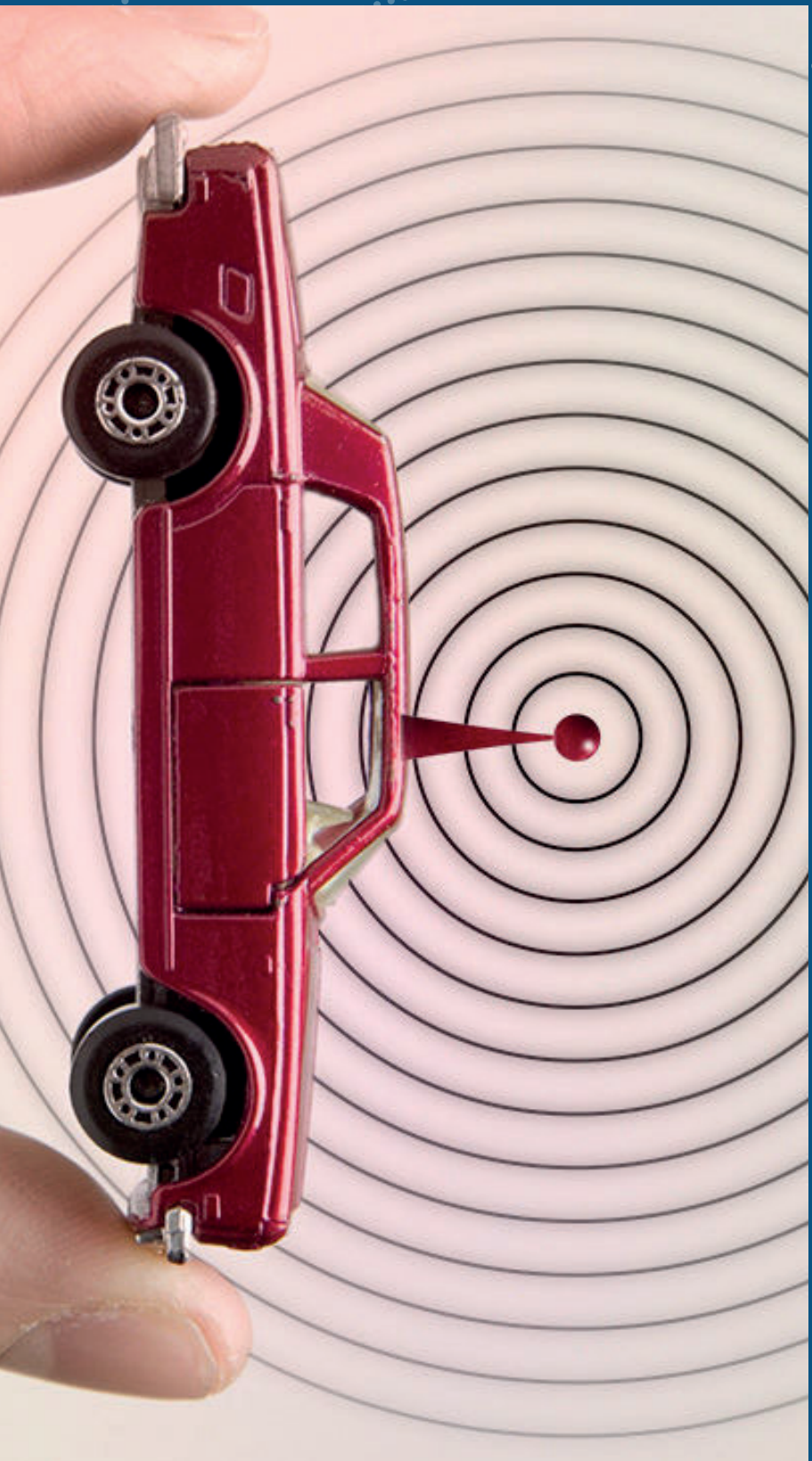




The effect of OTA "over the air" on the aftersales business model



BOVAG

All for better mileage.

Research commissioned by BOVAG Carried out by VMS | Insight June 2020





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MANAGEMENT SUMMARY

The major developments in the automotive industry are electrification, ADAS as a precursor to autonomous driving and the 'connected car'. They all have an impact on the way people will be mobile in the future, the infrastructure will be set up, road safety will be guaranteed and customer contact will take place or the division of roles in the chain will be (re)organised. BOVAG wants to gain clear insight into the consequences of these developments for aftersales. At the beginning of 2018, BOVAG, together with VMS | Insight researched the consequences of electrification for aftersales. Current market insights have been translated into a number of practical scenarios for which the effect on aftersales has been calculated. A similar study was conducted a year later, in 2019, but with regard to the consequences of ADAS for aftersales. The research report that now lies before you is the third step in mapping the consequences of technological developments for car retailers. How will the aftersales services provided by the car retailer be affected if manufacturers are able to diagnose vehicles remotely and provide them with improved software and add new functionalities, with or without payment? That is the central question answered in this report.

BOVAG commissioned this study with a threefold goal:

1. To provide insight into developments related to OTA.
2. To identify these developments and translate them into scenarios for the expected penetration of OTA in the Dutch market and vehicle fleet.
3. Determining the impact on aftersales potential, the factors which play an important role in this and the areas in which the car retailer can take action.

The study concerns passenger cars and is mainly qualitative in nature. Where possible, results are expressed in or supported by figures.

What is OTA?

The OBD port has always been a car's most important connection to the outside world.

Nowadays, cars are increasingly "connected": via the internet with an online telematics platform, with each other, with other road users, with smart infrastructure and with other stakeholders. In practice, the online telematics platform is now usually controlled by the OEM (Original Equipment Manufacturer, read: manufacturer). Modern cars have many computers and control units. They are all controlled by software. Software errors (bugs), new versions (of, for example, navigation maps) or newly added functionalities mean that software needs to be regularly updated.

Another example is the upload of new software and the teaching-in of sensors after a repair. If software can be uploaded remotely "over the air", this is OTA.

OTA (Over The Air) is a designation for the remote programming and reprogramming of individual Electronic Control Units (ECUs) and/or the central software management system. A distinction is made between FOTA (F = firmware = system software; comparable to Windows) and SOTA (S = software/application software; comparable to Office).

Advantages of OTA and expected development

OTA has important advantages, initially mainly for the manufacturer. The most important are:

- Cost savings (especially on recall costs; IHS has calculated that performing a software update at the dealership costs about \$ 100 per car and expects car manufacturers to save about \$ 35 billion per year by OTA by 2022)
- The ability to push necessary software updates centrally to all affected vehicles
- More control on vehicles.
- It offers the opportunity to develop completely new revenue models and to build up a unique, distinctive position compared to competitors.

With OTA, extra functionalities can be switched on or off remotely, when the driver wishes and for as long as necessary. Think of extra horsepower for a ride through the mountains or heated seats for winter sports. Installed without having to go to a workshop, convenience serves the customer. Software as needed. The OTA platform provides the infrastructure for this.

All car manufacturers are active with OTA. Premium manufacturers lead the way. Developments are rapid. OTA functionality is already increasingly present and enormous growth is predicted. Few manufacturers apply OTA for "vital" updates. But that will also change once the systems are mature, and safety and liability risks can be eliminated. In concrete terms, there is already a lot of technology 'under the hood' (with some brands there has been for many years) to facilitate the connection between manufacturer and car. But pending legislation and safety, this is not yet (fully) activated in use. If this were the case, some manufacturers will instantly have a grip on a large number of construction years. Mercedes, for example, since the rollout of Mbrace2 in 2012, already has an extensive fleet where OTA can be applied. Car manufacturers claim exclusive access to vehicles due to complexity (management of up-to-date software), road safety, security and liability. The stakes are high: it concerns grip on vehicles, grip on drivers and (also) grip on the chain. The expectation is that the domains of infotainment, automated software recalls and just-in-time updates will be the most developed and exploited by 2030. Some dealer contracts are already prepared for the (online) sale of over the air software updates (for example for extra infotainment functionalities, activating seat heating, extra horsepower or extra range), including the margin split or commission for the retailer (= the dealer who initially sold the car) for a certain period. With regard to aftersales management, little seems to be regulated in the contracts between manufacturers and dealers. Let alone with the independent channel.

Penetration OTA is increasing rapidly

In a realistic scenario, 35% of the total number of new passenger cars sold will be equipped with FOTA by 2025. That's 140,000 vehicles out of a total 400,000. By that time, the Dutch fleet will consist of about 460,000 passenger cars with FOTA. By 2030, 80% of all new cars sold will have FOTA. The total number of passenger cars with FOTA will then be 1.8 million, about 22% of the total fleet. For SOTA these penetration figures are considerably higher: in a realistic scenario, 70% of the total number of new passenger cars sold will be equipped with SOTA by 2025.

That's 280,000 vehicles out of a total 400,000. Consequently, 1.1 million passenger cars in the total fleet will have SOTA. By 2030, 90% of all new cars sold will have SOTA. The total number of passenger cars with SOTA will then be 2.8 million; exactly one third of the total fleet.

Consequences of OTA for dealerships and independent car companies

Cost reduction, grip on vehicles and drivers, grip on the chain, grip on (broader) ecosystems, extra revenue; these are potentially important advantages of OTA for the OEM. Dealers will, in many cases, benefit from their relationship with their OEM for aftersales services. However, a dealer-manufacturer relationship is a dependent relationship. As knowledge about the customer/the vehicle and the control increasingly come to rest in one hand, there is a risk that the added value of the dealer will decrease and the chance of interchangeability is greater. Moreover, having to perform less work because increasingly more is done over the air will, in any case, lead to a loss of turnover. And a potentially loosening customer relationship. Independent car companies are, in principle, at a disadvantage with OTA; they do not automatically belong to the network that will have access to data, software and systems from the OEM. Important drivers for power (or more friendly: grip) in this context are the technology to facilitate the connection of participants to an ecosystem, on the one hand, and (being able to) gain access to the ecosystem, on the other. EU regulations in particular determine how the balance of power will crystallise in the future. Are there no advantages for the retailer? There certainly are: higher customer satisfaction through updates via OTA has a positive effect on the entire organization and increased car sales as a result of better market appreciation for the extra services that a brand offers via OTA also lead to more regular maintenance and repair in the workshop and upsell options for roof boxes or winter tyres.

Role of EU legislation in OTA

When it comes to legislation and regulations, four dimensions can be distinguished: self-determination over data, competition, privacy and the influence of type-approval authorities. Two dimensions largely determine the playing field: self-determination over data and competition. This concerns, respectively, the ownership of data and systems (who owns the data and who owns the systems or software?) and access to data and systems (who gets access to the data and who gets access to the systems or software?). Intellectual property and (cyber) security are important criteria here. Legislation is in the making. It is expected that draft legislation will be available by the end of 2020 and that 2 years later, at the end of 2022, there will be definitive legislation or a so-called regulation. The third dimension is privacy. The legislative framework has already been clearly defined with the GDPR/HVG. New product propositions in which "over the air" is an essential part must of course be GDPR/HVG-proof. Moreover, the market will increasingly demand hard guarantees for privacy. In addition, the properties of cars cannot simply be adjusted. In Europe, type-approval authorities (such as TÜV or RDU) certify a car.

This is the fourth dimension. The type-approval authority may need to be consulted and/or need to issue approval if a vehicle changes properties due to a software update. This, however, depends on the effect that a software update has on type approval. The regulations for this have (also) not yet been worked out.

Consequences for the revenue model

Modern cars are becoming more like iPads on wheels. Cars are becoming more complex due to software and the need to update it regularly. OTA is the only way to manage that with 100% coverage and security, and in a way that is acceptable to a customer (as a customer you do not want to visit your garage every week for a software update). OTA is therefore indispensable in the future and will become a "fact of life" for the future workplace. In addition, sometimes things break or damage needs to be repaired. Sometimes this activity is accompanied by the uploading and commissioning of software; this can only take place if the workshop is authorised to do so. The infrastructure to enable OTA can also be used to sell additional services. The question is which players will benefit from this and which will not. The total market for maintenance and repair is shrinking for traditional retailers. Especially in hours. The EV requires less maintenance and software, and extra services are over the air. The challenge for the retailer is:

1. to keep a grip on vehicles and customers
2. to be part of a controlled repair & maintenance flow
3. guarantee access to brand-specific knowledge and software. This can be done by joining or collaborating with a brand organization, or by joining an Onboard Telematics Platform (OTP).

Compete for data, access to the vehicle and ultimately the customer

OTA can provide a sharper boundary between (brand) dealers and independent car companies. Basically it is about who has access to data, software and customers. EU legislation will determine the framework for this. A reasonably level playing field is necessary for the consumer/owner to determine which qualified aftersales party is given access. Qualified aftersales party in this context means: being part of a brand organization, and/or certified by a brand organization and/or being part of a certified partnership. Qualified also means having knowledge and being able to understand and apply OTA data protocols.

Strategic choices are indispensable

Even more than is the case with other developments such as electrification and ADAS, the retailer will have to make choices: answer the company's life questions. Who are you? Who do you want to be? Who can you be? Where do you want to be in the chain? What status/position goes with it? Who are your partners to achieve that? Speed of action is required and the timeframe is strongly determined by technological progress and the frameworks of new legislation.

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FOREWORD

After researching the impact of electric cars on the aftersales business model, and the influence of ADAS on it, this study into the consequences of Over The Air technology - or 'OTA' - concludes a triptych. BOVAG commissioned the researchers from VMS | Insight to do this, and the reports provide both independent car companies and brand dealers insight into the future. After all, these developments are rapidly influencing the behaviour of customers, the processes in your workshop and the profitability of aftersales. Your sector association, therefore, sees it as its task to collect as much information about this as possible, so that you can make the right choices.

More and more new cars are 'connected' and can automatically communicate with external parties. OTA also means that updates can be carried out and new functionalities can be added to a car without the intervention of a mechanic. The process is similar to the way in which your laptop and mobile phone update automatically. Nowadays, we think it's normal for our computers to receive an update from Microsoft, Apple, HP, Samsung or Google. In fact, if we had to run to the KPN store or MediaMarkt every time we needed this, the fun of using it would quickly disappear. Cars are becoming more like mobile computers every day: the only thing is that we are all so used to regular maintenance - and therefore also the necessary updates - being carried out in our workshops.

