



STUDY

THE SOFTWARE RACE

Are Chinese Automakers
Taking the Lead?

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// In the global car market, China is revolutionizing customer experiences—and software-defined vehicles are the key to remaining competitive in the long term. //

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About the data collection

The data for this study was collected as part of a comprehensive survey. A total of approximately 5,000 people were surveyed. Participants were aged 18 and over and located in China, the USA, Germany, Sweden, Poland, Italy, and the UK. A population-representative panel was selected, using quotas for age, gender and—in China and the USA—geographical regions.

Executive summary

As the Chinese automotive industry continues to develop rapidly, the term “Software-Defined Vehicles” (SDVs) has become a hot topic. But the first OEM to postulate and systematically implement the paradigm “car as computer” was actually Tesla—more than 10 years ago.

In their purest form, SDVs have a redundant central computer that runs the car’s software in its entirety, as well as establishing a connection to the OEM’s back end (over the air). This approach has been adopted by Chinese manufacturers, who are systematically applying it to new EVs.

This paradigm and the architecture behind it form the basis for centralized control of the car’s functions and component properties, as well as customer access to app stores or functions-on-demand. Connecting hardware and software allows for the creation of customer-centric, expandable ecosystems that make possible new business models while simultaneously constituting additional revenue pools for the OEMs.

Tesla and the Chinese OEMs, as well as the Korean manufacturers, are developing their new EV models on platforms that follow this paradigm. Traditional OEMs, on the other hand, face challenges in devel-

opment resulting from the use of distributed architectures with 100+ electronic control units (ECUs), all of which are delivered by their suppliers with proprietary software components. The key is the consistent implementation of software development methodology, as well as the development of a centralized software architecture.

However, that transition will require a great deal of effort on the part of the hardware-driven, engineer-laden traditional OEMs. The speed of implementation will be the deciding factor in how well the traditional OEMs can compete with the new market players, and whether they can secure a share of the new revenue pools for themselves.

This study investigates what customers demand from a car, now and in the future. What role do SDVs play? What role do traditional vehicles still play? The differences between global automobile brands in terms of popularity and technological advances will be a central aspect of this inquiry and will play an important role in the analysis.

10 key facts from the study

58%

A clear global trend: 58% of those surveyed could imagine purchasing a Chinese car. In China, that number reached nearly 100%.



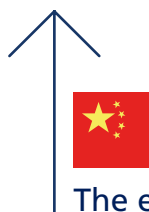
Good value for the money is critical for the success of Chinese vehicles in Europe—especially in Germany.

Globally, customers also maintain their extremely high expectations for traditional hardware features.

For

73%

of all customers—and for nearly 100% of Chinese consumers—digital vehicle features are already a decisive factor.



The expectations for vehicle hardware and software are significantly higher for customers in China vs. those in Western markets.



The interest in unlocking autonomous driving functionality is almost twice as high in China as in Europe and the USA.



In China, only cars with digital vehicle features will sell on the market.



Compared to their global counterparts, Chinese consumers are significantly more willing to pay for autonomous driving features "on demand."

36%

of those surveyed believe that European car manufacturers have a significant need to improve their performance in terms of electric range;

41%

in terms of value for money.

Globally, German OEMs are recognized for their expertise in digital vehicle features. However, that trend is on a slight decline, whereas Chinese OEMs, in particular, are showing a rapid upswing.





China's automotive innovation: A paradigm shift for the traditional car market

Thinking about your next car purchase,
would you consider buying a car from a
Chinese manufacturer?

58%

In total



98%

China



47%

Europe



44%

USA



46%

Germany



Image 1: The majority of respondents would consider purchasing a car from a Chinese manufacturer

If it wasn't apparent before, the Shanghai Auto Show in 2023 made it clear that the automotive market is standing on the brink of a radical transformation. Within a short period of time, new Chinese manufacturers have developed an impressive portfolio of products and services that challenge traditional automotive brands not only in China, but also in Europe, ASEAN and South America. In view of these significant changes, it is time for established OEMs to rethink their own product portfolios.

A survey conducted by MHP in collaboration with the Motorpresse Stuttgart showed that 57% of consumers in Europe, China, and the USA would possibly or definitely consider purchasing a car from a Chinese manufacturer. In China, this tendency is quite pronounced: nearly 98% of Chinese respondents see a car from a Chinese manufacturer as an option, followed by Italian citizens with nearly 55% and participants from the United Kingdom with around 50%. In Germany, more than 45% of those surveyed would consider purchasing a Chinese car.

The strength of the Chinese automotive industry's influence on the global market landscape varies depending on the vehicle segment in question. While brands in the luxury and sports car segment—such as Rolls Royce, Bentley and Porsche—largely maintain their dominant position in the market; competition in the premium segment is heating up as up-and-coming Chinese car manufacturers are exerting more influence there. With their innovative, customer-oriented solutions, they are putting pressure on traditional brands. The most intense competition is occurring in the price-sensitive high-volume segment, where emergent Chinese brands like BYD and GAC Aion are continuously taking market share from established industry leaders.

Two paths, one goal: The brand strategy of the Chinese challengers

For vehicles and services to sell successfully in major markets such as China, Europe and the USA, brand identity and brand image play a key role.

Companies that want to gain a foothold in these regions often use one of the following two strategies:

1. Establishment of new global brands: Businesses create new brands that appeal to the cultural and stylistic preferences of the target group in question.

Two Paths to brand development in Europe and China



Development of new global brands

Nio, XPeng, BYD,
Zeekr, Lynk & Co., ...
approx. 20 brands
with a presence in
Europe



Acquisition of brands with brand heritage

Polestar, MG, Lotus,
Smart

Image 2: Two key ways to create successful brands in the long-term

Examples of this are brands such as Lynk & Co., XPeng and Nio. Instead of copying the product and service offers of established brands, manufacturers take innovative approaches in their brand image, product offers and communication.

2. Acquisition of traditional brands: In this strategy, car manufacturers take the approach of acquiring familiar, established brands. One major advantage of this tactic is that these brands are often well-known and have already earned the trust of their target audiences. The acquisitions are regularly followed by radical changes to the product portfolios.

To ensure that the vehicles meet the aesthetic and functional needs of the key global regions (China, Europe, and the USA), some companies base their development and design departments in the USA or Europe. For example, the brands Zeekr and Polestar, which belong to Geely, rely on a team of experts in Sweden. Similarly, Nio runs a design center in Munich, has opened an innovation hub in Berlin, and has multiple software teams working in the USA.

