation without any connection to the vehicle innovation.

The product innovation is exclusively performed in the R&D department (Daimler AG, 2017) in Germany. After the experience of the current study, the ideal approach would certainly connect the product development and the service innovation in a simultaneously process. The integration of a service-oriented product development and the utilisation of common IT platforms would enhance the all-over product service offer. The assembly of hardware and service development in the early stage of the innovation process could create an additional competitive advantage, but also create further synergies in the innovation process. Moreover, the integration of important suppliers in the "Discover" stage could be experimented in a future study. The knowledge and expertise of key providers in the process could be of additional value to optimize the process model.

5 Conclusions

5.1 Introduction

The world is constantly changing and new trends in customer behaviour are setting the path for new mobility solutions. The increasing digitization in the automotive industry obliged car manufacturers to face new innovation processes, particularly in terms of service innovation. Moreover, political and environmental restrictions could further generate implications and sanctions for the automotive sector. The aim of the research consisted of investigations through an explorative study to support the transformation of Mercedes-Benz from a traditional car manufacturer to an integrated mobility service provider. The research was performed via a pragmatism philosophy and an explorative, inductive approach. The embedded single case study with in-depth interviews and workshops, as methods for data collection, assured the generation of sufficient and appropriate data. Performing a qualitative research study can be compared to a marathon race. To employ this allegory of sports, the winning spirit in a race is the research philosophy; the race strategy translated to research is the methodology. The race tactics consists in the methods and the endurance involves data collection and analysis. Only the coherent coordination and fine-tuning of all elements with the appropriate preparation of a well-defined research provides respectable result. The data collection of interviews and the Thematic Analysis supported a systematic, but flexible method to analyse the huge amount of qualitative data. The researcher followed ethical principles in relation to the participants and the investigation. The study already interpreted scrupulously all research questions in the different discussion sections. The following sections will synthesize the findings in a broader approach and reflect on the entire study. Furthermore, the researcher presents the main contribution to knowledge and practice and makes recommendations for future research. The thesis will close with final comments and personal reflections of the practitioner researcher.

5.1.1 A broader perspective

The research gained new insights in terms of current forces of change and how to apply possible measures to tackle potential threats in the Spanish automotive environment. Current challenges of the industry required a mindset change to a more service-focused approach and this is especially true for Mercedes-Benz. By means of this important paradigm change, Mercedes-Benz would be in a position to master the digital service transformation. Future mobility will certainly be linked to new services, connectivity, flexible finance solutions, electric cars, premium product-services and alternative, cleaner mobility solutions. The study identified seven important customer needs for the creation of an improved mobility service ecosystem to enhance the product-service portfolio of Mercedes-Benz. The newly developed service innovation process “DOING” allowed the structured transformation of customer needs into valuable customer services within the Mercedes-Benz mobility service ecosystem to create a competitive advantage in the industry.

5.1.2 Motivational aspects

The integration of the “DOING” process in the Spanish organisation had also positive motivational impacts. Employees of Mercedes-Benz were proud to be part of the innovation project in the company. But there exists also limitations of this study in terms of the exclusive participation of internal managers. A future workshop could be managed with external participants and suppliers to increase co-creation, additional knowledge and expertise.

5.2 Contributions to knowledge

The undertaken research strived for rigour and relevance in terms of contribution to both knowledge and practice. This section explains how the study closed the research gap and extended existing theory towards new areas in the field of service innovation management. The qualitative research methods of this study sought to develop theory that is grounded in systematically gathered and analysed data (Urquhart, Lehmann and Myers, 2010; Presthus, 2016).

5.2.1 New insights into changing customer attitudes to mobility

Technological progress and new mobility trends are impacting attitudes towards individual mobility. New mobility service proposals convinced even passionate car drivers to consider “pay per use” of customer-oriented mobility solutions. Inevitable changes in society create new trends in customer behaviour towards individual mobility. Demographic (Choo, 2011, Reinhardt et al. 2017, Watts, 2020) change affects distribution of ages, income and wealth of populations, employment, legislations and impacts customer behaviour towards mobility. These changes polarised our participants and were simultaneously experienced from internal participants with anxiety and external participants perceived these changes with enthusiasm. External participants embraced the technological opportunities while internal participants saw the changes as a threat for their jobs. The research reinforced the overall picture and confirmed behavioural changes in the utilization of mobility. Future mobility environment will be fully connected, service-oriented with emission-free powertrain technology (Williams, 2005, Schöttle, 2018). The study introduced new mobility services with flexible finance solutions, premium product-services and alternative, cleaner technologies with a service-centric approach.

Participants perceived technology as an enabler to create customer-oriented mobility service solutions. Mobility solutions linked to connected services were identified to enhance the quality of life. Individual mobility was recognized as an integrative and flexible approach linked to alternative services. Digitalisation enhances mobility service solutions through connected and autonomous vehicles. Moreover, participants perceived environmental awareness as the main driver towards clean vehicles, such as electric or hybrid cars. The findings outlined the importance of the customer`s voice with the definition of clear service needs and their future expectations.

Understanding these critical changes and anticipating future service solutions could establish a competitive advantage. **Likewise, the findings enriched the understanding of future mobility solutions, trends and connected services and their impact on customer alterations and provided contribution to knowledge for explaining and predicting** (Gregor, 2006; Weber *et al.*, 2016). The research gained valuable insights into customer attitudes towards individual mobility, which the current body of literature (Elliott and Urry, 2010; Bienzeisler, 2017; Mahut *et al.*, 2017; Audenhove *et al.*, 2018) didn`t express in a similar and specific way.

5.2.2 The criticality of anticipating service needs and solutions

Knowing external forces of change (Watts, 2020) **and how they are impacting mobility solutions, trends and connected automotive services** consisted in a real challenge, as the body of literature is still limited and very fragmented for the automotive sector. **The environmental scan** (Choo and Auster, 1993) **and the resulting impacts on future mobility service solutions, which are linked to new services and connectivity, flexible finance solutions, electric cars, premium product-services and alternative, cleaner mobility solutions in the Mercedes ecosystem, contributed to theory for predicting** (Gregor, 2006; Weber *et al.*, 2016) **in terms of innovation management theory.** The main body of literature didn`t present a combined model of environmental scan (Choo, 2001; Reinhardt *et al.*, 2017), analysing the forces of change (European Commission, 2018; Watts, 2020) and the resulting implications for the automotive industry. This combined model was yet not performed in this specific manner in the current automotive literature (Dombrowski and Engel, 2014; Mahut *et al.*, 2017; Audenhove *et al.*, 2018). Using environmental scanning to identify specific forces of change (Watts, 2020) and their potential impacts on mobility, emphasised the importance of mobility service solutions in automotive research. Applying the method of the environmental scan in the automotive industry and knowing current and future threats, trends and relationships within the automotive sector, will be very useful to anticipate accurate mobility service solutions in the future. After technological and ecological challenges, the automotive sector encounters the subsequent challenge of customer-oriented mobility service solutions. The demographic (Watts, 2020) change and alterations in purchase decisions emphasised the need for new mobility service solutions (Vecchio and Tricarico, 2018).

Correspondingly, our findings underpinned the desire for future service solutions to satisfy customer needs. This knowledge can potentially create a competitive advantage in the automotive sector. **Even more important is the development of adapted service strategies and not being disrupted by these external forces of change.** The required paradigm change from close to open innovation (Chesbrough, 2003) in the automotive industry via the use of OI (Hsieh *et al.*, 2013) and co-creation (Ili, Albers and Miller, 2010) was confirmed by this research. Due to the increasing pressure, the automotive industry (Townsend and Calantone, 2014) has to adapt to new solutions of co-creation in their innovation strategy.

The principal literature proposed very generic recommendations, but the body of literature did not argue on specific models of how to integrate them into the automotive industry. **Our study developed new knowledge concerning a specific automotive framework to integrate OI and co-creation** (Cano-Kollmann, Awate and Hannigan, 2017) **in a new process model.** The research contributed to knowledge in terms of design and action and gives prescriptions for constructing a new process model (Gregor, 2006). The use of the expertise (West and Bogers, 2014) of automotive managers and external participants, gathering the voice of the customer, in the Mercedes-Benz Corporation contributed to management innovation theory and went beyond the existing body of literature. The findings emphasised to put more efforts on the development and the recognition of mobility service solutions in the automotive industry. Future study can benefit and improve this interesting approach to further develop management theory in the automotive sector and potentially in other hardware-oriented industrial sectors. Nevertheless, this approach should be tested for other industries in further research.

5.2.3 The value of open workshops in new service development

The case study approach, by using workshops (Labonte and Laverack, 2001; Sims, 2006) in the Mercedes-Benz business environment to develop a new process model, consisted of a novel and dynamic approach to original service development. **The discussion of the main body of literature indicated that this method was rarely used in specific academic, automotive research** (Labonte and Laverack, 2010; Shrivastava, 2018) **and therefore, contributed to existing methodology knowledge** (Saunders, Lewis and Thornhill, 2008) **in research design**. Workshops, as research method (Sims, 2006; Bedford and Harrison, 2015) can be used to develop, create and experience new ways in an academic and professional environment.

The use of workshop method (Sims, 2006, Shrivastava, 2018) promoted research culture and developed the automotive expertise of the participants and their personal motivation. The researcher applied this concept from social science to the automotive industry, as a new mechanism for service development. The design and execution of our workshops were performed to solve a specific business problem. This approach also underpinned the required paradigm change from closed to open innovation by employing external knowledge and expertise in our workshops.

The application and adaptation of workshops to the necessity of the automotive sector introduced a novel idea in the industry for service development. Through the successful performance of our workshops, this method contributed to both, knowledge and practice and proved its validity.

5.2.4 A new service innovation process model: “DOING”

Likewise, the development of the novel “DOING” service innovation process model made a meaningful contribution to management theory as a specific process model for the Mercedes-Benz Corporation to effectively develop new services with an open source approach. Hereby, the research contributed to knowledge for design and action (Gregor, 2006; Weber *et al.*, 2016) **in terms of innovation management theory.** To sum up, the main contribution to knowledge in strategic management theory consisted in the development of a brand-new process model (Easterby-Smith, Thrope and Jackson, 2015) and demonstrated the evidence of the literature that the “Stage Gate” process and other service innovation processes, such as DT (Cooper, 2008; Brown and Katz, 2011; Plattner, 2011)
and front-end innovation had only limited influence on service innovation in the automotive sector (Khurana and Rosenthal, 1998; Boeddrich, 2004; Martinsuo and Poskela, 2011). **The new “DOING” process set the focus on service development as a core business, in an industry, which still operates with a hardware-oriented innovation process**. New product services will find their way to the market through a specific automotive service innovation process model. Future study and research practice will benefit and improve the existing model to create a meaningful impact in the automotive sector. The research in terms of service innovation is just in the starting blocks of automotive research.

5.2.5 An improved mobility service ecosystem for Mercedes-Benz

The current Mercedes Development System (Räse, 2010) and other external innovation processes (Boeddrich, 2004; Cooper, 2008; Plattner, 2011) were analysed and evaluated as too complicated and not suitable to integrate additional services into the traditional innovation process. The combination of specific stages from diverse innovation processes and the development of a complete innovation framework resulted in a brand-new service innovation process model.

Via the application of the "DOING" process and the design of the second workshop, the starting point of a Mercedes-Benz mobility service ecosystem was introduced. The study presented seven main digital services linked to Mercedes-Benz vehicles. Through the consequent link of services to the hardware product, customers will receive an instant mobility service solution to their expressed need. The creation of a mobility service ecosystem (Carroll and Helfert, 2010) was designed as a combination of services and mobility solutions linked to the vehicle. **The mobility service ecosystem is defined by the powerful integration of mobility services, connected to the vehicle on proper owned digital platforms, to a complete system.** The consequent link of product to a mobility services ecosystem will keep the customer in the brand environment and improves customer loyalty all the way through the entire value chain. The research demonstrates a strong focus on companies' capabilities sourcing and matching of processes and systems. Management research will benefit from the creation of a proper mobility service ecosystem to preserve the complete value chain of an OEM. **The contribution to knowledge consisted in the development of a core digital service portfolio to a complete mobility service ecosystem for Mercedes-Benz. The research contributed to knowledge for design and action** (Gregor, 2006; Weber *et al.*, 2016) **in an improved mobility service ecosystem.**

5.3 Contribution to practice

5.3.1 Prove and application of the service innovation process

Through the concrete application of the "DOING" process in the Mercedes-Benz organisation, a new mobility services portfolio was designed and the "Share4Business" project went live in the Spanish market to better satisfy customer needs and expectations. By these means, the undertaken investigation is relevant for **practicing managers and organisations and the research findings make a meaningful contribution to existing practice**. To summarize, the contribution to practice consisted in the implementation of an open service innovation process in the automotive sector and the development of universal principles (Saunders, Lewis and Thornhill, 2008) for Mercedes-Benz to support the transformation to an integrated mobility service provider.

The contribution of this research represents a better understanding of the implementation of a systematic SIPM in an organisation by applying adapted strategies, processes and actions (Gray, 2004). **Moreover, the research demonstrated the significance to integrate internal, external managers and the voice of the customer to gather necessary knowledge for empirical service innovation.**

5.3.2 Developing digital services to design a mobility service ecosystem

The research improved a better understanding of a specific business problem and developed findings of practical relevance (Gray, 2004) for the Mercedes-Benz Corporation. The combination of specific stages from diverse innovation processes and the development of a complete innovation framework resulted in a brand-new service innovation process model. Via the application of the "DOING" process and the design of the second workshop, a **Mercedes-Benz service portfolio with seven main digital services was introduced as starting point of a mobility service ecosystem.** Management practice will benefit from the development of digital services linked to Mercedes-Benz vehicles to preserve the complete value chain of the OEM.
The contribution to practice consisted in the development of a core digital service portfolio and the application in a real-world business environment to design a mobility service ecosystem.

5.4 Limitations of the study

The explorative study was based on researcher`s beliefs and interpretations and therefore, based on a subjective view on the world, in contrary to an objective point of view in natural science. Although the resulting limitations of the inquiry were already mentioned in the course of the study, the research encountered more general limitation in the empirical research and the literature review.

5.4.1 Availability of current studies

As already expressed in the literature review, only a limited number of academic studies, related to service innovation and specifically to the automotive sector were available. Certainly, due to the fact that the automotive sector is still innovating in a closed environment, it is difficult for researchers to access the industry.

Therefore, the literature offers only little guidance in terms of service innovation processes and digital PSS. The development of service innovation, in terms of processes and digital PSS through an open source approach, is still in the starting blocks of academic research. Additional debates are needed to explore these topics in more detail for the digital transformation in the automotive industry.

5.4.2 A broader perspective

The empirical study, as already explained, executed only a brief scan of the current business environment to describe the impact on the automotive sector. Understanding external forces of change and resulting trends and risks to develop effective responses, should be explored and discussed in further study. Only few OEMs` are scanning the environment in an effective way to respond to future challenges. This is certainly one of the reasons why the industry find itself currently in a critical situation. The explorative study was exclusively performed in the Mercedes-Benz environment and therefore, the study has no claim to general validity for the entire industry.

5.4.3 Limited number of participants

External mangers and customers were completely integrated in the Mercedes-Benz research environment and the limited number of ordinary customers had a certain influence on the general validity of the study. More ordinary customers could potentially increase the amount of service ideas and mobility needs.

5.4.4 Connecting the dots

Another limitation consisted of the isolated service innovation approach in the Spanish organisation without connexion to the R&D department in Germany. Further research could potentially identify an ideal approach through the connection of product development and service innovation in a simultaneously process for further improvement.

5.4.5 Value for money

The particular business model development in the “DOING” process did not achieve the expectations of the researcher in terms of business model development.

Designing a solid business model is a further challenge to finalize the complete picture of service innovation in the automotive environment. The innovation and the design of an adequate business model could emphasize the profit situation of Mercedes-Benz. Therefore, the outlook for future research should focus on business model innovation and business model design and will be discussed in the following chapter.

5.5 Future research

5.5.1 Introduction

The creation of an open PSS in the Mercedes-Benz ecosystem is a suitable starting point, but yet not enough to face all future challenges of the industry. PSS integration in a sustainable business model is a resulting challenge of our research; finding a smart way to create profits out of the new business system. One weakness of the “DOING” model was certainly the development of a sustainable business model. Business model innovation (BMI) is vital for corporations in a world, which is constantly changing. The generation of profits from developing, producing and selling goods and services is an essential business challenge.

Business Model Design (BMD) is important to understand the development of current and future, exciting business models and how to perform, as a managerial task, successful business models. The development of a new business model, which is linked to a performing PSS is an important challenge for the automotive industry to become an integrated mobility service provider.

