strategy&

Formerly Booz & Company

&

In the fast lane

The bright future of connected cars

pwc

Contacts

Chicago

Evan Hirsh
Partner
+1-312-578-4725
evan.hirsh
@strategyand.pwc.com

Düsseldorf

Dietmar Ahlemann
Partner
+49-211-3890-287
dietmar.ahlemann
@strategyand.pwc.com

Frankfurt

Richard Viereckl
Senior Partner
+49-211-5300-123
richard.viereckl
@strategyand.pwc.com

Jörg Assmann
Partner
+49-211-5300-195
joerg.assmann
@strategyand.pwc.com

London

Jens Nackmayr
Partner
+44-20-7393-3218
jens.nackmayr
@strategyand.pwc.com

Mark Couttie
Principal
+44-20-7393-3538
mark.couttie
@strategyand.pwc.com

Paris

Rich Parkin
Partner
+33-1-44-34-30-47
rich.parkin
@strategyand.pwc.com

Shanghai

John Jullens
Partner
+86-21-2327-9800
john.jullens
@strategyand.pwc.com

About the authors

Richard Viereckl is a senior partner with Strategy& based in Frankfurt. With more than 30 years of experience consulting with leading automotive companies across the world, he specializes in transformation of manufacturing, sales, and R&D organizations.

Jörg Assmann is a partner with Strategy& based in Frankfurt. As a member of the operations team, he specializes in the automotive industry, helping companies restructure for growth through reorganization, cost reduction, and sales promotion.

Christian Radüge is an associate with Strategy& based in Munich. A member of both the engineered products and services and the operations practices, he focuses on process and product development, with an emphasis on the automotive industry, and in particular the connected car.

Executive summary

You may not be able to leave all the driving to your car yet, but you certainly will within the next decade. Indeed, in every respect, the cars of the future will be very different from the ones drivers are currently familiar with. That's because carmakers are developing a variety of new technologies that will make cars far more digitally connected than they are now.

Navigation systems will enable drivers to determine not just the fastest route but also the most fuel-efficient. Vehicle management systems will provide detailed information about the car's performance, and automatically send data to insurance companies and fleet owners. Technologies such as antifatigue devices will reduce accidents, and soon, systems that monitor drivers' vital functions will alert them to potential problems. And driver assistance and safety systems will let the car take over driving in traffic jams and on the highway, and drive much more safely than humans.

Carmakers will benefit significantly through the close connections these cars will establish with customers, boosting brand loyalty and lock-in. But getting there will require manufacturers to develop interfaces that are even more user-friendly than the ones cars have now, and speed up the product-development cycle to match the speed of the consumer electronics companies that are also competing to develop connected products for cars. In turn, these objectives will depend on whether automakers can integrate their IT efforts much more tightly with the customer-facing parts of their business than they do now.

There is a significant prize at stake — the manufacturers that can bring the truly autonomous vehicle closer to reality first will have a considerable competitive advantage in the marketplace.

A fast-growing market

The well-publicized attempts by companies like Google and universities around the world to build a functioning autonomous vehicle — one that essentially drives itself — have focused considerable attention on how the car of the future will look and function. Yet assisted driving is only one of the many new technologies and products automakers are incorporating into the cars they build.