China vs. Europe Different positioning

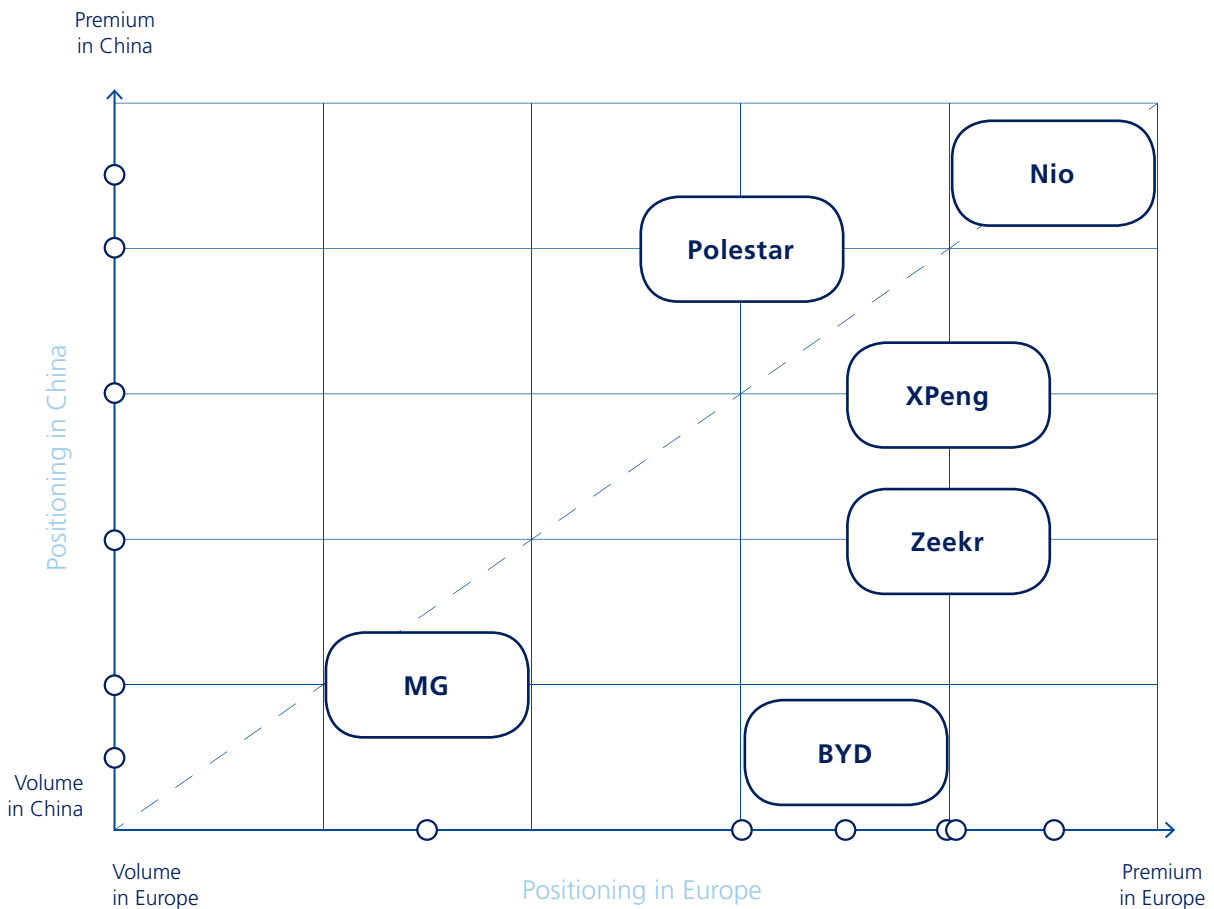


Image 3: Divergent brand positioning in China and Europe

This gives us a chance to see how brand positioning can vary between export markets and the domestic market. For example, Nio and Polestar are considered premium brands in both China and Europe. Brands like BYD or MG are more of a mass-market product in China, while striving to position themselves in the premium segment in Europe. Whether these strategies will meet with long-term success is something that remains to be seen in the next few years. But when these plans are implemented strategically, the flexible market positioning and pricing can be of a great advantage to the manufacturer.

Focus on buyers: Customer-centric approach replaces product-centric strategies

The emergent Chinese automotive brands are following a new business strategy: placing particular emphasis on the customers' perspectives when building their product and service portfolio. The consumer's needs and desires are front and center—especially when it comes to digital features and the integration of networked ecosystems.

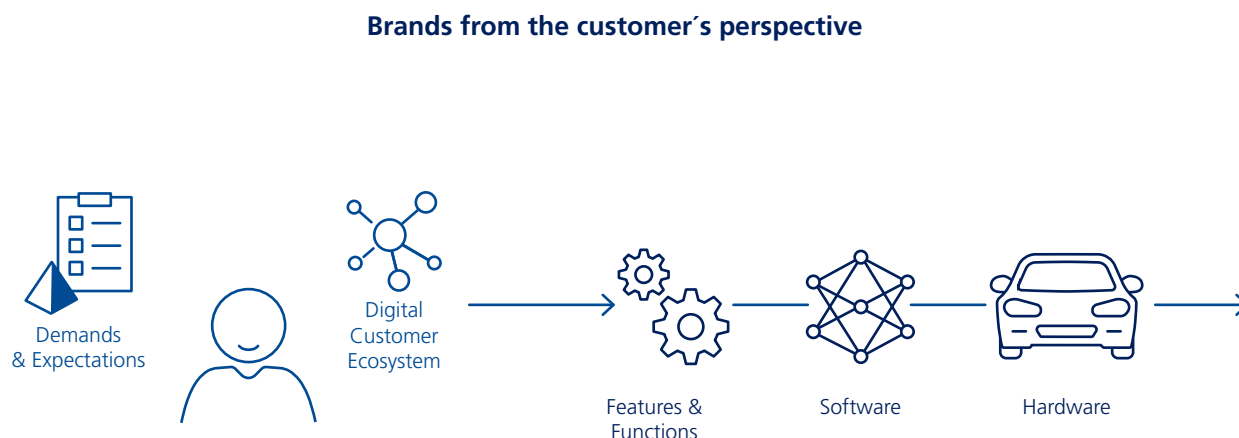


Image 4: Seeing things from the customers' perspective: Portfolios and services are customer-oriented

This contrasts sharply with the approach taken by traditional car brands, whose primary focus in the past has been the product itself. Features and customer demands were often only considered as an afterthought. The customer-centric approach taken by Chinese brands unites digital expertise, progressive design and high product quality in a comprehensive package.

The results of this strategy are impressive. Chinese OEMs are not only developing individual vehicles or services; they are creating entire ecosystems. These consist of digital platforms, features, and products that adapt based on the specific, ever-changing needs of the customer. It is particularly worth emphasizing that the customer's complete digital ecosystem is the central focus point here; the car and its software are integrated into the ecosystem as a "device". It is exactly this change of paradigms that allows Chinese brands to stand out and compete successfully in the global market.

To meet the needs of the customer in a targeted manner, Chinese companies use a software-first approach that relies on software-defined vehicles (SDVs) as enablers. Without a software-based approach and an efficient platform strategy, the gap between the young challengers and the established OEMs cannot be closed.

Chinese brands impress consumers with cutting-edge technical features

As mentioned previously, 50% of survey respondents could imagine purchasing a Chinese car. The reasons

given for choosing a car from a Chinese brand show that user-friendliness is becoming ever-more important:

Good infotainment systems, modern connectivity, high-quality assistance systems and interior design featuring large screens are particularly popular in China, but are becoming more important in Europe as well. This is where the Chinese manufacturers can make the most of their strengths. For 65% of Chinese respondents, good digital features are a reason to purchase a car from their home country. In Europe, that number is 51%.

It is a widespread belief that Chinese brands are positioning themselves more in the premium, higher-price segments—but consumers contradict that belief. Globally, nearly 50% of survey respondents say that a good value for the money is essential when purchasing a car. In Germany, that number is even higher at 66%.

For 38% of participants, the high quality of Chinese cars is the next most-important criteria following value for money.

Global perspectives: European automotive brands have some catching up to do

From the customer's perspective, the areas European automakers most need to improve in are price, range, and software.

What speaks in favor of purchasing a car from a Chinese manufacturer?

Response in % | Multiple answers possible

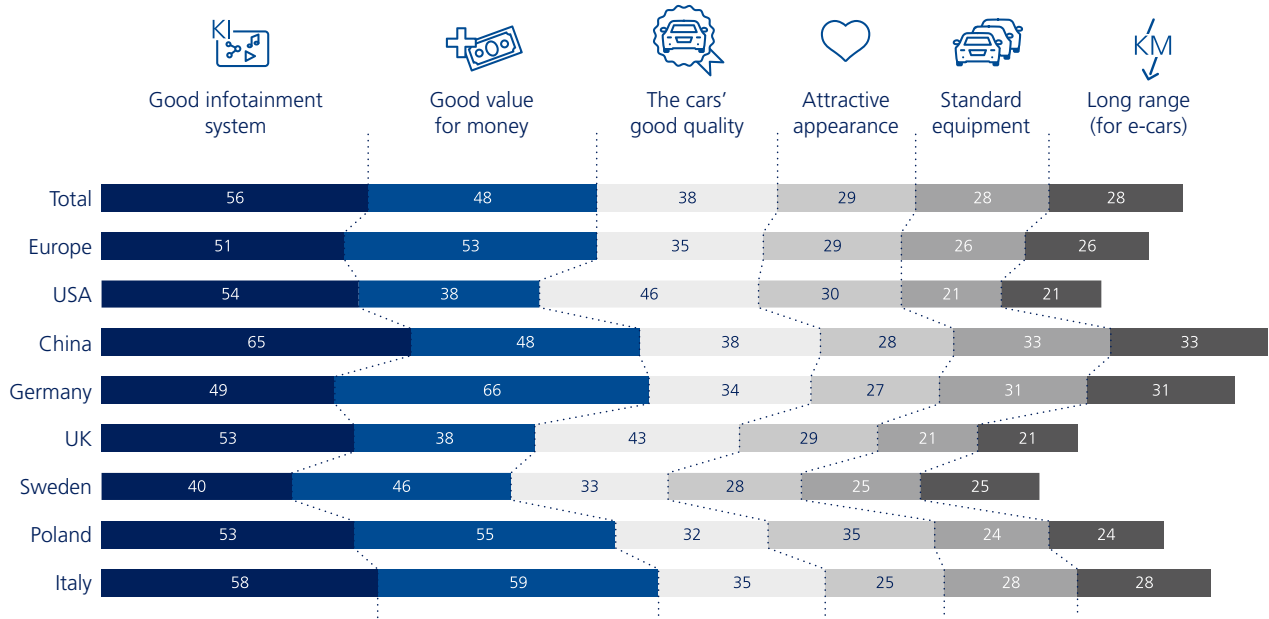


Image 5: Reasons for purchasing a car model from China

Where do you see the greatest need for European automakers to catch up?