The strength of a premium brand like Mercedes-Benz, linked to a strong PSS, with an extended and sustainable business model could represent a USP for a carmaker and a trustful approach towards the customer. The business model definition and the actual business model of the car producer Mercedes-Benz could be investigated in a first step. The development of BMI and the efficient design of the business model could be explored in a second step. This research could complete the holistic approach of the current study.

5.5.2 Value creation through an effective business model

New economy corporations, such as Amazon, Google, Alibaba and others are disrupting the business models of the “old industry”. To stay at the top of the food chain, corporations should frequently interrogate their business approach.

The study of Chesbrough (2010) explains different methods of business model innovation, but also the doubts of corporations and managers, why they don't conduct such experiments, to probe for potential new business models before the time comes when external innovations render their traditional ones redundant. Leading a corporation through an effective business model permits the company to generate profits; nevertheless, a running business model should be examined and updated from time to time, not risking the disruption from outside the corporation. Before entering into further detail of BMI, it is important to provide general definitions of a business model as the basis for future research. The research of Amit and Zott (2001) defines a business model in an explicit way as a model, which consists in a structure and a specific governance to create value through the exploitation of business opportunities. Another explanation is given by Chesbrough (2010, p. 354); "the economic value of a technology remains latent until it is commercialized in some way via a business model". These definitions explain a business model as a method of doing business by generating profits to sustain the business upright, by specifying where it is positioned in the value chain and the needed resources. A business model seeks to capture the essence of how a firm does business and generate profits. The research of Visnjic Kastalli and Van Looy (2013, p. 176) indicates that "product sales and service sales complement each other and that the customer proximity of service offerings reinforces the positive feedback from services to product sales". Digital services, retrofitting services, remote maintenance, data analytics and service development are key for a customer-oriented value offer. The traditional business model of Mercedes-Benz consists of a traditional business model, which is yet not in the condition to exploit the full potential of digital services and worth future research.

5.5.3 The concept of Business Model Innovation

BMI receives actually great attention from researchers and mangers. In a world where disruption and starts up corporations are gaining increasingly more importance, traditional business models being disrupted by new technology companies, corporations are searching for new solution maintaining their "competiveness" Chesbrough`s (2010). Many large firms, such as Amazon, Apple, Google and Samsung succeeded not just because of their new technologies but also because of their pioneering use of BMI (McGrath, 2010).

Changing the business model incorporates risk taking capabilities and strong leadership; that could be the reason for some of the managers to maintain the exploitation of the traditional business model until the very end (Chesbrough and Rosenbloom, 2002). In the case of Mercedes-Benz, future research could put the focus on BMI in combination with an effective PSS strategy.

5.5.4 The concept of Business Model Design

The design of a business model (Zott and Amit, 2010) is a key decision for an entrepreneur who creates a new firm. It is certainly a crucial one and perhaps a more difficult task for general managers to reshape their old model and to make their firm fit for the future. The challenge of how to design a business model (Amit and Zott, 2015) and what its antecedents are just as important for both scholars and practitioners. Not only the design, but also the link to the business purpose is an essential part of BMD. Ideally, a novel and well-designed business model is difficult to imitate and provides sustainable competitive advantages (Teece, 2010). Corporations, such as Mercedes-Benz should invest enough time and energy for a holistic BMD approach. New technology, such as hybrids and fuel cell are actually introduced in the market and nothing else changes. Cars will be produced, bought and used exactly in the same way, unless political institutions are incentivising in a consistent way the car industry. The two concepts of BMI and BMD are going hand in hand and only the consequent connection enables the creation of a novel and performing business model for a digital PSS. Through the integration of an effective PSS into a novel business model, Mercedes-Benz could create a substantial, competitive advantage in the automotive sector.

5.6 Final comments and personal reflections

Having almost finished my personal research journey into the world of individual mobility and service innovation, it is time to reflect the last years of this extraordinary learning experience.

5.6.1 A memorable experience

As an enthusiast of the concept of life-long learning, the research endeavour was a new but significant experience. In one of the DBA learning modules, we were asked to reflect the different roles of our professional, academic and private life.

The additional role as researcher and practitioner was not easy to integrate into my professional and familiar environment and I realised its deep impact on my existence. Nevertheless, family and friends encouraged me in my academic journey. The academic process of reading, writing, discussing and arguing amplified my personal and professional skills. Adopting academic methods opened my horizon and created broader perspectives.

5.6.2 Conceiving the master plan

The elaboration of the research strategy was meticulously planned, like a chess strategy. It seemed to me like a construction of a wonderful building, where all the pieces had to perfectly fit together. The DBA learning modules were very helpful to find the right path between the different philosophical positions. The most difficult issue was to anticipate the expected outcome, with methods I never experienced before. However, the final findings and outcome of the study confirmed the choices I made some years ago.

5.6.3 Execution of the master plan

I experienced the execution of my investigation as the most enjoyable time of my research endeavour. The carry out of the first interviews became standard routine with no genuine surprises. The outcome was satisfactory, but I expected a more future-oriented vision of mobility from the participants. They only further developed existing technologies. An optimised interview introduction with more detailed future mobility technologies examples could have been useful to further exploit this vision. Perhaps, additional interview questions would have been more beneficial on this specific item. On the other hand, designing the workshops was a real pleasure; creating activities, moderating the working groups was an interesting experience and somehow an “out of the box” approach in the academic environment. The reading of specific literature, the organisation of the workshops and performing the mock groups was a stimulating and enjoyable process. The principal surprise was the motivation and the capacity of the participants to develop a new process model and to create a service-product portfolio in only two workshops. The findings were unexpected in their intensity and profoundness. The design of an agile method and the choice of the participants were the key success factors of the entire study. The execution of my investigation was absolutely the most pleasurable time of the entire research.

5.6.4 An iterative process

Structuring the immense amount of data and writing comprehensive statements was a difficult challenge. Academic writing, structuring the entire thesis consisted in an unexpected and lengthy procedure. Sorting your own thoughts and clearly formulating them to third parties was a time-consuming and difficult process. Reading, again and again and returning to the beginning, never stopping this iterative process became a test of patience. Nevertheless, the iterative process of reading, reflecting and writing also enhanced my skills and became a well-established routine of perseverance and discipline.

5.6.5 Just before the finish line

I would like to compare my research endeavour to a marathon race, which ends in a final sprint. The DBA degree is associated with effort, deprivation and a lot of work during several years. Nevertheless, it is a great opportunity to grow and to be proud of the already accomplished work. A Chinese saying from Confucius states that, “the route is the goal”; and this is certainly true for my DBA experience.

6 References

Alhojailan, M. I. (2012) 'Thematic Analysis: A critical review of its its processes and evaluation', *West East Journal of Social Sciences,* 1(1), pp. 39-47. doi: 10.1177/1525822X02239569.

Amit, R. and Zott, C. (2001) 'Value creation in e-business', *Strategic Management Journal*, 22(6–7), pp. 493–520. doi: 10.1002/smj.187.

Amit, R. and Zott, C. (2015) 'Crafting Business Architecture: the Antecedents of Business Model Design', *Strategic Entrepreneurship Journal*, 9(4), pp. 331–350. doi: 10.1002/sej.1200.

Andrew, James P. and Harold L. Sirkin (2007) *Payback: Reaping the Rewards of Innovation*, Portland: Havard Business School Press.

Athanasopoulou, A.,de Reuver, M.,Nikou, S., Bouwman, H. (2019) 'What technology enabled services impact business models in the automotive industry? An exploratory study', *Futures*, 109, pp. 73–83. doi: 10.1016/j.futures.2019.04.001.

Audenhove, F., Smith, A., Rominger, G., Bettati, A. (2018) *The Future of Mobility 3.0, Reinventing mobility in the era of disruption and creativity.* Available at: https://www.adlittle.com/en/insights/viewpoints/future-mobility-30. (Accessed: 24.01.2019)

Baines, T. (2015) 'Exploring Service Innovation and the Servitization of the Manufacturing Firm', *Research-Technology Management*, 58(5), pp. 9–11. doi: 10.5437/08956308X5805002.

Baines, T S., Lightfoot, H W,. Evans, S., Neely, A., Greenough, R., Peppard, J., Roy,R., Shehab, E., Braganza, A., Tiwari, A., Alcock, J RAngus, J P., Bastl, M., Cousens, A., Irving, P., Johnson, M., Kingston, J., Lockett, H., Martinez, V., Michele, P., Tranfield, D., Walton, I M., Wilson, H. (2007) 'State-of-the-art in product-service systems', *Proceedings of the Institution of Mechanical Engineers*', *Part B: Journal of Engineering Manufacture*, 221(10), pp. 1543–1552. doi: 10.1243/09544054JEM858.

Baregheh, A., Rowley, J. and Sambrook, S. (2009) 'Towards a multidisciplinary definition of innovation', *Management Decision Journal of Knowledge Management Iss Strategy & Leadership*, 47(6), pp. 1323-1339. doi.10.1108/00251740910984578.

Barquet, AP., Seidel, J., Buchert, T., Galeitzke, M., Neugebauer, S., Oertwig, N., Rozenfeld, H., Seliger, G. (2016) 'Sustainable Product Service Systems - From Concept Creation to the Detailing of a Business Model for a Bicycle Sharing System in Berlin', *Procedia CIRP*, 40, pp. 524-529. doi: 10.1016/j.procir.2016.01.127.

Bartl, M., Jawecki, G. and Wiegandt, P. (2010) 'Co-Creation in New Product Development: Conceptual Framework and Application in the Automotive Industry', *Methods*, 1(10), pp. 1-9. doi: 10.180234/9865.

Beck, K., Beedle, M., Van Bennekum, A., Cockburn, A., Cunningham, W., Fowler, M., Grenning, J., Highsmith, J., Hunt, A., Jeffries, R., Kern, J., Marick, B. (2001) *Manifesto for Agile Software Development*, *The Agile Alliance*. Available at: https://moodle2019-20.ua.es/moodle/pluginfile.php/2213/mod_ resource/ content/2/agile-manifesto.pdf (Accessed: 19.11.2019).

Bedford, D. and Harrison, F. (2015) 'Leveraging environmental scanning methods to identify knowledge management activities in transportation', *Journal of Knowledge Management*, 19(3), pp. 579–592. doi: 10.1108/JKM-01-2015-0004.

Bell, R. and Bell, H. (2016) 'An enterprise opportunity for entrepreneurial students: Student enterprise development and experience assessed through the student voice', *Education and Training*, 58(7/8), pp. 751-765. doi: 10.1108/ET-12-2014-0150.

Beuren, F. H., Gomes Ferreir, M. G. and Cauchick Miguel, P. A. (2013) 'Product-service systems: A literature review on integrated products and services', *Journal of Cleaner Production*, 47, pp. 222–231. doi: 10.1016/j.jclepro.2012.12.028.

Bianchi, M., Marzi, G. and Guerini, M. (2018) 'Agile, Stage-Gate and their combination: Exploring how they relate to performance in software development', *Journal of Business Research*, 110, pp. 538-553. doi: 10.1016/j.jbusres.2018.05.003.

Bienzeisler, L. (2017) 'Impacts of an Autonomous Carsharing Fleet on Traffic Flow', *ATZ worldwide*, 110, pp. 60-63. doi: 10.1007/s38311-017-0059-3.

Boeddrich, H. J. (2004) 'Ideas in the Workplace: A new approach towards organizing the Fuzzy Front End of the innovation process', *Creativity and Innovation Management,* 13(4), pp. 274-285. doi: 10.1111/j.0963-1690.2004.00316.x.

Bozward and Rogers-Draycott (2017) 'Value Creation Programmes: Lessons from an early stage implementation', *Education and Training*, 20, pp. 1–17. doi: 10.1007/S41959-020-00033-5.

Braun, V. and Clarke, V. (2006) 'Using thematic analysis in psychology', *Qualitative Research in Psychology*, 3(2), pp. 77–101. doi: 10.1191/1478088706qp063oa.

British Psychological Society (2014) 'Code of Human Research Ethics', *British Psychological Society*, 1(1), pp. 1–44. doi: 180/12.2014.

Brown, T. (2008) ´Design Th!nking´, Havard Business Review, 10, pp. 1-10. doi: 20190508-105953.

Brown, T. and Katz, B. (2011) 'Change by design', *Journal of Product Innovation Management,* 28(3), pp. 381-383. doi: 10.1111/j.1540-5885.2011.00806.x.

Burchett, H., Umoquit, M. and Dobrow, M. (2011) 'How do we know when research from one setting can be useful in another? A review of external validity, applicability and transferability frameworks', *Journal of Health Services Research and Policy,* 16(4), pp. 238-244. doi: 10.1258/jhsrp.2011.010124.

Cano-Kollmann, M., Snehal, A. and Hannigan, T.J., Mudambi, R. (2017) 'Burying the Hatchet for Catch-Up: Open Innovation among Industry Laggards', *California Management Review,* 60(2), pp. 17-42 . doi: 10.1111/jpim.12065.

Carroll, N. and Helfert, M. (2010) 'Management Service capabilities within open innovation: Revisiting the applicability of capability maturity models"Capabilities for managing service innovation: towards a conceptual framework" Service capabiliti', *Journal of Service Management*, 28(4), pp. 275–303. doi. 10.1108/JEIM-10-2013-0078.

Carter, L. (2010) 'How to Conduct Surveys: A Step-by-Step Guide', *Canadian Journal of University Continuing Education*, 36(2), p. 198. doi: 10.21225/d53s33.

Casadeus-Masanell, R. and Ricart, J. E. (2010) 'From strategy to business models onto tactics', *Long Range Planning,* 43(2-3), pp. 195-215. doi: 10.1016/j.Jrp. 2010.01.004.

Chan, F. K. Y. and Thong, J. Y. L. (2009) 'Acceptance of agile methodologies: A critical review and conceptual framework', *Decision Support Systems,* 46(4), pp. 803-814. doi: 10.1016/j.dss.2008.11.009.

Charmaz, K. (2016) 'Constructivist grounded theory', *The Journal of Positive Psychology*, 12(3), pp. 299–300. doi: 10.1080/17439760.2016.1262612.

Chen, J., Zhao, X. and Wang, Y. (2015) 'A new measurement of intellectual capital and its impact on innovation performance in an open innovation paradigm', *International Journal of Technology Management*, 67(1), pp. 128-142. doi: 10.1504/IJTM.2015.065885.

Cherubini, S., Lasevoli, G. and Michelini, L. (2015) 'Product-service systems in the electric car industry: critical success factors in marketing', *Journal of Cleaner Production*, 97, pp. 40–49. doi: 10.1016/j.jclepro.2014.02.042.

Chesbrough, H. (2010) 'Business Model Innovation: Opportunities and Barriers', *Long Range Planning,* 43(2-3), pp. 354-363. doi: 10.1016/j.lrp.2009.07.010.

Chesbrough, H. (2011) 'Bringing Open Innovation to Services', *MIT Sloan management review*, 52(2), pp. 85-91. doi: 2010/12/a4daa5e156.

Chesbrough, H. (2011b) 'Open Innovation Where We' ve been and where we' re going', *Harvard Business Publishing*, 4, pp. 2012–2014. doi: 10.5437/089565308X5504085.

Chesbrough, H. (2012) 'Why companies should have open business models', *MIT Sloan management review*, 48(Winter), p. 23. doi: 10.1022/2039388-x.

Chesbrough, H. and Rosenbloom, R. S. (2002) 'The role of the business model in capturing value from innovation : evidence from Xerox Corporation' s technology spin-off companies', *Industrial and Corporate Change*, 11(3), pp. 529–555. doi: 10.1093/icc/11.3.529.

Chesbrough, H., Vanhaverbeke, W. and West, J. (2006) *Open Innovation: Researching a New Paradigm*. Oxford: Oxford University Press

Chesbrough, Henry W (2003) *Open Innovation: The New Imperative for Creating and Profiting from Technology*. Boston: Harvard Business School Press.

Chesbrough, H. W. (2006) 'Open Business Models: How to Thrive in the New Innovation Landscape', *Researchtechnology Management*, 50, p. 256. doi: 10.1111/j.1540-5885.2008.00309_1.x.

Choo, C. W. (2001) 'Environmental scanning as information seeking and organizational learning', *Information Research,* 7(1), pp. 1-10. doi:10.1016/10388921.

Choo, C. W. and Auster, E. (1993) 'Environmental Scanning : Acquisition and Use of Information by Managers', *Annual Review of Information Science and Technology,* 28, pp. 279-314. doi: 10.1016/1432222.

Clarke, V. and Braun, V. (2017) ‘Thematic analysis’, *The Journal of Positive Psychology*, 12(3), pp. 297–298. doi: 10.1080/17439760.2016.1262613.