How cars are connected to their environment will change enormously over the next five to seven years. Already, new driver assistance and safety systems can park the car autonomously, maintain a safe distance between cars at highway speeds, and warn drivers of hazards ahead. Communications, entertainment, and so-called well-being technologies make driving more comfortable and enjoyable. And real-time mobility and vehicle management systems provide up-to-the-minute traffic information, optimal routing, and information on the car's status and help drivers reach their destinations faster, more reliably, and more efficiently.
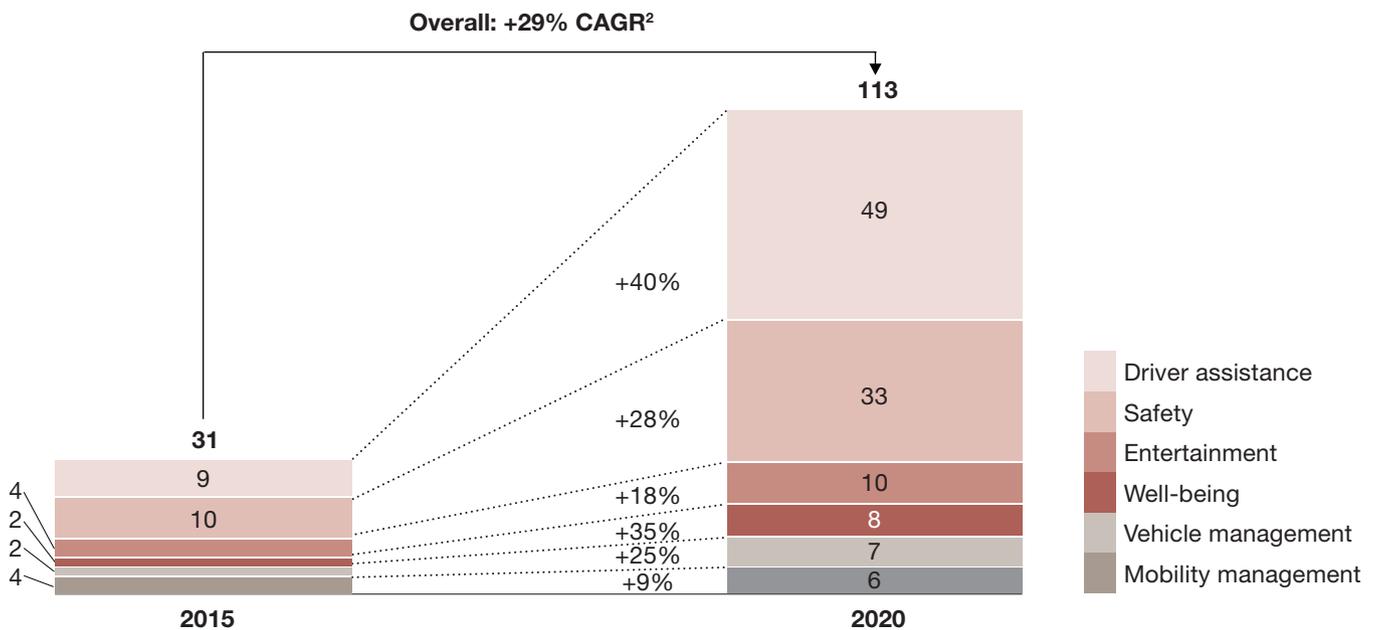
Taken together, this collection of new features will greatly expand the capabilities of what's been called the "connected car," transforming not just how we drive, but how we buy and maintain cars, and how automakers sell them. Management Engineers at Strategy& and the Center of Automotive Management recently joined forces on a study, called "Connected C@r 2013," to better understand future trends in connected cars, including innovations, potential hurdles, and detailed market growth projections. Conducted through interviews with German carmakers, dealer surveys, and automobile sales projections, the study suggests that worldwide sales of connected car products will increase almost fourfold between 2015 and 2020, adding more than €110 billion (US$149 billion) in revenues in the passenger car segment alone (*see Exhibit 1, next page*).

Added revenue isn't the only benefit that car companies will see from the rapid development of the connected car. These technologies will offer buyers greater flexibility in personalizing the cars they choose, and enable greater contact between manufacturers and customers —

strengthening the bonds between them and increasing loyalty to the brand. The automakers that can achieve these goals first will gain a real edge in the highly competitive global market for new cars.

Exhibit 1

Revenues in the connected car market will nearly quadruple between 2015 and 2020, led by driver assistance and safety technologies

Overall: +29% CAGR[2]

Total connected car market, 2015–20[1]
Connected car revenues (€ in billions)

Legend:
- Driver assistance
- Safety
- Entertainment
- Well-being
- Vehicle management
- Mobility management

[1] Does not include commercial vehicles.

[2] Compound annual growth rate.

