McKinsey&Company

Competing for the connected customer – perspectives on the opportunities created by car connectivity and automation

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Competing for the connected customer – perspectives on the opportunities created by car connectivity and automation

Contents

Executive summary

The purpose of this report is to offer a perspective on the value that is going to be enabled by increasing in-car connectivity and automation. Based on extensive consumer and executive surveys across three geographies (Asia, Europe, and North America), we outline the **impact of connectivity and automation on the automotive industry,** and discuss potential strategies for automotive industry incumbents and newcomers alike.

Globally, customer demand for car connectivity **is increasing at a very high speed:** over the past year, the share of customers willing to **switch their car brand for better connectivity has almost doubled** from 20 percent in 2014 to 37 percent in 2015. The willingness to pay a subscription fee for connected services went from 21 percent in 2014 to 32 percent in 2015. **Chinese customers are particularly enthusiastic about connected cars** – 60 percent of respondents are willing to switch their car brand for improved connectivity.

Against many expectations, **personal data privacy does not seem to be a major roadblock** to customer acceptance. Already today, a large majority of consumers very consciously share their personal data with their smartphone software manufacturer; **only a quarter of customers categorically refuse to let OEMs use their driving data.** That said, consumer privacy will remain a focal point of interest for consumers themselves as well as most likely for regulators. Thus, car manufacturers and suppliers should continue to take this issue very seriously and offer the appropriate safeguards.

Connectivity and autonomous driving functionalities will likely create a **multitude of new business models** and monetization opportunities. For consumers, **driving-related applications** (e.g., connected navigation, networked parking) exhibit **higher purchase** relevance than driving-unrelated ones (e.g., e-mail, music streaming). These applications are currently being developed and need to be shaped further to find those that will add the most value to customers (e.g., improved safety, improved convenience).

Capturing this massive opportunity **will require scale, speed, and agility.** To help reach this, we believe that today's industry landscape of single (OEM) competitors may evolve towards a **play of competing ecosystems.** In such an ecosystem, OEMs and other players could cooperate using the same (software) platform to aggregate driver data (e.g., location and road conditions) and provide application programming interfaces (APIs) to third-party developers to offer additional services. This would provide the scale necessary to be able to offer new **functionalities and services while preserving brand-specific differentiation.** Furthermore, OEMs will likely need to push an end-to-end digitization of their organizations and **build up skills for software development** to fulfill new requirements (e.g., to enable faster innovation cycles).

Creating customer acceptance will be key to enabling more in-car connectivity as well as automated driving functionality. Our research indicates that the biggest hurdles to customers' acceptance are their concerns about the cyber security of connected cars and concerns about the reliability of cars with autonomous functions.

* * *

We wish to express our appreciation and gratitude to the German Association of the Automotive Industry (VDA) for their support and valuable contributions. In particular, we would like to thank Dr.-Ing. Ulrich Eichhorn, Managing Director, and Graham Smethurst, Head of Coordination Unit Networked and Automated Driving.

Methodology

McKinsey Connectivity and Autonomous Driving Consumer Survey 2015

In July and August 2015, McKinsey & Company conducted a survey of 3,184 recent car customers in Germany (1,123), the US (1,051), and China (1,010), asking about their preferences for car purchases, interest in data-based services, privacy behavior and concerns, and their view on cars with autonomous functions.

The goal of the survey was to gauge customers' interest in and willingness to pay for new connectivity and autonomous driving features. The survey also sought to understand customers' depth of knowledge of these features and their level of concern regarding personal data security. The results have been analyzed across geographies, car manufacturer preferences, and age and income groups.

Overall, the trends observed are similar across geographies. However, as a whole, the Chinese respondents were much more enthusiastic than Germans and Americans about all aspects of connected and autonomous driving features.

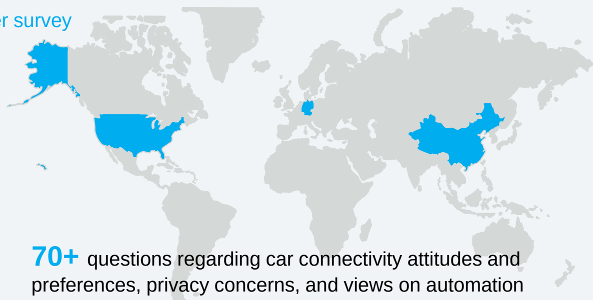
McKinsey Connectivity and Autonomous Driving Executive Survey 2015

In parallel to the consumer survey, a survey of 91 executives in automotive and related industries was conducted to assess the maturity of the industry with respect to digitization, connectivity, software development, and autonomous driving.

Of those executives, 20 were working directly for automotive companies and automotive suppliers and the others for automotive-related engineering companies. The perspectives of the automotive executives are strongly aligned with the results of the survey, and together they form the foundation of this document.

Surveys of automotive consumers and executives give insight on their readiness for connectivity and automation, and the implications for the industry

Consumer survey



70+ questions regarding car connectivity attitudes and preferences, privacy concerns, and views on automation

3,000+ representative car customers (1,000+ per market)

3 key markets (US, Germany, China)

+

Executive survey

90+ respondents from automotive and automotive-related industries

20 OEM and tier-1 top executives

50+ questions assessing attitudes on connectivity and automation, and the digital maturity of the organizations

Findings supported by discussions with selected automotive executives

Both surveys conducted in July and August 2015

SOURCE: McKinsey Connectivity and Autonomous Driving Executive and Consumer Survey 2015

1

Connectivity and automation have the power to significantly impact the automotive industry

For many industries, the past 10 years have been characterized by significant disruptions. Despite that trend, the automotive industry has seen consistency of major players and of their business model. For example, industry sectors such as media and telecommunications witnessed revolutionary shifts in their industries' structures and business models, driven by the evolution from content ownership to on-demand streaming (e.g., music/video streaming services) and/or the entry of new players with innovative value propositions (e.g., introduction of the iPhone, incl. the App Store and iTunes).

For the automotive industry, the last decade has been marked by continuous evolution and improvement of existing technologies. Overall, the industry's business model has remained largely unchanged, and both economic downturns and attempts at consolidation have had little or no effect on the industry's overall structure.

- The large upfront capex investments required for the production and distribution of automobiles represent rather high barriers to entry for potential newcomers. In the last 10 years, the top 10 list of OEMs by revenue has only seen one new entrant (SAIC)[1].

- Very recently, Tesla's success has awakened the industry with its technology (e.g., fully electric powertrain, software updates over the air) and direct-sales approach, but thus far it is a niche player in terms of sales.

In contrast to the relative consistency of the past decades, we expect that the confluence of four major trends will significantly impact the way consumers perceive and experience mobility in the next 10 to 20 years: electrification, connectivity, automation, and shared/diverse mobility.

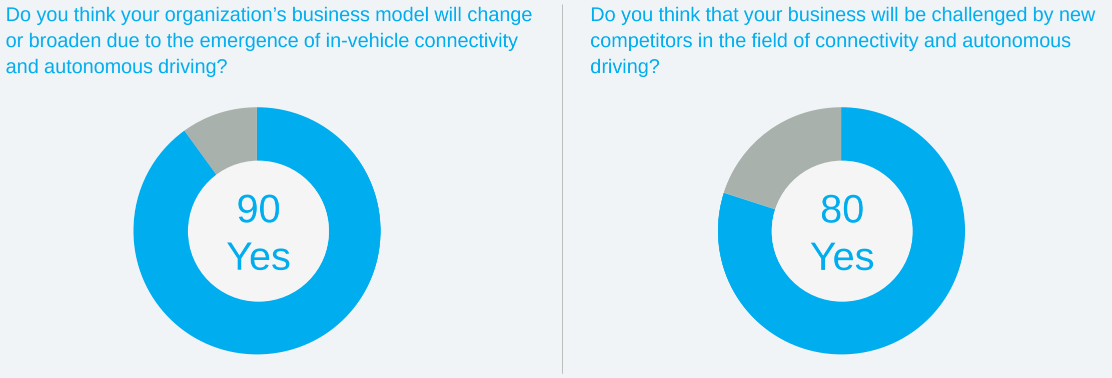
Automotive executives agree: 90 percent of them believe that their organization's business model will change or broaden because of connectivity and autonomous driving, and 80 percent expect that their business will be challenged by new competitors due to digitization and in-vehicle connectivity (Exhibit 1).

In this publication, **we focus on connectivity and automation.** The electrification of the powertrain is currently expected to reach significant market share only in the medium to long term, depending on macroeconomic developments. Shared and diverse mobility models are currently still in the pilot stage. Many OEMs are experimenting with those models (e.g., car sharing/pooling, ride sharing, e-hailing), but most have yet to earn significant profits. We do, however, expect these models to profit massively from the global spread of in-car connectivity and automation.