Response in % | Multiple answers possible

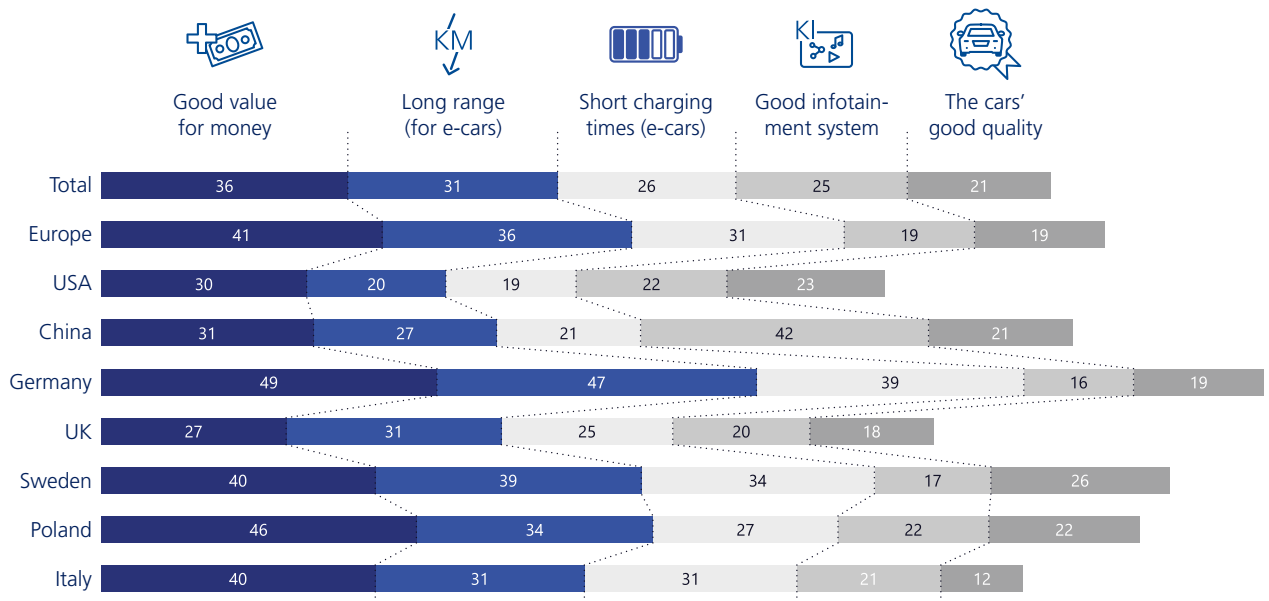


Image 6: Areas needing improvement can be clearly defined

More than 35% of the nearly 5,000 survey participants said that the value for money of current vehicles has room for improvement; in Germany, nearly 50% of participants shared this opinion. In the UK, only 27% of participants consider value for money to be decisive in their purchasing decision—the lowest value among all nationalities.

Looking at the survey responses, we can see that vehicle range and charging times are categories where there is an urgent need to catch up. More than 30% of participants worldwide say that companies need to work on range. More than 26% of participants listed charging time as being in need of improvement. But perceptions differ significantly among customers in China, the USA and Europe. 31% of European respondents see a need for improvement in charging times; that number was 21% in China and only 19% in the USA.

This makes it clear that buyer needs to vary by region, and consumers in China believe that European automakers need to improve in different areas than

customers from the USA and Europe itself. The best example is the localization of the vehicles. 13% of Europeans indicated that the vehicles need to better adapt to local demands. In China, that number is nearly twice as high: 24% of Chinese respondents believe that European auto manufacturers need to focus more on the localization of their products and services. The situation was similar when it came to online sales. Respondents from China estimated the need for European manufacturers to improve as being three times as high as participants from Europe.

The results make one thing clear: European carmakers should act quickly to close the gaps in charging time, range, and value for money. This way, they can avoid losing their relevance in the marketplace while taking the opportunity to address their customers' needs and explore modern technologies in this context.





Software- defined vehicle architecture as an enabler

Value of the vehicle increases over the lifespan

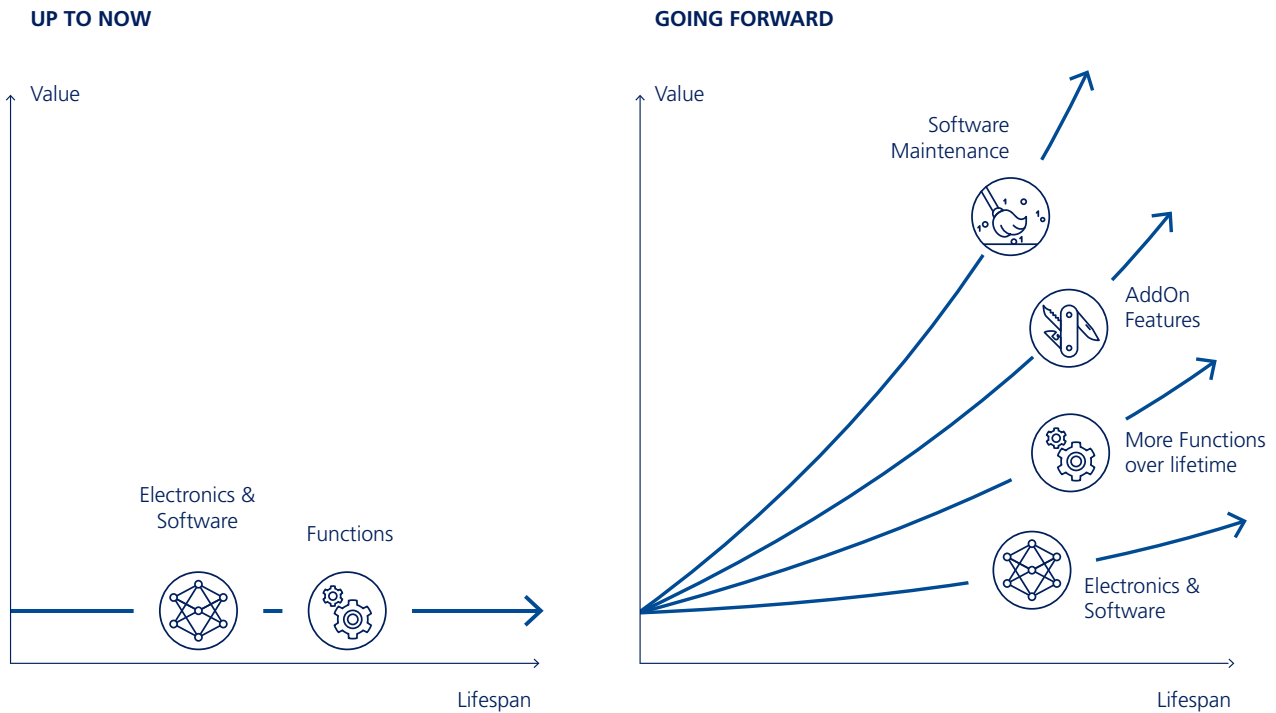


Image 7: Value of SDVs increases across the lifespan

The concept of software-defined vehicles was first formulated by Tesla more than 10 years ago, and it has been developed continuously since then. Other companies such as BYD, XPeng, Rivian and NIO have oriented themselves on Tesla and subsequently developed their vehicles along similar lines. When it comes to the SW stacks that differentiate them from the competition, the challengers take a vertical approach.

Good to know:

In a vertical approach, a company maximizes the value created from differentiating components within the technological value chain while minimizing the use of suppliers. Along with the software, semiconductors (chips) and battery cells are currently differentiating components within the value chain. The software also takes a position of paramount importance because it serves as the interface with the customer and has a critical impact on the customer experience (CX).

Traditional manufacturers are forced to manage the balancing act between existing platforms and the development of new SDV-based platforms. They are faced with the challenge of centralizing the various

platforms and models in software-defined vehicles. The Renault group, Stellantis and Volvo Cars have implemented software platforms that are primarily developed and made available by third parties.