Collins, H. and Evans, R. (2017) ‘Probes, Surveys, and the Ontology of the Social’, *Journal of Mixed Methods Research*, 11(3), pp. 328–341. doi: 10.1177/1558689815619825.

Conklin, G. H., Weiss, C. H. and Bucuvalas, M. J. (1982) ‘Social Science Research and Decision-Making’, *Social Forces,* 60(3), pp. 919-920. doi: 10.2307/2578408.

Cooper, H. M. (1988) ‘Organizing knowledge synthesis: a taxonomy of literature reviews’, *Knowledge in society*, 1(1), pp. 104–126. doi: 10.1007/BF03177550.

Cooper, H. M. (1989) *Integrating research : a guide for literature reviews*. 2nd edn. London: Sage Publications.

Cooper, R. G. (1990) ‘Stage-gate systems: A new tool for managing new products’, *Business Horizons*, 33(3), pp. 44–54. doi: 10.1016/0007-6813(90)90040-I.

Cooper, R. G. (1999) ‘Winning at new products: Acelerating the process from idea to launch’, *Journal of Management,* 13(3), pp. 54-56. doi: 10.1177/ 0149206310365001.

Cooper, R. G. (2008) ‘Perspective: The Stage-Gate’, *Journal of Product Innovation Management*, 25, pp. 213–232. doi: 10.1111/j.1540-5885.2008.00296.x.

Cooper, R. G. and Edgett, S. J. (2003) ‘Overcoming the crunch in resources for new product development’, *Research Technology Management, 53, pp. 48-58*. doi: 10.1080/08956308.2003.11671566.

Cooper, R. G., Edgett, S. J. and Kleinschmidt, E. J. (2002) ‘Optimizing the stage-gate process: What best-practice companies Do-I’, *Research Technology Management*, 45(5), pp. 21–27. doi: 10.1070/08956454.2002.11768899.

Costley, C., Elliott, G. and Gibbs, P. (2010) *Doing work based research : approaches to enquiry for insider-researchers*. 4th edn. London: Sage Publications Ltd.

Coughlan, F., Cronin, M. and Ryan, P. (2007) 'Step-by-step guide to critiquing research', *British Journal of Nursing*, 16(11), pp. 25-37. doi: 10.12986/bjon.2007. 16.12.23726.

Creswell, J. W. (2003) *Research design Qualitative quantitative and mixed methods approaches*. 4th edn. Los Angeles: SAGE Publications.

Crotty, M. (1998) *The Foundations of Social Reearch Meaning and perspective in the research process*. London: *SAGE Publications*.

Crozier, G., Denzin, N. and Lincoln, Y. (1994) 'Handbook of Qualitative Research', *British Journal of Educational Studies*. Sage Publications, 42(4), p. 409. doi: 10.2307/3121684.

Curedale, R. A. (2013) *Design Thinking Pocket Guide*. 2nd edn. Topanga: Design Community College Inc.

Daimler AG (2017) *Corporate Profile | Daimler AG; Interactive Annual Report 2017/Business Model*, *Intranet Daimler AG*. Available at: https://annualreport2017.daimler.com/combined-management-report/business-model/corporate-profile.pdf. (Accessed: 16.04.2017).

Dannenberg, J., & Burgard, J. (2013) *Innovationsmanagement in der Automobilindustrie. Oliver Wyman Automotive (Munich 2007).* Available at: http://www. oliverwyman. com/de/pdffiles/Car_Innovation_2015_deutsch. pdf Accessed (17.11.2018)

Dombrowski, U. and Engel, C. (2014) 'Impact of electric mobility on the after sales service in the automotive industry', *Procedia CIRP,* 16, pp. 152-157. doi: 10.1016/j.procir.2014.01.022.

Dosi, G. (1990) ‘Finance, innovation and industrial change’, *Journal of Economic Behavior and Organization*, 13(3), pp. 299–319. doi: 10.1016/0167-2681(90)90003.

Dotzel, T., Shankar, V. and Berry, L. L. (2013) ‘Service innovativeness and firm value’, *Journal of Marketing Research,* 50(2), pp. 259-276. doi: 10.1509/jmr.10.0426.

Doyle, L., Brady, A.M. and Byrne, G. (2009) ‘An overview of mixed methods research’, *Journal of Research in Nursing*, 14(2), pp. 175–185. doi: 10.1177/1744987108093962.

Dybå, T. and Dingsøyr, T. (2008) ‘Empirical studies of agile software development: A systematic review’, *Information and Software Technology,* 50(9-10), pp. 833-859. doi: 10.1016/j.infsof.2008.01.006.

Easterby-Smith, M., Thorpe, R. and Lowe, A. (2002) *Management Research: An Introduction*, 2nd, London: SAGE Publication LTD.

Easterby-Smith, M., Thrope, R. and Jackson, P. (2015) *Management & Business Research*. Available at: http://eprints.lancs.ac.uk/29759.pdf (Accessed: 12.05.2018).

Elkjaer, B. and Simpson, B. (2011), ‘Pragmatism: A lived and living philosophy. What can it offer to contemporary organization theory’, *Philosophy and Organization Theory,* 32, pp. 55-84. doi: 10.1108/S0733-558X(2011)0000032005

Elliott, A. and Urry, J. (2010) *Mobile Lives*. London: Routledge.

Erbeldinger, J. and Ramge, T. (2013) *Durch die Decke denken: Design Thinking in der Praxis*. München: Redline-Verlag.

Erwin, P. C. (2015) ‘Forces of change’, *American journal of public health*, 105(5), p. 836. doi: 10.2105/AJPH.2015.302575.

Ettlie, J. E. and Elsenbach, J. M. (2007) ‘Modified Stage-Gate® regimes in new product development’, *Journal of Product Innovation Management*, 24(1), pp. 20-33. doi: 10.1111/j.1540-5885.2006.00230.x.

European Commission (2018) *Reducing CO2 emissions from passenger cars | Climate Action*, *European Commission*. Available at: https://ec.europa.eu/clima/policies/transport/vehicles/carsen (Accessed: 23.06.2019).

Eveleens, C. (2010) *Innovation management; a literature review of innovation process models and their implications*. Available at: https://d1wqtxts1xzle7.cloudfront.net/33190893/Innovation-management-literature-review-.pdf?1394550205=&response-content-disposition. (Accessed: 12.02.2017).

Finlay, L. (2002) 'Negotiating the Swamp: The Opportunity and Challenge of Reflexivity in Research Practice', *Qualitative Research*, 2(2), pp. 209-230. doi: 10.1177/146879410200200205.

Fritsch, M. (2017) 'The theory of economic development – An inquiry into profits, capital, credit, interest, and the business cycle', *Regional Studies*, 51(4), pp. 654–655. doi: 10.1080/00343404.2017.1278975.

Gallais, T. Le (2008) 'Wherever I go there I am: reflections on reflexivity and the research stance', *Reflective Practice*, 9(2), pp. 145–155. doi: 10.1080/14623940802005475.

Gallouj, F. and Savona, M. (2009) 'Innovation in services: A review of the debate and a research agenda', *Journal of Evolutionary Economics,* 19, p.149 . doi: 10.1007/s00191-008-0126-4.

Gassmann, O., Enkel, E. and Chesbrough, H. (2010) 'The future of open innovation', *the Authors Journal compilation,* 40(3), pp. 213-221. doi: 10.1111/j.1467-9310.2010.00605.x.

Gebauer, H., Fleisch, E. and Friedli, T. (2005) 'Overcoming the service paradox in manufacturing companies', *European Management Journal, 23(1), pp. 14-26*. doi: 10.1016/j.emj.2004.12.006.

Goedkoop, M. C., van Halen, J. G., Te Riele, R.M., Rommens, J. M. (1999) 'Product Service systems, Ecological and Economic Basics', *Product Innovation Technology Management,* 3(1), pp. 3-105. doi:10.1113./J.2323.x.

Gouldner, A. W. (1970) *The Coming Crisis Of Western Sociology*, *14th European Operations Management Association Conference, Ankara, Turkey.* Available at: https://archive.org/stream/in.ernet.dli.2015.130890/2015.130890. (Accessed: 03.05.2018).

Gray, D. (2004) *Doing research in the real world*. London: Sage Publications Ltd.

Gregor, S. (2006) 'The nature of theory in Information Systems', *MIS Quarterly: Management Information Systems, 30(3), pp. 611-642*. doi: 10.2307/25148742.

Griffin, A. and Hauser, J. R. (1993) 'The Voice of the Customer', *Marketing Science*, 12(1), pp. 1–27. doi: 10.1287/mksc.12.1.1.

Gustafsson, A., Kristensson, P. and Witell, L. (2012) 'Customer co-creation in service innovation: a matter of communication?', *Journal of Service Management*, 23(3), pp. 311–327. doi: 10.1108/09564231211248426.

Hamilton, K., Dunnett, S. and Downey, H. (2012) 'Researcher identity: Exploring the transformatory power of the research experience', *Journal of Consumer Behaviour*, 11(4), pp. 275–282. doi: 10.1002/cb.1386.

Hänsch Beuren, F., Gitirana Gomes Ferreira, M. and Cauchick Miguel, P. A. (2013) 'Product-service systems: a literature review on integrated products and services', *Journal of Cleaner Production*, 47, pp. 222–231. doi: 10.1016/j.jclepro.2012.12.028.

Hansen, M. T. and Birkinshaw, J. (2007) 'The innovation value chain', *Harvard Business Review,* 6(7), pp. 1-13. doi: 10/102007.43656543.

Harrison, H., Birks, M., Franklin, R., Mills, J. (2000) *Forum, qualitative social research*, *Forum Qualitative Sozialforschung / Forum: Qualitative Social Research. Deutsche Forschungs gemeinschaft*. Available at: http://www.qualitative-research.net/index. php/fqs/article/ view/2655/4080. (Accessed: 22.06. 2017).

Hart, C. (1998) *Doing a literature review: Releasing the social science research imagination*. London: SAGE Publications Ltd.

Hart, C. (2001) *Doing a Literature Search: The Purpose of Seacrhing the Literature*. 2nd edn. London: SAGE Publications Ltd.

Hayes, N. (2000). *Doing psychological research: Gathering and analysing data.* Washington: Open University Press.

Hsieh, J. K., Chui, H-C., Wie, C-P., Yen, R.,Cheng, Y-C. (2013) 'A practical perspective on the classification of service innovations', *Journal of Services Marketing,* 27(5), pp. 371-384. doi: 10.1108/JSM-10-2011-0159.

Ili, S., Albers, A. and Miller, S. (2010) 'Open innovation in the automotive industry', *R&D Management*, 40(3), pp. 246–255. doi: 10.1111/j.1467-9310.2010.00595.x.

Jacquette, D. (2013) *Ontology*. Buckinghamshire: Acumen Publishing.

James, W. (2004) 'The Meaning of Truth', *The American Journal of Psychology, 21(1), p. 172*. doi: 10.2307/1412964.

Jefatura del Estado (2015) 'Ley 34/2007, de 15 de noviembre, de calidad del aire y protección de la atmósfera', *Boletín Oficial del Estado*, BOE-A-2007(16 noviembre de 2007) 275, pp. 10–15. doi: 10.1016/j.watres.2009.01.011.

Johansson-Sköldberg, U., Woodilla, J. and Çetinkaya, M. (2013) 'Design thinking: Past, present and possible futures', *Creativity and Innovation Management,* 22(2), pp. 121-146. doi: 10.1111/caim.12023.

Johnson, P. and Clark, M. (2014) *Business and Management Research Methodologies*. London: Sage Publications Ltd.

Johnson, R. B., de Waal, C., Stefurak, T. (2017) 'Understanding the philosophical positions of classical and neopragmatists for mixed methods research', *KZfSS Kölner Zeitschrift für Soziologie und Sozialpsychologie*, 69(S2), pp. 63–86. doi: 10.1007/s11577-017-0452-3.

Kelemen Rumens, N, M. (2008) *An Introduction to Critical Management Research*. London: Sage Publications Ltd.

Kerlinger, F. N. (1973) *Foundations of behavioral research*. New York: Holt, Rinehardand and Winston.

Kessler, T. and Stephan, M. (2013) 'Service transition in the automotive industry', *International Journal of Automotive Technology and Management,* 13(3), pp. 1-13. doi: 10.1504/IJATM.2013.054919.

Khurana, A. and Rosenthal, S. R. (1998b) 'Towards Holistic "Front Ends" in NPD', *Production Innovation Management*, 15(1), pp. 57–74. doi: 10.1111/1540-5885.1510057.

Kimberly, J. R. (1981) 'Managerial innovation', *Handbook of Organizational Design*, 1(84), pp. 84–104. doi: 10.9870.345425.

King, N., Cassell, C. and Symon, G. (2004) *Essential guide to qualitative methods in organizational research*. London: Sage Publications Ltd.

Kock, A., Heising, W. and Gemünden, H. G. (2015) 'How ideation portfolio management influences front-end success', *Journal of Product Innovation Management,* 32(4), pp. 539-555. doi: 10.1111/jpim.12217.

Kyndt, E. and Baert, H. (2013) 'Antecedents of Employees' Involvement in Work-Related Learning: A Systematic Review', *Review of Educational Research,* 83(2), pp. 273-313. doi: 10.3102/0034654313478021.

Labonte, R. and Laverack, G. (2001) 'Capacity building in health promotion, Part 2: Whose use? And with what measurement?', *Critical Public Health*, 11(2), pp. 129–138. doi: 10.1080/09581590110039847.

Labonte, R. and Laverack, G. (2010) 'Critical Public Health Capacity building in health promotion: For whom? And for what purpose?', *Critical Public Health,* 11(2), pp. 111-127. doi: 10.1080/09581590110039838.

Langley, A., Royer, I. and Langley Isabelle Royer, A. (2006) 'Perspectives on doing case study research in organizations', *M@n@gement*, 3(3), pp. 81–94. doi: 10.3917/mana.093.0081.

Lee, G. and Xia, W. (2010) 'Toward agile: An integrated analysis of quantitative and qualitative field data on software development agility', *MIS Quarterly: Management Information Systems,* 34(1), pp. 87-114. doi: 10.2307/20721416.

Lenfle, S. and Loch, C. (2011) 'Lost roots: How project management came to emphasize control over flexibility and novelty', *California Management Review,* 53(1), pp. 32-55. doi: 10.1525/cmr.2010.53.1.32.

Lenfle, S. and Midler, C. (2009) 'The launch of innovative product-related services: Lessons from automotive telematics', *Research Policy,* 38(1), pp. 156-169. doi: 10.1016/j.respol.2008.10.020.

Lerch, C. and Gotsch, M. (2015a) 'Digitalized Product-Service Systems in Manufacturing Firms: A Case Study Analysis', *Research-Technology Management*, 58(5), pp. 45–52. doi: 10.5437/08956308X5805357.

Lerch, C. and Gotsch, M. (2015b) ‘Digitalized Product-Service Systems in Manufacturing Firms: A Case Study Analysis’, *Research-Technology Management*, 585, pp. 45–52. doi: 10.5437/08956308X5805357.

Liao, Z. (2018) ‘Social capital and firms’ environmental innovations: The moderating role of environmental scanning’, *Business Strategy and the Environment*, 27(8), pp. 1493–1501. doi: 10.1002/bse.2207.

Lillis, A. M. (1999) ‘A framework for the analysis of interview data from multiple field research sites’, *Accounting and Finance,* 39(1), pp. 79-105. doi: 10.1111/1467-629X.00018.

Lincoln, Y. S. and Guba, E. G. (1985) *Naturalistic Inquiry.* London: Sage Publications.

Lusch, R. F. and Vargo, S. L. (2004) ‘Evolving to for Logic Marketing’, *The Journal of Marjeting*, 68(1), pp. 1–17. doi: 10.1300/J047v07n04_02.

MacCormack, A., Verganti, R. and Iansiti, M. (2001) ‘Developing products on “Internet time”: The anatomy of a flexible development process’, *IEEE Engineering Management Review*, 47(1), pp. 133-150. doi: 10/199773876486834.

Mack, N., Woodsong, C., McQueen, K., Guest, G., Namey, E. (2011) *Qualitative Research Methods*: *A data collector’s field guide*. North Carolina: Family Health International.

Mahut, F., Daaboul, J., Bricogne, M., Eynard, B. (2015) ‘Survey on Product-Service System applications in the automotive industry’, *Science Direct,* 48(3), pp. 840-847. doi: 10.1016/j.ifacol.2015.06.188.

Mahut, F., Daaboul, J., Bricogne, M., Eynard, B. (2017) ‘Product-Service Systems for servitization of the automotive industry: a literature review’, *International Journal of Production Research*, 55(7), pp. 2102–2120. doi: 10.1080/00207543.2016.1252864.