Source: Management Engineers at Strategy& analysis

Six product categories

To better understand what the connected car will look like, it is useful to divide the technologies involved into six categories and more closely examine their technical and commercial prospects (*see Exhibit 2, next page*).

Mobility management includes all the systems that allow drivers to reach their destination quickly, safely, at reasonable cost, and with optimal fuel consumption. Cars can already access real-time traffic information through their onboard navigation systems, and reroute automatically to avoid traffic jams, and they can provide information on inexpensive refueling stations and parking lots. Over the next few years, drivers will be able to access highway warnings and messages, and navigation systems will be able to pinpoint the most fuel-efficient routes for current traffic patterns.

These types of efficiencies will become even more critical — and more popular — as the world grows increasingly urbanized. Drivers in Moscow, for instance, currently spend more time in traffic jams than those in any other city, according to GPS device maker TomTom; drivers there spend an average of 127 hours each year stuck in traffic. China, too, faces real challenges in its race to urbanize, and it is expected to be the largest market for mobility management products through 2020.

Most of the technological prerequisites for these systems — in particular, real-time onboard navigation and other subproducts — are already available, and the tools needed for holistic transportation management will soon follow. We expect that market penetration will significantly increase by 2015, but because the technology is already in wide use today, the growth rate will then slow to an average of 9 percent annually through 2020.

Vehicle management includes a variety of functions that help drivers reduce running costs and increase ease of use and maintenance, such as remote-control unlocking and starting, onboard information about vehicle conditions, service scheduling and updates, and the automatic

Most of the technological prerequisites for these systems — in particular, real-time onboard navigation — are already available.

Exhibit 2

The connected car segment comprises six distinct product categories

Mobility management	Vehicle management	Entertainment
Functions that allow the driver to reach a destination quickly, safely, and in a cost-efficient manner	**Functions that aid the driver in reducing operating costs and improving ease of use**	**Functions involving the entertainment of the driver and passengers**
Examples: - Current traffic information - Parking lot or garage assistance - Optimized fuel consumption	Examples: - Vehicle condition and service reminders - Remote operation - Transfer of usage data	Examples: - Smartphone interface - WLAN hot spot - Music, video, Internet, social media - Mobile office
Safety	**Driver assistance**	**Well-being**
Functions that warn the driver of external hazards and internal responses of the vehicle to hazards	**Functions involving partially or fully automatic driving**	**Functions involving the driver's comfort and ability and fitness to drive**
Examples: - Collision protection - Hazard warnings - Emergency functions	Example: - Operational assistance or autopilot in heavy traffic, in parking, or on highways	Examples: - Fatigue detection - Automatic environment adjustments to keep drivers alert - Medical assistance

The connected c@r

Source: Management Engineers at Strategy& analysis

transfer of data to fleet owners and insurance companies regarding how the car is actually being driven.

Many of these tools can be particularly useful to owners of vehicle fleets, such as company and service vehicles, as well as companies in the car-rental and car-sharing industries. In Germany alone there are around 1.6 million company fleets, with a total of about 4 million vehicles; each of the 10 largest fleets maintains at least 3,000 cars. Using these new technologies to manage fleets offers the potential for significant efficiency increases, especially attractive in the face of rising cost pressures. And although many of the technologies needed to support these functions are already established, we forecast that worldwide sales in this segment will triple by 2020.

Entertainment has been a basic need in virtually every vehicle since Motorola introduced the first car radio in 1930. Cars are already equipped with a wide range of entertainment and communications features for both drivers and passengers, including smartphone

interfaces, wireless local area network hot spots, access to social networks, Internet music and video, and advanced mobile office functions controlled by voice recognition software.

In-vehicle entertainment is particularly popular in Asia, and China will remain the largest market through 2020. But overall revenue growth will lag that of other connected car technologies in the region because of price pressures brought by competition with aftermarket suppliers in the consumer electronics industry.

Well-being functions serve the comfort and safety of drivers through a variety of technologies. For example, antifatigue devices capture images of drivers through onboard cameras and warn them when they are overtired, and other well-being systems optimize the climate, music, and even seat functions to keep drivers alert. Soon, systems will be available that can monitor a driver's vital functions, such as heart rate, and warn him or her of problems.