In contrast, companies like Mercedes-Benz AG, the BMW Group, Volkswagen, and Hyundai rely on their own vehicle operating systems that they develop in-house. These are supplemented with co-operations. In the next chapter, we will discuss how these approaches differ.

Meeting customer expectations with a software-first approach

Chinese and German customers have similar demands in terms of product features when it comes to premium car brands. The only difference is this: in China, consumers demonstrate a greater interest in intelligent cockpits and advanced driver assistance systems (AD/ADAS). Their readiness to activate these types of systems after purchase is also higher. With an eye to the future, we can see that technological innovations play a decisive role for a significant number of buyers when

purchasing a car. This fact shows that customer preferences have changed drastically in the past few years and that vehicles with cutting-edge technology and digital features are gaining in popularity. Consequently, car manufacturers would be well-advised to take this shift into account and equip their products with the options that consumers want. To meet the ever-growing, ever-changing demands of their customers, a “software first” approach is indispensable.

An overview of the benefits of SDVs:

- **Updates without a trip to the service center:** Vehicles can be updated and equipped with additional functions using over-the-air updates (OTA).
- **Improved user experience:** Drivers can adjust and personalize the driving experience to suit their particular preferences.
- **Increased driving safety:** The software-first approach with implementation and maintenance of ADAS or AI assistants can reduce accidents on the road.
- **Efficiency and range:** Vehicle software, AI and machine learning can be adapted to improve efficiency and increase vehicle range.
- **Payment device:** The vehicle can serve as a payment device, e.g. for charging stations or for numerous other services.
- **Continuous optimization:** Regular updates and the use of artificial intelligence ensure continuous improvement of the on-board assistants and avatars.
- **Third-party integrations:** An open ecosystem makes it possible to integrate third-party applications, which opens up nearly unlimited options for users.
- **Customer loyalty:** Customer data can be used to create personalized offers that increase customer loyalty.
- **High residual value:** SDVs can be sold for a higher residual value compared to traditional vehicles, because the models can hold their own against later models over a longer period of time.
- **New potential revenue:** OEMs hope to create new revenue streams using software defined vehicles. Software updates, on-demand functions and the monetization of data should lead to increased revenue.

The relevance of new vehicle features is increasing

Which role will newer vehicle features (like infotainment, assistance systems, connectivity, etc.) play in the purchase of a car in 5 years?

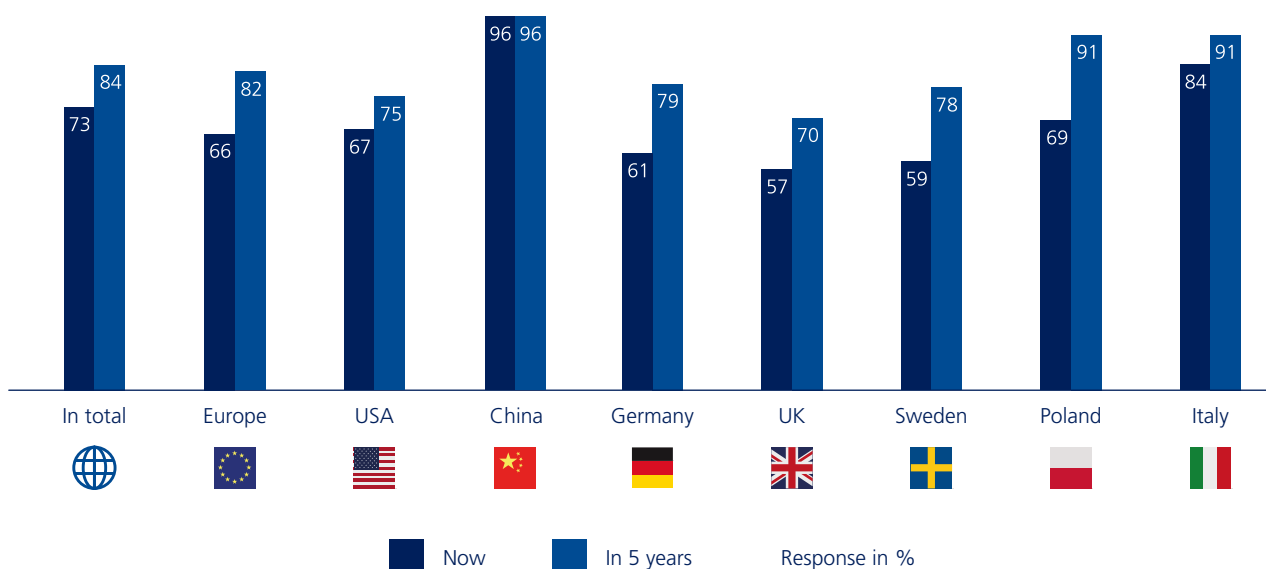


Image 8: Newer vehicle features are increasingly important to buyers

The relevance of new vehicle features such as powerful infotainment systems, ADAS and assistance systems and connectivity will increase in nearly all of the surveyed regions in the coming years. In China, over 95% of consumers already say that these criteria play a decisive role when buying a vehicle. In Europe, on the other hand, the importance of modern vehicle features is increasing at the highest rate of all regions surveyed: the relevance of this aspect will increase by more than 15%, according to survey results.

Focus on updates and layer logic

Current developments in the automotive industry are similar to the transformation in the mobile phone industry. The introduction of more powerful hardware, an overarching operating system (e.g. Apple iOS or An-

droid OS) and an app store that created an open ecosystem turned the mobile phone industry on its head.

We still talk about what is known as the “NOKIA effect”: the industry changed drastically as we made the innovative leap to the modern smartphone. Manufacturers like NOKIA, Siemens or Blackberry have stepped away from the business of mobile devices altogether. Whether we should expect a comparable development in the automotive industry remains to be seen. Although the comparison does seem quite relevant, vehicles are systems that are far more complex than smartphones and tablets. Cars have different safety requirements and much longer usage lives.

The future E/E architecture for cars will be centralized and connected to the cloud. The fragmented E/E architectures that are currently so common are marked by decentralized ECUs and a central gateway and are not suitable for software-defined vehicles.

From “fixed functions” to “always updatable”

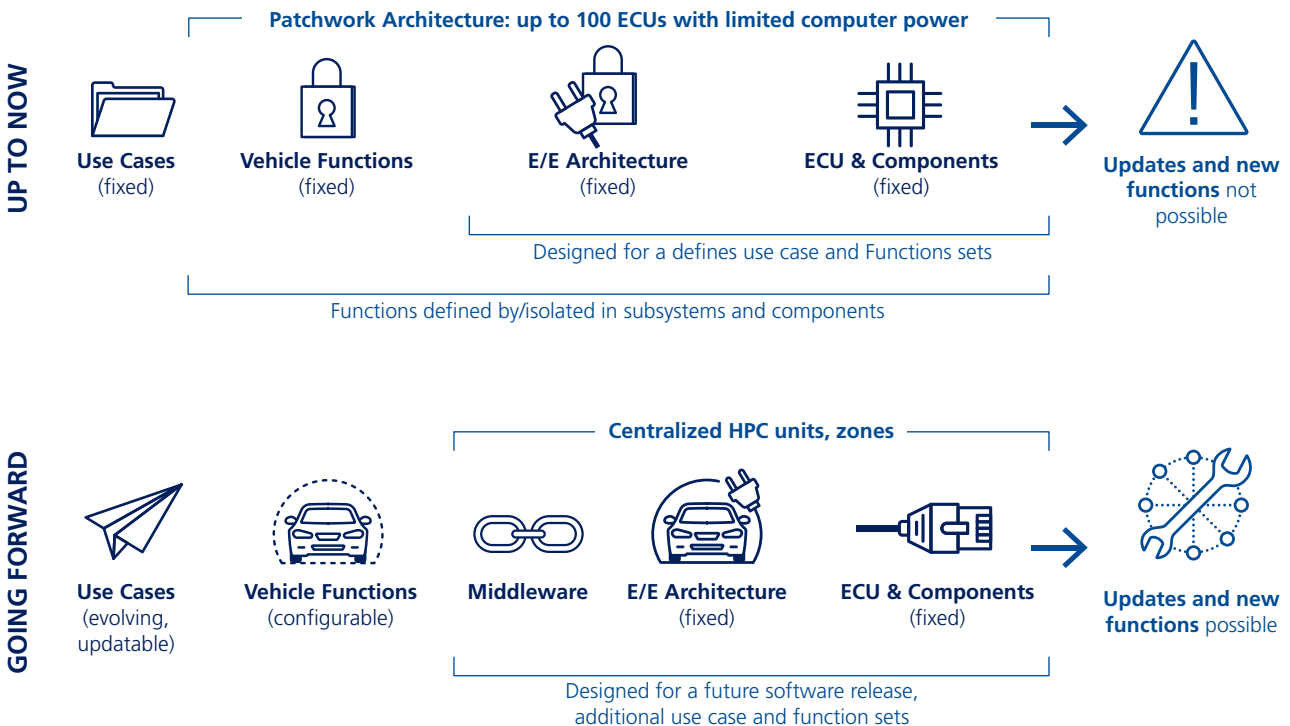


Image 9: Development of car models from fixed functionality to progressive development that is possible at any time

For Ford CEO Jim Farley¹ and his competitors, the classically designed car has a marked disadvantage: in a modern car, you can find modules with computer chips from up to 150 different suppliers. The software on the modules was developed by the associated supplier, and it is impossible to connect them with each other. The software's IP also belongs to the individual supplier. If an OEM like Ford wants to make a change to the software at some later point, it has to outsource this task to the supplier. What's more, the software is written in different programming languages and structured differently.