Malterud, K. (2001) ‘Qualitative research: standards, challenges, and guidelines’, *The Lancet*, 358(9280), pp. 483–488. doi: 10.1016/S0140-6736(01)05627-6.

Manzini, E. and Vezzoli, C. (2003) ‘A strategic design approach to develop sustainable product service systems: examples taken from the environmentally friendly innovation’, *Journal of Cleaner Production*, 11, pp. 851–857. doi: 10.1016/S0959-6526(02)00153.

Martinsuo, M. and Poskela, J. (2011) ‘Use of evaluation criteria and innovation performance in the front end of innovation’, *Journal of Product Innovation Management,* 28(6), pp. 896-914. doi: 10.1111/j.1540-5885.2011.00844.x.

McGrath, R. G. (2010) ‘Business models: A discovery driven approach’, *Long Range Planning*, 43(2–3), pp. 247–261. doi: 10.1016/j.lrp.2009.07.005.

McKinsey (2016) ‘Automotive Revolution; Perspective Towards 2030’, *Auto Tech Review*, 5(4), pp. 20–25. doi: 10.1365/s40112-016-1117-8.

Meltzoff, J. (2005) ‘Ethics in Research’, *Journal of Aggression, Maltreatment & Trauma*, 11(3), pp. 311–336. doi: 10.1300/J146v11n03_03.

Miles, M.B & Huberman, A. (1994) *An expanded sourcebook: Qualitative data analysis*. 2nd ed. London: Sage Publications Ltd.

Mont, O. (2002) ‘Clarifying the concept of product – service system’, *Journal of Cleaner Production*, 10, pp. 237–245. doi: 10.1016/S0959-6526(01)00039-7.

Morelli, N. (2003) ‘Product-service systems, a perspective shift for designers: A case study - The design of a telecentre’, *Design Studies*, 24(1), pp. 73–99. doi: 10.1016/S0142-694X(02)00029-7.

Morgan, D. L. (2014) ‘Pragmatism as a Paradigm for Social Research’, *Qualitative Inquiry*, 20(8), pp. 1045–1053. doi: 10.1177/1077800413513733.

Myhren, P., Witell, L., Gustafsson, A., Gebauer, H. (2017) 'Incremental and radical open service innovation', *Journal of Services Marketing*, 32(2), pp. 101-112. doi: 10.1108/JSM-04-2016-0161.

Neely, A. (2007) 'The Servitization of Manufacturing: an Analysis of Global Trends', *14th European Operations Management Association Conference, Ankara, Turkey*,1(1) pp. 1–10. doi: 10.1007/s12063-009-0015-5.

Nonaka, I. (1991) 'The Knowledge Creating Company', *Harvard Business Review*, 69, pp. 96-104. doi: 10.1016/0024-6301(96)81509-3.

O' Mahony, T., Zhou, P. and Sweeney, J. (2012) 'The driving forces of change in energy-related CO 2 emissions in Ireland: A multi-sectoral decomposition from 1990 to 2007', *Energy Policy*, 44(5), pp. 256-267. doi: 10.1016/j.enpol.2012.01.049.

OECD (2005) Organisation for Economic Co-operation and Development Statistical Office of the European Communities. *Guidelines for collecting and interpreting innovation data.*, *Oslo Manual*. Available at: https://www.oecd-ilibrary.org/science-and-technology/oslo-manual_9789264013100-en. (Accessed: 23.02.2018)

Oliver, P. (2010) *The Student's Guide to Research Ethics*. Maidenhead: Open University Press.

Ostrom, A. L., Bitner,M.J., Brown, S.W., Burkhard, K., Goul, M., Smith-Daniels, V., Demirkan, H., Rabinovich, E. (2010) 'Moving forward and making a difference: Research priorities for the science of service', *Journal of Service Research,* 13(1), pp. 4-36. doi: 10.1177/1094670509357611.

Ostrom, A. L., Parasuraman, D., Bowen, E., Patricio, L., Voss, C.A. (2015) 'Service Research Priorities in a Rapidly Changing Context', *Journal of Service Research,* 18(2), pp. 127-159. doi: 10.1177/1094670515576315.

Patton, M. (1990) *Qualitative evaluation and research methods*. 2nd edn. London: Sage Publications Ltd.

Patton, M. (2001) ‘Qualitative Research and Evaluation Methods.’, *US Patent 2,561,882 - 806 Pages*, p. 806. doi: 10.1001/978-3-653-12567-3.

Plattner, L. and Meinzel,C. (2011) *Design Thinking: Understand – Improve – Apply*. Available at: https://doi.org/10.1007/978-3-642-21643-5_1. (Accessed:14.06.2018).

Polanyi, M. (1967) *The Tacit Dimension*. Chicago: The University of Chicago Press.

Porter, M. E. (1980) ‘Competitive Strategy: Techniques for Analyzing Industries and Competitors’, *Competitive Strategy*, 1(6), p. 396. doi: 10.1002/smj.4250020110.

Prahalad, C. K. and Ramaswamy, V. (2004) ‘Co-creating unique value with customers’, *Strategy & Leadership*. 32(3), pp. 4-9. doi: 10.1108/10878570410699249.

Prahalat, C.K. and Ramaswamy, V. (2000) ‘Co-opting customer competence’, *Harvard business review,* 1(2), pp. 1-15. doi: 10.00/79247985/667376.

Presthus, W. (2016) ‘How To Frame Your Contribution To Knowledge ? a Guide for Junior Researchers in Information’, *Nokobit*, 24(1), pp. 28–30. doi:11250/2440006.

Pryor, C., Holmes,M., Webb, J-W. (2019) ‘Top Executive Goal Orientations’ Effects on Environmental Scanning and Performance: Differences Between Founders and Nonfounders’, *Journal of Management*, 45(5), pp. 1958–1986. doi: 10.1177/0149206317737354.

Randolph, J. J. (2009) ‘A Guide to Writing the Dissertation Literature Review’, *Practical Assessment, Research & Evaluation*, 14(13), pp. 1–13. doi: 10.1306/D426958A-2B26-11D7-8648000102C1865D.

Räse, U. (2010) *Nachhaltige Produktentwicklung bei Mercedes-Benz-Werkzeuge zum Controlling von Projektfortschritt und Produktreifegrad*, *21st Symposium on Design for X, Buchholz nr. Hamburg, 02.-03.09. 2010*, pp. 1–10. Available at: http://papers.designsociety.org/nachhaltige _produktentwicklung_ bei_mercedes-benz-werkzeuge_zum_controlling_von_projektfortschritt _und_ produktreifegrad_keynote_paper.paper.30024.htm. (Accessed: 04.05.2017).

Reinhardt, R., Domingo, S. Grcia, B.A., Christodoulou, I. (2017) *Macro environmental analysis of the electric vehicle battery second use market*. International Conference on the European Energy Market, EEM. Available at: https://ieeexplore.ieee.org/ abstract/document/798203. (Accessed: 23.02.2019).

Remus, U. and Wiener, M. (2010) 'A multi-method, holistic strategy for researching critical success factors in IT projects', *Information Systems Journal*, 20(1), pp. 25–52. doi: 10.1111/j.1365-2575.2008.00324.x.

Ritchie, J. and Lewis, J. (2003) *Qualitative Research Practice , a Guide for Social Science Students and Researchers*. London: SAGE Publications Ltd.

Rowley, J. (2014) 'Designing and using research questionnaires', *Management Research Review*, 37, pp. 7–26. doi: 10.1108/MRR-02-2013-0027.

Saunders, M., Lewis, P., Thornhill, A., Bristow, A. (2015) *Understanding research philosophy and approaches to theory developm*ent. Harlow: Pearson Education.

Saunders, M., Lewis, P. and Thornhill, A. (2009) *Research Methods for Business Students*, fith edition. Harlow: Pearson Education Limited.

Schallmo, L. and W. (2018) *An Integrated Design Thinking Approach-Literature Review , Basic Principles and Roadmap for Design Thinking*. The ISPIM Innovation Conference. The Name of the Game, Stockholm, Sweden on 17-20 June. Available at: htpps://www.ispim.org. (Accessed: 09.03.2019).

Schöttle, M. (2018) ‘Urban Mobility Trend Indicators’, *MTZ worldwide*, 79(11), pp. 8–13. doi: 10.1007/s38313-018-0119-0.

Schumpeter, J. A. (1934) ‘The Theory of Economic Development: An Inquiry Into Profits, Credit, Interest, and the Business Cycle’, *Social Science Electronic Publishing*, 25(1), p. 255. doi: 10/19348299427/9247.

Schumpeter, J. A. (1942) ‘Capitalism, Socialism and Democracy’, *Business Horizons*, 48(3), pp. 199–207. doi: 10/19428798249/98794797.

Shaw, D. (2006) ‘Journey Making group workshops as a research tool’, *Journal of the Operational Research Society*, 57(7), pp. 830–841.
doi: 10.1057/palgrave. jors.2602155.

Shore, D. A. (2012) *Forces of change : New strategies for the evolving health care marketplace*. San Francisco: A Wiley Imprint.

Shrivastava, S. and N. (2018) ‘Assessment of change in knowledge about research methods among delegates attending research methodology workshop’, *Perspectives in Clinical Research*, 8, pp. 83–90. doi: 10.4103/picr.PICR.

Simons, H. (2009) *Case study research in practice*. London: SAGE Publications Ldt.

Sims, N. H. (2006) *How to run a great workshop : the complete guide to designing and running brilliant workshops and meetings*. Harlow: Pearson/Prentice Hall Business.

Snyder, H., Witell, L., Gustafsson, A., Fombelle, P. (2016) ‘Identifying categories of service innovation: A review and synthesis of the literature’, *Journal of Business Research*, 69(7), pp. 2401-2408. doi: 10.1016/j.jbusres.2016.01.009.

Spanish Government (2018) *Calidad del aire*, *Spanish Goverment*. Available at: https://www.miteco.gob.es/es/calidad-y-evaluacion-ambiental/temas/atmosfera-y-calidad-del-aire/calidad-del-aire/. (Accessed: 06.01.2019).

Stanford University and Center for the Study of Language and Information (U.S.) (1997) ‘Stanford encyclopedia of philosophy.’, *Stanford University Press*. Stanford University. Available at: https://plato.stanford.edu/archives/spr2014/entries/epistemology/. (Accessed: 12.04.2018).

Stephen, W., George, M. and Chris, T. (2012) ‘Successful extreme programming: Fidelity to the methodology or good teamworking?’, *Information and Software Technology,* 55(4), pp. 660-672. doi: 10171016/j.infsof.2012.10.002.

Tan, A. R., Matzen, D., McAloone, T.C., Evans, S. (2010) ‘Strategies for designing and developing services for manufacturing firms’, *CIRP Journal of Manufacturing Science and Technology*, 3(2), pp. 90–97. doi: 10.1016/j.cirpj.2010.01.001.

Teece, D. J. (2010) ‘Business Models, Business Strategy & Innovation’, *ScienceDirect*, 43(2–3), pp. 172–194. doi: 10.1016/j.lrp.2009.07.003.

The United StatesDepartment of Justice (2016) *Volkswagen to Spend Up to $14.7 Billion to Settle Allegations of Cheating Emissions Tests and Deceiving Customers on 2.0 Liter Diesel Vehicles | OPA | Department of Justice*, *United States Department of Justice*. Available at: https://www.justice.gov/opa/pr/volkswagen-spend-147-billion-settle-allegations-cheating-emissions-tests-and-deceiving. (Accessed: 15.03.2017).

Thomas, B., Miller, C. and Murphy, L. (2011) *Innovation and Small Business - Volume 2*, *Ventus Publishing ApS*. Available at: https://library.ku.ac.ke/wp-content/downloads/2011/08/Bookboon/Economics/innovation-and-small-business-volume-2.pdf. (Accessed: 23.07.2018).

Thompson, V. A. (1965) ‘Bureaucracy and Innovation’, *Administrative Science Quarterly, 10 (1), pp. 1-20*. doi: 2811ed59-f527-48b1.

Tidd, J., Bessant, J. R. and Pavitt, K. (2005) *Managing innovation : integrating technological, market and organizational change*. 6th edn. New Jersey: Wiley.

Tommasetti, A., Troisi, O. and Vesci, M. (2017) 'Journal of Service Theory and Practice Measuring customer value co-creation behavior: Developing a conceptual model based on service-dominant logic', *Journal of Service Theory and Practice, an International Journal Iss Journal of Service Theory and Practice*, 27(4), pp. 930–950. doi: 10.1108/JSTP-10-2015-0215.

Torraco, R. J. (2005) 'Writing Integrative Literature Reviews: Guidelines and Examples', *Human Resource Development Review*, 4(3), pp. 356–367. doi: 10.1177/1534484305278283.

Torraco, R. J. (2016) 'Writing integrative literature reviews: Using the Past and Present to Explore the Future', *Human Resource Development Review*, 15(4), pp. 404–428. doi: 10.1177/1534484316671606.

Townsend, J. D. and Calantone, R. J. (2014) 'Evolution and Transformation of Innovation in the Global Automotive Industry', *Journal of Product Innovation Management*, 31(1), pp. 4–7. doi: 10.1111/jpim.12075.

Tukker, A. (2004) 'Eight Types of Product– Service System: Eight Ways to Sustainability?', *Business Strategy and the Environment*, 13(4), pp. 246-260. doi: 10.1002/bse.414.

Urquhart, C., Lehmann, H. and Myers, M. D. (2010) 'Putting the "theory" back into grounded theory: Guidelines for grounded theory studies in information systems', *Information Systems Journal, 20(4), pp. 357-381*. doi: 10.1111/j.1365-2575.2009.00328.x.

Vargo, S. L. and Lusch, R. F. (2008) 'Service-dominant logic: Continuing the evolution', *Journal of the Academy of Marketing Science*, 36(1), pp. 1–10. doi: 10.1007/s11747-007-0069-6.

Vecchio, G. and Tricarico, L. (2018) 'May the Force move you&quot: Roles and actors of information sharing devices in urban mobility', *Science Direct*, 88, pp. 261-268. doi: 10.1016/j.cities.2018.11.007.

Vendrell-Herrero, F., Myrthianos, V., Parry, G. (2017) ‘Digital dark matter within product service systems’, *Competitiveness Review*, 27(1), pp. 62–79. doi: 10.1108/CR-11-2014-0037.

Visnjic Kastalli, I. and Van Looy, B. (2013) ‘Servitization: Disentangling the impact of service business model innovation on manufacturing firm performance’, *Journal of Operations Management*, 31(4), pp. 169–180. doi: 10.1016/j.jom.2013.02.001.

Walker, R. (1983) ‘Three good reasons for not doing case studies in curriculum research’, *Journal of Curriculum Studies,* 15(2), pp. 155-165. doi: 10.1080/0022027830150205.

Walters, D. and Rainbird, M. (2007) ‘Cooperative innovation: a value chain approach’, *Journal of Enterprise Information Management*, 20(5), pp. 595–607. doi: 10.1108/17410390710823725.

Wang, Q., Voss, C., Zhao, x., Wang, Z. (2015) ‘Modes of service innovation: a typology’, *Industrial Management & Data Systems*, 115(7), pp. 1358–1382. doi: 10.1108/IMDS-03-2015-0067.

Watts, G. (2020) *The New Venture Coursebook: a comprehensive guide to planing and new business*. London: Routledge.

Weber, K. M., Amantidou, E., Erdmann, L., Nieminen, M. (2016) ‘Research and innovation futures: exploring new ways of doing and organizing knowledge creation’, *Foresight,* 18(3), pp. 193-203. doi: 10.1108/FS-04-2016-0017.
Wedeniwski, S. (2015) *The mobility revolution in the automotive industry.* Berlin: Springer Verlag.

Weiller, C., Shang, T., Neely, A., Yongjiang, S. (2015) *Competing and Co-existing Business Models for Electric Vehicles: Lessons from International Case Studies*. Available at: http://www.innovation-portal.info/wp-content/uploads/2015-January-Business-Models-for-EV.pdf. (Accessed: 12.04.2017).

West, J. and Bogers, M. (2014) 'Leveraging external sources of innovation: A review of research on open innovation', *Journal of Product Innovation Management*, 31(4), pp. 814–831. doi: 10.1111/jpim.12125.

Whittemore, R. and Knafl, K. (2005) 'The integrative review: updated methodology', *Wiley Online Library*, 52(5), pp. 546–553. doi: 10.1111/j.1365-2648.2005.03621.x.

Whyte, W. F. (1991) 'Participatory action research', *Sage Publications*, 94(1), pp. 20-29. doi: 10.1016/j.apmr.2012.07.033

Williams, A. (2005) 'Product-service systems in the automotive industry: the case of micro-factory retailing', *Journal of Cleaner Production*, 14(2), pp. 172-184. doi: 10.1016/j.jclepro.2004.09.003.