Exhibit 1

A large majority of automotive executives believe that in-vehicle and automation connectivity will significantly change their business

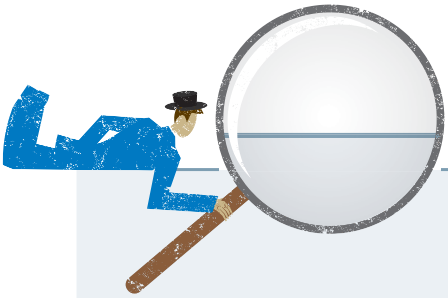
Percent of automotive executives



SOURCE: McKinsey Connectivity and Autonomous Driving Executive Survey 2015

The move towards more connected cars, and ultimately cars with autonomous functions, will include many intermediate stages. While certain functionalities in the car can be automated without the need to establish communications with the car's surroundings (e.g., automatic collision prevention), fully autonomous driving will not be possible without such a connection.

In order to differentiate between different levels of automation and connectivity, a common language is needed for discussion both within and outside the automotive industry. Hence, we believe a **shared and distinct nomenclature** to be worthwhile and have developed a proposal as a basis for future discussions (see text box 1).



Text box 1:

Proposed nomenclature on connectivity and automation

Nowadays, many people use a mobile device for constant access to communication and information services (e.g., e-mail, messaging services, Web search and browsing, or social media). More and more cars have integrated these functionalities so that it is convenient, safe, and legal for drivers to access these services as well. The **"connected driver"** controls the functions of these communication and information services via the car's interface, but the mobile device itself remains the gateway for all connections.

"Connected car" describes a car equipped with communication technology that allows for the direct flow of data to and from the car, without the need for a mobile device. Besides the known communication and information services from the mobile world, a connected car can communicate directly with "the cloud" to offer services such as connected navigation, including dynamic routing based on traffic, weather, or road conditions, or an automatic parking spot finder that offers directions to available parking spots. A connected car will be able to exchange information in real time with its immediate surroundings, including other vehicles (vehicle-to-vehicle; V2V) and/or infrastructural elements (vehicle-to-infrastructure; V2I). This is also an enabler for data-enhanced driving functionalities such as automatic vehicle speed adjustment in accordance with traffic flow and speed limits, or collision avoidance.

"Cars with automated functions" offer selected functionalities where the car operates independently. These functionalities are designed to make the experience of owning and driving a car more convenient, more efficient, and safer. Possible applications could be an autopilot on highways, temporary platooning of multiple cars similar to a cycling peloton, and self-parking on private property (garage, carport). This does not necessarily relieve the driver of his/her responsibility to be in control of the vehicle at all times: he/she remains "in the loop" and in ultimate control. A car with automated functions does not have to be cloud-connected, as it can rely only on its sensors and actuators for selected automated functionalities as well (e.g., automated parallel parking or self-parking on private property).

Nevertheless, these functionalities can be enhanced by connectivity (e.g., to adapt to the driver's routine and pull the car out every morning at 7:00 a.m. or even adapt to the meeting schedule on the driver's calendar).

The **"car with autonomous functions"** drives completely independently (steers, accelerates, brakes) on all roads in all circumstances. This functionality allows the car to complete tasks even without the "driver" being in the car (e.g., driving to the gas station or to a remote parking spot). Such a car relieves the driver of his/her responsibility to be in control of the vehicle and shifts the liability to the manufacturer or developer (driver is "out of the loop"). A car with autonomous functions anticipates and acts independently based on gathered internal and external information (e.g., from other vehicles (V2V), or from infrastructural elements (V2I), or directly from the cloud). This allows the car to supplement its sensory information with real-time updates about other vehicles' behavior, traffic control, parking spots, toll gates, etc.

2

Tremendous opportunities are emerging for those who adapt to the new playing field

The trends of connectivity and automation will lead to a much more diverse and fragmented landscape of automotive business models. On this new playing field, the participating players (OEMs, tier-1 players, and new market entrants) need to choose carefully where to focus (e.g., consumers rate driving-related functionalities such as connected navigation or networked parking as especially important). These new offerings will require new capabilities and sufficient scale – for acquiring both, speed and agility will be key. Building or participating in ecosystems could help OEMs reach sufficient scale and gain access to required capabilities outside their core skill set and to do so faster than trying to compete on their own.

2.1 Car customers worldwide are increasingly demanding connectivity – and their willingness to pay for it is rising

The comparison of our 2014 and 2015 consumer surveys[2] shows a clear trend that connectivity features are becoming more and more important to customers. The number of people who would switch from their current OEM to another manufacturer they trust if it was the only one that offered a car with full access to apps, data, and media, rose from 20 to 37 percent across all geographies within just one year (Exhibit 2). The fact that – within just one year – the number of people willing to switch car brands for connectivity has almost doubled shows that connectivity is evolving from a should-have to a must-have feature for every OEM.

At the same time, consumers' willingness to pay for connectivity is increasing. We saw a positive trend in the number of people who would be willing to pay for connected services in their car, with approval rates for subscription-based payment models increasing from 21 to 32 percent globally in the past year.

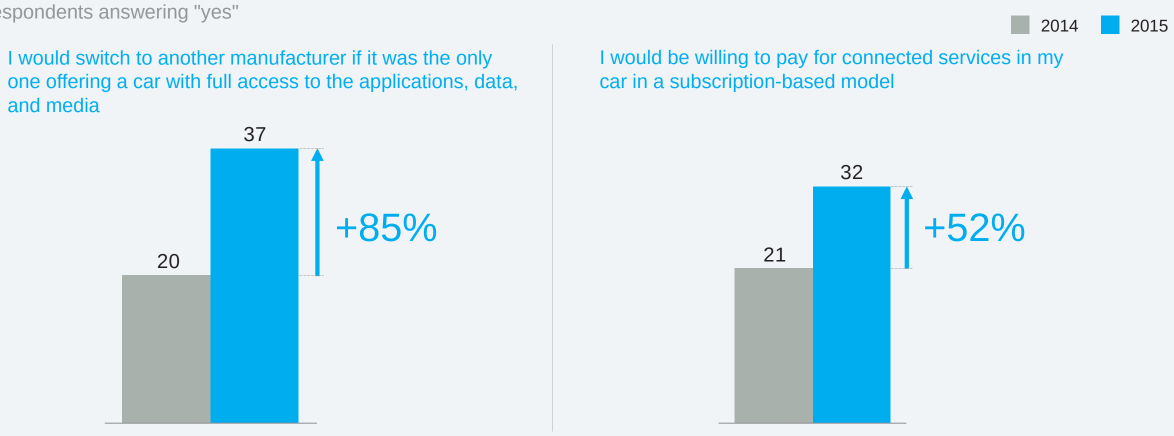
Connectivity features do not matter equally to all customers. In China, the world's largest car market, connectivity features are key for consumers with 60 percent stating that they would switch manufacturers to get connectivity features. In Germany, on the other hand, only 20 percent of consumers would do so. There are also significant differences between customers based on age, size of the city of residence, and OEM preference (Exhibit 3).

To be able to benefit from this clear trend and realize these new opportunities for monetization, it is necessary for the relevant players to understand the customers' needs and expectations in detail.

Exhibit 2

Both willingness to switch manufacturer and to pay a subscription fee for connected car services has increased significantly in the past year

Percent of respondents answering "yes"



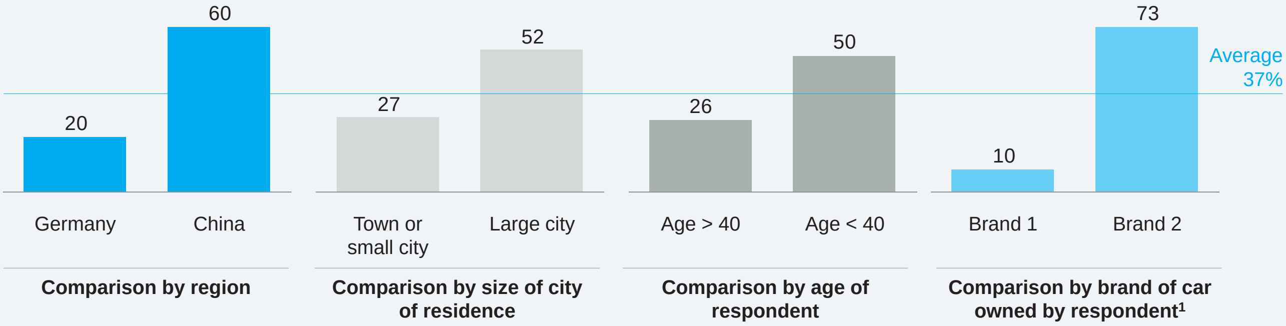
SOURCE: McKinsey Connectivity and Autonomous Driving Consumer Survey 2014 and 2015

Exhibit 3

Customer willingness to switch manufacturer varies significantly by country, brand, age, and city size

Percent of respondents answering "yes," 2015 survey

I would switch to another manufacturer if it was the only one offering a car with full access to the applications, data, and media



1 Smallest/largest share of owners of any brand in any region

SOURCE: McKinsey Connectivity and Autonomous Driving Consumer Survey 2015

2.2 Against expectations, personal data privacy will not be a major roadblock

Overall, customers seem to be more educated about the usage of their personal data and more willing to share this data than commonly assumed. The majority (88 percent) of consumers are well aware that certain data from their mobile devices is openly accessible to applications and shared with third parties. More than two-thirds of consumers consciously decide to grant certain applications access to their personal data, even if they may have generally disabled this access for other applications (Exhibit 4).