OTA offers car manufacturers a wide range of possibilities for new revenue models, to save costs and to guarantee safety. After all, recalls required to update software can be carried out remotely, without being dependent on the willingness of a driver or on the planning of a workshop. It can also offer advantages for car companies, because no extra time has to be set aside for this. Moreover, it reflects positively on a brand, since a problem is solved immediately and without hassle. On the other hand, OTA can lead to the manufacturer solving more and more cases directly and the car company being sidelined. The most important aspect for both the dealer and the universal is at stake here: the customer relationship. After all, anyone can sell cars and gather knowledge, but the relationship with your own customers is unique and cannot be replicated. That's why it's of the utmost importance to keep up to date with developments in this area, so that you can determine your own role in this. And that you retain control over that decision. This report helps with that. BOVAG is always keeping a close watch to emphasise the crucial position of the retail sector, and to prevent a monopoly of manufacturers.

Bert de Kroon
Chairman of BOVAG Car Dealers

Gerard ten Buuren
Chairman of BOVAG Independent Car Companies

READING GUIDE

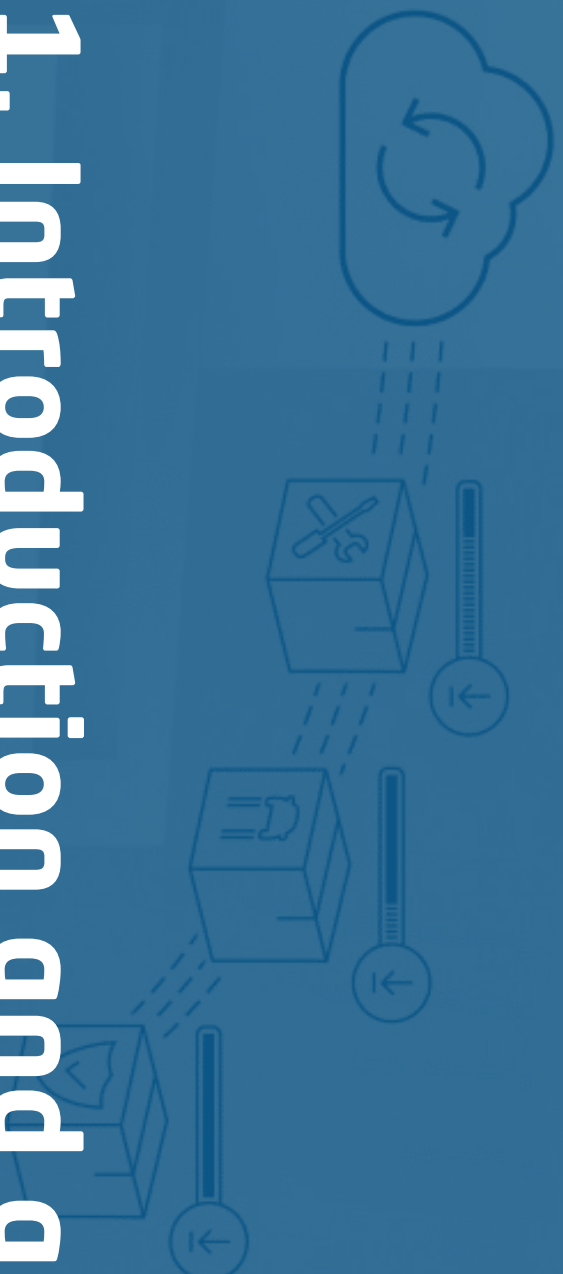
This report has been made as accessible as possible by combining developments and facts with a brief explanation. The scenarios and the outcomes of the modelling are also presented concisely. It is therefore more of a PowerPoint presentation with explanatory notes than a traditional report with large pieces of text.

The structure is as follows:

1. Introduction and approach to research
2. Market map
3. Scenarios of the impact of OTA on aftersales
4. Literature and sources overview
5. Terms and abbreviations

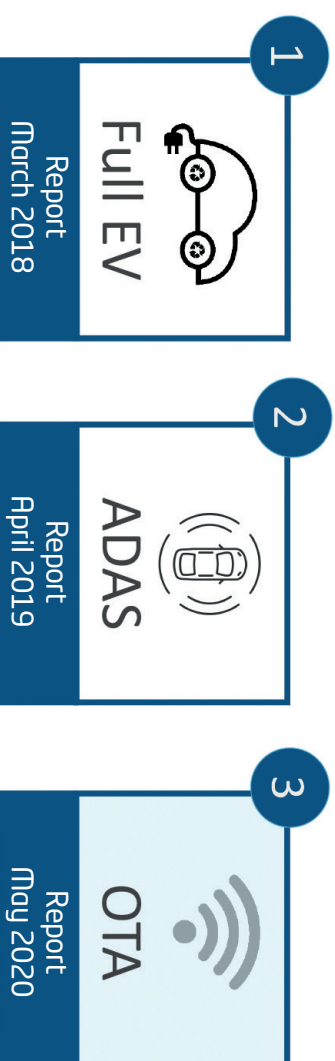


1. Introduction and approach - Research question



1. INTRODUCTION AND APPROACH - RESEARCH QUESTION

What is the effect of:



ON aftersales?

Derived research questions:

- 1 Development**

OTA stands for "Over The Air". In particular, the remote execution of software updates is central to this. To what extent and at what pace will OTA be introduced? What concrete plans do car manufacturers and suppliers have? How does the market view this? What are the benefits of OTA? What are the consequences for aftersales?
 - 2 What are the interests in the chain? And which frameworks do legislation and regulations provide?**

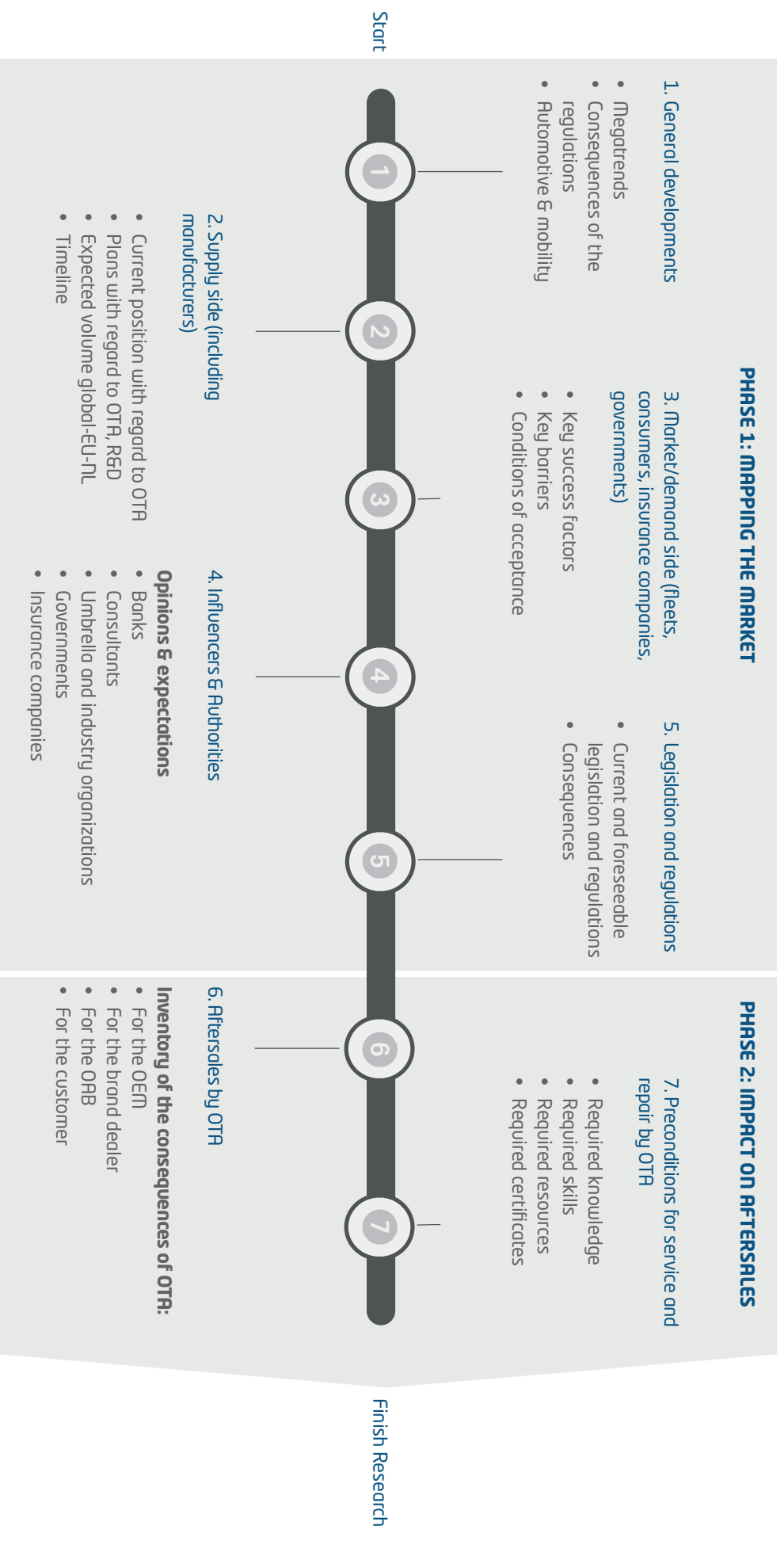
From manufacturer to customer, and all parties in between: which interests are served? What role does the legislator play?
 - 3 Aftersales volume**

How can the effect of OTA on the aftersales volume be interpreted? Are differences between brand dealers and independent car companies to be expected? Are there other variables?
 - 4 Know-how**

What knowledge, skills, resources and certificates are required to service or repair vehicles equipped with OTA functionality?
 - 5 Simulation**

Can the insights obtained be contained in a concrete and practically usable simulation model? So that the effects for the Dutch fleet, specifically, become visible?
- Scope of research:
- Dutch market for private and business passenger cars
 - The research is mainly qualitative in nature. Where possible, results are expressed in or supported by figures
- The research is built on three pillars:
1. Desk research - what's available, already published
 2. Interviews with experts - what are experiences and opinions in the field (experts within and outside the automotive industry, scientists)?
 3. Modelling - how can insights obtained be translated into concrete scenarios for the Dutch situation and what are the consequences?

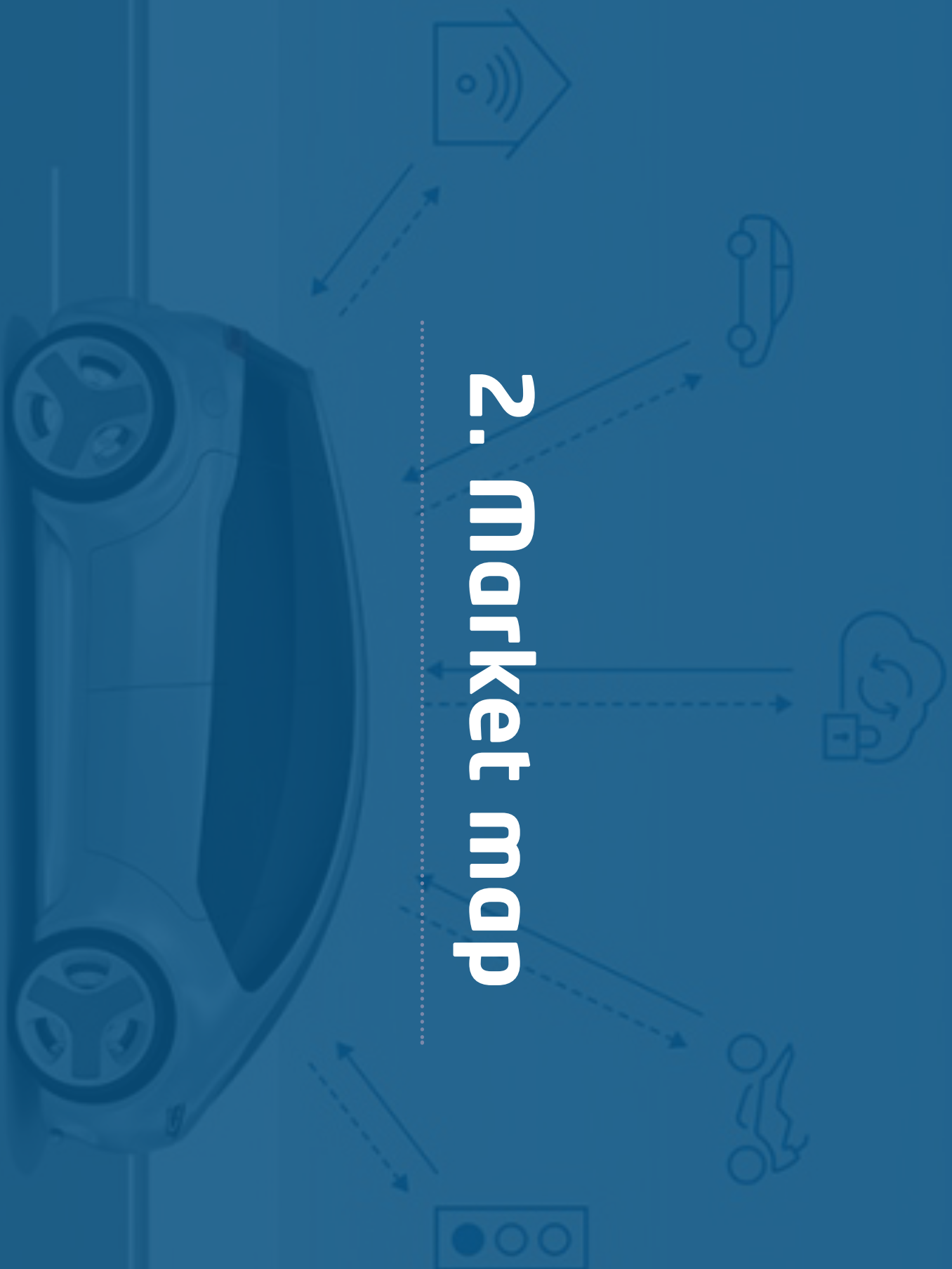
1. INTRODUCTION AND APPROACH - 7-STEP RESEARCH



The market analysis was performed in 7 steps. The first phase is devoted to mapping the market and the expected developments with regard to OTF. The second phase concerns the consequences for aftersales.