To get around this problem, software-defined vehicles must use an E/E architecture with a central, high-performance computer and a few zones with individual zone-control units. This means that the next generation of E/E architecture will be divided up into just a few zones that are controlled by ECUs. A central HPC connects the zones and the core of the E/E platform. A

cockpit domain controller delivers the compute power for the in-car infotainment and entertainment offerings.

The software should primarily be developed internally and separately from the hardware to make frequent updates possible. The challenge here is that, up until now, car manufacturers have not developed any automotive software. To be able to develop the software in-house, businesses will need new forms of organization, innovative working methods and talent with the necessary skills.

An SDV's hardware layer generally consists of an infotainment computer in the vehicle, an ADAS computer, controls for the exterior and interior, a central steering mechanism and a connectivity module. On the basis of this hardware layer, an expanded software layer controls all processes—including general functions, SDKs and APIs.

Software-defined vehicles as enablers to remain competitive

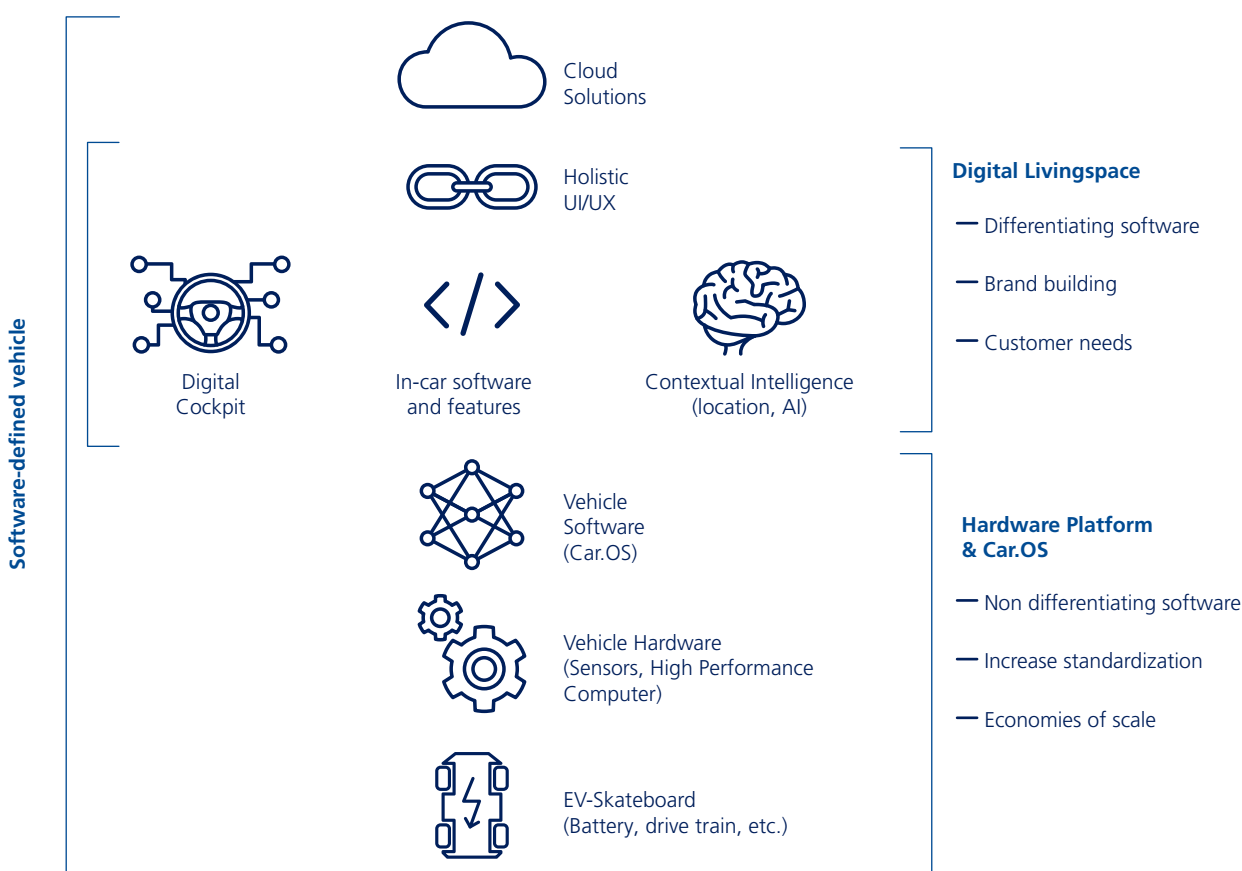
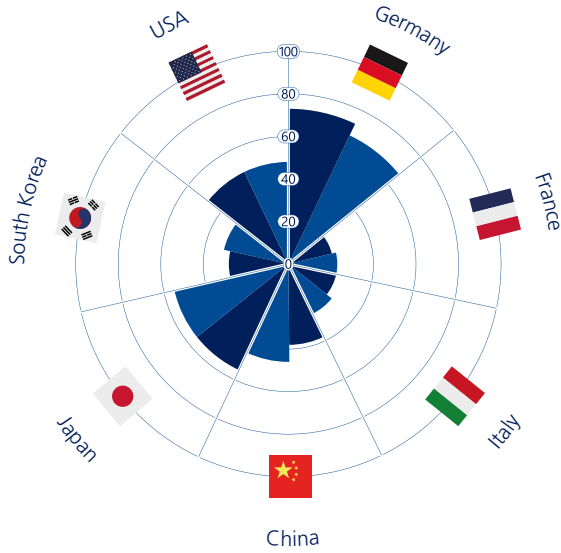


Image 10: Overview of the layer logic of a software-defined vehicle

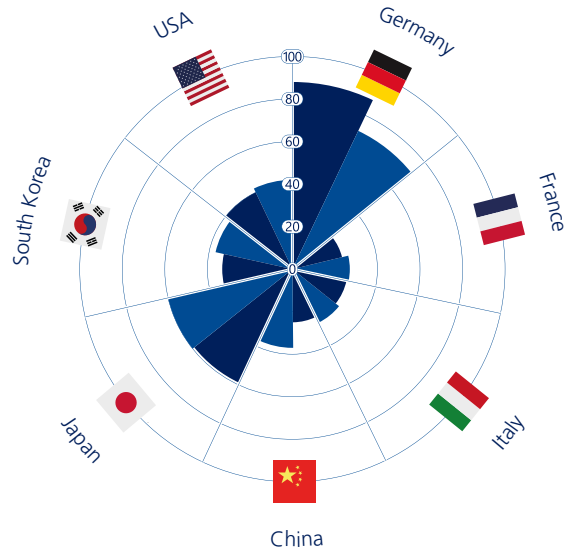
¹ Ford CEO Jim Farley | Fully Charged Podcast

**In your opinion, which car manufacturers have particular expertise in newer vehicle features?
(such as infotainment, assistance systems, connectivity, etc.)**

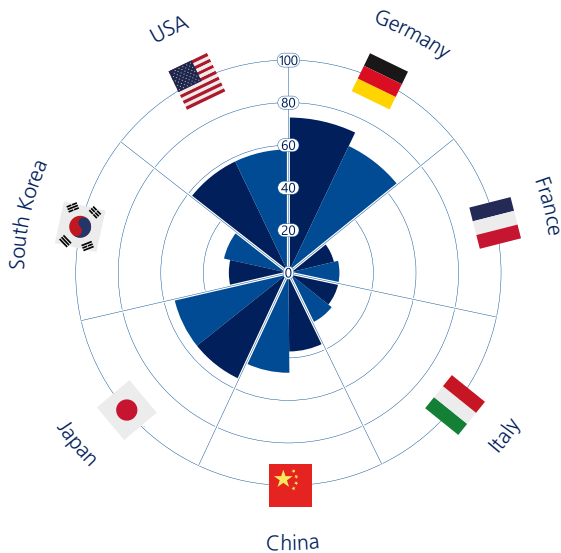
Global respondents



German respondents



Chinese respondents



Globally, German OEMs are recognized for their expertise in digital vehicle features. However, that trend is on a slight decline, whereas Chinese OEMs, in particular, are showing a rapid upswing.