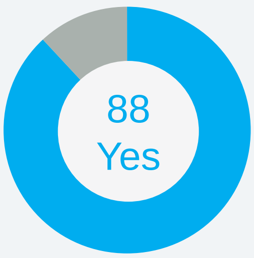
This indicates that consumers value various applications differently – and readily approve the usage of their personal data by important applications in return for the full range of functions.

Exhibit 4

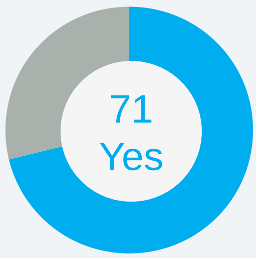
Consumers are well informed on topics of data privacy and are willing to share their personal data with some applications

Percent of respondents

Are you aware that certain data (e.g., current location, address book details, browser history) is openly accessible to applications and shared with third parties?



Do you consciously decide to grant certain applications access to your personal data (e.g., current location, address book details, browser history), even if you may have generally disabled this access for other applications?



SOURCE: McKinsey Connectivity and Autonomous Driving Consumer Survey 2015

According to our consumer survey, car customers are most likely to grant access to their personal driving data to applications that are clearly related to driving functionalities such as navigation and mobility apps (Exhibit 5). We assume that consumers do this in the awareness that sharing their information leads to an improved product for them as well as for other users. On the other hand, consumers seemed significantly less inclined to grant access to other connectivity applications that are not directly related to driving, with games scoring the lowest approval rates overall.

In general, it seems that concerns about data privacy will not be a major roadblock, as 76 percent of consumers are willing to let OEMs use their position data to improve their software (Exhibit 6): these are split into 55 percent of global consumers who would allow OEMs to use their data without any formal guarantees and an additional 21 percent who would be open if they had guarantees that the data would not be sold to third parties without their consent. There are regional differences, too: Chinese customers are most willing to share their data, whereas German customers are more wary. Despite the customers' openness towards sharing their driving data, privacy issues remain important to customers and regulators alike. OEMs should continue to take this issue seriously and maintain appropriate safeguards.

Our results show that customers are willing to share their data and are doing so consciously with the manufacturers of their smartphone's software already today. An interesting finding is that in certain regions (e.g., Germany), they would be even more willing to share this data with their car's OEM than with their smartphone's software manufacturer (Exhibit 7), whereas in China, the opposite is true. In the US, consumers' trust in OEMs and smartphone software manufacturers seems to be more or less evenly spread.

Exhibit 5

Consumers are most willing to grant access to applications that are directly related to driving such as navigation applications

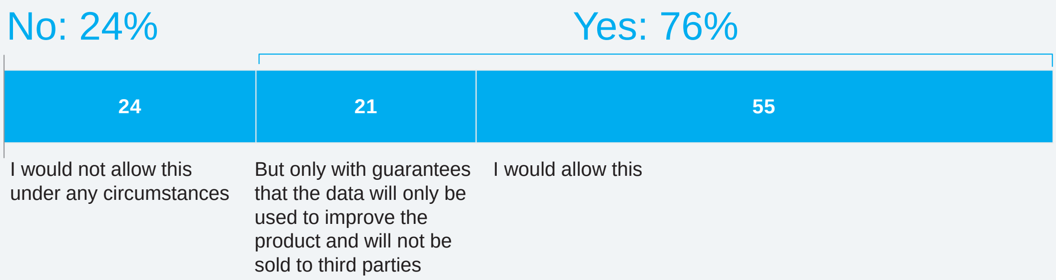
Percent of respondents naming a given application

SOURCE: McKinsey Connectivity and Autonomous Driving Consumer Survey 2015

Exhibit 6

76% of respondents are willing to allow their cars to send data to their manufacturer to improve the product under certain conditions

Would you allow your car to track your location and report it anonymously (e.g., to enable your carmaker to improve the next generation of your car)?



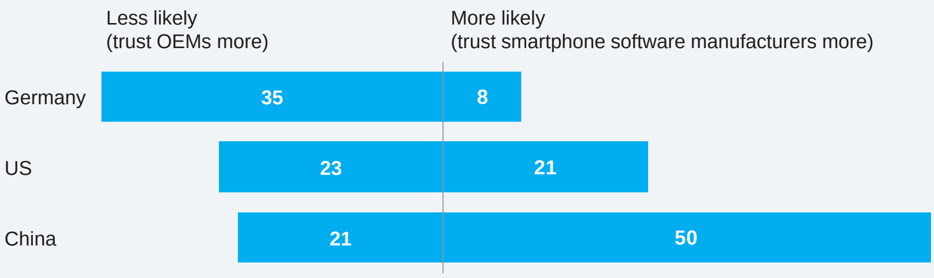
SOURCE: McKinsey Connectivity and Autonomous Driving Consumer Survey 2015

Exhibit 7

OEMs are more trusted in Germany than in the US and China in terms of data privacy and protection

Percent

If data about your driving pattern (destinations, routes, etc.) was collected by the manufacturer of your smartphone software (e.g., Apple, Google, Microsoft) instead of your car manufacturer, would you be more or less likely to allow access to it?



Note: Total of 100% per country; answers of remaining percent not indicated: "neither" or "no preference"
SOURCE: McKinsey Connectivity and Autonomous Driving Consumer Survey 2015

2.3 Connectivity and automation create new and promising business models

Connectivity and automation will likely enable a multitude of interconnected new functionalities, services, and business models, offering enormous growth potential for automotive industry incumbents and newcomers alike. According to our executive survey, 85 percent of global automotive executives agree with this statement.

Exhibit 8 gives a nonexhaustive overview of possible business models that we believe might realistically develop by 2025. Whereas there seems to be consensus in the industry that these novel services and functionalities offer enormous opportunities, it is not yet entirely clear who will succeed in monetizing which part of the value chain.

Exhibit 8

Novel services and functionalities offer enormous opportunities – however, it is not yet clear who will succeed in monetizing which of the business models

2015 - 25

Providers of …	Customer segments: Drivers/passengers		Governments/ municipalities	Dealers/workshops/ aftersales
Cars	**(Semi)-autonomous driving** functionalities	Location-,destination-, and driving-pattern-based **adver-tisement/promotion**	**Provision of (semi-)auton-omous cars** for public car-sharing fleets	**Lead generation** through maintenance recommen-dations and targeted campaigns
	Connected navigation, incl. real-time traffic, weather and road conditions, and POI routing	**Remote preventive diag-nostics** and maintenance based on car/fleet data (e.g., Bosch Drivelog Connect)	**Consolidated vehicle data-based road maintenance** (e.g., deicing, snow clear-ance)	**Diagnostics and order-ing** (e.g., live booking of maintenance, remote checkups (predealer visit), parts availability verification)
Content/ service	For drivers/passengers: **phone, office, e-mail, audio applications**	For passengers only: **Internet, social media, video, game applications**	**Traffic management and V2I communication,** incl. usage-based tolling and taxation system, and adaptive traffic control to optimize flow and divert traffic from congestion	**Data-driven connected marketplace** for repair/ maintenance and after-sales (e.g., Bosch Drivelog Connect, AutoScout24)
	Content feed by linear providers (cable networks) and dynamic streaming services (e.g., Spotify, Netflix)			
	Car sharing aggregators (e.g., CarJump for a combination of DriveNow and car2go, moovel for independence of means of transport (car, taxi, train, etc.))			
Mobility	**Multibrand standardized carpooling/sharing** (e.g., CiteeCar, Flinkster, Stadt-mobil, book-n-drive)	**Personalized microcar sharing/automotive time share** (e.g., Audi unite)	**Enhancement of public transport with car sharing fleet,** incl. fleet management, payment, maintenance and (re-)distribution of vehicles	
	Single-brand standardized carpooling/sharing (e.g., DriveNow (BMW), car2go (Smart), Multicity (Citroën))	**Personalized dynamic car pooling** (e.g., Audi Select)		
	Taxi/e-hailing/ride-sharing (e.g., mytaxi, Uber, Clever-Shuttle)			
Infra-structure	**SIM cards** and **LTE sites** along highways/national routes to enable broadband traffic		**Networked parking** (guidance, ticketing, payment, enforcement)	
Insurance	**Personalized insurance** policies based on driving behavior/pattern analysis			

Further extensions possible

SOURCE: McKinsey

Each of these models can be classified along the following four dimensions, and each of these dimensions expands the automotive playing field:

- Customer segment: drivers/passengers, governments/municipalities, maintenance and servicing/aftersales, and businesses in general.