2. Market map



2.1 DEFINITION AND BACKGROUND OF OTA

Introduction

To gain a good understanding of OTA it is important to know the wider context.

Data (vehicle status information), software (new releases and update management operating systems, applications and infotainment) and infrastructure (the communication platform with which information is exchanged) play an important role in this.

The following data, software and infrastructure are explained in more detail in succession.

1. Data:

The car generates different types of data for various applications:

- About the vehicle, about the use, about the user.
- This data, in all its forms, is an important source for various parties and all kinds of services.
- The willingness to share data has a strong relationship with perceived privacy.
- Guaranteeing the agreed privacy rules is therefore an important precondition.
- The modern car not only supplies data, but as a 'connected car' is also connected to an ecosystem of, among others, the OEM (manufacturer), service providers, other road users, smart infrastructure and other stakeholders.

2. Software

- Modern cars have many computers and control units. They are all controlled by software. Software errors (bugs), new versions (of, for example, navigation maps) or newly added functionalities mean that there is a need to update software. Another example is uploading new software and teaching-in sensors, for example, after a repair.
- If software can be uploaded remotely "over the air", this is OTA.
- A distinction is made between FOTA (Firmware Over The Air, this is system software comparable to Windows) and SOTA (Software Over The Air, this is (application) software, comparable to MS Office). The remainder of this report mainly refers to software over the air, which includes both FOTA and SOTA. References to FOTA will be clearly indicated.

3. Infrastructure

- The 'path' over which data and software is exchanged was generally always a fixed, physical access to the vehicle. The OBD port has always been a car's most important connection to the outside world. Nowadays, cars are increasingly "connected": via the internet to each other, to the servers of the manufacturer, etc. Depending on the available functionalities, a connected vehicle can send and/or receive data over the air and receive and upload software over the air.

**What does the DNA string of a modern vehicle consist of?
And who has an interest in it?**



Data (vehicle status information) that a vehicle generates:

- Status and error codes vital functions
- Status and error codes non-vital functions
- Usage data (acceleration, braking, gear, cornering speed, etc.)
- User data (who is the driver, background info, profile/preferences)
- Location information

Derivative information:

- Environmental data (status and error codes in combination with location data, the condition of the road surface for example).
- Remote diagnosis, predictive maintenance

Interested parties:

- | | |
|---|---|
| <ul style="list-style-type: none">• OEM (manufacturer)• Retail channel (dealer and independent car company)• Aftermarket• Road authorities | <ul style="list-style-type: none">• Insurance companies• Fleet managers• Government• Other external parties (often with a commercial interest) |
|---|---|

According to Intel, a car generates 4,000 GB per day with an average use of 1 hour (!). To give an impression: this is equal to 500 hours of HD video or 6.5 million document pages. Intel distinguishes 3 categories of data:

1. Inside-out data: the data generated by the vehicle's sensors, such as cameras that detect the difference between people and vehicles.
2. Outside-in data: data that enters the vehicle from the outside, for example navigation data or communication with other vehicles and traffic objects.
3. Personal data*: data generated by the users of the vehicle themselves, such as personal music preference, social media use or data from wearables.

source: Intel *Personal data is also referred to as privacy data

Connected and OTA

- Connected means connected to the outside world. A connected car does not necessarily have OTA. A car with OTA functionality is always connected.
- Wireless connection via Wifi or 4G/5G characterises both the connected car and OTA.
- The big difference between connected and OTA is in the type of data:
- Connected basically involves making data generated by the vehicle and user available (so-called vehicle status information) and interpreting received signals = data out/data exchange.
- OTA is a specific part of the data exchange: OTA is about checking and adjusting system software = programming software, so code in.

Software that can be installed via OTA:

- Improved version of the existing software:
- Bugs, software errors
- Progressive insight, better performance
- Add new/additional software:
- New functionalities and/or better driving experience (whether or not paid for by the owner/driver)

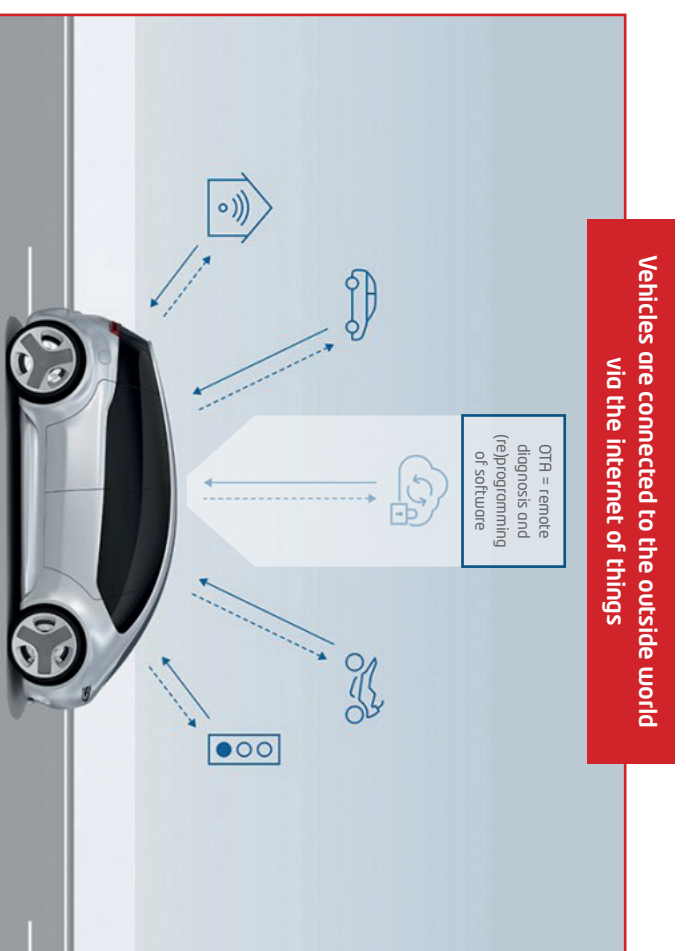
Connected ≠ OTA

Exchange information
(data out/data exchange)

Installing software
(code in)

Vehicles are **connected**: via the **IoT** (Internet of Things), with an online telematics platform, with each other, with other road users, with smart infrastructure and with other stakeholders. In practice, the online telematics platform is now usually under the control of the OEM.

OTA – over the air, is a designation for the remote programming and reprogramming of individual Electronic Control Units (ECUs) and/or the central software management system. A distinction is made between FOTA (Firmware Over The Air), this is system software comparable to Windows) and SOTA (Software Over The Air, this is (application) software, comparable to MS Office).



Based on a Bosch visual

2.1 GENERAL DEVELOPMENTS

Remote software programming:



Software-over-the-air technologies enable vehicle manufacturers to remotely update vehicle software or install new software from a cloud-based server.

Important advantages of OTA:

- Cost savings (especially on recall costs)
- The ability to push necessary software updates centrally to all affected vehicles
- Reach 100% of eligible vehicles
- More control over the life of the vehicle (or: as long as the OEM supports the vehicle with updates)
- Grip on users and channels
- Infrastructure for new revenue models
- Optimise customer satisfaction
- Analysing and marketing (behavioural) data

Strong focus on
OEM interest!

OEM indicates that it has
strong arguments for a dominant
management position:

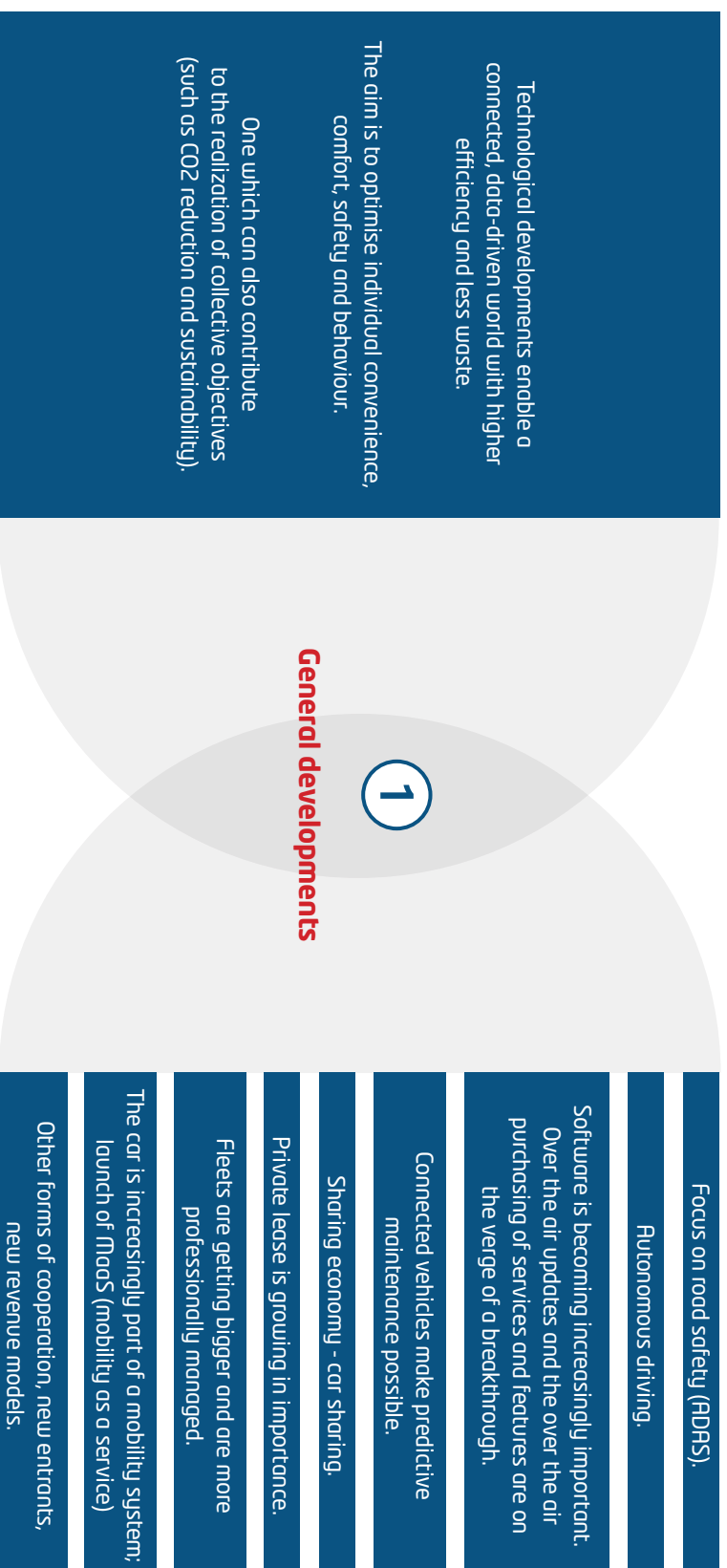
**Quality, safety (cyber security), intellectual
property and product liability are paramount**

But what is the risk factor for the
retailer (the brand dealer and the
independent car company)?
And where are the opportunities?

2.2 GENERAL DEVELOPMENTS

A compact overview of general trends and trends in automotive and mobility can be found on this page and the following ones. Subsequently, a more in-depth look at the supply side, the demand side, the legislative framework and the expected effect of OTA on the balance of power in the market respectively.

Important trend:



2.3 SUPPLY SIDE

General with regard to OTA:

'Connected' is evolving from one-way traffic via dialogue to an embedded (= integrated) platform.

Connectivity, electrification and autonomous driving go hand in hand. Software makes this possible.

OTA updates are shifting from telematics and infotainment to powertrain and safety.

OTA is mainly applied in new generation cars, which means there are many differences in the driving fleet.

OTA makes it possible to develop products and services "agile": you start with an MLP (minimum lovable product) that you continuously improve and enrich through updates.

On the one hand, the number of sensors, cameras and ECUs (electronic control units) per vehicle is increasing enormously; this requires up-to-date software, solid update management and the high-level knowledge of technical experts.

On the other hand, the number of ECUs is decreasing because they are increasingly centrally controlled by so-called domain controllers. This is a potential barrier to the independent channel.

Security is a particularly important topic: both with regard to a flawless and complete update process and with regard to the prevention of cyber hacks.

2 Supply side

Manufacturers and retailers:

All car manufacturers are active with OTA. Premium manufacturers lead the way. Major differences in vision, development of revenue models and current use. Clear parallels can be seen with the development of electrification and ADAS.

Development is fast. New vehicles often have OTA functionality. Most manufacturers are generally still reluctant to use it actively.

Cars are getting more complex. More and more computers, sensors, control units and software. Brand-specific knowledge is required for damage repair, maintenance and repair, or access to that brand-specific knowledge (including software).

Car manufacturers claim exclusive access to vehicles due to complexity (management of up-to-date software), road safety, security and liability.

The stakes are high: grip on vehicles, grip on drivers, grip on the chain.