■ Now ■ In 5 years Response in %

Image 11: Estimated expertise of international car manufacturers in terms of implementation of new vehicle features

The user interacts with the application layer, while the OEMs either develop their own layer or enter into partnerships with hyperscalers like Google or Amazon. The user interface is often designed by the brands themselves to create a unique brand experience.

Cloud services and a constant connection between the vehicle and the data clouds are essential to SDVs. A cloud service is connected with the SDV to collect, process and analyse data. The insights that are attained make it possible to develop new use cases and business models.

It is essential to keep regional differences in mind. An OEM will need to think about at least two different cloud services: one solution will be needed for China, and another for Europe and the USA. The reason for this is that US cloud providers like AWS, Azure, or Google Cloud are either not active in China or can provide only very limited services. Chinese cloud providers, on the other hand, face challenges in the USA and Europe. As a result, businesses must adopt a dual strategy to meet the needs of their customers globally. The localization in terms of the networking and integration into digital ecosystems is a comparable issue; customers have different expectations in different regions. In China, the integration of digital ecosystems such as WeChat or AliPay is essential. In the USA and Europe, on the other hand, ecosystems such as YouTube, Facebook, or payment platforms like PayPal must be integrated.

Expertise in the implementation of new vehicle features

As previously mentioned, the relevance of digital features will continue to increase in all surveyed regions in the coming five years. Nonetheless, traditional vehicle features will also continue to play a significant role.

Attractive offers in terms of production quality, steering, and chassis have become hygiene factors that are expected by customers around the world.

Expertise in the implementation of digital features was also studied as part of the survey—with a surprising result. German manufacturers enjoy a reputation for having the highest level of expertise in this area—although this tendency is waning, according to the worldwide opinion of survey participants. When it comes to European manufacturers, though, things look quite different. In this case, the global participants do not believe that European brands have expertise in digital offers. The manufacturers from the USA enjoy the highest level of trust now and in five years.

Based on the survey results, the Chinese brands will make the greatest progress in the coming five years.



Implementation: The path to software-defined vehicles

On principle, companies will need to adhere to the following principles to profitably sell software-defined vehicles:

- The vehicle’s hardware must be future-oriented. That means that even future software releases will need to be compatible with the existing vehicle architecture and components, without any noticeable limitations for the users.
- When developing the software, it is important that the software is largely hardware-agnostic, as well as being backwards-compatible with existing E/E configurations.
- Similar to smartphones, there must be an ecosystem with services and functions available, to make on-going expansion and monetization possible.

In the following, you will be presented with an overview of the greatest challenges facing car manufacturers on their path to software-defined vehicles.

Decoupling of software and hardware as a key challenge

One of software-defined vehicles’ significant differences is that the development of hardware and software is decoupled.

- Software must be developed in such a way that it is backwards-compatible with the current generation of hardware.
- The applicable hardware should be configured so that future versions of the software will run on it smoothly. This requires a change in thinking because, until now, it has been extremely rare for hardware manufacturers to build in more hardware capacity than currently needed.
- Finally, a customer-centred ecosystem is required to create new revenue streams.

Decoupling of hardware & software development

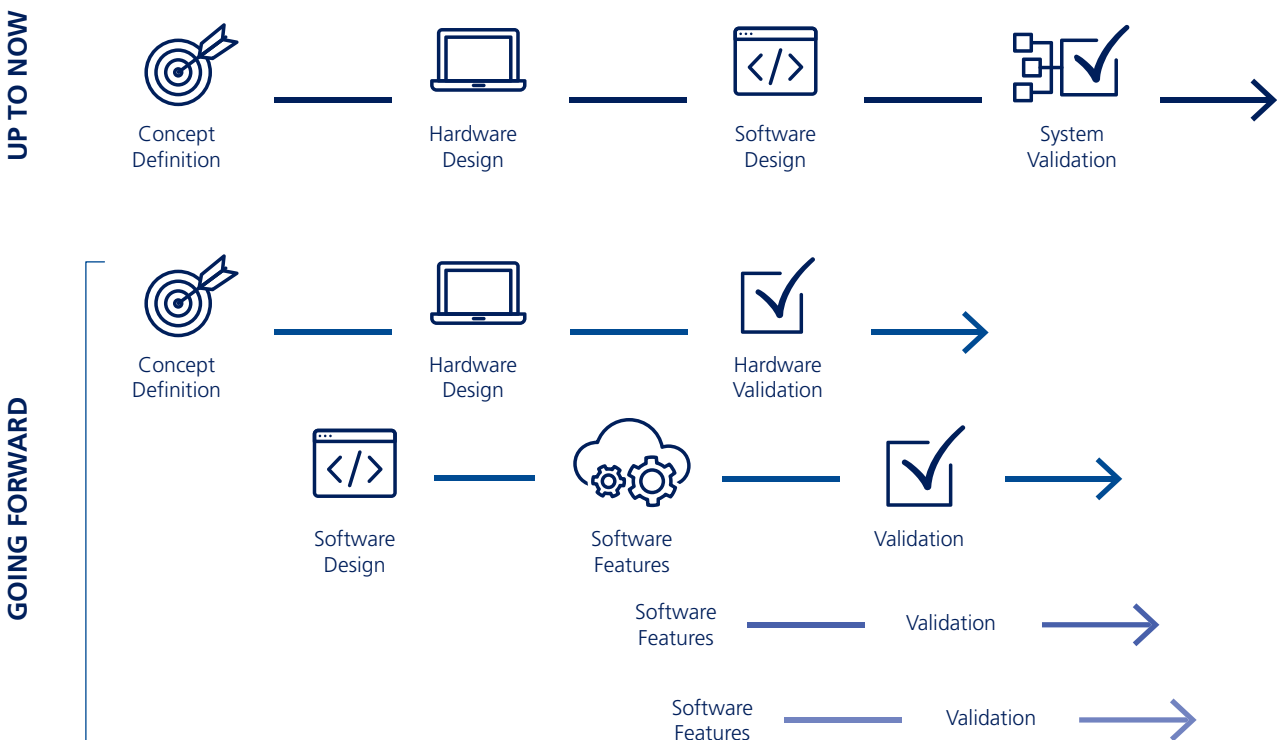


Image 12: An overview of the progression of decoupled hardware and software

Use of zones instead of domain architecture

A zonal architecture in cars is an approach to redesigning the electrical and electronic architecture (E/E architecture) that should satisfy the increasing requirements of connected, software-defined vehicles. In contrast to the domain architecture that is currently used, which separates functions like infotainment or the vehicle's chassis into separate domains, zonal architecture attempts to organize the functions based on their location in the vehicle.

Transitioning from a domain architecture to a zonal E/E architecture can help to speed up the development of new vehicles. Instead of using domain controllers (ECUs) that often number into the hundreds, a zonal architecture typically uses a small number of zone controllers. While traditional cars typically divide similar functions into domains, zonal architecture divides the car into multiple zones and the functions are assigned to the individual zones.

Each zone has one, or sometimes more, ECUs, which are used by multiple data streams. Depending on the vehicle's complexity, four to six zones are created. The zone ECUs are connected to a central computer. The network, comprised of a central computer and a few ECUs in the zones, takes over the functionality that would previously have been handled by a large number of domain controllers.

The benefits of a zonal architecture are obvious. The complexity of the connections and wiring is reduced, which reduces both weight and the effort required for assembly. Signals and data no longer need to be sent through the entire vehicle. They are processed locally in each zone. That saves components and energy. The number of ECUs is drastically reduced, and new functions can be added to the zones more easily.

Another benefit of the zonal E/E architecture is that it can be used across all car models. Configuration of functions and installation of updates can be done by adjusting the zones, without needing to change the E/E architecture. That saves development time and, of course, costs.