- Type of product/service and technology: connectivity hardware (e.g., built-in infotainment system or advanced driver assistance system (ADAS) sensors/actuators); real-time services (e.g., a dynamic map layer for a navigation system with real-time information on traffic, weather, and road conditions); data consolidation and analysis (e.g., remote preventive diagnostics and maintenance based on live car-data feed); shared mobility services (e.g., carpooling or ride sharing services).

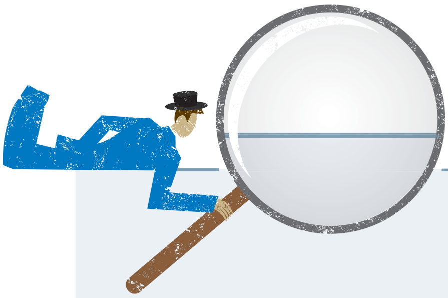
- Business rationale: increase vehicle sales (e.g., when OEMs equip their vehicles with new (semi-)autonomous driving functionalities); generate service profits (e.g., from offering infotainment content); monetize data (e.g., by pricing car insurance based on individual driving patterns or offering engine updates after purchase).

- Monetization model: free (base) offering, sale/licensing, subscription-based payment, usage-based payment, dynamic demand-based pricing.

The emergence of new business models and changes in existing ones will not only unlock new customer segments, but will also attract industry newcomers. The benefits of connectivity and automation may expand the traditional driver/passenger segment while also allowing players to tap into segments (e.g., governments and municipalities) that so far have not been attended to by the traditional automotive industry.

At the same time, traditional car manufacturers will be joined by content/service providers, end-to-end mobility providers, infrastructure providers, and insurers in the competition for the connected customer as new services and business models will allow them to access customers in the car and target this new value pool. Especially consumer technology companies can build on their relationship with smartphone users to monetize data-based services in the car (text box 2).

In this complex and fragmented landscape, it is crucial for OEMs to identify the opportunities that offer the greatest potential for differentiation.



Text box 2:

Tech players target customers in the car, building on superior software and data analytics

Google distributes its Android OS free of charge to handset manufacturers in exchange for access to user data, and Android Auto is built in the same way. Google is also testing a driverless car, which it has announced will be market ready in 2020.

Apple, on the other hand, is a hardware seller with superior product design and user experience. Apple recently poached industry experts from several automotive companies and reserved car testing facilities, fuelling rumors about the development of an "iCar."

Uber, which is an example of new types of software-enhanced mobility solutions, has disrupted the taxi business in certain cities with a simplified business model based on superior software algorithms that, for example, allow for short waiting times (drivers are directed to locations where customers are most likely to hail) and prices matching supply and demand (prices higher at peak times).

2.4 Driving-related connectivity functionalities seem to offer higher differentiation potential than driving-unrelated ones

To better understand the multitude of functionalities and services enabled through connectivity and automation, they can be categorized in two groups as shown in Exhibit 9: data-based services and data-enhanced driving functionalities.

Data-based services could prove to be a prominent source of recurring revenues in a similar way to, for example, the smartphone industry. Those functionalities can be classified as driving-related or driving-unrelated. Driving-unrelated services are, for example, messaging and social media, Web browsing, and a personal music library. These are services that the connected customer already uses outside the car. By bringing these services into the car and enabling their use through the car's HMI and infotainment system, OEMs can greatly increase comfort and safety levels for drivers and passengers alike. Examples of driving-related functionalities, on the other hand, include parking spot finders, connected navigation, personalized car insurance, after-sales services or mobility services like intermodal routing (e.g., moovel), carpooling and sharing (e.g., DriveNow, Car2Go), and e-hailing services (e.g., Uber, mytaxi).

Data-enhanced driving functionalities require a car with automated functions: this automation will increase customer convenience and safety, optimize CO_2 emissions, and reduce noise and congestion levels. Examples include automatic collision avoidance; one way to achieve this would be vehicle-to-vehicle communication where vehicles exchange their location and speed/acceleration data, either directly between vehicles or via the cloud.

Another example is a self-parking functionality. These benefits of convenience and safety will further increase with “autonomous driving,” and they will not require any input from the driver at all. This will massively change the use case of the car, allowing former drivers to make use of their freed-up time and OEMs to provide personal mobility to those currently unable to operate a vehicle (e.g., the elderly, those with physical disabilities).

Overall, consumers rate driving-related features as more important than driving-unrelated ones. There is a significantly higher willingness to switch OEMs for driving-related functionalities (e.g., connected car or automated driving functionalities) (55 to 60 percent) compared to driving-unrelated functionalities (e.g., services that offer constant access to communication and information) (41 percent) (Exhibit 10).

Exhibit 9

Services and functionalities can be categorized

I Data-based services – IA Driving-unrelated	Telephone and e-mail	
	Messaging services and social media	
	Web browsing, news services	
	Personal music library and streaming	
	Personal video library and streaming	
	Games	
I Data-based services – IB Driving-related	Connected navigation	Driving-related
	Networked parking	Driving-related
	Workshop and after-sales services	Driving-related
	Personalized insurance	Driving-related
	Mobility solutions	Driving-related
II Data-enhanced driving functionalities (auto-mated/automation)	Automated platooning	Driving-related
	Autopilot in selected environments	Driving-related
	Self-parking on private property	Driving-related
	Automated collision prevention (incl. automated braking)	Driving-related
	Fully autonomous driving	Driving-related

SOURCE: McKinsey

Exhibit 10

Customers are more interested in driving-related car features than they are in driving-unrelated car features

Percent of respondents willing to switch, stating that the given functionality would make them switch

Would you switch from your current car manufacturer to another manufacturer you trust if it was the only one offering these functionalities? Which functionalities would make you switch?

SOURCE: McKinsey Connectivity and Autonomous Driving Consumer Survey 2015

Although customers increasingly expect driving-unrelated services to be well integrated into their cars, these services do not offer great potential for differentiation. Rather, they may increasingly be seen as a sort of “hygiene factor” for consumers. OEMs will need to ensure a seamless integration into the car, yet these driving-unrelated services will most likely not be the offerings by which OEMs can set themselves apart from their competition.

Driving-related functionalities clearly offer the better differentiation potential. The application that is most relevant for the car purchase decision is connected navigation, including real-time traffic, weather and road conditions, and point-of-interest routing (52 percent).

For the development of these driving-related, data-based services and data-enhanced driving functionalities, OEMs can build on their car-related know-how and access to relevant driving-related data (e.g., reading out the fault memory of control units for remote diagnostics). With new entrants trying to expand from driving-unrelated to driving-related data-based services, competition for the connected customer can be expected in this area.

2.5 Today’s landscape of single competitors will evolve towards a play of competing ecosystems

As the competition for the connected customer intensifies, the automotive industry landscape will likely become more complex and more fragmented. The key questions are: 1) Who will succeed in monetizing which part of the business? 2) What will the key success factors be?

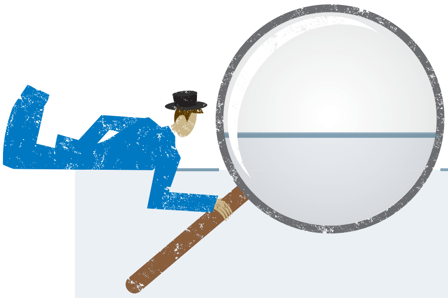
Automotive players will have to expand or partly shift their business towards offering the aforementioned new services and functionalities. Offering such a varied set of services will require a diverse set of new capabilities as well as sufficient scale for operation.

The connected car will feature a high number of interfaces (e.g., to infrastructure, to other vehicles, and to some cloud-based platform) for which common standards are required (cross-brand, cross-geographies). Building an ecosystem of multiple OEMs with a shared platform might turn out to be a more promising way for them to succeed than to try competing on their own.

In such an ecosystem, OEMs and other players could cooperate using the same (software) platform to reach sufficient scale and to acquire specific capabilities for providing functionalities and services while keeping control over data flows. The advantages for the participating OEMs would lie in exchanging and sharing certain data based on common standards to enable functionalities that each OEM could use as a brand-specific differentiating factor towards the customer. For example, OEMs could offer intelligent navigation systems with dynamic routing based on real-time road, weather, and traffic conditions gathered from cars of different OEMs, enabled by a shared data base and common communication protocols.

The success story consumer technology players have written by building powerful ecosystems around their mobile devices serves to illustrate the power such systems can have (text box 3). Consumer technology players create sufficient scale for their ecosystems (e.g., by offering extensive APIs for third-party developers. Apple's iOS, for example, currently features approximately 630,000 independent app developers[3].