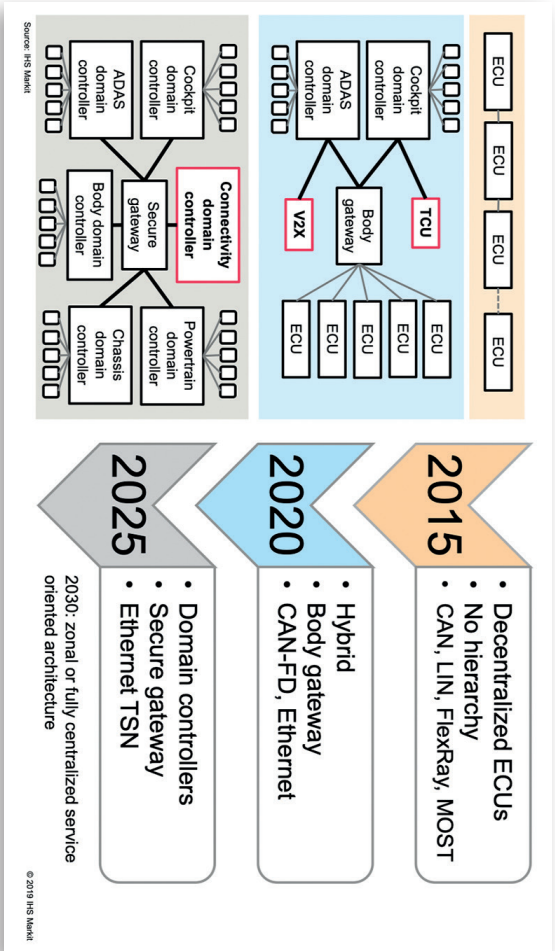
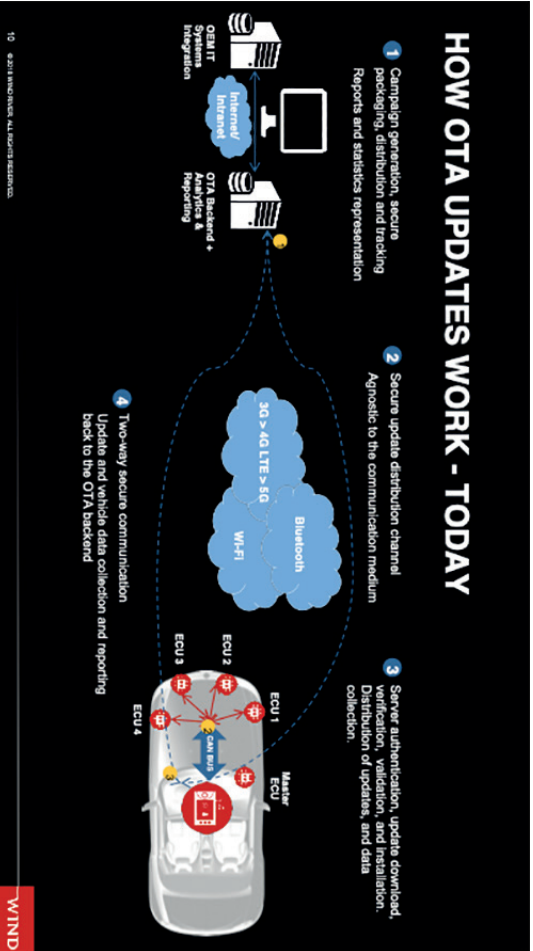
Still unclear - regulations in the making:
1. Who has access to which data (who can 'read')?
2. Who can perform which updates (who can 'write')?

Preconditions for OTA

- Software is verified, loaded and installed via a secure data connection (3G, 4G, 5G, Bluetooth or WiFi). Stability of the connection is a prerequisite.
- Identification (vehicle, VIN, ECU, current software version, etc.) is crucial.
- Measures with regard to (cyber) security are also crucial, during all stages of use. So at standstill (not activated), while driving (activated) as well as during the update process.

The "software defined car" provides an evolution in the way in which electronics are controlled

- From one-way traffic via dialogue to an embedded (= integrated) platform.
- Or more concretely: from more and more separate ECUs (see image on the right, situation 2015) to centralised domain controllers (situation 2025). The primary responsibility of the domain controller is to verify ("who you are") and validate ("what you are allowed to do") user access on the network.
- Centralization and security protocols reduce cyber-security risks and enable targeted updates remotely. And give the OEM the opportunity to give third parties access to the software at different levels.



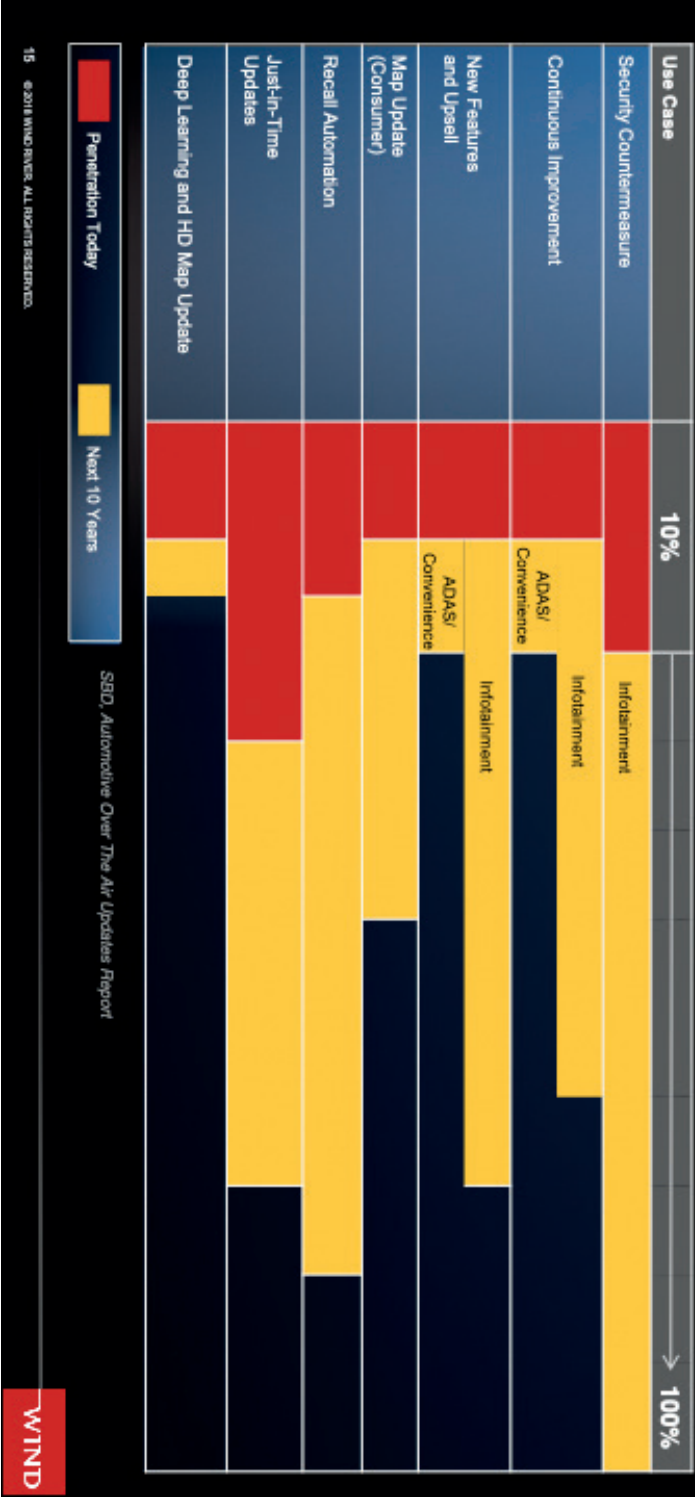
source: Consolidation in Cockpit Electronics, IHS Markit, 2019

EXPLANATION OF SUPPLY SIDE

OTA functionality increasingly available, huge growth predicted.

- Back in 2018, Wind River, software developer for the automotive industry, estimated that 5-10% of all new cars sold have some form of OTA.
- OTA is mainly used for security measures and just-in-time updates.
- The expectation is that the domains of infotainment, automated software recalls and just-in-time updates will be the most developed and exploited by 2030.

OTA AND SWLCM USE CASES Projected for the next 10 years



The important trends for the future go hand in hand. In fact, they will reinforce each other.

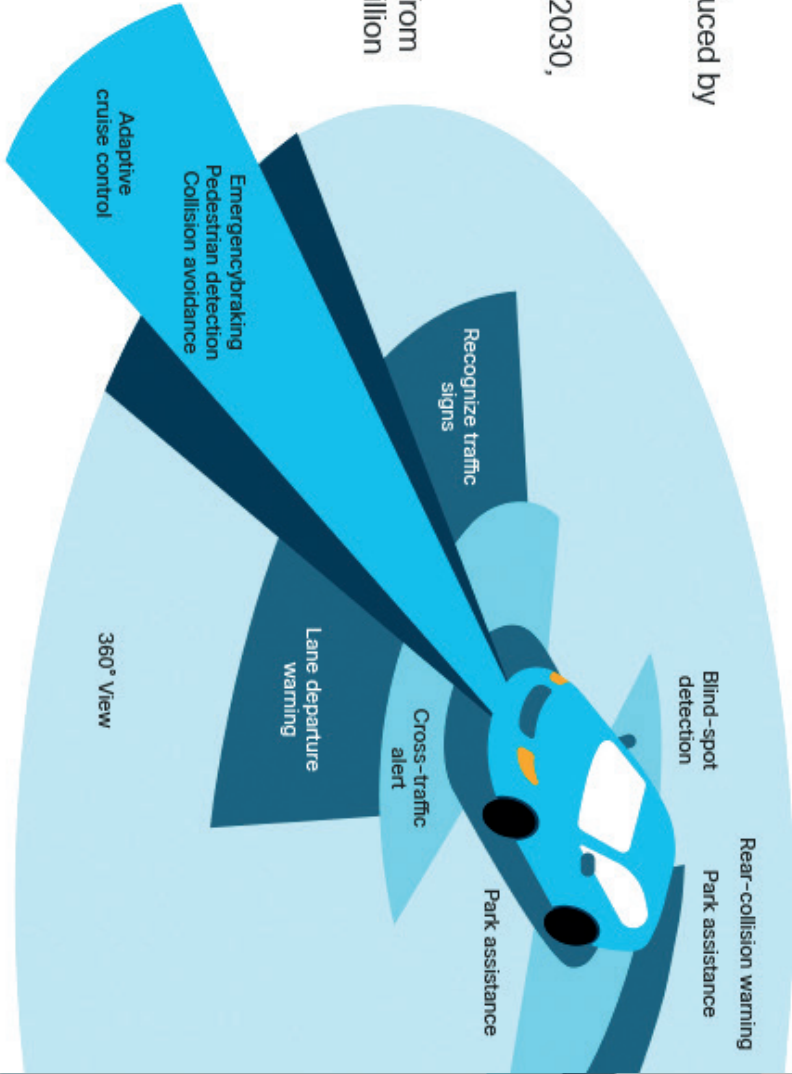
- Connected - 80% of new cars by 2030
- Autonomous driving - 15% of new cars in 2030, 90% in 2040
- Over-the-air - strong growth from 2020
- Electrification - 50% of new cars worldwide by 2040 according to Bloomberg, 75% of new cars in the Netherlands according to the realistic scenario created by BOVAG (The effect of the electrically powered (company) car on the aftersales business model (March 2018))

Connected
80% of new vehicles produced by 2030 will be connected

Autonomous
15% of new vehicle sales 2030, 90% by 2040¹

Over-the-Air
Global OEM cost savings from software updates > \$35 billion by 2022²

Electrification
50% of new vehicles by 2040³



source: McKinsey, IHS, Bloomberg New Energy Finance

EXPLANATION OF SUPPLY SIDE

The number of recalls and the number of cars involved is increasing enormously

- Research from the University of Padua from 2019 demonstrates that today the majority of recalls are software related.
- IHS confirms this picture: As of 2014, more than 40% of all recalls are software related.
- Recalls cost the manufacturers (a lot of) money. IHS has calculated that a dealer implementation of a software update costs \$ 100 per car. And then predicts that car manufacturers could save about \$ 35 billion in 2022, through OTA.
- And can also lead to reputation damage and liability issues (for example, the Takata airbags case).
- Car complexity is only increasing: more computers, more software, more code.
- Being able to perform rapid and effective recalls among all affected vehicles is therefore crucial.
- According to ABI Research, in addition to the need to reduce the cost of recalls, Tesla's success in autonomous driving (and all the software it requires) and increasing safety risks due to increasingly complex software have contributed to the rise of OTA. They see the potential for considerable risk for the retailer.

Abstract University of Padua/IEEE

"It is revealed that the majority of the recalls are due to software related problems"

Past few years:

1. Increase #recalls
2. Increase #recalled vehicles

Last 5 years (2014-2018, worldwide): 189 recalls

13 million vehicles

Concrete examples:

1. Volvo1 59,000 vehicles
2. Honda2 350,000 vehicles
3. GM3 4.3 million vehicles

All recalls could have been resolved with OTA updates

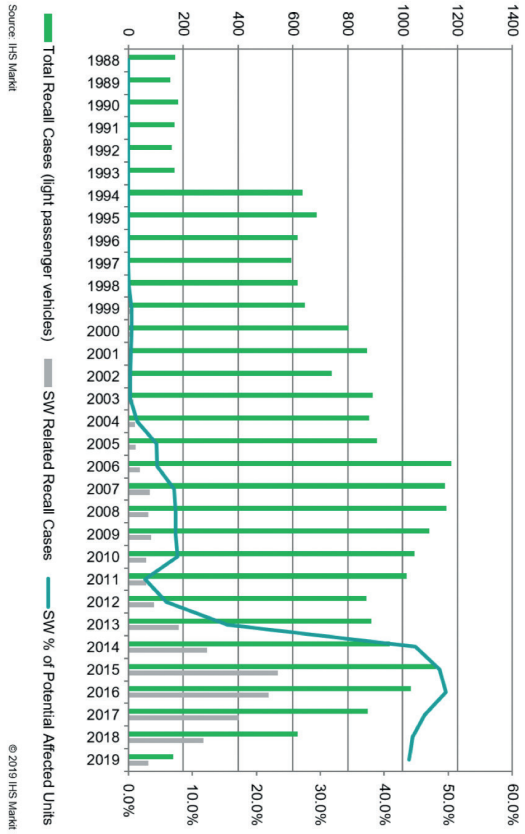
source: University of Padua/IEEE, 2019

1. Engine and electronics failure when the car is moving

2. Error in parking brake software

3. Blockage of properly functioning airbags in the event of an accident

Total recall cases, by model year (MY)



source: IHS Markit, Automotive Over-the-Air updates (OTA), 28 March 2019

ABI Research

Three factors changed the course of the automotive industry and paved the way for the future of OTA:

1. Recall cost
2. Tesla's success as the foundation of autonomous driving
3. Security risks based on software complexity

"The car dealers have everything to lose"

source: ABI Research, 2019

More and more vehicles have OTA. Few manufacturers apply OTA for "vital" updates.