This is a particularly attractive area for automakers, as the number of older, affluent motorists is growing rapidly, a sharp contrast to the decline in the number of younger drivers. As a result, more such age-specific products will likely appear. Between 2015 and 2020, we expect this segment to grow 35 percent, and the U.S. will remain the largest market.

Driver assistance includes the group of technologies that can improve — or take over — the actual performance of the car. Systems are already available that can automatically park the car in tight spots, autonomously steer the car, brake for obstructions, and speed up and slow down in traffic jams.

Technology is moving quickly in this area. Some products, such as motorway technology that can drive the car at high speeds in so-called road trains — in which vehicles automatically maintain a fixed distance from one another — may become available as early as 2017; by 2020, these systems may not require any driver monitoring or intervention at all. Such technologies will push revenue growth in this segment to 40 percent annually. Driven by its rapidly increasing number of cars and motorway kilometers, China will become the largest market — its motorway network has been growing by more than 5,000 kilometers a year since 1998. However, the uncertain legal framework surrounding this segment, especially regarding autonomous driving, remains a potential obstacle to its growth.

Safety technologies include external danger warnings for drivers regarding severe weather, hazardous road conditions, and the like, as well as the car's own internal autonomous collision protection and

emergency functions (*see "Europe's eCall System"*). Some of these technologies are already available, including danger warning and collision protection, yet they will continue to become more sophisticated. We expect that by 2020 the category will reach €30 billion (US$41 billion) in sales, following annual growth of 28 percent, and the U.S. will remain its largest market.

Europe's eCall system

Although its overall market potential is not as large as that of the U.S. or China, Europe has a valuable head start in the creation of fully connected cars — the European emergency call system, or eCall. The European Commission is committed to establishing a fully functional eCall service for all new models of cars and light commercial vehicles in the European Union by 2015. This involves installing in these vehicles devices that automatically report traffic accidents and their location to the European emergency hotline, promoting faster rescues and thus reducing the number of road casualties and severe injuries.

Acting as a market maker and icebreaker in terms of price, eCall, we believe, will provide the E.U. with a real advantage. The proposed initiative would require that every new car come equipped with 3G/4G and GPS systems, which can also serve as the basis for the car's phone and navigation systems. This requirement will likely reduce the added costs for more comprehensive connected car equipment, and the potential difference is considerable. The hardware costs for entertainment, mobility, and vehicle management systems now total about €130 (US$176) per car, whereas hardware costs for basic eCall connectivity are about €90 (US$122) per car. This means that eCall installation will effectively reduce the cost of future hardware by roughly 70 percent.

The customer connection

The enormous revenue potential of the connected car market isn't the only benefit that automakers are likely to reap. Just as important are the many new contact points with drivers the technology will offer, giving manufacturers any number of opportunities to stay in touch with customers after they buy their cars.

The technology will allow not only automakers but also dealers and repair shops to communicate with drivers, and enable manufacturers to build vehicles with more personalized content. Notices can already be sent to drivers that their next inspection is due, with a reminder of the location of the nearest authorized repair shop, combined with a special offer or maintenance promotion. By boosting customer brand loyalty and lock-in, such features will generate real added value for drivers and manufacturers alike.