Over time, this expansion will likely shift the current play of single competitors in the automotive industry towards a play of competing ecosystems. The ecosystem that reaches scale first will benefit most from positive network effects, meaning that the value of a product or service provided within the ecosystem increases with the number of participants in the ecosystem. This in turn yields the opportunity to set industrywide standards and to increase user familiarity and trust. Therefore, speed and agility are key for the relevant players.



Text box 3:

Examples of powerful ecosystems built around mobile devices

Google's Android operating system offers standard interfaces (run-time environment, libraries, application framework, etc.), which other hardware and software makers must use and, therefore, creates a huge ecosystem. It also includes Google's platform services (e.g., Google Maps), which are not open source and serve as the data source to give Google access to every Android device. Android Auto is based on the same principle; the only difference is a slightly subdued HMI so as not to distract the driver.

Similarly, Apple has established one operating system for all (mobile) Apple products. It maintains full control over customer data through its ecosystem with iOS, the App Store, and one ID across all devices. However, Apple does not monetize this data to the same extent that Google does. Apple is focused on selling premium-priced devices based on unique product design and usability, which it combines with a strong, yet closed ecosystem centered on the proprietary iOS to lock in customers with curated content.

Facebook provides access to user data for third-party application programmers through its Graph API, the core of its platform. The API allows programmers to get data in and out of Facebook's social graph. It is a low-level HTTP-based API that can be used to query data, post new stories, upload photos, and perform a variety of other tasks that an app might need to do. Facebook was able to create an ecosystem with approximately 1.5 billion active users from which two-thirds log in on a daily basis.*

* Facebook Web site, accessed August 17, 2015, http://newsroom.fb.com/company-info/

However, due to the evolution of automotive software architecture over decades, each OEM has to deal with the legacy of its current architecture. Most OEMs have developed proprietary, modularly designed domain architectures enabling car functions/functionalities through a high number of modules (e.g., head/infotainment unit, communication, powertrain, chassis, thermal systems, fuel systems, active/passive safety, ADAS), each with a multitude of control units running on different protocols (e.g., FlexRay, CAN, LIN, MOST). OEMs will likely need to invest in modernizing and simplifying their software architecture. One option might be to decouple the driving-unrelated parts (e.g., the infotainment unit) from the driving-related and safety-critical parts. Here, again, participation in a bigger ecosystem could help share the development burden while at the same time ensure standards for communication between different OEMs.

The current reach of a single OEM is small compared to the customer reach tech players already have to the connected customer outside of the car. With regard to driving-unrelated services, OEMs would thus likely remain in an inferior position both in terms of capabilities and scale.

The picture looks different for driving-related functionalities where OEMs can play to their strengths and use the fact that each car on the road is able to provide a multitude of valuable data points. In connected navigation, for example, the service quality does not depend on scale alone, but hinges on the quality of information gathered by each vehicle. Each connected car comes with several sensors that can be used to increase the quality of the navigation service (e.g., by reporting icy conditions based on ESP interventions). This is just one example of many where the multitude of sensors in a connected car could be used to offer a service superior to what is possible by using just the location and direction data gathered by a smartphone.

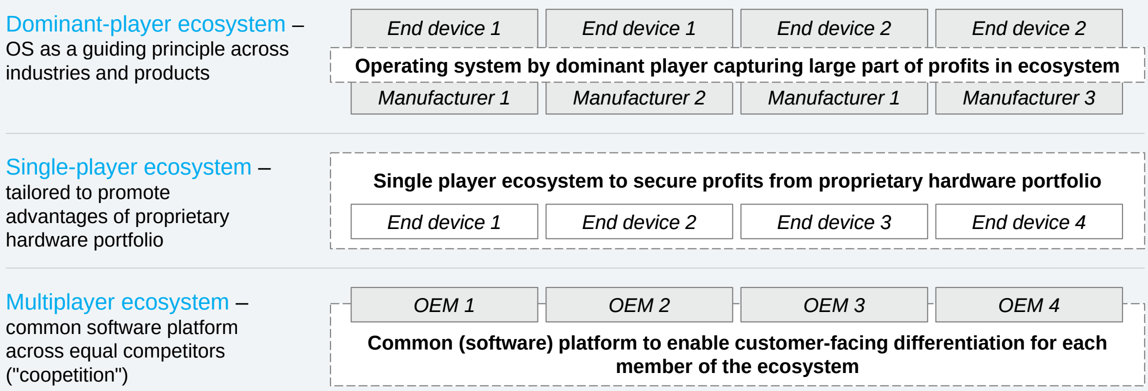
Another example – networked parking in cities – could reduce the amount of parking-dedicated real estate as well as time spent searching for available parking spots. Yet it requires an ecosystem in which OEMs, car park operators, infrastructure providers, and municipalities cooperate, using a single software platform. The higher the number of players participating, offering, and using parking spots, the higher the value of the service. An ecosystem of multiple OEMs might thus give a competitive edge for offering driving-related functionalities.

To achieve this, a common denominator for the industry needs to be found to apply the concept of ecosystems to the automotive industry overall. Such an ecosystem would enable communication across cars of different makes and models and offer intelligent functionalities while keeping control over data flows (Exhibit 11).

Automotive players have started to build partnerships to achieve sufficient scale and capabilities that – until now – had long been unthinkable in the automotive industry and represent a deep cultural change (e.g., the acquisition of Here by Mercedes, BMW, and Audi[4]; cooperation of Bosch and TomTom ; cooperation of Continental AG with IBM and Cisco). Some alliances in the in-vehicle infotainment space have already been formed as well (e.g., Genivi, Mirrorlink). This trend is expected to continue, and even today 57 percent of automotive executives anticipate opening up their software/API to third parties or external software developers. Furthermore, the participation of nonautomotive players in such an ecosystem would add new and valuable competencies (e.g., for map data).

Exhibit 11

A multiplayer ecosystem among equals may put OEMs in the position to offer customer-facing differentiating functionalities based on a common software platform



SOURCE: McKinsey

Realizing such an ecosystem would require a sound governance model to ensure compliant communication and collaboration between competitors (e.g., to define a cost allocation method for operating the infrastructure of such an ecosystem). Tier-1 suppliers may adjust accordingly by capturing scale effects of cross-OEM technology platforms and evolving even further into the role of a system integrator ("Tier-0.5 supplier").

3

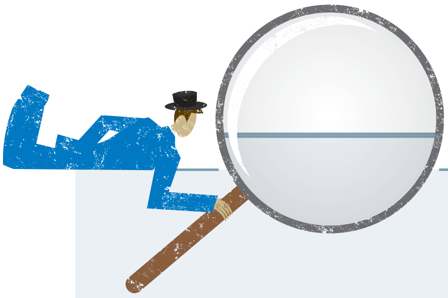
Automotive players need to take action in two key areas to compete for the connected customer

As automotive customers become increasingly connected, catering to their connectivity needs will soon become central to manufacturers' business models. Most OEMs recognize that gaining the connected customer requires transformation, but many have yet to take sufficient action. Structural transformation in the form of end-to-end digitization and an effort to improve customer acceptance are two key areas on which success in the connectivity and automation space depends.

3.1 A holistic end-to-end digitization of OEMs is necessary to enable future business models

In order to position themselves to successfully compete for the connected customer, OEMs should adopt a holistic perspective in defining their future business requirements, with a particular focus on internal digitization and the creation of a digital end-to-end user experience. This requires software development skills, integration into an ecosystem, and a closer relationship with the end customer.

OEMs need to build up skills for software development to match their new competitors' capabilities and fulfill new requirements (e.g., cyber security, faster innovation cycles). This involves moving to a software development model based on top, in-house talent in an agile and fast-paced development structure, complemented by the capabilities of partners in a common ecosystem. This structure allows for tighter end-to-end control over user experience. Companies like Tesla, Google, and Apple develop most of their core software themselves (text box 4), but generally, OEMs have outsourced large parts of their software development. Acquisitions of software companies are one option for bringing more talent in-house, and some large automotive suppliers have recently taken this step (e.g., Continental AG's acquisition of Elektrobit and Bosch's acquisition of ProSyst).



Text box 4:

Why talent acquisition is key for software development – and what OEMs need to consider in this context

"Five great programmers can completely outperform 1,000 mediocre programmers."

Marc Andreessen*

Tech firms routinely value top engineers at USD 750,000 to 1.5 million** when "acquihiring" a company. Starting base salaries at large tech firms for recent graduates are in the order of USD 100,000 to 150,000***, with significant additional stock options and bonuses. Apple and Google, for example, are prestigious employers that offer extremely attractive pay, stock options, working environments, and benefits.

OEMs may consider changing their recruitment strategies in order to attract top software engineering talent. This would involve improving their image as an IT employer, for example, by increasing the attractiveness of their digital divisions. Enabling faster, more agile software development processes in the context of stand-alone digital units could be one way in which OEMs build organizations that compete with tech companies for the attention of software engineers. Only 50 percent of automotive executives, however, state that their organization currently has a separate unit and business model for digital/data-based services.