- Tesla is the frontrunner (and perhaps the inventor) of OTA. Almost everything at Tesla happens 'remotely' (see next page).
- GM, Ford, Mercedes, BMW, Audi, VW, Opel, Jaguar, Volvo and many more manufacturers: they have OTA, they experiment with it, they gain experience, but gradually increase the actual use.
- Underlying reasons:
 - Systems have not yet matured
 - (Cyber) risks are still too great
 - Liability issues
 - Unclear EU regulations (what is allowed, what is not allowed)
 - In this context: when does a car still conform to the original type approval?
 - Revising contracts/agreements with dealers and service partners takes time
 - Testing acceptance: not only dealers and service partners have to get used to them, but customers too
- Some manufacturers potentially already have a grip on vehicles of many years of construction. Mercedes, for example, since the rollout of Mbrace2 in 2012, already has an extensive fleet where OTA can be applied.

...it seems like a matter of time before OTA is really 'common business'...

Discussions with both dealers and independent car companies show that software is now only a small part of all activities

- Software updates are now relatively rare. Updates are mainly during the first three years of a car's life and after that software-related activities actually only take place when components are replaced (after which reprogramming/reaching-in has to be performed).
- It is expected that software-related activities will increase.
- The general opinion is that diagnosis via OBD (physical port) shifts to OTA ("connected drive").
- Some dealer contracts are already prepared for the (online) sale of over the air software updates (for example for extra infotainment functionalities, activating seat heating, extra horsepower or extra range), including the margin split or commission for the retailer (= the dealer who initially sold the car) for a certain period. With regard to aftersales management, little seems to be regulated in the contracts between manufacturers and dealers. Let alone with the independent channel.

TECH TRANSPORTATION CARS

GM's new 'digital nerve system' will enable over-the-air software updates on all vehicles

The new architecture will be capable of handling 4.5 terabytes of data an hour

By Andrew J. Hawkins | @andjphawk | May 21, 2019, 2:36pm EDT

f t SHARE

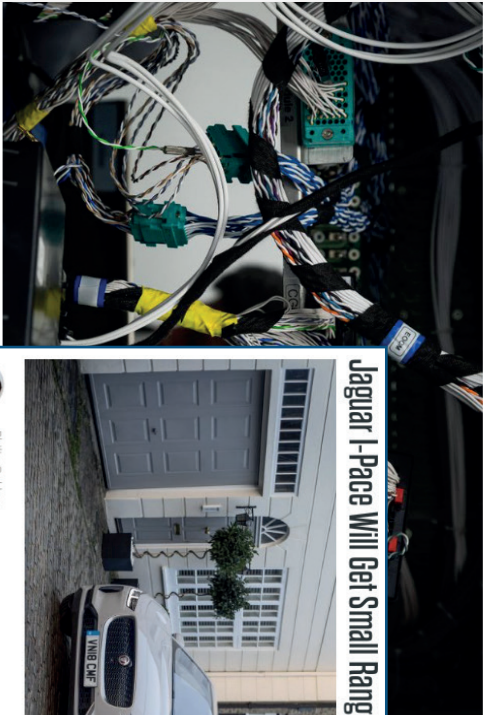


Photo by Jeffrey Saenger for General Motor



Philipp Oakley

Jaguar I-Pace Will Get Small Range-Increasing OTA Update



General Motors unveiled a new electronic platform for its vehicles on Monday that's designed to handle the heavy data loads that will become increasingly necessary as cars get smarter and more autonomous. This new "digital nerve system" will enable smartphone-style over-the-air software updates on all GM vehicles in the next four years, said Mark Reuss, president of GM.

The new platform will make its debut on the recently unveiled 2020 Cadillac CT5 sedan. After that, it will go into production later this year and should be rolled out to most vehicles within GM's lineup by 2023.

"IT IS A REAL DIGITAL NERVE SYSTEM."

"It is a real digital nerve system that will deliver the future of connectivity, autonomous vehicles, and cybersecurity," Reuss said in an interview with *The Verge*.

More and more manufacturers are offering OTA functionalities. Source: The Verge, 21 May 2019 and TU Automotive, 9 December 2019

EXPLANATION OF SUPPLY SIDE

Recently in the news: Tesla can enable and disable remote purchased options

At the beginning of 2020, the experience of an American buyer of a used Tesla was widely reported in the media: after the purchase of that used Tesla, the Autopilot option had suddenly 'disappeared'. It turned out that Tesla had remotely disabled this option, costing many thousands of dollars. At first, this news item raised many eyebrows, but provided that agreements about use, useful life and possible possession and transfer to third parties are clearly recorded, there is nothing to worry about. In any case, it is a clear example of the power and the potential of retrospectively, remotely:

- adjusting functionalities
- adding performance
- adding vehicle-related and non-vehicle-related services
- extending service life...

Incidentally, such examples are also known from other manufacturers. This usually concerns subscriptions purchased online that relate to infotainment.

The car is increasingly becoming the mobile platform on which all kinds of functionalities can be switched on or off, when the driver wishes and for as long as necessary. Think of extra horsepower for a ride through the mountains or heated seats for winter sports. Software as needed. The OTA platform provides the infrastructure for this.

In the future, buyers of a used car will have to conduct thorough research into the status and properties of a car and the conditions under which agreements have been made about its useful life. For example, is a feature inextricably linked to the car? Or to the legal owner? Or to the driver?

Tesla Remotely Removes Autopilot Features From Customer's Used Tesla Without Any Notice [Updated]

Jason Torchinsky
20/06/20 4:10pm
Filed to: TESLA



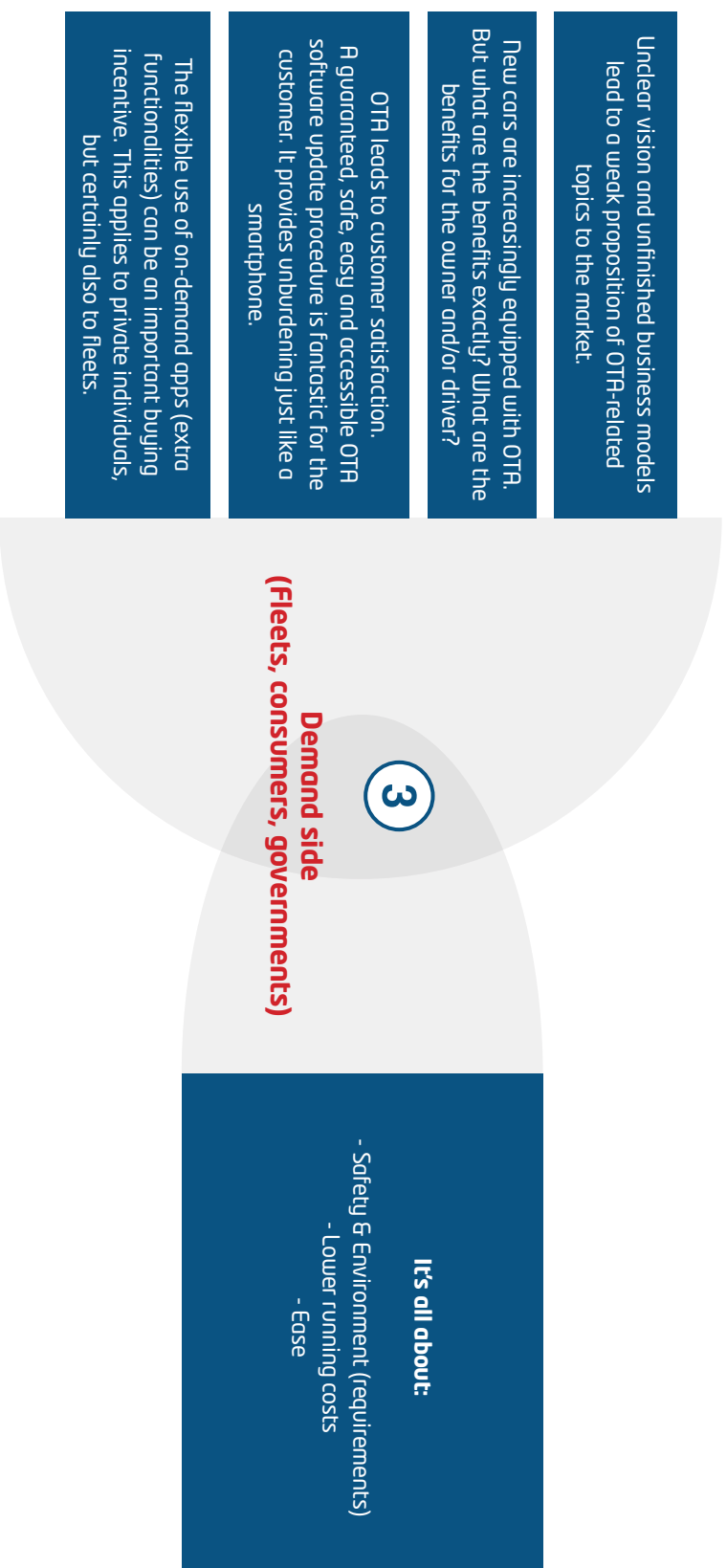
One of the less-considered side effects of car features moving from hardware to software is that important features and abilities of a car can now be removed without any actual contact with a given car. Where once de-contenting involved at least a screwdriver (or, if you were in a hurry, a hammer), now thousands of dollars of options can vanish with the click of a mouse somewhere. And that's exactly what happened to one Tesla owner, and, it seems many others.

Alec (I'll withhold his last name for privacy reasons) bought a 2017 Tesla Model S on December 20 of last year, from a third-party dealer who bought the car directly from Tesla via auction on November 15, 2019. The car was sold at auction as a result of a California Lemon Law buyback, as the car suffered from a well-known issue where the center-stack screen developed a noticeable yellow border.

When the dealer bought the car at auction from Tesla on November 15, it was optioned with both Enhanced Autopilot and Tesla's confusingly-named [Full Self Driving Capability](#); together, these options totaled \$8,000. You can see them right on the Monroney sticker for the car:

TESLA MODEL S 75D			
STANDARD EQUIPMENT		AS EQUIPPED	
CHASSIS			
• 100 kWh battery pack (standard)			
• 100 kWh battery pack (standard)			
• 100 kWh battery pack (standard)			
PAINT			
• Multi-color paint (standard)			
WHEELS			
• 20" wheels (standard)			
EXTERIOR			
• 20" wheels (standard)			
INTERIOR			
• 16" center stack (standard)			
SALES TAX, TITLE, AND LICENSE			
• \$103 (standard)			
OPTIONAL EQUIPMENT			
• \$3,750 (standard)			
SALES TAX, TITLE, AND LICENSE			
• \$103 (standard)			
SALES TAX, TITLE, AND LICENSE			
• \$103 (standard)			

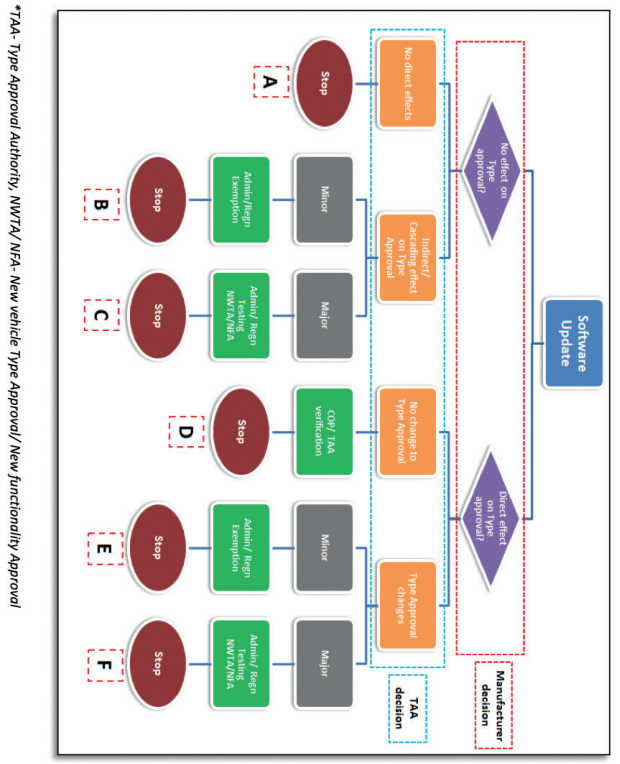
2.3 MARKET/DEMAND SIDE



2.5 LEGISLATIVE FRAMEWORK

A step further: OTA is not a matter of course in the EU!

- Tesla has been using OTA updates for years. Other (also very large, renowned) manufacturers have not yet widely adopted OTA. Why not?
- There is a big difference in the way a vehicle is certified for the North American market (US and Canada) and the EU. In the US and Canada there is self-regulation. The OEM certifies on the basis of regulations. In the EU, the inspection body is responsible for the approval and issues the type approval or the certificate of conformity (CoC).
- The big question with every software update in the EU is: will the vehicle remain exactly in accordance with the original type approval after the update? Or will there be any small or large deviations? In the first case, you as a manufacturer must be able to demonstrate that this is the case. In the second case, the software update cannot simply be carried out.
- The EU regulations have not yet been worked out. However, a position paper is circulating in Brussels with a decision tree on how to deal with software updates. Basically, depending on the effect that the software update has on the type approval, the type-approval authority should or should not be consulted and/or be required to give approval (see below).



source: Position paper Unece - United Nations Economic Commission for Europe, 2019

Why Haven't Over-The-Air Updates Taken Over The Auto Industry?

Tesla has had OTA updates for years. Big established automakers still aren't adopting them at scale. Why not?

BY BERTEL SCHMITT FEBRUARY 27, 2019

There has been a lot of speculation as to why other OEMs aren't doing Over The Air Updates [OTA] the way Tesla does. Are they daft? Or are they greedy for the update money made in the shop? After diving deep into the topic, I have come up with a surprising reason: OTA, the way Tesla appears to be doing it, is illegal in many, if not most parts of the world.

Is Tesla's OTA illegal in many countries?

Last year, Tesla's Model 3 famously fell out of the good graces of Consumer Reports for having lousy brakes. "The Tesla's stopping distance of 152 feet from 60 mph was far worse than any contemporary car we've tested and about 7 feet longer than the stopping distance of a Ford F-150 full-sized pickup," wrote the reputable institution. Days later, Tesla CEO Elon Musk vowed that the problem would be fixed immediately over-the-air. "Firmware fix for upgraded brake performance on standard Model 3 started rolling out yesterday," Musk promptly tweeted.