Williams, A. (2006) 'Product service systems in the automobile industry: contribution to system innovation?', *Science Direct*, 15(11-12), pp. 1093-1103. doi: 10.1016/j.jclepro.2006.05.034.

Xu, L., Prybutok, V. and Blankson, C. (2019) 'An environmental awareness purchasing intention model', *Industrial Management and Data Systems,* 119(2), pp. 367-381. doi: 10.1108/IMDS-12-2017-0591.

Yang, X., Moore, p., Pu, J.S., Wong, C.B. (2009) 'A practical methodology for realizing product service systems for consumer products', *Computers and Industrial Engineering*, 56(1), pp. 224–235. doi: 10.1016/j.cie.2008.05.008.

Yardley, M. and Marks, D.F. (2007) *Research Methods for Clinical and Health Psychology*. London: Sage Publications Ltd.

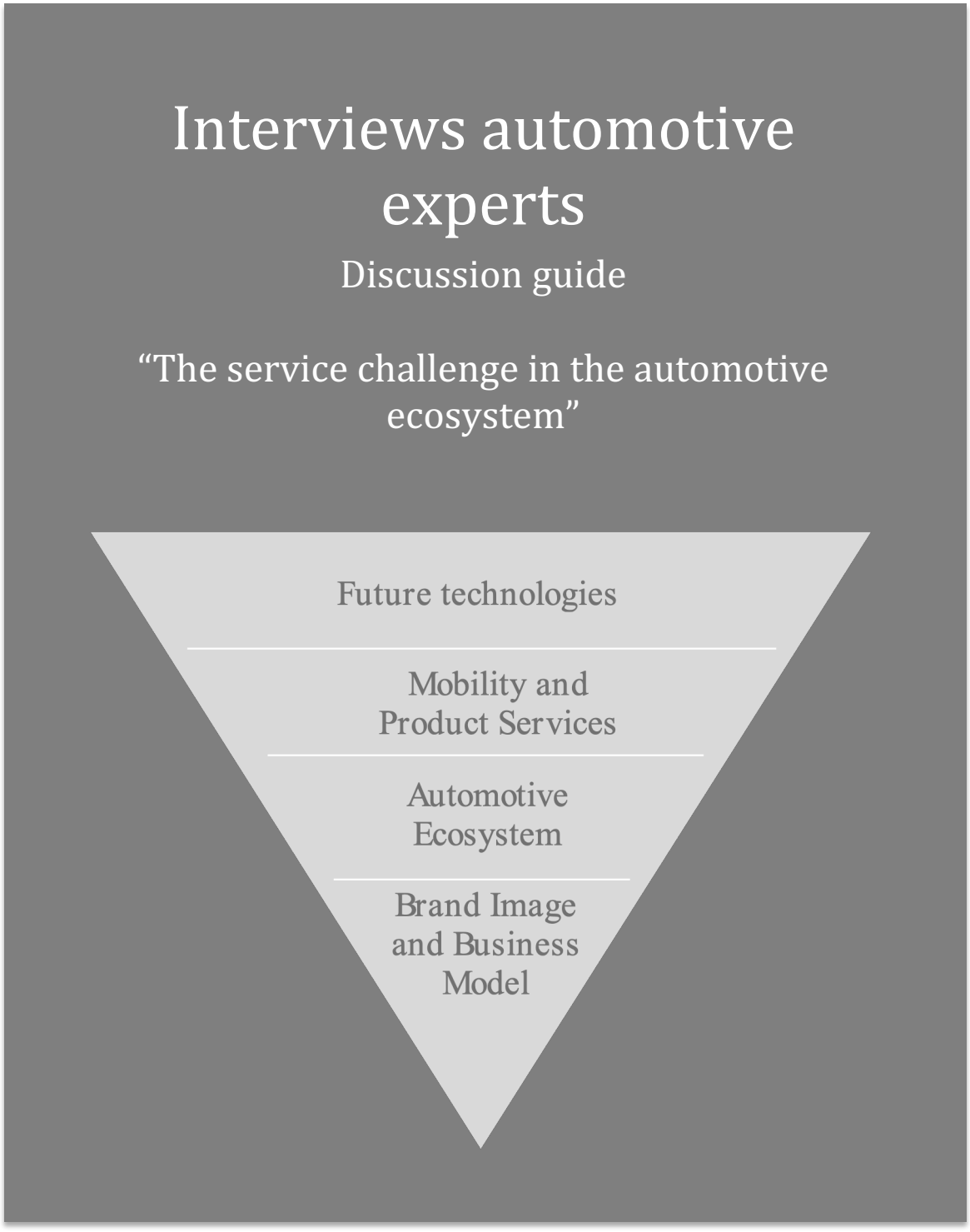
Yin, R. K. (2011) ‘Case Study Research Design and Methods’, *The Canadian Journal of Action Research*, 14(1), pp. 26--48. doi: 10.33524/cjar.v14i1.73.

Zott, C. and Amit, R. (2010) ‘Business Model Design: An Activity System Perspective’, *Long Range Planning*, 43, pp. 216–226. doi: 10.1016/j.lrp.2009.07.004.

7 List of Appendices

7.1 Appendix A: Data Collection Tool Interviews

Interview Compilation with five different Participants. All 15 participants answered the entire, but identic interview questions. For a better understanding, the researcher presents a compilation of two internal and three external participants for each of the five thematic themes.



Compilation of Questions

Participant: AE/P1, AE/P5, PM/P10, PM/P13, PM /P14

A. PRESENTATION AND INTRODUCTION

Short presentation of research/researcher and purpose of the research.

Short input of actual Mobility Services:
Comprehensive electric mobility. Car sharing - Car2Go.
Assistance when parking in certain areas, parking in big cities.
Pay-per-use Car.
Change of vehicle in case of need.

LEISURE AND ENTERTAINMENT:
Access to multimedia content from the vehicle: Netflix, Spotify.
Listen to and answer (via voice) emails, WhatsApp, etc.

TIME MANAGEMENT:
Parking solutions.
Cleaning service while the vehicle is not in use.
Charging service (electrical) while the vehicle is not in use.

1. FUTURE Technologies / 1-QF 1-4

Madrid, Date 11.02.2019 Time: 10:00 – 11.30 H

Participant: AE/P1

Introduction:

Hi, my name is XXX, I've been in the brand for 30 years, and I've been through many positions, always in sales and marketing. I've been head of the area, products, marketing and now I have all the training programs of the dealer network, the academy. We take care of the training of all the staff. Daimler Central establishes job profiles that have to be qualified and on that we do the programs, in some skill or system. From managers to mechanics recently incorporated in our brand, including programs for sales and customer service.

1. **What will be your relationship with technology in the future?**

We are going to have to give a lot of service in customer experience. The client travels much more now than before, they have more base of comparison, by continents, cultures, and they see another type of services. In Asian countries they have a luxury that we do not have here, we are more austere here, and the client comes back and wants that. Trips to Tokyo or Beijing are made by Emirates via Dubai because on-board service has a difference in space and service that other companies do not.

2. **How will you communicate in 5 years' time? How are you going to relate to your friends/relatives?**

Probably more via digital Medias, but I still hope face to face encounters with my relatives.

3. **What will happen to leisure / entertainment? How will you enjoy your free time?**

I do not think it changes much at the level of what is valued. People get older with more health. There is more sport, more money to travel and sunbathe at any time of the year, go to Vienna to the opera, to a musical in New York. People can develop their hobbies in other places.

4. **What types of new services or products will companies / brands offer?**

It is necessary to go deeper into the customer experience, at the multichannel level, at any point of contact with the customer, and to give that service with a click, to be able to do the whole process. To be able to configure, teach, take a test car, making the delivery, without having to come to the dealership at any time. We have to be able to develop that service. Obviously charging the cost of it. But as an urbanite they are 20 euros more because they pick me up to take it to the workshop, I value my time. It has to be made to measure and to the letter, to be able to offer all the possibilities of services.

2. MOBILITY AND PRODUCT SERVICES / 2-QM 1-8

Madrid, Date 11.02.2019 Time: 14:30 – 16.00 H

Participant: AE/P5

Focus on the mobility, transport and how we will move in the future.

1. **How will mobility change in the next 5 years? What will the client do in different way? What is new? What has disappeared?**

I think this part is more in the initial discourse. To be able to rent vehicles in different ways and immediately. There will be people who only want property, others rent by the hour and other mixed models.

Also, on the financial issue. Proposed products and services ... (reads) this is an opportunity and a challenge. We need sellers with a very high level of competence with special training. That they have greater knowledge. We enter an unknown world for the sales force. The share service has to be previously managed by the dealer. Development of infrastructure recharge, it has to be done by the English court or electric company. I believe that manufacturers should not invest in the development of infrastructure but in cars. They are the electricians who have to put the pasta and for now, they have not done it. What the app gives a lot of benefit is clear. Real mobility for Premium customers. Electric cars will cost between 40 and 60,000 euros. Alternatives, a combustion vehicle at low cost or without cost. In addition, in a country as big as Spain, the client wants freedom of movement; in Switzerland, it is easier to do so. Replacement for maintenance or repairs. Excellent crane service. This does give benefit. I have to ensure that I can move the car to a charging point and I can go wherever I want.

2. **What will be exciting in terms of mobility? How do you see the payment for use and services?**

The use of car sharing or with “Mytaxi”; you could negotiate a discount with them. There you can give an added value. An excellent crane service for the customer. Finally, the agreement with an electric company for the installation. I think that for the customer it would have to be already all-inclusive, it is mandatory because a charger is between 1,500 - 2,000 euros, between 1 and 4 points of the price of the car, it would have to be there. And delivery of the product to the client explaining well pros and cons during the sales process and when you deliver the car. For example, the heating of seats, I can put it as standard and charge it only in winter that the customer can choose to activate it. Just as you rent mobility, you rent this. If I'm going to take my grandchildren, I can rent a movie for them, which at other times I do not want at all. In the end, the car is also a platform for mobility and entertainment, also for the driver, when it is automated. Being able to download an entertainment program for a trip. We all have at home those payment options, channels, at a click, we are all accustomed. The evolution capacity of the data process may be multiplied by a thousand, I have no doubt that the car will be such a platform. This is going very fast. The connected car also generates a lot of data, just going from here to the door of the sun, will be making interconnections.

3. **How relevant will mobility be in general? Will it increase? Decrease?**

Those who give you a last generation mobile instead of just voice. Before you could not imagine it. We'll see.

4. **What are you seeing through the VR glasses and how will mobility be experienced?**

People do not know what they need, in order to think about a revolutionary concept, clients are not able to do so; for that we have the visionaries within the companies.

5. **How will people use mobility during the week, on the weekend, at work and for holidays?**

The restrictions come from the political sphere, the change is taking place due to the episodes of contamination, they have begun to limit there and they are going to veto the diesel in the big cities. People want to be able to move freely, even if they have to replace technology. That opens up many wounds and blisters. But as I see society and Mercedes, where you have to solve barriers is a little what Smart is doing. People say I buy the electric, but how do you charge it? They are selling the car without the charger. Solutions as easy as that, and that make the installation ready for use, you have to give them to the client. You have to see what use you are going to give to the vehicle to sell it. People will use car to go to work, but they want to change the car for the weekend or on holidays, more flexibility to change for the right car.

6. **What will be the role of private owned vehicles? Of public transport? In addition, what about electric bikes, electric scooters?**

They are fine until the day you have an emergency and there are no cars. That day I consider buying a car. I do not think everything will be that way, I think that different models of ownership and use will coexist. Each person perfectly knows their needs. I have worked with Smart since its launch. It does not reach 10% if the car has more than two people and yet it is very difficult for people to carry only two seats. We all have the "And yes ..." in mind, we want to have mobility at all times, if my son gets up with peritonitis I want to be able to leave quickly and not listening to the switchboard saying that it remains waiting.

7. **How will car-sharing or similar services evolve in the future? What do the they offer as services?**

Car sharing will become more important with autonomous driving, but we still have a legal problem, and infrastructure. The non-autonomous car, its drivers, are the biggest enemy of the autonomous, parameterized. We will start with those long-distance routes where it is easier to fly and the impacts are much smaller. So, car-sharing plays already an important role to enter to the city centre, but most of the people use it additionally to their own car.

A vehicle for shared use, not only at the level of the employees of the company, but even shared with other companies or individuals. It will depend on the particular technology that is available to have and enjoy these vehicles.

8. When are these services used?

Obviously you need very strong investments for these services. Brands must be able to charge it, not just develop it. BMW and Audi are very advanced. The problem is the public authorities that are the owners of the infrastructures and these are not ready. This investment by the public authorities I think it will take and will go far behind the technology. They restrict the traffic but there are only 20 recharging points and they will not make many new ones. The manufacturers' business is very concentrated, and we prefer to collaborate with each other than with others.

3. Change / 3-Qc 1-9

Madrid, Date 25.02.2019 Time: 11:00 – 12.30 H

Participant: PM/P10

1. What will be the factors to shape these new mobility options? What will be the future trends of mobility?

We are going to provide a service to the people who wants to enter in Madrid and who are not allowed to enter. Just imagine the Madrid protocol: 1st 70 kilometres per hour inside the M30, 2nd they won`t let you park, 3rd I don't know how many. And then at some point they say" on even days even numbered licence plates enter, on odd days, odd numbers licence plates". And what I`m supposed to do, go to Barajas Airport and rent a car, or plug in hybrid cars and what – change it every day? With zero emission cars you can. We have a sufficient stock of vehicles for those who want to enter inside the M30. I believe the rental business will be affected.

9. What will happen with the traffic in big cities? What will be enhanced? What will the regional government therefore do?

We are doing well as a company; we are opening important offices in development city to provide rental services. But we cannot wait 8 hours for charging, when it takes 5 minutes to refill the car at a gasoline station.

Fast charging can be solution, because it takes only 20 minutes to recharge the car. More and more people will rent a car instead of buying one. More and more restriction will arise in the big cities.

10. What do you see in terms of change in vehicle technologies?

I just remembered, we also have a motorcycle, but only one person uses it. We are going to keep needing vehicles. The technology is changing now, but it still hasn't come together. It's like when we were in that period when there were powerful Nokia`s, but they weren't a Smartphone… they had a keyboard like a computer, but it didn't work like a Smartphone. Right now, we're in something similar to then. If you change to something, you're going to stay there… and these are big investments… Something is going to happen, but it's still a bit early. We bought a vehicle less than a year ago. We thought about a hybrid because of consumption and its ecological, to do things correctly, and we couldn't. A year ago, a hybrid vehicle was for very short distances and low velocity… and we need to go places outside of Madrid, take the M40, you have to go more than 50 and they are long distances, to go from Getafe to San Sebastián de los Reyes and come back is 60 or 65 km. The hybrid wasn't possible for us. Things would be worse for us with the hybrid, because if you have to go over 50, the other combustion engine kicks in, and as it is smaller because two engines need to fit inside, the consumption is higher. On a motorway, a hybrid uses more than a conventional petrol or diesel car, at least the earlier ones did. We need to be able to do motorway kilometers, for work as well as at the weekend. There was something, but only like a Premium, there's Lexus... but now we're really talking, the prices go up, and we have to be continually updating. Right now, we have to get a new one, and we haven't done anything because we haven't seen anything that is right for us.

11. What will happen to combustion engines?

The legislation is going to put the cross, we're not going to put the cross. But the limitation of circulating within the centre of Madrid is going to be a reality for diesel vehicles and they are going to impose it, or there's going to have to be flexibility to find a solution. In the two main cities with the highest levels of pollution - in the end that's going affect you. We have 35% of the fleet there and in the end you have to have a homogeneous fleet and you have to invest in the issue of CSR. It's an issue of image, but also of not polluting. There are some hospitals still inside the centre of Madrid so our employees have to be able to move around the centre of Madrid. We will try to find a vehicle that allows them access, if the law allows you to, you can park for free, and in our sector the legislation will oblige us. It's going to oblige us to do it, to evaluate much more than which model, or which manufacturer to use, because now also tax issues are going to change, depending on the extras the vehicle has, this will affect the type of taxes. Now the WLTP legislation that has come out means they no longer accept the emissions that manufacturers produced in their laboratories - this European legislation wants them to give you the emissions in real time. That means those cars that previously had CO2 levels of 100, will now have 130.