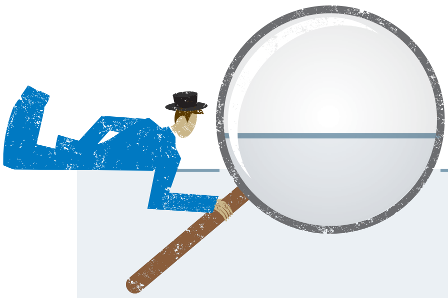
* As cited in: Mavericks at Work: Why the Most Original Minds in Business Win, William C. Taylor, Polly G. LaBarre, Harper, 2008

** http://bits.blogs.nytimes.com/2013/04/07/how-deal-makers-put-a-value-on-start-ups-disruptions/

*** http://www.businessinsider.com/life-at-stanford-in-2015-2015-4?utm_source=slate&utm_medium=referral&utm_term=partner

The ability **to develop new software quickly** will be crucial to enabling new business models and to allowing consumers to benefit from new features and keep their older vehicles competitive with newer models (text box 5). The life cycle of a typical car model is 5 to 7 years, while tech companies like Apple or Google update their operating systems every few weeks in order to roll out new features or to react to bugs and vulnerabilities. Traditional OEMs should consider emulating this by introducing a two-speed innovation model with small updates being rolled out quickly and as needed in between larger and less frequent updates. Over 85 percent of automotive executives agree that this model is necessary for them. This new model can be complemented by developing **the ability to push software updates over the air.** This would significantly increase the ease with which frequent software updates can be delivered to the end customer and, ultimately, the reach of these updates.

Once OEMs are able to quickly and easily update the software of their cars, they may consider **opening up new revenue channels by offering customers tailored additional features for a fee.** This could be done even years after the original release of the car and could include, for example, engine power upgrades, a navigation system update/add-on, or a software update to increase fuel efficiency. What this means – analogously to the current model employed by Tesla – is that monetization for the OEMs does not end with the sale of the car to a wholesaler with the occasional after-sales service, but continues throughout the life cycle of the car through a sustained relationship with the customer. Across these new touch points and over time, OEMs can learn about the customer's individual preferences and offer them tailored features that match their usage of the vehicle.



Text box 5:

Case example: Tesla upgrades its cars like Apple updates iPhones – over the air

Just as Apple and Google are continuously upgrading their operating systems for customers, Tesla is pushing free over-the-air upgrades for their customers' cars. The last update (version 6.2) was released in April 2015 and offers a multitude of new functionalities to its customers (e.g., ADAS features like automatic emergency braking or blind spot warning, improved forward collision warning, range assurance, trip planner, improved maps, and navigation).

The way that Tesla has set up its software and distribution makes it easier for them to push frequent over-the-air updates to their vehicles. Tesla develops its software in-house and designed a software architecture suitable for over-the-air upgrades right from the beginning. Tesla's model of selling their cars directly to end customers affords them direct customer contact, meaning that they do not have to pass through the intermediary of the car dealership the way traditional OEMs do. Additionally, Tesla's cars have a battery that supplies enough energy for software updates while the car is in park (the update to version 6.2, for example, takes an average of 45 minutes).*

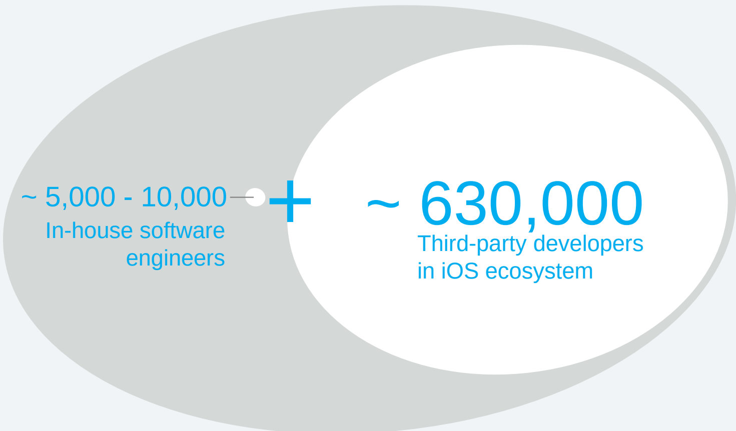
Over-the-air software updates are beneficial for both Tesla and their customers: while drivers receive software updates with new functionalities that make their cars more valuable, Tesla uses these customer touch points as a way to increase satisfaction and loyalty and gather fleetwide performance data. Tesla can also use over-the-air software updates to patch issues that otherwise would result in expensive recalls. A prerequisite, however, is that security challenges be adequately taken into consideration.

* http://www.teslamotors.com/sites/default/files/tesla_model_s_software_6_2.pdf
http://www.technologyreview.com/news/524791/why-your-car-wont-get-remote-software-updates-anytime-soon/

In addition to strengthening their internal software development capabilities, OEMs should focus on building or participating in ecosystems to benefit from the respective capabilities of their partners. As outlined in Chapter 2.5, a large ecosystem might allow access to a large number of third-party developers that could be leveraged to provide additional functionalities to their customers through their APIs. However, the scale at which the benefits of an ecosystem are fully realized is large: Apple, for example, supplements their in-house engineers with about 630,000 external iOS developers (Exhibit 12). Creating a common ecosystem among several OEMs might be one way for each OEM to reach this critical scale quickly and at moderate cost.

Exhibit 12

Example – their ecosystem gives Apple access to a large pool of software developers



SOURCE: Apple annual report: Apple Web site; McKinsey analysis

3.2 Creating further customer acceptance is critical in paving the way for autonomous driving

Creating customer acceptance is key to paving the way for vehicles with autonomous functions. Our research indicates that the biggest hurdles to customers' acceptance are their concerns about the cyber security of connected cars and concerns about the reliability of cars with autonomous functions.

Several cases in 2015 illustrate that cyber security is a major concern for all OEMs, as connected cars represent a whole new opportunity for attackers. One instance of a discovered vulnerability, for example, took place in July 2015, when white hat hackers managed to take control over critical features of a Jeep Cherokee through its "Uconnect" infotainment system, remotely sending commands to the dashboard functions, transmission, brakes, and steering. FCA US – the maker of Jeep – ended up recalling 1.4 million vehicles to fix the security flaw[5]. Other publicized instances of white hat hacking include the remote unlocking of BMW, Mini, and Rolls-Royce vehicles, requiring the patching of 2.2 million vehicles to improve the encryption level for communication between the affected vehicles and BMW's servers[6]. Tesla was also affected: in August 2015, hackers working with Tesla publicized finding a total of six vulnerabilities that would leave the software open to hacking – those vulnerabilities were patched over the air[7]. As these instances demonstrate, the danger to OEMs lies not just in the risk to their customers, but also in the significant financial and reputational risk associated with such breaches.

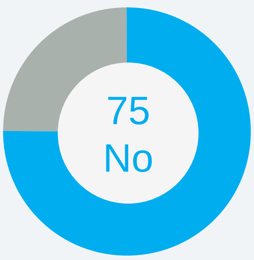
These breaches show that there is a need for OEMs to improve their cyber security capabilities to ensure that they can anticipate and prevent further vulnerabilities. However, OEMs need to acknowledge that there is no 100 percent secure system and strive for effective and fast countermeasure strategies in the event that a vulnerability is discovered. Currently, 75 percent of surveyed automotive executives admit that they do not have a countermeasure strategy in place in case their vehicles are hacked (84 percent across all surveyed industry experts), and only 30 percent of automotive executives say that their companies preemptively cooperate with white hat hackers (18 percent across all surveyed industry executives; Exhibit 13).

Exhibit 13

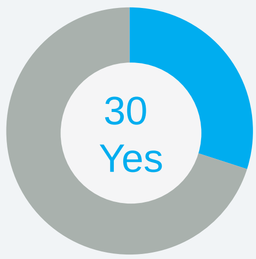
A large majority of automotive executives say that they do not have a countermeasure strategy in place in case their vehicles are hacked

Percent of automotive executives

Does your organization have a countermeasure strategy in place in case your vehicles are hacked?



Do you cooperate with "white hat hackers" (i.e., external computer experts who intentionally attack and try to gain access to your systems) to identify loopholes or vulnerabilities in your network security?



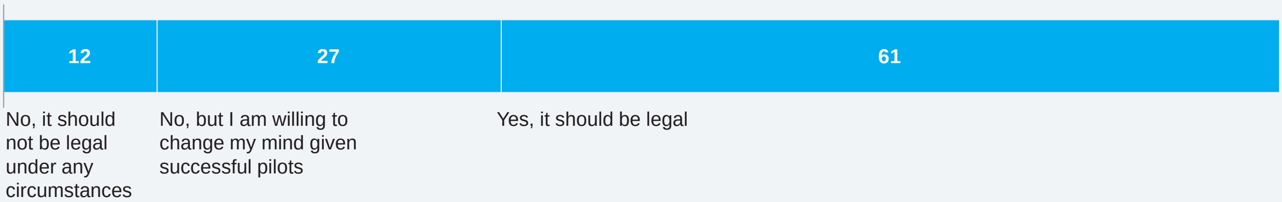
SOURCE: McKinsey Connectivity and Autonomous Driving Executive Survey 2015

Exhibit 14

Only a small majority of consumers are willing to accept cars with autonomous functions; however, additional successful pilots will help increase their acceptance

Percent

Do you think the government should legalize the use of cars with autonomous functions? If not, would favorable accident statistics from pilot projects or the successful introduction of autonomous cars in other countries be likely to change your mind?