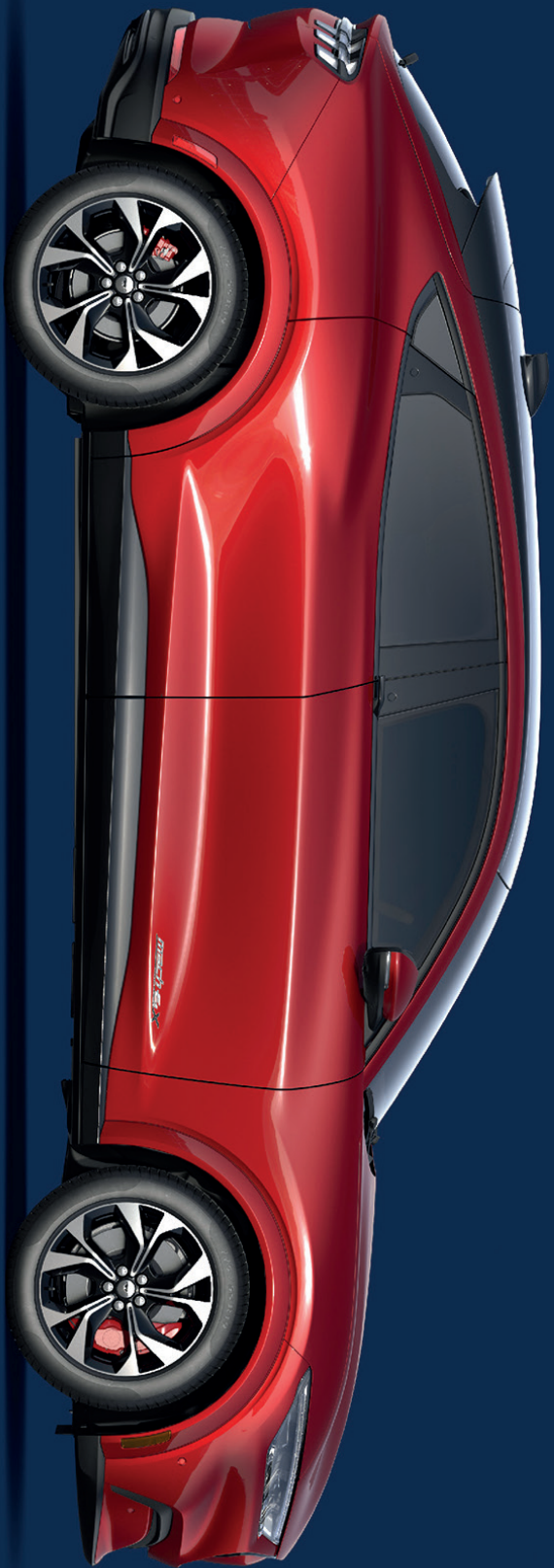
Firmware fix that improves braking?

In the U.S. and Canada, the OEM certifies that the vehicle complies with all rules, such as FMVSS in the U.S., or CMVSS north of the border, along with other voluntary agreements such as NCAPs and more, and the car is good to go. OEMs must have all tests and documentation done in case the authorities come checking. Nobody really worries a lot what is done to the car once it's off the lot.

US/Canada self-regulation (by OEM)

In Europe, India, China, Japan, and many other countries, compliance with the rules must be demonstrated to the authorities. If the regulators are happy, they issue a "certificate of conformity" with the rules. This CoC, often nicknamed the "birth certificate of the car," is the basis of the type approval, and it allows the car to be sold and operated.

Europe: CoC = base



2.6 EXPECTED EFFECT OF OTA ON THE BALANCE OF POWER IN THE MARKET

The positive consequences of OTA for the OEM are not directly there for the retail channel (the dealer and the independent car company)

- Cost reduction, grip on vehicles and drivers, grip on the chain, grip on (broader) ecosystems, extra revenue; these are potentially important advantages of OTA for the OEM.
- Dealers will, in many cases, benefit from their relationship with their OEM for aftersales services. However, a dealer-manufacturer relationship is a dependent relationship. As knowledge about the customer/the vehicle and the control increasingly come to rest in one hand, there is a risk that the added value of the dealer will decrease and the chance of interchangeability is greater.
- Moreover, having to perform less work because increasingly more is done over the air will, in any case, lead to a loss of turnover. And a potentially loosening customer relationship.
- Carrying out repairs means that software often also has to be uploaded and adjusted; this can only take place if the workshop is authorised.
- Independent car companies are, in principle, at a disadvantage with OTA; they do not automatically belong to the network that will have access to data, software and systems from the OEM.
- Important drivers for power (or more friendly: grip) in this context are the technology to facilitate the connection of participants to an ecosystem, on the one hand, and (being able to) gain access to the ecosystem, on the other.
- EU regulations in particular determine how the balance of power will crystallise in the future.

Type of service	Type of software	Key/importance	Impact of OTA on OEM	Impact of OTA on Dealer	Impact of OTA on ORB
Updates/recalls	Vital	• OEM: grip on vehicle and cost reduction • Retail channel: ability to (continue to) service vehicle and maintain customer relationship	+++	-	-- → -
Updates/recalls	Non-vital	• OEM: grip on vehicle and cost reduction • Retail channel: ability to (continue to) service vehicle and maintain customer relationship	+++	-	-- → -
Upsell/new services	Vital	Revenue	+++	+	-
Upsell/new services	Non-vital	Revenue	+++	+	-

Provided 1: The independent channel has direct or indirect access to status information, diagnosis and software

Provided 2: The consumer can actively choose to whom access is granted

Strong dependence on EU regulations!

Provided: OEM and dealer resp. brand channel and independent channel make (contractual) agreements about margin sharing

All kinds of scenarios are possible in the future. It is also possible that the brand channel and independent channel agree on margin sharing when selling new services. The minuses of the impact of OTA on the independent channel can then (theoretically) also become pluses.

In the table on this page, the impact is worked out for OTA (code in); For Connected services (data out/data exchange), the pluses and minuses look different

- Information with regard to (predictive) maintenance, usage information, location data; all things that are considered to be 'new gold'.
- Money can be made here!
- Dealers who are part of the OEM network undeniably have advantages over other non-certified parties.
- These other parties will be adversely affected, unless a highly Onboard Telematics Platform (OTP) is available through which independent companies still have access to individual vehicle (data).

How the balance of power in the aftersales market will crystallise is mainly determined by EU legislation

- Two dimensions largely determine the playing field: self-determination over data and competition. This concerns, respectively, ownership of data and systems (who owns the data and who owns the systems [for software?]) and access to data and systems (who gets access to the data and who gets access to the systems [for software? Intellectual property and (cyber) security are important criteria here.
- Legislation is in the making. It is expected that draft legislation will be available by the end of 2020 and that 2 years later, at the end of 2022, there will be definitive legislation or a so-called regulation.

Customer influence

	SMALL	LARGE
NOT	OEM 100% in charge, third parties have no access, the customer has little influence	OEM 100% in charge, third parties have no access, the customer only has influence on privacy-sensitive data
BALANCE	OEM must provide access to certain data and systems, third parties have access, customer has no voice	OEM must provide access to certain data and systems, third parties have access, customer decides to whom
COMPLETE	OEM must provide full access, customer has no voice	OEM must provide full access, customer decides to whom

=

Most likely scenario

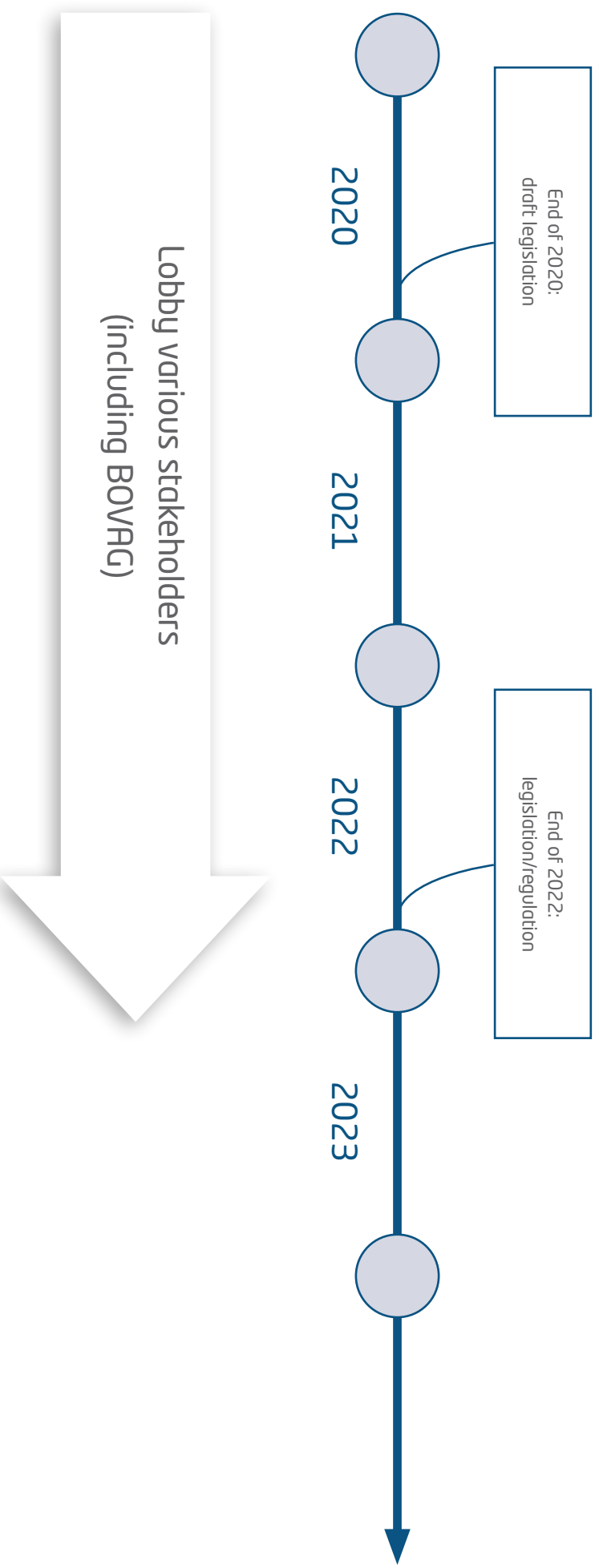
The practical elaboration can be realised in many ways. Ranging from providing selective access to factory systems to an Onboard Telematics Platform (OTP) on which data is made available to third parties.

- The third dimension is privacy. The legislative framework has already been clearly defined with the GDPR/AVG. New product propositions in which "over the air" is an essential part must of course be GDPR/AVG-proof. Moreover, the market will increasingly demand hard guarantees for privacy.

All scenarios can be traced back to EU legislation



Planning of the development of EU legislation with regard to ownership and access to vehicle data and systems



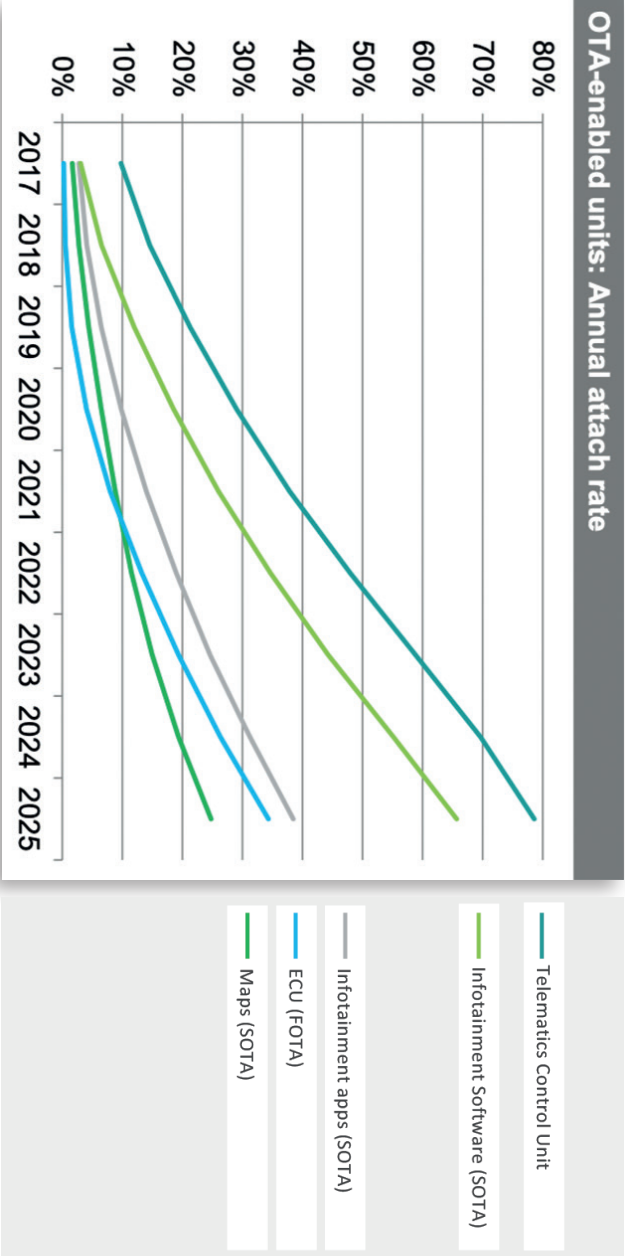
3. Impact of OTA on aftersales



3.1 EXPECTED PENETRATION (AND USE) OF OTA

According to IHS, new cars increasingly have features to enable OTA. Telematics and infotainment are leading the way.

- By 2025, more than 350 million vehicles (worldwide) will have some form of OTA.
- Vital software can be uploaded remotely for a third of all passenger cars produced by 2025. Think of engine management, powertrain, battery management, chassis tuning, safety.
- The most important players are currently active: Tesla, Mercedes-Benz, Volvo, Ford, FCA and the suppliers Horman, Airbiquity and Wind River.
- Forecast: SOTA is growing faster than FOTA. By 2025, 80% of all new passenger cars sold will have SOTA and 35% will have FOTA. In 2030, these percentages will be 90% and 80% respectively.