Some of these are things that with technology will be very easy to change. Why should we all have to pay the same road taxes all if there are people who use the car more than other people? I don't agree, if you pollute more, you pay more; it can be measured and it can be controlled. It is also a lobbying issue by the electric companies to force this situation and force manufacturers to change, to have another type of consumption and to overturn the issue of oil and make it electricity consumption. Diesel, it looks like a dinosaur to me, because of the pollution… and petrol cars, sincerely I don't see them as being appealing in the future either, I imagine that technology being left behind, it will only be around for vintage cars. I just don't see it. I don't see it as competition for the electric. For example, it would be like these days comparing it to getting a coal heater for the home.

12. Do you think that the future car technology will be purely electric? What will be the impact in 5 years 'of individual mobility?

Well, we depend on the legislation too. Hybrid or electric, but in the future it must be emission free. If I had to choose today I would go for LPG, petrol and gas, directly. In the short term I would go for petrol with gas, immediately, I'd go for it already, tomorrow, because I can't manage with electric, with a 100% electric. I can't let employees go on holiday to the beach because they won't make it, and I cannot limit their weekend use.

Even so, it would be necessary to look at the LPG infrastructure, which is not so easy.

But you still have petrol and gas. If it is also for personal use, autonomy is essential. If you want to go to Almeria, you can't have to stop halfway through a four-hour trip to charge up.

A lot of autonomy isn't that important, 200km would be fine, and the autonomy you already find on the market fits well for company use, because when you return to the office we can put them in the charging stations in our parking lot. In this sense there's no problem. If you go somewhere else there isn't any problem either, because you have the option of charging in any plug, even if the charging is slow. In this sense there's no problem

13. What will be the role of plug-in hybrids?

I see electric vehicles, shared vehicles. Hybrid vehicles and some autonomous.

An electric car is still so expensive, the manufacture of those cars is much more expensive and the companies are smaller.

Our experience has been, we have tried to allocate a pair of electric cars for shared use, and we have not been able to manage them, but in 5 years we can see that working. For the moment and the transition. The best cars are hybrids, at least for the next 5 years.

14. Do you see vehicles that operate with other technologies?

I don't see the electric vehicle in 5 years yet, I believe that we will start with hybrids. I think that we still lack a little bit of what you need for electric vehicles to work, such as infrastructure – we still lack that. But that is indeed the future, everything points to it because they are limiting a lot, increasingly, and in no time they will begin to change taxes, fuels, we will go back to LPG and they are focusing us on the electric vehicle. Also, it is in the hands of the manufacturers, they have to continue investing in this technology.

15. What do you think about connected cars? What will they provide as additional services? What will be the advantage of OEMs` and users?

As a product, a connected car should offer security and comfort. It would be great for us if we could locate the movements of each salesperson, that they had geolocation. That the vehicles were interconnected with each other? I don't think it would be very practical for us. And that they could have internet in the vehicle? Well, perfect, their own little screen.

16. What do you think about autonomous vehicles? How do you imagine this technology?

I see it as being possible, but very complicated, for the matter of legislation.

Technologically it's easy to do if all the vehicles are autonomous, because they communicate with each other, they know where they're going to turn… The problem is combining autonomous vehicles with those driven by people. It would be necessary to have a huge amount of radar and much more technology that will make the vehicle more expensive, more complicated.

If all cars are autonomous, that would make things easier. But are you going to force people to get rid of their cars? If you already have a vehicle and don't have the money to buy an autonomous one, what do you do? It's complicated. I see it as a state matter, legislative, it's complicated.

4. Product Service-System / 4-QP 1-5

Madrid, Date 22.02.2019 Time: 15:00 – 16.30 H

Participant: PM/P13

1. What other kinds of services / features will vehicles offer in the next 5 years?

It would be ideal by time of usage, time or kilometres, and with a loyalty plan for that company or brand of vehicle, with a more affordable price. To pay a fee… like the Amazon Prime system, that you pay a fixed fee and have discounts or faster deliveries… and then a variable part based on usage and on the vehicles you end up choosing.

A fixed part of the subscription fee… and another payment for usage. It would be more flexible than the rental system, and you could change the car when you wanted.

2. **What kind of digital applications will link services to the vehicle?**

Well they can start work as soon as they leave their house in the morning, video conferences, even virtual meetings while in the car, until they reach wherever they are going: the office, to see a client, etc. But in the meantime, you'll be taking advantage of the time, you can be productive from the get-go, without wasting an hour or forty-five minutes in a traffic jam. You'll be in a traffic jam, but you will be being productive, you will be working in the car through applications. Firstly, you will have a series of telecommunication features that will allow you to do your work, because of the connectivity that is going to be provided by the vehicle itself for business and private.

3. **What kind of products and services from other industries might be interesting to offer in the car industry?**

An app that will have a directory, notifications, some messaging, but it is an issue also of new monitors. Connection of people and systems and technology.

4. **What kind of service should MB or smart offer in the future?**

Well, I think mobility will be always relevant, the car should help to balance private and professional life. More flexibility for different mobility needs. My viewpoint is also about reducing costs, which means less expenditures for the company. Smart should offer an electric car2Go or similar car sharing for my company to go in the city centre; taxi is too expensive for meetings downtown.

5. **What could be the ideal mobility system for consumers?**

Well, rental is pay-per-use, but long-term and short-term or and mix with public transport or car sharing. So, what would be ideal for me is that there were electric cars at the rental company because our biggest cost is petrol, all the rest is included, they provide maintenance, tune-ups, mileage, and everything would be there and without petrol. If the cars were all electric and the rental company covered the matter of batteries, any incident related with the battery, with the electrical part of the car itself that would be great.

5. AUTOMOTIVE ECOSYSTEM / 5-QE 1-5

Madrid, Date 01.03.2019 Time: 16:00 – 17.30 H

Participant: PM/P14

1. **Which companies or brands may execute these ideas in 5 years? From which industry? Are there brands that fit with some ideas more than others?**

Well, on the highest level, BMW; TOYOTA also innovates a lot in this sense…

2. **What should each brand provide by offering new services linked to the car?**

Safe vehicles, like Volvo makes, associate it with vehicles that are safe, the technological matter, all with a computer onboard with the information we spoke about, comfort and the idea of costs, the electric car, the environment, that it has good service for any type of technical failure, that you are always well covered.
Mercedes has a powerful image, if you enter the electric world you have to have all the necessary services to cover yourself.
Smart is basically a city car, not for making long trips. They don't work for us, because the salespeople make longer trips. I don't know anything about Smart, if they have connected cars… I assume they do, because others like Toyota or Lexus have them, BMW also. I don't think Mercedes is being left behind

3. **What could be the advantage for the company to offer these types of services?**

We are the customer, so they should deliver what the customer wants.

4. **What is the distinguishing factor of a brand?**

I am a Mercedes user, so I have a poor opinion of their evolution. Again, in terms of connectivity they are still in the Stone Age. But that's not just Mercedes, it's all brands. They have to evolve a lot because the technology is out there, there's loads of technology, but vehicle manufacturers never use the latest technology in terms of connectivity, or even in terms of in-vehicle entertainment. I like Smart, they are great vehicles for moving around a city like Madrid, and if on top of that they are electric, so much the better. I see Smart cars as being great solutions for cities, especially electric ones. And then, Mercedes has changed a lot. They have good designs. Volvo makes, associate it with vehicles that are safe.

5. **How will MB compete with its long-standing competitors (BMW, Audi, Mini and Toyota)? In addition, with new technological players (Google, Apple, Amazon, UEBBER etc.)?**

   How should Mercedes compete? Well, some of their vehicles should be autonomous, or all of them could be autonomous and electric, they could decide one way or the other. The brand would have to continue to provide the comfort and safety that it gives to passengers,

for whoever is driving it or is inside the vehicle. Entertainment technology has to continue and has to improve and improve quicker than it has been doing up until now.

More important issues?

No.

Thank you very much for your time!

7.2 Appendix B: Data Collection Tool Unit II/Workshop I

Workshop to develop a new Service Innovation Process for MBE

Workshop 1

Development of a new Service Innovation Process

Madrid, 09.-10.04.2019

Participants: WG/P1, WG/P2, WP/14
Workshop-Leader: Roland Schell

Agenda: **Day One**

Introduction Background of the study 60 min

- Social, political, environmental and technological challenges.
- Endangered Profitability and Business Model
- Concept of Open Innovation
- Main findings Unit I & II

-Discussion-

Group Work I Developing a coherent Process Framework

Two Groups of 7 Part. 90 min

- How to integrate an open source approach to identify customer needs?

-Group presentations and discussion-

-Energizing Break- *15 min*

Introduction Innovation Processes 60 min.

- Stage Gate Process
- Mercedes-Benz Development System
- Design Thinking Approach

-Discussion-

-Lunch Break- *60 min.*

Group Work II How to adapt a service innovation process to the needs of MB?

Two Groups 90 min.

- What are important parameters/building blocks for the workability for each process step?

-Group presentations and discussion-

Group Work III Definition of the first Process Stage
Two Groups 60 min.

- How to identify customer needs and the integration in a process stage?

-Group presentation and discussion-

-Energizing break- *15 min.*

Group Work IV Definition of the following Process Stage
Two Groups 60 min.

- How to organize and prioritize customer needs?
  -Group presentations and discussion-

Agenda: **Day TWO**

Introduction Wrap up and summary of the first day 20 min.

Group Work V Definition of the next Process Stage
Two Groups 60 min.

- How to validate customer needs, analysing the business model and the feasibility of needs?
  -Group presentations and discussion-

Group Work VI Definition of the fourth Process Stage
Two Groups 60 min.

- How to launch a service product that satisfies customers' expectations.
  -Group presentations and discussion-

-Energizing break- *15 min.*

Group Work VII Definition of the fifth Process Stage

Two Groups 60 min.

- How to consolidate initiated services and integrate them into the operational business?
- Group presentations and discussion-
-

Group Work VIII Definition of Key roles in each Stage

Two Groups 60 min.

- What are the key roles in the different process stages?

-Group presentations and discussion-

-Lunch Break- *60 min.*

Group Work VIIII What is needed in terms of resources and measurement for each stage?

Two Groups 90 min.

- Which resources in terms of resources, data, reports etc. are needed to guarantee the quality of each stage?
- What kind of standard of measurement is needed to guarantee the validity of each stage?

-Group presentations and discussion-

-Energizing break- *15 min.*

Group Work X Definition of Quality Gates

Two Groups 90 min.

- What kind of Quality Gate is needed and after which stage to guarantee the all-over process standard?

-Group presentations and discussion-

- ***Wrap up and summary of the workshop*** 45 min.

Roland Schell
MB Spain

Madrid, 09.04.2019
Phone +34679659082
E-Mail: Roland.Schell@daimler.com

7.3 Appendix C: Data Collection Tool Unit II/WS II

Workshop to explore an open PSS for Mercedes-Benz

Workshop 2

Exploration of an open Product Service-System

Madrid, 07.05.2019

Participants: WG/P1, WG/P2, -WG/P14
Workshop-Leader: Roland Schell

Agenda:

Introduction Background of the study 60 min.

- "DOING" Process
- Main Findings of Unit I&II
- Identified Needs
- Requirements of the future Mercedes-Benz Ecosystem

-Energizing Break- *20 min.*

Group work I Qualification of Customer Needs

Seven Groups of 2 participants working on one need 120 min.

The "DOING" Process - Discover Stage

- How to describe and qualify the identified customer needs?
- What is the nomenclature the future service?

- Integration of need in Meta-planer (context, task and pain points and nomenclature of the future service) with argumentation and final common discussion.

-Lunch Break- *60 min.*

Group work II Prioritization of Customer Needs

Seven Groups of 2 participants discussing each need 120 min.

The "DOING" Process – Organize Stage

- Prioritization along "Opportunity size" "Strategic/Market fit" and "Right-to-play".
- Mercedes Ecosystem

- Integration in Meta-planer as a 5 min. pitch (argumentation) and final common discussions

-Energizing Break- *20 min.*

Group work III Validation of “PRIO I” desirable need and enquiry of specification of MVP

Two Groups of 7 participants 120 min.

The “DOING” Process – Initiate Stage

1. What are the specifications of the MVP for “Share 4 Business”?
2. What about the IT-system environment of “Share 4 Business”?

- Presentation and final common discussion

- ***Wrap up and summary of the workshop*** 60 min.

Roland Schell
MB Spain

Madrid, 07.05.19
Phone +34679659082
E-Mail: Roland.Schell@daimler.com

7.4 Appendix D: Analytics Literature Review

SUBJECT		Open Innovation/ open service innovation/ customer co-creation			
AUTHOR	TITLE	SUMMARY	ANALYSIS	CRITICAL DISCUSSION	TRACK HISTORY
Chesbrough, Vanhaverbeke and West	**Open Innovation (2006)**	Historical summary of the concept of OI and further development. Utilization of Business models to define requirements. Paradigm shift from closed to open Innovation. Through the development of OI to Innovation oft Business models and services.	The father of OI describes his concept of OI as paradigm shift from closed to Open Innovation. Further development of Business models and services through OI.	OI as the new paradigm for Innovation with some concrete example of different companies and industries. An example of applied science and useful for all industries as well for the automotive industry. To be further developed for PSS and Business model design through OI.	Concept of OI, history of OI
H. Chesbrough	**Bringing Open Innovation to services (2011a)**	To see the business as Service innovation business and not only product driven. Openness in the process of outside in and inside out flows.	Problem definition of mature markets to develop service innovation business and the important role of the customer in the process. Focus offers on utility, rather than the product.	Starting to explain the role of customer to gain his tacit knowledge and to find appropriate business solutions via open ended questions. More possibilities to exploit in this field. Starting point of further investigation.	Open innovation, service innovation, concepts of OI, cooperation with customer in OI.

H. Chesbrough	**Open Innovation Where We ' ve Been and Where We ' re Going (2011b)**	Support of the thesis from Chesbrough (2011a)	Support of thesis Chesbrough (2011a)	For the services business approach, the value chain must be replaced by a different kind of pattern; creating the Customer's Experience as Services Value Web.	Open innovation, servitization
N. Carroll, M.Helfert	**Service capabilities within open innovation (2010)**	Design of new business models through OI in immature ecosystems .Process of value co-creation in modern service environment to exploit service capabilities. Sharing business value through collaboration in an ecosystem.	OI environment from a capability perspective, due to further service orientation. New model of Service capability sourcing model (SCSM) through service co-creation and OI to create new service offering.	Service ecosystem is a combination of servitization and OI. Strong focus on the companies' capabilities sourcing and matching of processes. The customer/ other partners (Chesbrough) as main stakeholders integration in the OI process is not fully described in the new SCSM model. Customer, suppliers and other partners should be integrated in the OI process and the research to fully understand the external service capabilities	SPP through OI, value creation
Wang, Voss, Zhao and wang	**Modes of service innovation: a typology (2015)**	Exploring service innovation via three modes of business model innovation, service product innovation and service process innovation. External involvement is necessary to successfully create innovation.	Incorporation of business model innovation into the study of service innovation with support of service product and/or process innovation. Business model innovation relies on external collaboration.	Understanding of successful service innovation via three modes of innovation. External collaboration of customers and business partners is required to business model innovation. The detailed role of external support should be more in the focus to describe the main part of the external partners. The case studies shows no example of the automotive industry.	Innovation management, service innovation, business model and open innovation, typology

Walters & Rainbird	**Cooperative innovation: a value chain approach (2007)**	The purpose of this paper is to review contributions to partner/cooperative innovation with the aim of evaluating the concept of a value chain business model	Partner or cooperative innovation combines elements of process and product innovation within a network structure. The creation of a product-service system, which can use its own resources. Extension to the supply chain (upstream and downstream) management and relationship management.	Innovation cooperation means active participation in joint R&D and other technological innovation projects with other organisations. A clear explanation as part of OI with a cost focus for companies. Focus on business partners and R&D cooperation's and less on customer cooperation. Cooperative innovation could be a seen as a specific part of OI with a clear focus and value creation.	Cooperative/partnership innovation. Process-management, Functional-management, Virtual organizations, Economic cooperation
Räse	**Nachhaltige Produktentwicklung bei Mercedes-Benz (2010)**	Description of the Mercedes-Benz Development System (MDS) via Scorecard and quality gates in a closed innovation process.	Controlling the development process, due to the increasing cost pressure and shortening of development time. Political pressure to reduce CO2 emissions and avoid recall actions for cost and image reasons.	The Mercedes-Benz Development System (MDS) is an engineered driven hardware process, which is designed around tangible products such as engines and other car components. This process describes the traditional car manufacturer innovation process. A closed innovation process to ensure cost and time targets. To sustain the value chain	Mercedes-Benz Development Process, MB Innovation