SOURCE: McKinsey Connectivity and Autonomous Driving Consumer Survey 2015

Beyond the issue of cyber security, OEMs should also consider ways to increase customer acceptance for cars with autonomous functions, as there is still some skepticism among consumers. Today, only 61 percent of consumers believe that cars with autonomous functions should be legal, and a mere 27 percent are willing to be convinced of their safety by favorable accident statistics from pilot projects or successful introductions of cars with autonomous functions in other countries (Exhibit 14). OEMs could increase consumer trust in cars with automated or autonomous functions by introducing those features gradually and by combining the introduction with a communication strategy on the convenience, efficiency, and safety benefits of vehicles with autonomous functions.

In addition, customers would like to retain the ability to take back control of a car with autonomous functions. Only 49 percent of respondents are interested in switching to a fully autonomous vehicle with no option for human control – even at no extra cost. This share increases to 79 percent if the car offers them the option of regaining control of the vehicle if they so desire (Exhibit 15). The reassurance of being in control during particularly unusual circumstances and/or an enjoyment of traditional, hands-on driving might be the reason for a preference for the "regain control" option.

Car OEMs understand that the preference for and enjoyment found in driving oneself are important factors for many car owners. They stress that it is not their goal to make the driver fully obsolete, as exemplified by Akio Toyoda:

"Another difference between automakers and IT companies is that our cars are preceded by 'Ai' (meaning 'love' or 'beloved' in Japanese). In other words, automakers create Ai-sya (beloved car), while IT companies make 'i-sya (i-Car).' We will keep this difference in mind (in the process of developing autonomous vehicles)."

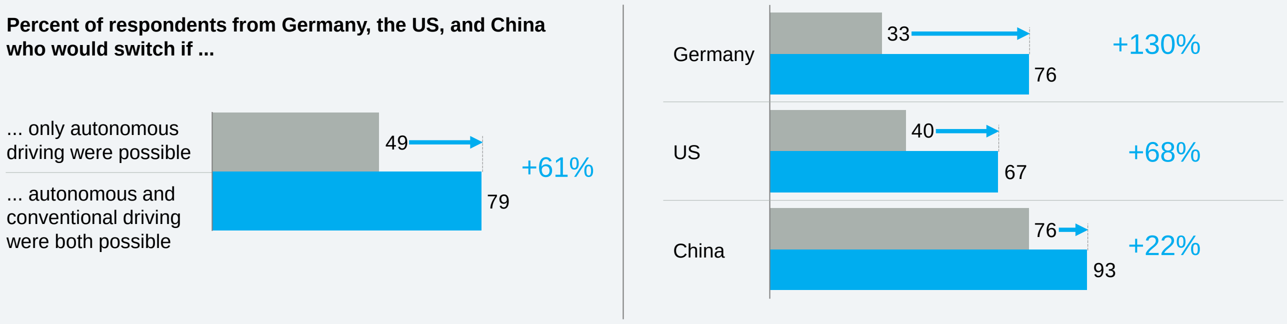
Akio Toyoda, president of Toyota Motor Corp

http://techon.nikkeibp.co.jp/english/NEWS_EN/20140517/352380/

Exhibit 15

The option for conventional driving increases customers’ openness to cars with autonomous functions

Would you choose a car with autonomous functions at no additional cost relative to a conventional car if there were no option to drive yourself? What if in this autonomous car you could choose whether to drive yourself or not?



SOURCE: McKinsey Connectivity and Autonomous Driving Consumer Survey 2015

The interest in owning an autonomous car is not uniform and most strongly depends on region and age. While 76 percent of Germans are interested in owning a car with autonomous functions, with or without the self-driving option to drive oneself, this share is 93 percent in China. Age also plays a role, with 87 percent of 18- to 29-year-olds interested in owning a car with autonomous functions compared with 66 percent of those over 60. OEMs should therefore carefully consider which demographic segment they are addressing when attempting to raise consumer acceptance.

Conclusion

The rise of connectivity and automation will transform the automotive industry and offers a range of **opportunities.** Consumer preferences have **shifted towards connected cars extremely quickly over the past year and are likely to continue to do so.** This **trend** is already most advanced in China.

Businesses with a stake in the game need **to take decisive action quickly** to secure or increase their share of the automotive value pool. The **creation of ecosystems** as well as company-internal capability improvements (e.g., improvement of internal software development capabilities) will likely be key to becoming able to monetize this trend.

We discussed the impact that connectivity and automation will have on the automotive industry, but there are also a number of additional trends: **electrification and shared/diverse mobility.** These four trends, together with others (e.g., Industry 4.0 and digitized sales channels) will flow together and coalesce to change the automotive industry as we know it today.

Appendix

Further key findings from the McKinsey Connectivity and Autonomous Driving Consumer Survey 2015

The McKinsey Connectivity and Autonomous Driving Consumer Survey included over 70 questions on vehicle connectivity and automated driving. Since not all the results could be explicitly mentioned in the main body of the report, this appendix provides some additional detail.

SOURCE: McKinsey Connectivity and Autonomous Driving Consumer Surveys 2014 and 2015

Surveys of automotive consumers and executives give insight on their readiness for connectivity and automation, and the implications for the industry

Consumer survey

70+ questions regarding car connectivity attitudes and preferences, privacy concerns, and views on automation

3,000+ representative car customers (1,000+ per market)

3 key markets (US, Germany, China)

+

Executive survey

90+ respondents from automotive and automotive-related industries

20 OEM and tier-1 top executives

50+ questions assessing attitudes on connectivity and automation, and the digital maturity of the organizations

Findings supported by discussions with selected automotive executives

Both surveys conducted in July and August 2015

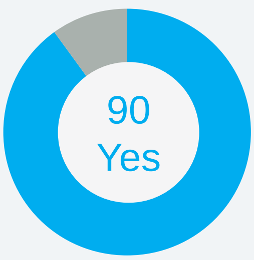
SOURCE: McKinsey Connectivity and Autonomous Driving Executive and Consumer Survey 2015

Exhibit 1

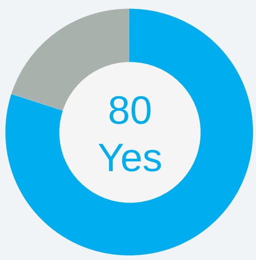
A large majority of automotive executives believe that in-vehicle and automation connectivity will significantly change their business

Percent of automotive executives

Do you think your organization's business model will change or broaden due to the emergence of in-vehicle connectivity and autonomous driving?



Do you think that your business will be challenged by new competitors in the field of connectivity and autonomous driving?

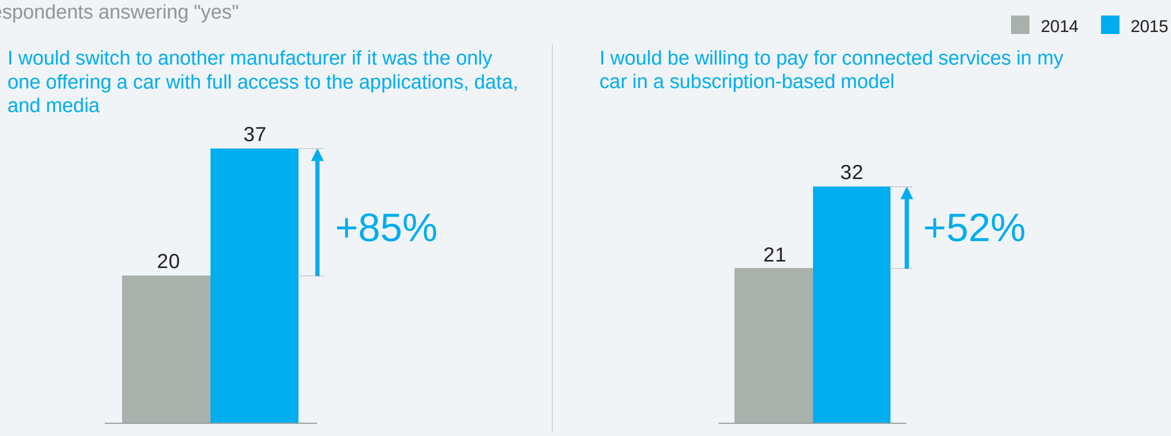


SOURCE: McKinsey Connectivity and Autonomous Driving Executive Survey 2015

Exhibit 2

Both willingness to switch manufacturer and to pay a subscription fee for connected car services has increased significantly in the past year