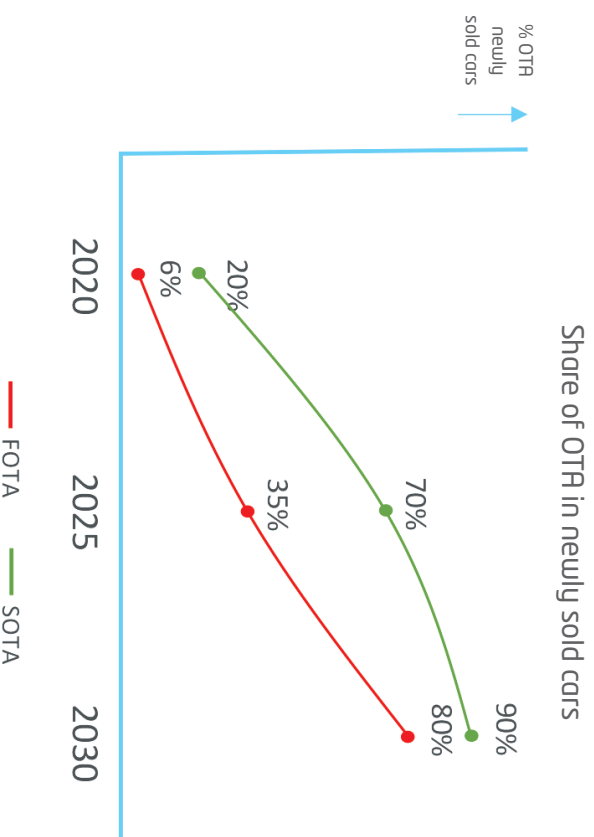
source: IHS Markit, Software and digitalization, 19 November 2019

Forecast OTA - new sales pass.cars		
	FOTA- market share	SOTA- market share
2015	0%	1%
2018	2%	8%
2022	12%	35%
2025	35%	70%
2030	80%	90%

source: IHS Markit, 2019, in combination with other sources and own research

Share of OTA will increase rapidly over the coming years

- In 2019, 2020, approximately 1 in 20 of all newly registered passenger cars will have FOTA functionality. This share is expected to increase to approximately 4 in 10 in 2025 and 8 in 10 in 2030.
- Until 2025, the increase will be mainly visible in the premium segment and electric vehicles.
- After that, OTA will become increasingly mainstream in all segments and all drive types.
- The introduction of SOTA will be faster. This also includes updates for infotainment and additional services to be purchased. These are less complex, entail lower security risks and also fit into a business model that is available in the short term and can generate income.



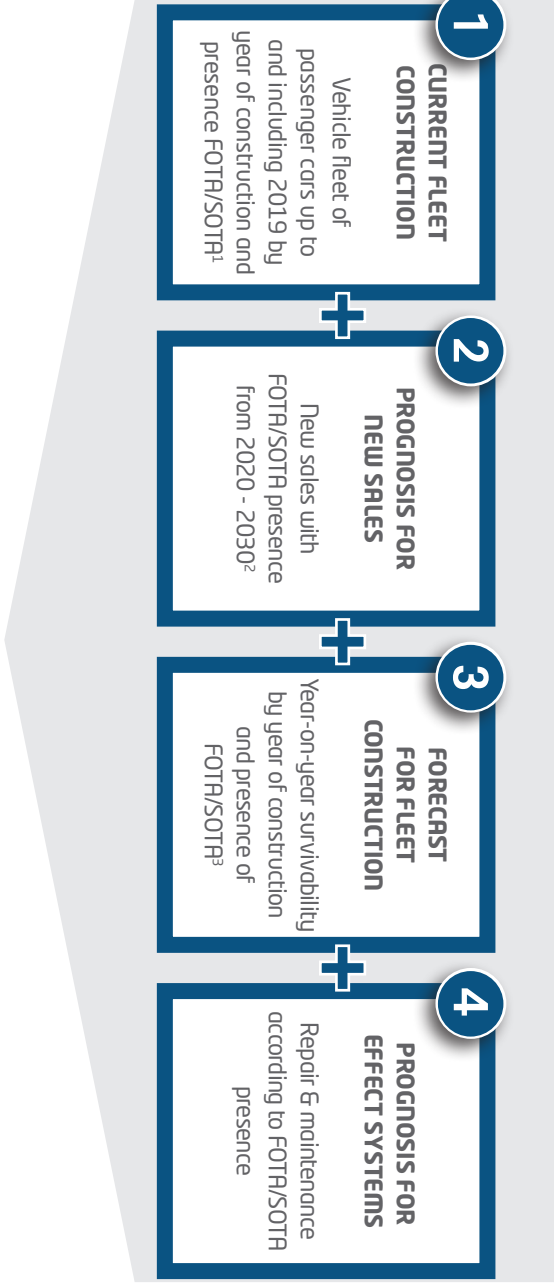
After a relatively long run with extensive testing, OTA will increasingly be used fully remotely

- Despite the presence of OTA, many manufacturers are not yet making full use of it. Reasons include that the systems have not yet fully matured and/or that safety cannot yet be sufficiently guaranteed and/or that the acceptance of service partners and customers still needs to be tested (see also page 20). Unclear legislation is also a brake on accelerated implementation in the first years.
- In practice, software updates are still installed in the workshop via Wi-Fi or using the old-fashioned OBD. Gradually, confidence in over the air will increase, as will its use.
- It is expected that from 2025 not only will the share of OTA increase sharply, but also the share "fully remote".
- SOTA is more likely to be applied remotely. For Firmware updates this will be done at a later stage; this is mainly due to the higher degree of complexity and security of firmware considered necessary, especially when it comes to "vital" systems.



3.2 BUILD-UP TO SCENARIOS WITH HARD FIGURES

Simulation of new sales & fleet development



Accurate prediction:

DEVELOPMENT OF VEHICLE FLEET + DEVELOPMENT EFFECT OF FOTR/SOTR = EFFECT ON DAMAGE RECOVERY, MAINTENANCE AND REPAIR

With distinction to:

- Presence/absence of FOTR/SOTR
- Year of construction (including clustering to 0-3, 4-6, 7-10, > 10 years) for the age of the fleet and distinction target groups dealer/independent car company

1) source: Automotive Dashboard RDC,
2) source: including international researchers, own processing

3) source: Koterpa 2.0 PBL, own processing

In order to be able to accurately predict the future aftersales needs of a changing fleet, three factors are of great importance: Firstly, the current fleet and its composition (broken down by FOTR/SOTR presence and year of construction). The second factor is the forecast of sales (including the FOTR/SOTR share). Third, the expected balance of imports, exports and scrap/demolition is important. Finally, the expected effect of FOTR/SOTR on aftersales. Together these factors determine the size, composition and use of the future fleet. And thus form the basis for determining the future need for aftersales.

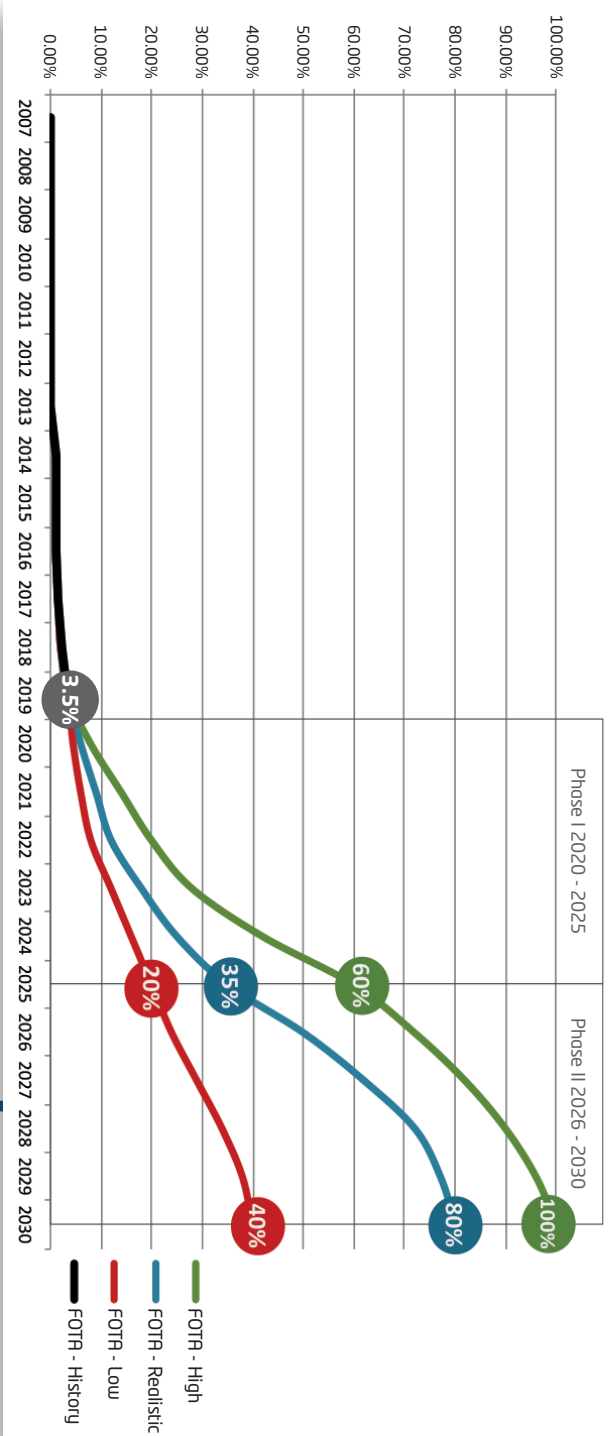
Scenarios of the impact of OTA on aftersales FOTA - Details

3.2.1 SCENARIOS OTA - PENETRATION FOTA

Prognosis for market share development of FOTA for new sold passenger cars
Low - Realistic - High

FOTA = Firmware Over The Air (remotely updating firmware = system software; comparable to Windows)

Prognosis for development of FOTA market penetration



Explanation of PHASE I (2020 - 2025):

- The FOTA market share in 2019 is approximately 3.5% of all new passenger cars sold.
- Only a handful of brands have FOTA functionality, only some of them actually use the "fully remote" options.
- More and more brands are rolling out FOTA, the increase is primarily visible in the premium brands and in electrically powered cars.
- As soon as manufacturers have confidence in the maturity of the systems and the regulations from the EU (2022/2023) provide clear frameworks, there will be a strong increase.
- A market share of 35% is expected by 2025.

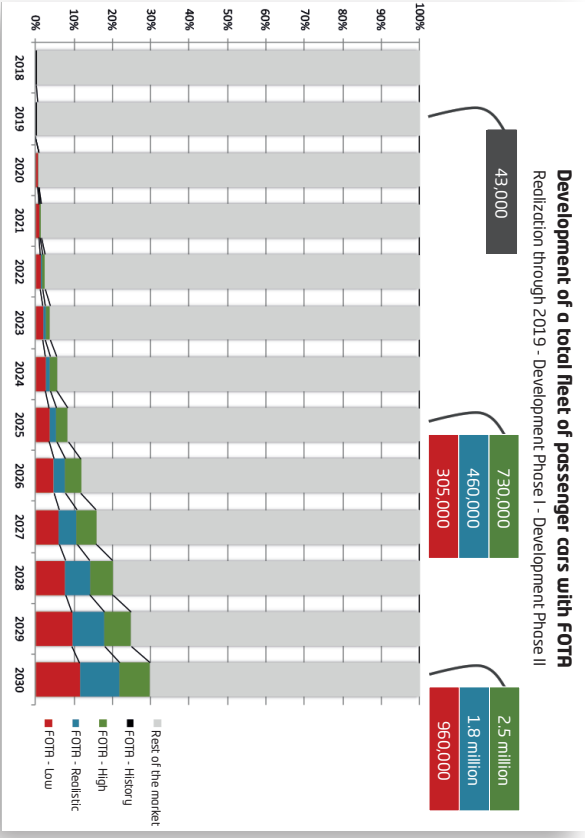
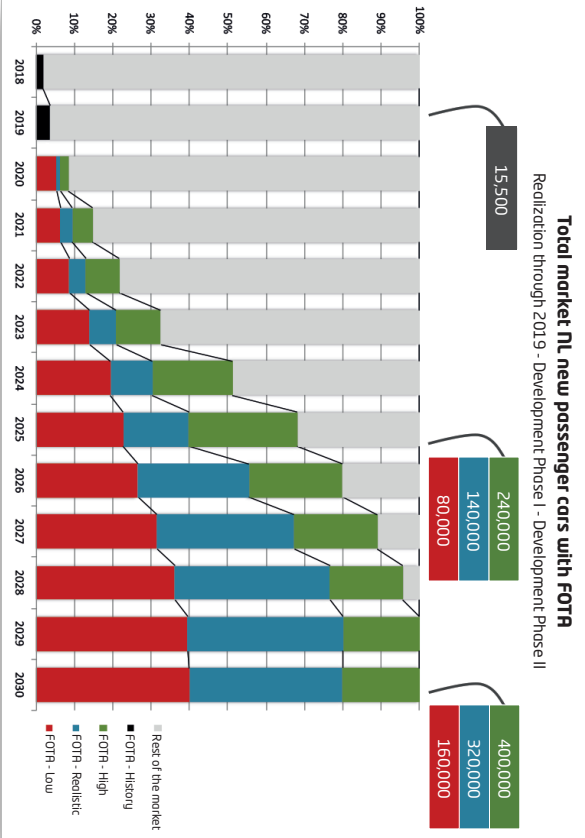
Explanation of PHASE II (2026 - 2030):

- The benefits of FOTA are becoming increasingly clear. FOTA becomes the norm: for the OEM (cost, grip), for the government (safety) and for the owner/user (cost, convenience).
- Increase to 80% of new cars sold by 2030 (up to 100% in the high scenario).

TRANSLATION OF MARKET (NEWLY SOLD PASSENGER CARS) TO VEHICLE FLEET

Translation of market (newly sold passenger cars) to vehicle fleet

MARKET → VEHICLE FLEET



In a realistic scenario, 35% of the total number of new passenger cars sold will be equipped with FOTR by 2025. That's 140,000 vehicles out of a total 400,000. By that time, the Dutch fleet will consist of about 460,000 passenger cars with FOTR. By 2030, 80% of all new cars sold will have FOTR. The total number of passenger cars with FOTR will then be 1.8 million; about 22% of the total fleet.