Ili, Albert Albers and Sebastian Miller	**Open innovation in the automotive industry (2010)**	Due to increasing innovation and cost pressure, the automotive industry needs to look outside their own boundaries to escape from this productivity dilemma. The study demonstrates that Open Innovation proves to be more adequate to achieve better R&D productivity for companies in the automotive industry than a closed innovation model.	Open Innovation in the context of the automotive industry does not yet seem to have made an impact. Need for further studies, due to the fact that the research shows the appropriateness of OI in the industry, especially in R&D of the carmakers. The research identifies global conclusions and recommendations regarding the relevance and the adoption of Open Innovation in the automotive industry in the context of strategy, process, methods and culture.	The study shows the need to implement OI in the R&D departments of the carmakers. But the approach is only focused on R&D within a partnership approach due to innovation and cost pressure. The role of cooperation's and customers is not described. The outcome of the studies demonstrates the necessity for further research of OI in automotive industry.	Open innovation, Car/automotive industry, R&D innovation, R&D productivity
Myhren, Witell, Gustafsson & Gebauer	**Incremental and radical open service innovation (2017)**	Open service innovation is an emergent development practice, where knowledge on how to organize development is scarce. Case study with internal participants is used to create relevant archetypes oft open service innovation: 1. internal group development; 2. satellite team development; 3.rocket team development.	Interesting demonstration of case study with internal employees to organize open service innovation. Co-creation with suppliers, customers and competitors. Only few research is done for open service innovation to organize knowledge development.	More research to organize knowledge creation in open service innovation needed, especially with case study approach by integrating customers. No recent study was found.	open service innovation, open innovation, radical and incremental innovation, case study method

Trischler, Perva & Scott	**Exploring the "black box" of customer co-creation processes (2017)**	Investigating the customer co-creation process by the effect of involving users with different backgrounds. The collaboration with users can result in a variety of new outcomes with higher user benefits. The recruitment process should be done with special considerations (motivation, management and intra team dynamics).	Integration of users into development teams and mix of internal and external participants. Dynamic and problematic process.	The approach of team integration to develop new services can be successful but need certainly the right team members.	Customer co-creation, open innovation, innovation process
Dannenberg & Burgard / Oliver Wyman Automotive	**Innovationsmanagement in der Automobilindustrie (2015)**	Analyse of the automotive environment in 2015, Innovation of new technologies, strategies and new trends.	New trends in the automotive and opportunities oft mobility solutions for different customer groups.	In the future, car manufacturers and suppliers will have to examine the chances of success of their innovations much more thoroughly. You have to know in advance which ones of the innovations for which customers of which brand are important.	open innovation, new trends in automotive industry

Townsend, Janell D. Calantone, Roger J.	**Evolution and Transformation of Innovation in the Global Automotive Industry (2014)**	Exploring some of the most salient topics related to innovation and product management in the context of the contemporary global automotive industry. OEs are increasingly turning to their supply chains for help in achieving innovation goals, with relational systems developing a more important role in the process, such as partnership and co-creation processes.	Product life-cycle management is a major point of consideration not only because of the massive resource and financial costs involved up front but also due to the importance of product acceptance in the market- place. In the future, much of the expected innovation will be driven by consumer demand for product features and government involvement through standards, regulation, and taxation.	Due to political, environmental, financial cost pressure and consumer related changes in society, the automotive industry has to adapt to new solutions of co-creation in their innovation processes. A change from closed towards open innovation.	open innovation, innovation management, automotive industry
Gustafsson, A., Kristensson, P. and Witell, L.	**Customer co-creation in service innovation: a matter of communication? (2012)**	Dimensions of customer co-creation and innovation of project development which influences product success.	Customer co-creation is a worthful approach for later product success	Applicable in the automotive industry, due to the fact that product is still king in automotive	Open innovation, customer co-creation

West, JoelBogers, Marcel	**Leveraging external sources of innovation: A review of research on open innovation**	The reviews research on open innovation considers how and why firms commercialize external sources of innovations. It examines both the "outside-in" and "coupled" modes of open innovation. From an analysis of prior research on how firms leverage external sources of innovation, it suggests a four-phase model in which a linear process—(1) obtaining, (2) integrating, and (3) commercializing external innovations—is combined with (4) interaction between the firm and its collaborators.	Specifically, it finds that researchers have front-loaded their examination of the leveraging process, with an emphasis on obtaining innovations from external sources. Research on obtaining innovations includes searching, enabling, filtering, and acquiring. Commercializing innovations puts the most emphasis on how external innovations create value rather than how firms capture value from those innovations. Finally, the interaction phase considers both feedback for the linear process and reciprocal innovation processes such as co-creation, network collaboration, and community innovation. Another gap is a tendency in open innovation to use "innovation" in a way inconsistent with earlier definitions in innovation management.	The success of open innovation among corporations is related to its capability to improve the innovation performance.	open innovation, critical review OI, Success factors

Chen, Jin Zhao, Xiaoting Wang, Yuandi	**A new measurement of intellectual capital and its impact on innovation performance in an open innovation paradigm. (2015)**	Companies have traditionally considered innovation an internal process, and accordingly, they have relied on their internal intellectual capital. However, this closed innovation strategy has, in recent years, been superseded by an open innovation strategy. The existing measurement model of intellectual capital, which is concerned mainly with an internal dimension, is no longer appropriate for open innovation practice. The measurement model of intellectual capital, expanding the concept to include both internal and external dimensions, both of which have the same three elements: human, structural, and relationship capital.	To test the reliability and validity of this new model, we explore the impact of each element on innovation performance through an empirical study of 149 companies in China, and we find that all elements of internal and external intellectual capital have a significantly positive impact on innovation performance. This implies that our new measurement is appropriate for firms with an increasing degree of openness for innovation.	An increasing number of firms recognized already the benefit of open innovation to their actual innovation activities	Open innovation, measurement of OI
Chesbrough, Henry W	**Open Innovation: The New Imperative for Creating and Profiting from Technology.(2003)**	The new imperative for creating and profiting from Technology. Xerox Park. Closed Innovation. Open Innovation. Business Model: Connecting Internal and External Innovation. From Closed to Open Innovation. Open Innovation at Intel. Creating Ventures. Business Model and managing IP. Making the transition	Support of quotation of OI	The utilization of diverse business models to define system and process requirements started a paradigm shift from closed to open Innovation (Chesbrough, 2003) in research studies and the industry. Open Innovation is a paradigm that assumes that firms should use external ideas as well as internal ideas, and internal and external approaches to the market.	Open innovation

Tommasetti, Troisi and Vesci	**Measuring customer value co-creation behavior (2017)**	In line with the precepts of service-dominant logic (SDL), the purpose of this paper is to devise a measurement framework of customer value co-creation practices during the service process.	By systematizing the construct of customer value co-creation behaviour within a comprehensive framework, the conceptual model attempts to fill a gap evidenced by previous research in order to show that actions performed by users during the value co-creation process strictly conform to SDL assumptions. Moreover, the framework underpinning the practical application of SDL principles could benefit future practitioners and suggest interesting implications for future research.	A method of measuring customer co-creation as a valid approach of problem solving	Customer co-creation, value creation, open innovation
Marcelo Cano-Kollmann1, Snehal Awate, T.J. Hannigan, and Ram Mudambi	**Burying the Hatchet for Catch-Up: Open Innovation among Industry Laggards (2017)**	Partnership Cooperation to catch up a leading position in the automotive industry via case study in the hybrid el. Drivetrain	example of actual cooperation's in the automotive industry	actual cooperation between GM, BMW and Daimler to catch up the hybrid leadership of Toyota	Open innovation, R&D, automobile industry, competitive strategy, case study, innovation
SUBJECT		Servitization & Product Service-Systems			

H. Chesbrough	Bringing open innovation to services (2011)	An important problem for advanced economies is that we know much less about how to innovate in services than about how to develop new products and technologies. Many open innovation concepts apply readily to services. One way companies can move toward open innovation in services is by working closely with customers to develop new solutions. Product-oriented companies face organizational challenges in moving to a greater emphasis on services.	For services, the value chain must be replaced by a different kind of graphic; one with creating customer experience as its focus. Often is invited to co-create the service. In the process of engagement and co-creation, tacit knowledge is elicited from the customer and the customer often learns tacit knowledge from the provider as well.	Services are intangible by nature, so that customers often cannot specify exactly what they want. It is often much harder to measure the services that are delivered, therefor the company should create an openness, which means from "outside in", where a company makes greater use of external ideas and technologies in its own business and from „inside out," in which a company allows some of its own ideas, technologies or processes to be used by other businesses.	open innovation, service innovation, value creation

Baines, T., Ziaee Bigdeli, A., Bustinza, O. F., Shi, V. G., Baldwin, J. and Ridgway, K.	**Servitization: revisiting the state-of-the-art and research priorities (2017)**	A Product Service-System (Baines et al., 2017) is an integrated combination of products and services. This concept embraces a service-led competitive strategy, environmental sustainability, and the basis to differentiate from competitors who simply offer lower priced products.	Profit from tangible and intangible services will be an important challenge to sustain the company`s value chain.	Generating profits from tangible and intangible services, such as park & recharging apps for electric cars or "pay as you drive" and others will be undoubtedly an important challenge to sustain the value chain of Mercedes-Benz. The research will investigate the integration of Product Service-Systems to the conventional innovation process of Mercedes-Benz.	Servitization, value creation, Product service-system
Baines, T.	**Exploring Service Innovation and the Servitization of the Manufacturing Firm (2015)**	Integration of PSS to the innovation process to vertical integration is a successful way for service innovation. Researchers have to identify organizations it will be the most productive to study and yet the automotive industry is one of them.	The term vertical integration practices within conventional production operations is usually taken as the extent to which a firm owns and takes responsibility for its upstream suppliers and its downstream customers.	In this case, the difference is the integration of a PSS to the hardware innovation and could be understood as a vertical integration of the downstream process. Open Innovation processes combine internal and external ideas into architectures and systems. The integration of a customer centric approach is necessary to cover future customer needs and expectations. All these different models show the actual gap and the necessity to integrate new approaches to the conventional automotive innovation process.	Service innovation, Product Service-System, Automotive, Value Creation

Baines, Tim, Lightfoot, Howard, Smart, Palie	**Servitization within manufacturing (2011)**	The debate about services-led competitive strategies continues to grow, with much interest emerging around the differing practices between production and servitized operations. The paper contributes to this discussion by investigating the vertical integration practice of manufacturers who are successful in their adoption of servitization. To achieve this the investigation of a cross-section of several companies which are successfully delivering advanced services coupled to their products.	Manufacturers who have embraced the servitization trend tend to retain capabilities in design and production, and do so because this benefits their speed, effectiveness and costs of supporting assets on advanced services contracts. Through this research seeks to simultaneously contribute to the debate in the research community and offer guidance to practitioners exploring the consequences of servitization.	Successful servitization demands that manufacturers adopt new and alternative practices and technologies to those traditionally associated with production operations. A prevailing challenge is to understand these differences and their underpinning rationale. The key success factor is the vertical integration of servitization. Researchers have to identify organizations it will be the most productive to study and yet the automotive industry is one of them.	Servitization, open innovation, value creation in the automotive industry

Zangiacomi, A., Oesterle, J., Fornasiero, R., Sacco, M. and Azevedo, A.	**The implementation of digital technologies for operations management: a case study for manufacturing apps (2017)**	Manufacturing applications address business to business (B2B) with highly customised applications developed for specific requirements, offering highly specialised solution-oriented and service-based software components, systems, and digital tools that aim at a fast and accurate decision-making support system. The paper describes the implementation of digital technologies for operations management using manufacturing or engineering apps (eApps), for product design and manufacturing processes. In particular, starting from the specific needs of two companies from mature European industries as automotive and food, this work depicts how this kind of solutions can support companies and improve their operations. In particular, related benefits and challenges faced for the full implementation of the developed tools are highlighted. Moreover, a business model to exploit the manufacturing apps is also proposed. The business model proposed for the exploitation of the eApps supports the commercialisation of all the revenue streams offered by this rapidly growing sector taking	The paper describes the implementation of digital technologies for operations management using manufacturing or engineering apps (eApps), for product design and manufacturing processes. In particular, starting from the specific needs of two companies from mature European industries as automotive and food, this work depicts how this kind of solutions can support companies and improve their operations. In particular, related benefits and challenges faced for the full implementation of the developed tools are highlighted. Moreover, a business model to exploit the manufacturing apps is also proposed. The business model proposed for the exploitation of the eApps supports the commercialisation of all the revenue streams offered by this rapidly growing sector taking into account the specific needs of the concerned stakeholders through a diversified value proposition.	The evidence of how the implementation of digital technologies (Zangiacomi et al., 2017) as eApps can support all the various operations management activities and decrease the resulting complexity in companies from different manufacturing scenarios also in mature and stable sectors. This example shows that digitization is entering in the production process of the companies to gain efficiencies, but demonstrates that the customer centric approach of innovation is not yet in the centre of attention of the automotive industry.	Product service-systems, automotive industry, open service innovation

		into account the specific needs of the concerned stakeholders through a diversified value proposition.			

Andrew Williams	Product service systems in the automobile industry: contribution to system innovation? (2006)	Investigating the actual and potential contribution that product service systems, which can make in moving beyond incremental technological improvements towards a focus on behavioural changes and system innovation in the automobile industry. It begins by discussing the means by which existing and planned PSS initiatives can be evaluated in terms of their contribution towards innovation at the system level in the automotive industry. Five key evaluative criteria including: evidence of 'higher-order' learning amongst stakeholders; changes in infrastructure and institutional practice; changes in vehicle design, manufacture and end-of-life management; changes in vehicle ownership structure; and changes in modes of producer user interactions. Structured overview of some current and planned PSS initiatives at the empirical level in the automotive industry.	Current initiatives do not unify these key elements of a PSS in a single, coherent system they do not constitute 'complete' versions of PSS, and therefore, fail to deliver the full range of envisaged benefits in contributing towards system innovation.		PSS, Automotive industry, open innovation

Andrew Williams	**Product-service systems in the automotive industry: the case of micro-factory retailing (2005)**	Solutions to the economic and environmental impacts of the automotive industry have largely focused on technological innovation at the level of products or processes. This paper argues that, in order to achieve sustainability, change processes must be undertaken at the functional and systemic level. The concept of product-service systems (PSS) represents a valuable opportunity to introduce such changes. PSS is predicated onnew forms of product ownership, stewardship, and design and producer consumer interaction. The challenge now is to investigate ways in which the PSS concept might be introduced at the empirical level.	The adoption of micro-factory retailing (MFR) ideas offer a means of introducing such a system-levelchange in the automotive industry. MFR is based on novel approaches to vehicle design that facilitate the economic viability of small-scale localised manufacturing sites. It is argued that such an approach to vehicle production, allows the adoption of a full-scale PSS at local levels. Furthermore, via aspects such as the unification of the commerce and manufacturing function, and the proximity of manufacturing and servicing sites to users, the MFR approach may also offer distinct advantages compared with prevailing visions of PSS. ?		PSS, automotive industry, Innovation
Mont.O	**Clarifying the concept of product-service system. (2002)**	A new trend of product–service systems (PSSs) that has the potential to minimise environmental impacts of both production and consumption is emerging. Attempt to build a theoretical framework for PSS and serves as a background for identifying possible investment needs in studying them.	There are three main uncertainties regarding the applicability and feasibility of PSSs: the readiness of companies to adopt them, the readiness of consumers to accept them, and their environmental implications. The main finding is that successful PSSs will require different societal infrastructure, human structures and organisational layouts in order to function in a sustainable manner.	Reflecting these aspects and refers to product service-system (PSS) as ‘‘a system of products, services, supporting networks and infrastructure that is designed to be: competitive, satisfy customer needs and have a lower environmental impact than traditional business models. Now added value is created by technological improvements, intellectual property, product image and brand names, aesthetic design and styling; all nonmaterial aspects of products	PSS, concept, benefits of PSS