Percent of respondents answering "yes"

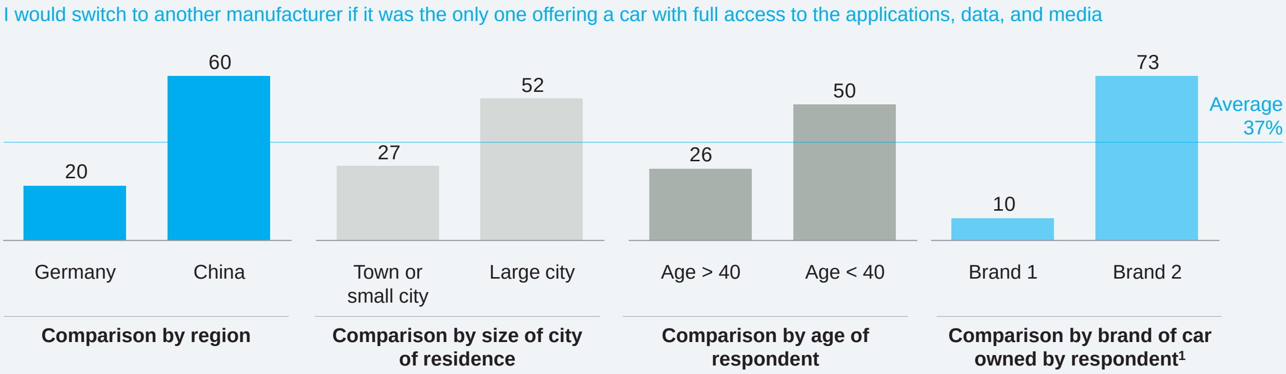


SOURCE: McKinsey Connectivity and Autonomous Driving Consumer Survey 2014 and 2015

Exhibit 3

Customer willingness to switch manufacturer varies significantly by country, brand, age, and city size

Percent of respondents answering "yes," 2015 survey



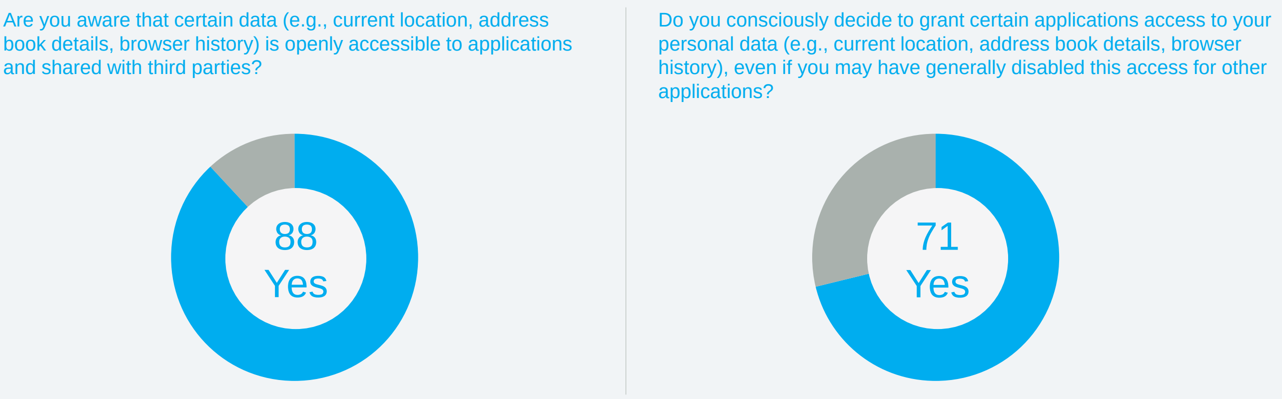
1 Smallest/largest share of owners of any brand in any region

SOURCE: McKinsey Connectivity and Autonomous Driving Consumer Survey 2015

Exhibit 4

Consumers are well informed on topics of data privacy and are willing to share their personal data with some applications

Percent of respondents



SOURCE: McKinsey Connectivity and Autonomous Driving Consumer Survey 2015

Exhibit 5

Consumers are most willing to grant access to applications that are directly related to driving such as navigation applications

Percent of respondents naming a given application

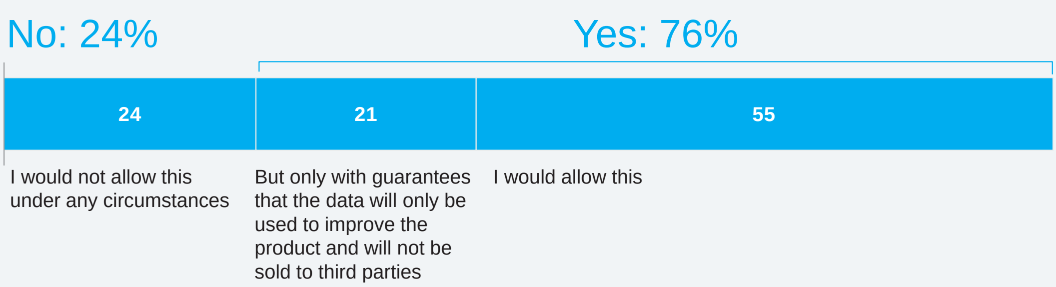
If you were to receive an application for free instead of paying for it, would you agree that the application could use your personal data in return? If so, which application would you grant access?

SOURCE: McKinsey Connectivity and Autonomous Driving Consumer Survey 2015

Exhibit 6

76% of respondents are willing to allow their cars to send data to their manufacturer to improve the product under certain conditions

Would you allow your car to track your location and report it anonymously (e.g., to enable your carmaker to improve the next generation of your car)?



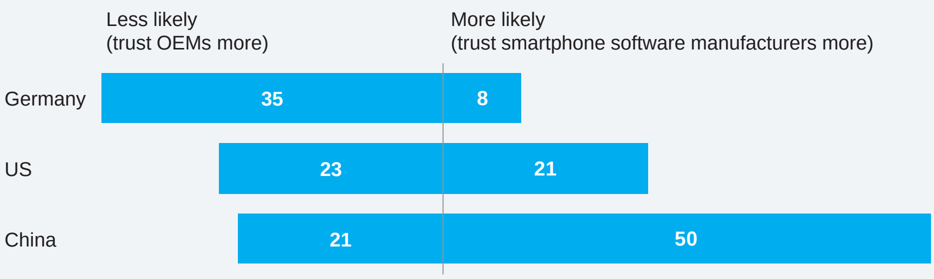
SOURCE: McKinsey Connectivity and Autonomous Driving Consumer Survey 2015

Exhibit 7

OEMs are more trusted in Germany than in the US and China in terms of data privacy and protection

Percent

If data about your driving pattern (destinations, routes, etc.) was collected by the manufacturer of your smartphone software (e.g., Apple, Google, Microsoft) instead of your car manufacturer, would you be more or less likely to allow access to it?



Note: Total of 100% per country; answers of remaining percent not indicated: "neither" or "no preference"

SOURCE: McKinsey Connectivity and Autonomous Driving Consumer Survey 2015

Exhibit 9

Services and functionalities can be categorized

I Data-based services

IA Driving-unrelated
- Telephone and e-mail
- Messaging services and social media
- Web browsing, news services
- Personal music library and streaming
- Personal video library and streaming
- Games

IB Driving-related
- Connected navigation
- Networked parking
- Workshop and after-sales services
- Personalized insurance
- Mobility solutions

II Data-enhanced driving functionalities (automated/automation)
- Automated platooning
- Autopilot in selected environments
- Self-parking on private property
- Automated collision prevention (incl. automated braking)
- Fully autonomous driving

Driving-related (IB and II)

SOURCE: McKinsey

Exhibit 10

Customers are more interested in driving-related car features than they are in driving-unrelated car features

Percent of respondents willing to switch, stating that the given functionality would make them switch

Would you switch from your current car manufacturer to another manufacturer you trust if it was the only one offering these functionalities? Which functionalities would make you switch?

SOURCE: McKinsey Connectivity and Autonomous Driving Consumer Survey 2015

Endnotes

1 Global Fortune 500, retrieved via S&P Capital IQ (financial information provider), 2015

2 "Connected car, automotive value chain unbound", McKinsey & Company, 2014

3 Jobs attributable to the iOS ecosystem: http://www.apple.com/about/job-creation/ (iOS ecosystem jobs estimate based on research by Dr. Michael Mandel and Judith Scherer of South Mountain Economics, "Geography of the App Economy," September 2012, as well as research from VisionMobile's "The European App Economy," July 2014, and "European App Economy," September 2013)

4 Deutsche Presse Agentur, http://www.dpa-international.com/news/international/german-carmakers-buy-nokias-digital-maps-business-a-46154892.html

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7 Wired.com, http://www.wired.com/2015/08/researchers-hacked-model-s-teslas-already/

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