Strengthening these connections, however, will require significant changes in the traditional business model of many automakers. They have long maintained only indirect contact with their customers — through mass-market advertising, for example — though this has been enriched recently through such technologies as social media. The connected car offers the potential for much closer ties, enabling the possibility of not just directly marketing new apps and services to customers, but increasing brand loyalty as well — and the car itself acts as a central hub for all these activities (*see "The Information Advantage," next page*).
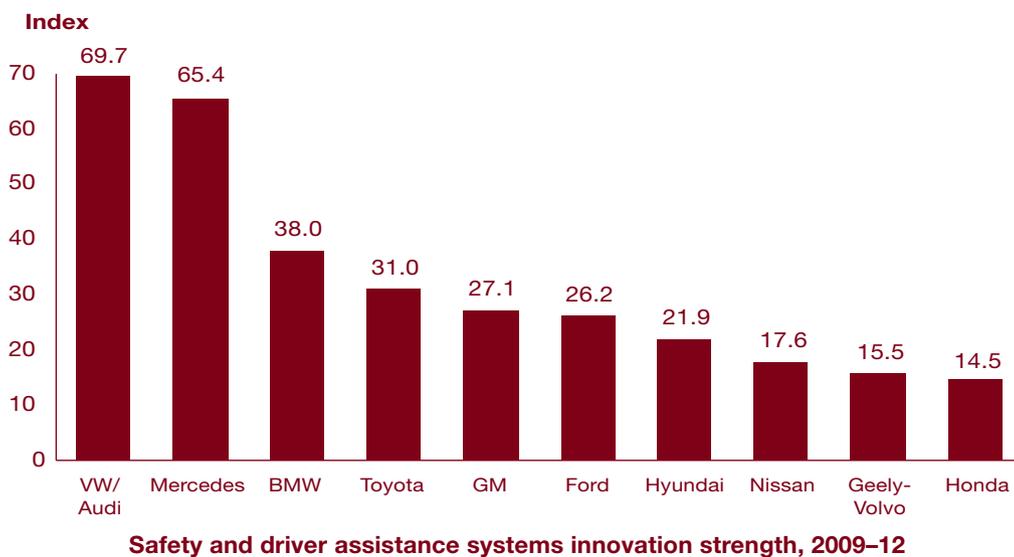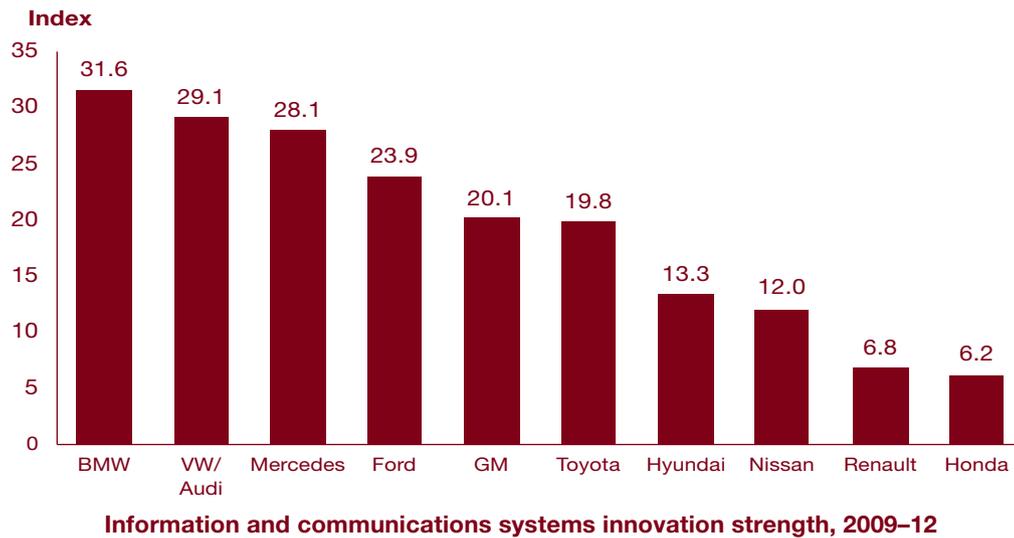
The information advantage

Who is leading the race to create the innovative new technologies of the connected car? According to a recent study by the Center of Automotive Management, Germany's three main car companies — BMW, VW/Audi, and Daimler — have the lead over their U.S. and Asian rivals in the development and implementation of the information and communications systems for these cars. And two of them — VW/Audi and Daimler — are maintaining an even greater advantage in the cars' safety systems (*see Exhibit A*).