Beuren, Fernanda Hänsch Gomes Ferreira, Marcelo Gitirana Cauchick Miguel, Paulo A.	Product-service systems: A literature review on integrated products and services (2013)	Academic and business interests in the product-service system have risen significantly in recent years. The product-service system represents a competitive opportunity for many companies as they seek to reduce consumption by altering how their products are used by providing services. To further establish this field, the objective of this paper is to present a literature review on the product-service system	Support to better understand and search of literature	The body of literature proposes several definitions and interpretations of PSS; the most cited explanations (Beuren, Gomes Ferreira and Cauchick Miguel, 2013) will be presented in this review	PSS, literature review PSS
Goedkoop Cees JG van Halen Harry RM te Riele Peter JM Rommens, Mark	Product Service systems, Ecological and Economic Basics (1999)	The project explores the subject 'products and services' in relation to sustainability, economy and environment. First, the project focused on developing a solid theoretical framework. Next, new analysis methods were developed and case studies were described and studied. The project was externally oriented, including discussions with experts of industry, science and policy. A Product Service system (PS system, or product service combination) is a marketable set of products and services, jointly capable of fulfilling a client's need. Understanding PS systems is interesting for companies as well as governments. PS system knowledge enables governments to formulate a next step in policy concerning sustainable production and consumption patterns. PS system knowledge enables	PS systems can prove beneficial to the environment in combination to creating (new) business. Key-factors of success are similar in many cases, e.g.: – Creating value for clients, by adding quality and comfort, – Customising offers or the delivery of the offer to clients, – Creating new functions or making smart or unique combinations of functions, – Decreasing the threshold of a large initial or total investment sum by sharing, leasing, and hiring,– Decreasing environmental load. Often this will bring additional and perceived Eco-benefits, – Increase the quality of the contacts with clients. Moreover, the study shows a potential to unlink environmental pressure from economic growth.The	PSS as a system of products, services, networks of players and supporting infrastructure that continuously strives to be competitive, satisfy customer needs and have lower environmental impact than traditional business models".Aspects of competiveness, customer satisfaction and "eco-friendly" behaviour are the basis for this business mode	PSS, explanation of PSS, Industry, contribution

		companies to find strategic options for business growth, renewal, innovation and diversification. PS systems knowledge is especially inspiring for those companies who regard sustainability as a co-pilot for management start			

Manzini, E Vezzoli, C	**A strategic design approach to develop sustainable product service systems: examples taken from the 'environmentally friendly innovation' Italian prize (2003)**	The product service systems' (PSS) sustainability potential is described in the framework of the new types of stakeholder relationships and/or partnerships, producing new convergence of economic interests, and a potential concomitant systemic resources optimization. In this perspective, it is argued that the design competencies should move towards those of the 'strategic design', thus introducing the concept of 'strategic design for sustainability': the design of an innovation strategy, shifting the business focus from designing (and selling) physical products only, to designing (and selling) a system of products and services which are jointly capable of fulfilling specific client demands, while re-orienting current unsustainable trends in production and consumption practices.	Some examples of PSS are presented and discussed using the PSS categories 'services providing added value to the product life cycle', 'services providing final results to customers', and 'services providing enabling platforms for customers'. The cases derive from an analysis of the 'environmental friendly innovation' yearly endowed prize submissions.	PSS is an innovation strategy, shifting the business focus from designing (and selling) physical products only, to designing (and selling) a system of products and services which are jointly capable of fulfilling specific client demands, while re-orienting current unsustainable trends in production and consumption practices.	PSS, development of PSS, innovation

Tan, A. R. Matzen, D. McAloone, T. C. Evans, S.	Strategies for designing and developing services for manufacturing firms (2010)	Product/service-systems (PSS) are in effect an approach to designing integrated products and services with a focus on both customer and product life cycle activities. A range of service-oriented design strategies can be found in current literature, from product-oriented DfX approaches to more customer-oriented approaches, such as integrated solutions.	Design strategies related to different types of services are mapped. Case studies from two industrial companies are used to confront the existing literature in order to improve the understanding of how manufacturing companies may align their product and service development activities with their business strategies.	In the PSS literature following terms are considered to be synonyms: servitization of the products, functional product development, service engineering and servicizing	PSS, Strategy, definition of Servizing
Arnold Tukker	EIGHT TYPES OF PRODUCT–SERVICE SYSTEM: EIGHT WAYS TO SUSTAINABILITY? (2004)	A product–service system (PSS) can be defined as consisting of 'tangible products and intangible services designed and combined so that they jointly are capable of fulfilling specific customer needs'. Many see PSSs as an excellent vehicle to enhance competitiveness and to foster sustainability simultaneously. In many markets products have become equally well performing commodities.	PSS incorporates three different perspectives, the first category are product-oriented services, where the business model is still largely associated with the sale of products to consumers, with some additional services. The second category consists of use-oriented services, where products remain central, but are owned by service providers and are made available to users in different forms (e.g. leasing or sharing). The third type is result-oriented services, where customers and service providers agree on a desired outcome (e.g. mobility) without specifying the product involved.	Tukker develops through the previously mentioned categories eight archetypes with specific economic impacts on Product Service-Systems: 1. Product-related service 2. Advice and consultancy 3. Product lease 4. Product renting and sharing 5. Product pooling 6. Activity management 7. Pay per unit use 8. Functional result	PSS, innovation, automotive industry

McKinsey	Automotive Revolution & Perspective Towards 2030 (2016)	The study starts from the general consensus that the industry is transforming and go further to specify and quantify the magnitude of change. The forecasts in this study should, thus, be interpreted as a projection of the more probable assumptions across all four trends, based on our current understanding. The forecast methodology is certainly not deterministic in nature, but should help industry players better prepare for the uncertainty by discussing potential future scenarios.	Support to better understand and search of literature and state of the art PSS.	The study of McKinsey explains that the Original Equipment Manufacturers (OEM) need to find the right strategy for differentiating their products and services, which largely means evolving their value proposition from "hardware provider" to "integrated mobility service provider." Product differentiation, as a strategic approach, should be pursued through a digital end-to-end user experience with a customer focus similar to software companies keeping products attractive throughout the lifecycle.	trends in automotive, innovation, mobility service provider
Andy Neely	The Servitization of Manufacturing: an Analysis of Global Trends (2007)	Manufacturing in developed economies is under massive pressure. Swaths of industrial sectors have been lost to the emerging economies in the Middle and Far East. Commentators have advocated that manufacturing firms in developed economies should respond by moving up the value chain, seeking to innovate and create more sophisticated products and services so that they do not have to	While this strategy is proving increasingly popular with policy makers and academics there is limited empirical evidence exploring whether it is being adopted in practice. And if so, what the impact of this "servitization" of manufacturing might be.		

		compete on the basis of cost alone.			
Cherubini, Iasevoli and Michelini	**Product-service systems in the electric car industry: critical success factors in marketing (2015)**	In the electric car industry, the service component assumes considerable importance and it is a relevant factor in purchasing decisions. Therefore, proper management of the "Product-Service System" (PSS) is essential. Identification of the main sub-systems of the PSS in the electric car industry and 2) identify the critical success factors (CSFs) in marketing. The review of the literature led to the definition of four sub-systems: vehicle, infrastructure, on-board electronics, and energy.	Based on these PSS sub-systems, organisations belonging to each sub-system were selected, and five managers were interviewed. The data were analysed using a cognitive mapping technique. Ten CSFs were identified, of which two belong to the vehicle sub-system (value proposition and product-service system bundle); one relates to the electronic on-board sub-system (advanced navigation systems); three relate to infrastructure sub-system (incentives, alternative transport systems and advocacy campaigns) and three belong to infrastructure and energy sub-systems (ease of use, proximity of charging point and standardisation). Finally, partnerships among players involve all the four sub- systems. Moreover, the relevance/manageability matrix offers evidence that partnerships represent a priority factor that requires immediate action from companies. The research	The research in the electric car industry with relevant service components assume considerable importance to a PSS as a relevant factor in the purchase decision. Thus, a proper management of a Product-Service System is essential in the industry. The research discovers four essential sub-systems of PSS in the electric car industry: 1. Vehicle 2. Infrastructure 3. On-board electronics 4. Energy. The study claims that consumers are willing to accept this new service approach and the challenge of novelty of the products. The findings of the study highlight the central role of the intangible components in creating an innovative automotive style in which functional and tangible benefits are integrated with symbolic and cultural status meanings. Based on these outcomes, the automotive industry will observe a significant increase of electric cars through the evolution from product-driven to a PSS-driven approach. The question is, who will create these additional services? Is it the car industry or external service-providers, which will disconnect the car from the service environment? The study claims the necessity to ink the PSS approach to the electric car. Thus, all these arguments can also be used for the whole car industry with its conventional powertrains. The user will claim for the need level of PSS, while purchasing a car, whether with a conventional or electric powertrain. The	PSS, automotive industry, success factors oft PSS

			offers a new means to identify CSFs by using a PSS analysis rather than taking an industry sector perspective	conclusion of the investigation demonstrate the necessity (Cherubini, Iasevoli and Michelini, 2015) of the electric car industry to incorporate multiple players in this business eco-system.	

Lerch, Christian Gotsch, Matthias	Digitalized Product-Service Systems in Manufacturing Firms: A Case Study Analysis (2015)	The term servitization has been used in recent years to describe a growing service orientation among product manufacturers, who are increasingly moving from simply selling products to offering supportive services tailored to the product. These services range from traditional product-related services such as maintenance, repair, and training to advanced customer-oriented services. Advanced services typically take the form of product-service systems (PSS), or physical products bundled with intangible services in a customized manner to fulfil all highly individual customer needs	In the digital era new definition of digitalized PSS are established as an evolution of service bundles: Thus, digitalized PSS may be defined as an integrated bundle of physical products, intangible services, and digital architectures designed to fulfil individual customer needs via automated, independent operation, with the goal to significantly improve customer outcomes. Manufacturers at this stage not only provide complex PSS to their customers, but also incorporate ICT solutions as a novel component in the product-service bundle, creating intelligent, independent operating systems that deliver the highest level of availability possible and optimize operations while reducing resource inputs.	The study develops three types of digitalized PSS I. Smart Service Delivery II. Smart Product Optimization III. Digital Brain As digitalization and servitization come together to speed manufacturers' evolution toward a focus on services, firms that are able to master this transformation will integrate tangible products, intangible services, and digital architectures to deliver novel digitalized PSS that provide highly customer-oriented and highly customized solutions. They will also force firms to broaden and extend their understanding of innovation management. Manufacturers must open up their perspective on innovation and rethink how to manage innovation processes.	PSS in automotive industry, digitization, digital PSS
Vural, Ceren Altuntas	Service-dominate logic and supply chain management: a systematic literature review	Discussion of S-D Logic applies to all economic exchanges, not just services. One change is that value is idiosyncratic, experiential, and contextual.	support for CLR	support for CLR	PSS, service dominate logic

Vargo, Stephen Lusch, Robert	**Evolving to a New Dominant Logic for Marketing**	Marketing inherited a model of exchange from economics, which had a dominant logic based on the exchange of "goods," which usually are manufactured output. The dominant logic focused on tangible resources, embedded value, and transactions. Over the past several decades, new perspectives have emerged that have a revised logic focused on intangible resources, the co-creation of value, and relationships. The authors believe that the new perspectives are converging to form a new dominant logic for marketing, one in which service provision rather than goods is fundamental to economic exchange.	An appropriate unit of exchange is perhaps the application of competences, or specialized human knowledge and skills, for and to the benefit of the receiver. These operant resources are intangible, continuous, and dynamic. We anticipate that the emerging service-centered dominant logic of marketing will have a substantial role in marketing thought. It has the potential to replace the traditional goods-centered paradigm.	The focus is shifting away from tangibles and toward intangibles, such as skills, information, and knowledge, and toward interactivity and connectivity and ongoing relationships. The orientation has shifted from the producer to the consumer. The academic focus is shifting from the thing exchanged to one on the process of exchange. Science has moved from a focus on mechanics to one on dynamics, evolutionary development, and the emergence of complex adaptive systems. The appropriate unit of exchange is no longer the static and discrete tangible good.	PSS, Innovation, service dominant logic

7.5 Appendix E: Coding Framework Unit I

Thematic Analysis		
Code Framework		Unit One/Interviews
Code	Theme	Definition
MT.1.0	Mobility Trends	Increasingly consolidated mobility trend towards hybrids (PHEV) and full electric cars (EV).
MT.1.1	MT	Legislation in the short to medium term is tending to increasingly benefit PHEV and electric cars
MT.1.2	MT	New ways of acquiring and using cars.
MT.1.3	MT	Ecological aspect have an important impact on the choice of the technology.
MT.1.4	MT	Future possibilities of connectivity and services is also changing client's behaviour.
AF.2.0	General Attitudes towards the Future	Major changes in future due to new technology
AF.2.1	AF	Fundamental changes in lifestyle
AF.2.1.1	AF	Human relations and all forms of communication.
AF.2.1.2	AF	Education and health.
AF.2.1.3	AF	Work: new professions and telework.
AF.2.1.4	AF	Experiential context: changes in cities versus suburbs.
AF2.1.5	AF	Consumption: online versus physical channels
AF.2.2	AF	Dual way, uncertainty and expectations
PS.3.0	Mobility and Product Services	Mobility and Product Services as game changer
PS.3.1	PS	Noticeable changes in mobility
PS.3.1.1	PS	Further legal traffic restrictions
PS.3.1.2	PS	Political and environmental restrictions
PS.3.1.3	PS	Hybrids and electric cars perceived as GREEN
PS.3.2	PS	Attitudes future mobility
PS.3.2.1	PS	Safety and quality of life
PS 3.2.2	PS	Moving forward
PS 3.2.3	PS	Ownership versus public transport and car sharing
PS 3.2.4	PS	Passionate drivers
PS 3.3	PS	Sensation of power
PS 3.3.1	PS	sensation of petrol engines

PS 3.3.2	PS	Scepticism about electric cars
PS 3.4	PS	Identification with Premium Product and quality of life
PS 3.5	PS	Sustainable approach in mobility
DC 4.0	Drivers of change in mobility	major changes in future mobility
DC 4.1	DC	Resistance and enthusiasm towards change
DC 4.1.1	DC	External members more excited towards change
DC 4.1.2	DC	Deep rooted resistance for internal members
DC 4.2	DC	Transition into political discussion
DC 4.3	DC	Opportunities and threats
DC 4.3.1	DC	Fear and insecurity
DC 4.3.2	DC	Excitement towards technology trends
DC 4.4	DC	Fear of change
DC 4.4.1	DC	A better future
DC 4.5	DC	more uncertainty
DC 4.5.1	DC	Future-oriented thinking leads to uncertainty
DC 4.6	DC	Future oft Mobility
DC 4.6.1	DC	Drivers oft change 1-7
NI 5.0	PSS Needs and Key Ideas	Needs and ideas for an effective PSS
NI 5.1	NI	New option for accessing vehicles
NI 5.1.1	Ni	Safety and Service plays a prominent role
NI 5.1.2	NI	Own your car
NI 5.1.3	NI	Owning as not sustainable
NI 5.1.4	NI	resistance for owning a car
NI 5.2	NI	Range of mobility services
NI 5.2.1	NI	alternative mobility solutions
Ni 5.2.2	NI	owning and being part of new trends
NI 5.3	NI	New financing options
NI 5.3.1	NI	Flexible financing options
NI 5.3.2	NI	Necessary adaptions to customer wishes
NI 5.4	NI	Identified Needs and Ideas
NI 5.4.1	NI	PSS development with ideas 1-7
NI 5.5	NI	Connected cars are attractive
NI 5.5.1	NI	Multi connected car

NI 5.5.2	NI	Connectivity enhances safety and quality of life
NI 5.6	NI	Clean vehicles as unavoidable development
Ni 5.6.1	NI	Enthusiasm about clean vehicles
NI 5.6.2	NI	Plug-in Hybrids as early adapters
NI 5.7	NI	Electric mobility as ecofriendly
NI 5.8	NI	Alternative technology with zero emission as natural gas and hydrogen
NI 5.9	NI	Autonomous cars as expected future of mobility
Ni 5.9.1	NI	Autonomous driving most adapted mobility service
NI 5.9.2	NI	Resistance of autonomous cars
NI 5.9.3	NI	Excitement about autonomous mobility
VP 6.0	Ecosystem and Premium	Ecosystem and power of Premium
VP 6.1	VP	Preserve the value of premium
VP 6.1.1	VP	Internals believe in traditional brands
VP 6.1.2	VP	Externals approach towards new technology corporations
VP 6.1.3	VP	Mercedes with leap in design for younger ones
VP 6.1.4	VP	tech. Oriented innovation for MB
VP 6.1.5	VP	e-smart as potential solution for inner-city
VP 6.2	VP	New players as result of paradigm shift
VP 6.2.1	VP	Tesla as new premium benchmark
VP 6.2.2	VP	Car is Mobile device
VP 6.3	VP	Paradigm shift for brands
VP6.3.1	VP	Coherence between technology and mobility
VP 6.3.2	VP	Ecosystem of Services
VP 6.4	VP	New Ecosystem
VP 6.4.1	VP	Technological choices
VP 6.4..2	VP	Car with state-of-the-art CONNECTIVITY AND PERSONAL ASSISTANCE
VP 6.5	VP	A new Premium Ecosystem
DP 7.0	Nuances of perspectives	Nuances between two different perspectives
DP 7.1	DP	Conservative perspective
DP 7.2	DP	Progressive and enthusiastic perspective
DP 7.3	DP	Attitude towards mobility of externals 1-8
DP 7.4	DP	Attitude towards mobility oft internals 1-8