Tesla is considered a pioneer of zonal architecture, but Chinese manufacturers such as Nio, BYD, Xpeng and Dongfeng are also quickly moving in this direction. Traditional car manufacturers like BMW, Mercedes-Benz and Volkswagen are more cautious in their approach, and are planning a gradual transition.

South Korean and Japanese manufacturers, on the other hand, are hesitant and observing the developments in the industry.

Implementation using a horizontal or vertical approach

When it comes to implementation, there are two possible paths.

- **Primarily vertical approach:** Some companies use this approach to defining their software-defined vehicles. With a vertical approach, the focus is on high internal value creation based on the innovative SW systems and the resulting functionalities.
- **Horizontal approach:** The horizontal approach is in direct contrast to the vertical approach. It places less emphasis on in-house value creation. The company enters into partnerships to develop the various layers of the software-defined vehicle structure.

Being deeply integrated in the Chinese market is essential to ensuring the company's long-term success and to continued expansion. Partnerships across different levels play a critical role in this integration.

Possible approaches to partnerships to ensure successful implementation

1. Horizontal partnerships in key technologies

The rapid technological advances in areas such as infotainment, ADAS/AD (Advanced Driver Assistance Systems/Autonomous Driving) and charging infrastructure demands specific expertise and innovative solutions. Horizontal partnerships can help businesses create synergies and collaborate to develop solutions that meet specific customer demands.

Infotainment partnerships: We can already find examples of best practices here, such as the cooperation between VW and ThunderSoft or Polestar and XingJi Meizu / Flyme Auto. These partnerships aim to offer customers an improved, localized in-car entertainment experience.

2. Comprehensive partnerships for the entire vehicle development process

Some established automotive brands have recognized the value of partnerships throughout the car's entire

development phase. For example, SAIC and Audi, VW and XPeng and Toyota and BYD have teamed up to serve the Chinese market together. These co-operations not only offer access to local resources and knowledge, but also offer the chance to develop products that are precisely tailored to meet the needs of Chinese customers.

3. Development of local expertise

To gain a foothold in the Chinese market, it is essential to develop local expertise. This can be done by establishing local units for software and electronic development, for example. These types of units ensure that the products and services meet the specific demands and preferences of the Chinese culture.

Strengthening independence

Partnerships might be important, but it is also crucial to attain a certain level of independence. This allows companies to stay flexible and react quickly to changes in the market. The trade-offs between independence, time-to-market, and access to technology must all be considered.

In short: Establishing a variety of partnerships and developing local expertise creates a solid basis that will help to secure long-term success in the largest automotive markets in the world. It should be taken into account that, even with partnerships, bringing new models to the market takes several years.

The automakers Toyota and BYD, for example, announced a vehicle development partnership at the end of 2019. The car was not presented for another three years. VW estimates that the models that they are developing in cooperation with XPENG will go to market in 2026. The cars from Audi and SAIC are expected in 2025.

Factors for a successful product launch

Chinese OEMs use three additional levers to accelerate product launches.

1. Use of manufacturing as a service

Chinese automotive brands use different mechanisms to rapidly expand their product portfolios. Zeekr and Nio, for example, both launched new products in an extremely short time frame.

Zeekr, a Geely brand, was able to rapidly launch three new models due to the existing resources in the group's development and production units. Zeekr benefited from the expertise that Geely itself had acquired as a shareholder, e.g. of Mercedes Benz or as Polestar's parent company (in partnership with Volvo). This also showed clearly that development and production themselves are no longer differentiating factors and that, when they are available, they can be used for different brands and customer experiences.

Nio entered the market as a newcomer and began production of eight models within five years. In that time, they also developed the new platform NT2 and launched the second generation of some models. At the same time, more than 100 Nio Houses and Nio Spaces were brought to market and a network of over 1,500 battery swap stations was developed. Nio is currently working on two new sub-brands for the volume and entry level segments, which will put it in competition with VW and other volume brands in the midterm. The speed was possible due to an important partnership: Nio entered into a joint venture partnership with the company JAC to produce the vehicles. Nio concentrates on developing and marketing the cars, while JAC can rely on its years of experience in automotive production.

2. Driving development with digital twins

Chinese OEMs follow a reliable approach: they build a digital twin using the vehicle's data. This allows them to continuously improve the vehicle and develop new customer-centric functions and services.

They can merge the vehicle's data points in the cloud to create a digital twin, allowing them to define targeted offers for customers. Manufacturers then use the data points related to aspects such as maintenance and energy consumption for targeted optimization of vehicle components. In this way, the driving data and signals from the ADAS systems can be used to create new safety features.

3. Get-it-done mentality

In addition to a focus on technological innovations, most new challengers in the market distinguish themselves with their get-it-done mindset. At all levels of the organization, the focus is on the goal of bringing products and services to market as quickly as possible in order to stay ahead of the competition. Thanks to

the previously described E/E architecture and the software-defined vehicle design, companies can quickly improve their products using customer data, without needing to wait for the next production cycle.

There's no need for endless debates based on intricately detailed decision-making documents. Instead, executives make their decisions quickly and efficiently—and the time saved allows the company to accelerate their market entry.

4. Embedding in regional digital ecosystems

Due to the focus on developing the vehicle and its functions, companies often overlook the fact that the customer experience in the car is defined above all by

the digital interfaces. Customers expect that the applications, apps, and services that they use on their smartphones will also be accessible on the infotainment system—with the same level of personalization as on their own phones. Because, as previously mentioned, digital ecosystems vary from region to region, integrations for each region must be created. It is impossible to overstate how relevant seamlessly integrated regional digital ecosystems are to buying decisions and customer satisfaction.

Think beyond the car: Expanding the brand into life domains as vision and mission

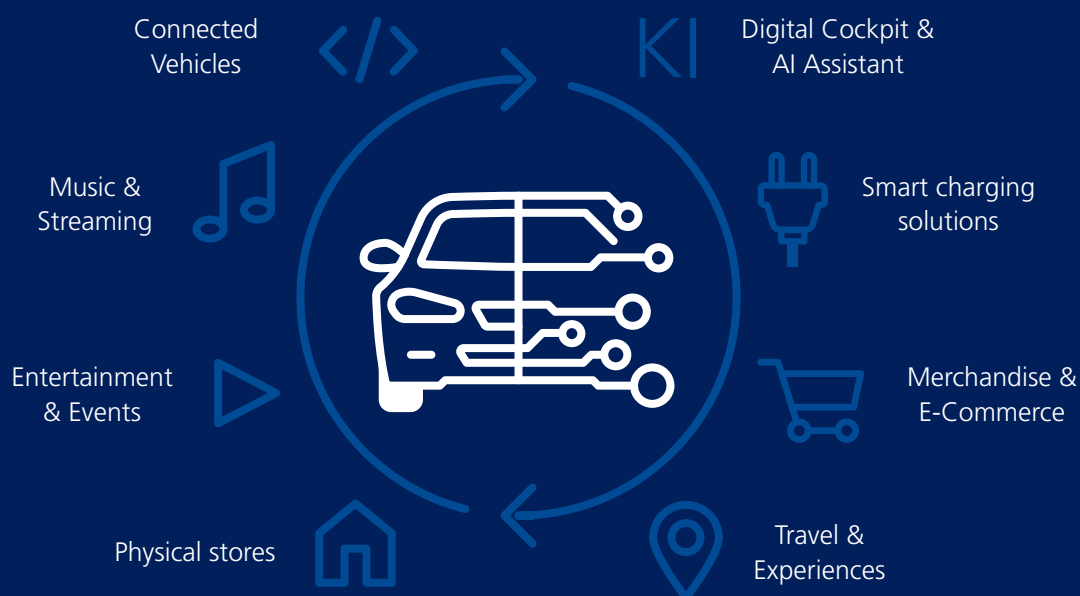


Image 13: Chinese OEMs occasionally have a larger user base within their digital ecosystems than they have actual vehicle owners



Challenges and goals for Western OEMs

OEMs in the Western world face several fundamental challenges in their efforts to remain competitive. By setting the correct targets, however, these can be overcome and the development of modern car models can be driven forward.

A double burden: Developing new platforms, maintaining existing ones

Established automotive manufacturers face a dual burden. Firstly, they need to modernize their existing platforms with strategies that bridge the gap by compensating for their current deficits compared to the advanced software-defined vehicles platforms. Secondly, it is essential that they simultaneously develop innovative, future-oriented software platforms that will efficiently close their fundamental technological gaps.