Exhibit A

German carmakers are leading the pack in both information and communications systems and safety systems

Index

Information and communications systems innovation strength, 2009–12

Company	Value
BMW	31.6
VW/Audi	29.1
Mercedes	28.1
Ford	23.9
GM	20.1
Toyota	19.8
Hyundai	13.3
Nissan	12.0
Renault	6.8
Honda	6.2

Index

Safety and driver assistance systems innovation strength, 2009–12

Company	Value
VW/Audi	69.7
Mercedes	65.4
BMW	38.0
Toyota	31.0
GM	27.1
Ford	26.2
Hyundai	21.9
Nissan	17.6
Geely-Volvo	15.5
Honda	14.5

Note: Innovation strength is a cumulative index calculated from four factors, in order of relative weight: degree of innovation, originality, maturity level, and area of focus (efficiency, safety, comfort, environment, and driving dynamics, among others).

Source: Center of Automotive Management "Automotiveinnovations 2013" study

Strategy&

Challenges and capabilities

To capitalize on the advances of the connected car, automakers will need to make changes in how they operate, and in some cases they will need to build significant new capabilities.

Back-end and front-end integration. The shift to the fully connected car will require that automakers rethink the role of their IT department and the technology capabilities they will need in the future. Until now, IT has served a primarily internal function, developing the extensive software every car needs to run. But now IT will be required to play a fully operational role, building and running the software that will enable the necessary connectivity and functionality for connected cars. And that, in turn, will force IT departments to fully integrate their back-office technology with the technology they develop for the cars — a critical, and likely costly, capability.

User-friendly hardware and interfaces. The connected cars of the future will be very complex, so a further key capability will involve creating the interfaces needed to provide drivers with safe, intuitive, user-friendly controls for their connected cars — especially for the increasing number of older drivers. To succeed, manufacturers will need to compete with consumer electronics companies that have already developed strong capabilities in this area.

The increasing complexity of the electronics in the connected car will also require the development of open interfaces and industry-specific standards. Although communications standards such as frequencies and protocols have already been established, cars cannot yet communicate with one another, because the semantics of communications remains undefined. Unless such standards are clarified and extended, the overall market for connected car products may be constrained.

Faster product cycles. The typical product cycle in the passenger car industry is about eight years; in the consumer electronics industry, it's less than a year. To successfully sell electronics products for connected cars, automakers will need to mimic the rapid development cycles of the

consumer electronics companies. The key for the automakers is to learn to build perfectly functioning, modular systems, into which updates and product developments can be integrated quickly and with little effort. Such a modular infotainment building set would allow for individual components to be updated through plug-and-play technologies several times during a car's life cycle.

Finding the talent. Given the significant changes in business and operating models demanded by the advent of the connected car, automakers will need to attract a range of talented employees with the know-how to carry out this transition. The skills required aren't just technical; car companies will need people who understand how to connect digitally with customers and how to monetize the connection. Telecommunications expertise will be especially important, and automakers are already beginning to attract talent from this critical industry.

Conclusion

The connected car market has the potential to significantly boost revenues for automakers in the next five to seven years, and to establish closer, more profitable connections with their customers. The sophistication of the technologies is impressive, but success won't be a matter of the technology alone. Car manufacturers must learn to bundle and sell the right mix of application and product packages for the right customers, and they must systematically invest in targeted research and development if they are to continue to maintain their technological leadership. Automakers that do not seize the opportunity will lose market share to competitors both inside and outside the auto industry, sooner rather than later.

Strategy& is a global team of practical strategists committed to helping you seize essential advantage.

We do that by working alongside you to solve your toughest problems and helping you capture your greatest opportunities.

These are complex and high-stakes undertakings — often game-changing transformations. We bring 100 years of strategy consulting experience and the unrivaled industry and functional capabilities of the PwC network to the task. Whether you're

charting your corporate strategy, transforming a function or business unit, or building critical capabilities, we'll help you create the value you're looking for with speed, confidence, and impact.

We are a member of the PwC network of firms in 157 countries with more than 184,000 people committed to delivering quality in assurance, tax, and advisory services. Tell us what matters to you and find out more by visiting us at strategyand.pwc.com.

This report was originally published by Booz & Company in 2014.

www.strategyand.pwc.com