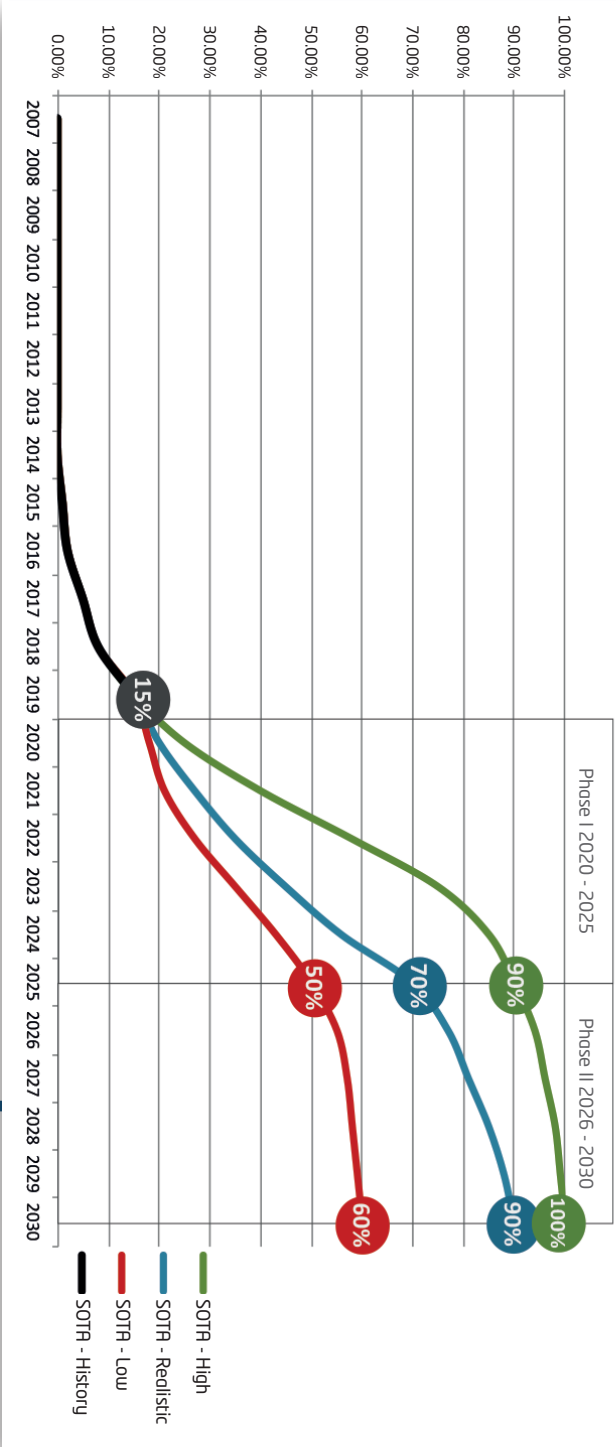
Scenarios of the impact of OTA on aftersales **SOTA** - Details

3.2.2 SCENARIOS OTA - PENETRATION SOTA

Prognosis for market share development of SOTA for newly sold passenger cars
Low - Realistic - High

SOTA = Software Over The Air (remotely updating software/application software; comparable to Office or other programs).

Prognosis for development of SOTA market penetration



Explanation of PHASE I (2020 - 2025):

- The SOTA market share in 2019 is approximately 15% of all new passenger cars sold.
- That means that SOTA is almost five times more present on a newly sold car than FOTA. Of course, this has everything to do with the fact that, as a rule, SOTA is less complex to manage because no vital processes are opened up.
- SOTA will continue to increase rapidly; the consumer will be fine with it. They will be getting more options to update, upgrade or purchase additional functionalities for a day or forever just like with their smartphones.
- Furthermore, the same arguments apply as mentioned for FOTA.
- A market share of 70% is expected by 2025.

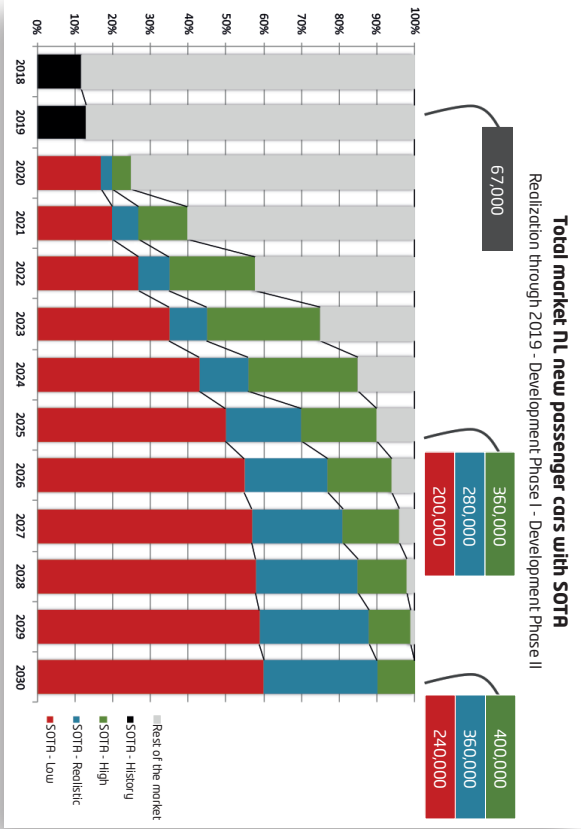
Explanation of PHASE II (2026 - 2030):

- SOTA continues to grow. There are plenty of reasons for users to want a car where you can purchase all kinds of services via SOTA. If a non-connected car is the equivalent of a first generation mobile phone, a car with SOTA is the equivalent of a smartphone.
- Increase to 90% of new cars sold by 2030 (up to 100% in the high scenario).

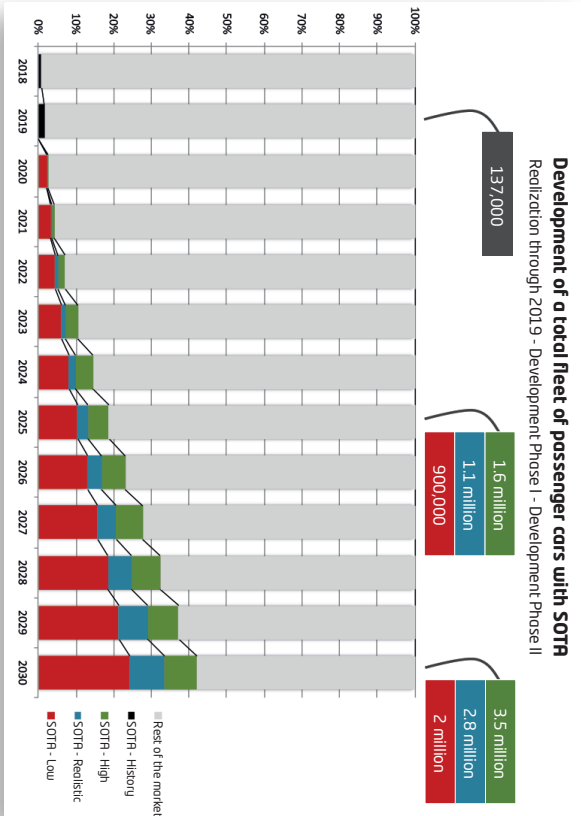
TRANSLATION OF MARKET (NEWLY SOLD PASSENGER CARS) TO VEHICLE FLEET

Translation of market (newly sold passenger cars) to vehicle fleet

MARKET



VEHICLE FLEET



In a realistic scenario, 70% of the total number of new passenger cars sold will be equipped with SOTR by 2025. That's 280,000 vehicles out of a total 400,000. By that time, the Dutch fleet will consist of about 1.1 million passenger cars with SOTR. By 2030, 90% of all new cars sold will have SOTR. The total number of passenger cars with SOTR will then be 2.8 million; exactly one third of the total fleet.

3.3 EFFECT OF OTA ON AFTERSALES

Share of OTA will increase rapidly over the coming years

• The so-called “ingrowth” of OTA in the market starts with the use of new cars. This means that over the years leading up to 2025 and 2030 respectively, the younger cars in the fleet will have OTA and the older cars much less or not. The 0-3 year fleet will represent 14% of all passenger cars in 2025, the share of FOTA (25.9%) and SOTA (56.8%) is significant in this relatively small part of the fleet. Most of the fleet consists of segments 7-10 years and older than 10 years (collectively accounting for 73% of all cars). Here OTA is hardly or not at all present.

• It is only a matter of time before OTA is also commonplace for older cars: of the 7-10 year old fleet, 16.1% FOTA and 40.9% SOTA in 2030.

• As previously written, the concrete consequences of this growth cannot be explained exactly. The technical development and especially the frameworks of new legislation are very decisive for this.



FOTA and SOTA can have a major impact on the connection between the car company and the customer/vehicle.
The extent to which the car company has to deal with this influences important strategic choices.



3.4 CONCLUSIONS ON THE IMPACT OF OTA ON AFTERSALES

The impact of OTA has consequences for the aftersales service of both the dealer and the independent car company
With regard to the workshop:

IN THE SHORT TERM, OTA HAS A LIMITED IMPACT ON MAINTENANCE AND REPAIR TURNOVER

- The OTA share is currently still limited. Moreover, existing OTA functionality is often not yet used "fully remote".
- But that will soon change; especially the young vehicle fleet will be equipped with OTA at a rapid pace.

OTA INITIALLY HAS ENORMOUS ADVANTAGES FOR THE OEM

- A few important advantages for the OEM: cost reduction of recalls (expected to be € 35 billion per year), certainty that updates are carried out, control over vehicles and users, infrastructure that enables new, additional revenue models.
- OTA also makes it possible to develop products and services "agile": you start with an MLP (minimum loveable product) that you continuously improve and enrich through updates.
- All this is basically positive for the consumer/end user. In return, they will receive certainty, safety, convenience, lower costs and a longer lifespan. In theory, as with smartphones, the promise of "lifetime updates and upgrades" is possible. In practice, the question is whether this can be achieved technologically and economically: the manufacturer will need to continue to actively support it. See the agreement with consumer electronics here: after a number of years, the system software has evolved in such a way that older versions can no longer be supported with updates.
- The retailer has a dependent role.

CONSEQUENCES FOR THE REVENUE MODEL

- Modern cars are becoming more like iPads on wheels. Cars are becoming more complex due to software and the need to update it regularly. OTA is the only way to manage that with 100% coverage and security, and in a way that is acceptable to a customer (as a customer you do not want to visit your garage every week for a software update). OTA is therefore indispensable in the future and will become a "fact of life" for the future workplace.
- The infrastructure to enable OTA can also be used to sell additional services. The question is which players will benefit from this and which will not.
- The total market for maintenance and repair is shrinking for traditional retailers. Especially in hours. The EV requires less maintenance and software, and extra services are over the air.
- The challenge for the retailer is 1. to keep a grip on vehicles and customers, 2. to be part of a controlled repair & maintenance flow and 3. to guarantee access to brand-specific knowledge and software. This can be done by joining or collaborating with a brand organization, or by joining an Onboard Telematics Platform (OTP).

COMPLETE FOR DATA, ACCESS TO THE VEHICLE AND ULTIMATELY THE CUSTOMER

- OTA can provide a sharper boundary between (brand) dealers and independent car companies. Basically it is about who has access to data, software and customers. EU legislation will determine the framework for this.
- A reasonably level playing field is necessary for the consumer/owner to determine which qualified aftersales party is given access.
- Qualified aftersales party in this context means: being part of a brand organization, and/or certified by a brand organization and/or being part of a certified partnership.
- Qualified also means having knowledge and being able to understand and apply OTA data protocols.

STRATEGIC CHOICES ARE INDISPENSABLE

- Even more than in the case with other developments such as electrification and FDAS, the retailer will have to make choices: answer the company's life questions. Answer the company's life questions. Who are you? Who do you want to be? Who can you be? Where do you want to be in the chain? What status/position goes with it? Who are your partners to achieve that?
- Speed of action is required and the timeframe is strongly determined by technological progress and the frameworks of new legislation.

This study provides an answer to the influence of OTA on aftersales. In order to paint a clear picture, it is assumed that other conditions will remain the same. Of course there are many more developments that have an impact.

Let us take a few examples:

- The rise of the electric car and the associated lower maintenance requirement (See The effect of the electrically powered (company) car on the aftersales business model BOVRG (March 2018)
- FDAS as a prelude to the autonomous driving car (see The effect of FDAS on damage repair, maintenance and repair. BOVRG (February 2019).
- Reducing the number of cars and car mileage due to increased partial use and the use of alternative modes of transport.





Updates completed.

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An overview of all consulted internet publications is available on request.

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5. TERMS AND ABBREVIATIONS

ADAS	- Advanced Driver Assistance System
BEV	- Battery Electric Vehicle
CO2	- Carbon Dioxide
COC	- Certificate of Conformity
CONNECTED CAR	- The car that is connected to the outside world via the internet
ECU	- Electronic Control Unit
EU	- European Union
EV	- Electric Vehicle
FCEV	- Fuel Cell Electric Vehicle (fuel cell or hydrogen)
FOTA	- Firmware Over The Air = system software; comparable to Windows
FULL EV	- Full Electric Vehicle (= BEV + FCEV)
GDPR/AVG	- General Data Protection Regulation/Algemene Verordening Gegevensbescherming
IOT	- Internet of Things
MAAS	- Mobility As A Service
NOX	- Nitric Oxide
ORAB	- Independent Car Company
OBD	- On Board Diagnostics
OEM	- Original Equipment Manufacturer (manufacturer)
ONBOARD TELEMATICS PLATFORM (OTP)	- Independent platform where vehicle data is made available in an unambiguous and safe manner to parties who wish to use it (at the request of and/or after approval of the owner). Can be seen as a digital variant of the physical OBD port.
OTA	- Over The Air = remote diagnosis and (re)programming of software
PREDICTIVE MAINTENANCE	- Predictive maintenance based on data
R&D	- Research & Development
RECALL	- Product Recall
SOTA	- Software Over The Air = software/application software; comparable to Office
TCO	- Total Cost of Ownership



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All for better mileage.

The effect of OTA “over the air” on the aftersales business model

Research commissioned by BOVAG carried out by VMS | Insight June 2020