Traditional OEMs face challenges at many levels:

- The customers already demand high-performance products and services. From their perspective, it doesn't matter which platform the vehicles are based on. They will penalize the OEM for a lack of features and insufficient performance.
- The costs for developing the platform could reach into the billions. That means that automotive companies need to carefully plan the financing for the transformation.
- As we have already shown, developing platforms for software-defined vehicles requires new processes, new forms of organization and—most of all—employees with the necessary skills. The organizational transformation is complex and will take time

Short-term strategies: Keeping the flywheel in motion

Up until now, major auto brands and companies were like a smoothly rotating flywheel. They are now beginning to rotate more slowly or irregularly. Here's a brief overview of how the flywheel effect works:

- The growing product portfolio is sold with single-digit profit margins; in the premium and luxury segments, two-digit profit margins are also possible.

- The sales volumes for the various models and derivatives increases continuously, often with positive "operating leverage".
- The resulting profits have been used to finance new platforms, models and model updates, which have, in turn, kept the flywheel going.

For many traditional OEMs, their business in China as well as Europe is essential to their survival as a company. Without the sales and profits from those regions, the car manufacturers are no longer able to develop new product platforms, update existing models or enter new business segments and regions.

Long-term goal: Their own vertical software-defined vehicle platform

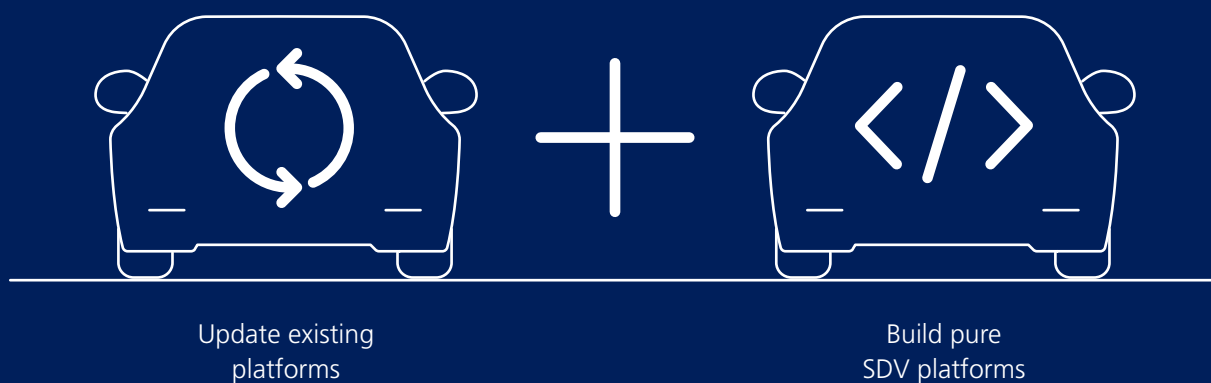
Companies must ensure that their software can be repurposed. To survive in this new era of networked cars, it is critical for OEMs to sink their software development costs while increasing the quality of the software. The new era of SDVs promises software platforms that companies will be able to use across multiple models and generations of vehicles. These will offer standardization and over-the-air updates that help OEMs to accelerate development while improving the quality of the end product.

Most car manufacturers and brands have already recognized the urgency of the situation and, in many cases, already began implementing appropriate strategies several years ago. Tesla's success and the transformation of China's automotive industry were wakeup calls that were impossible for the traditional car manufacturers in Europe, South Korea, Japan, and the USA to miss. Nonetheless, the process of waking up is simply taking too long for the traditional manufacturers. This is a boon to the up-and-coming challengers, who take strategic advantage of their competitor's lumbering progress to put themselves yet further in the lead.

But the traditional OEMs shouldn't be accused of idleness. In recent years, many of them have already announced plans to build software powerhouses. With dedicated teams, budgets in the billions, and—in some cases—dedicated companies, they are developing the software platforms of the future and combining them with the hardware platforms.

Traditional OEMs must continue developing platforms while simultaneously starting with SDV platforms

TRADITIONAL OEMs



NEWCOMERS

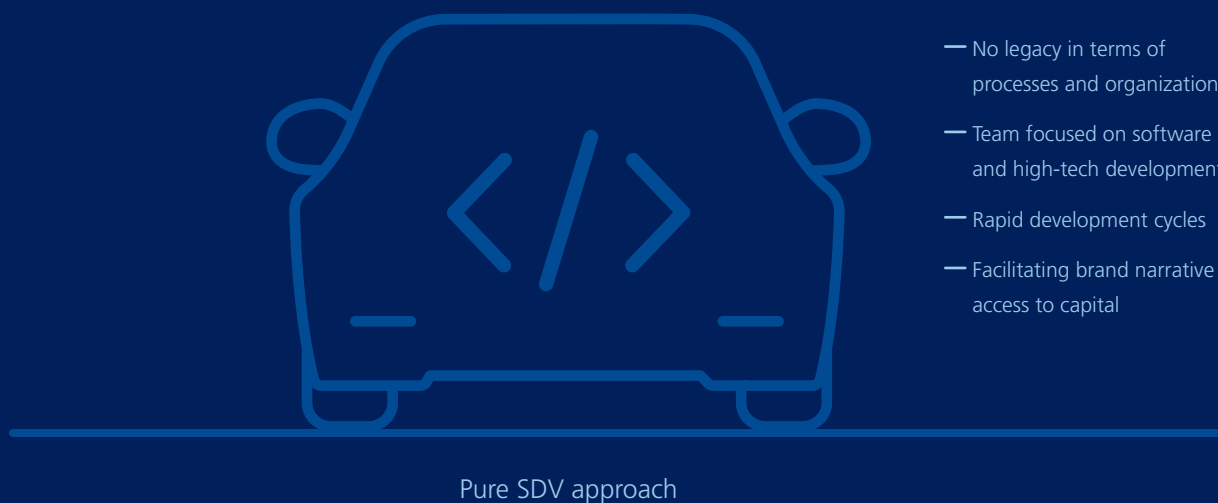


Image 14: Traditional OEMs face a double burden when implementing an SDV approach

Strategic approaches: How traditional automotive companies plan to become software powerhouses

In recent years, a number of OEMs have announced that they plan to shift their businesses towards becoming software powerhouses. This step reflects the increased focus on digitalization and connectivity in the automotive sector. The following is an overview of the leading automotive companies and their strategic approaches:

1. Stellantis

- **Goal:** Developing the vehicle as an open software-defined platform
- **Strategy:** Providing dedicated teams and generous budgets for innovative software solutions and combining said software with hardware platforms
- **Market entry:** Implementation of the software solutions in the first models beginning in 2024
- **Partnerships:** Partnering with technology giants such as Amazon or Foxconn for quicker development

2. Volkswagen

- **Goal:** Development of operating systems and application software for future generations of vehicles, across the group
- **Strategy:** Swift reaction to the transition and introduction of the software unit CARIAD
- **Products:** CARIAD is responsible for the VW.OS and other software solutions
- **Partnerships:** Co-operations with companies such as Bosch and Mobileye or Horizon Robotics to accelerate development

3. Toyota

- **Goal:** Developing a coherent software strategy for future models
- **Strategy:** Bundling software development capacity under the flag “Woven by Toyota”
- **Products:** Main development unit is concentrating on the “Arene” software platform for future models

4. Ford

- **Goal:** Clear division between up-and-coming e-cars and traditional combustion engine models
- **Strategy:** Radical redesign of the business models. The unit “Ford Model e” is focused on the next gen-

eration of exclusively electric, software-defined vehicles while work on the traditional product palette continues in parallel

- **Economic importance:** Product palettes with combustion engines are still essential to Ford’s turnover and profits, which are reinvested in the development of new software-defined vehicles

The automotive industry is in the midst of a radical transformation, in which software and connectivity play an ever-increasing role. Each manufacturer is doing its best to find its own unique way forward, so that it can successfully gain a foothold in this new era.

Taking the lead: Status quo of Chinese automotive brands in Europe

Chinese car brands have been available on the European market for several years. The brand MG (acquired by SAIC) was already sold in Europe in 2011, and the availability of additional brands has been increasing continuously since 2020. The market entries of NIO, BYD and Polestar, in particular, have attracted a great deal of attention.

But the high regard that these brands received has not been reflected in the sales numbers so far. Brands like MG and Polestar, which have been active in Europe for some time and which can build on their existing brand recognition and credibility, show new-vehicle registration numbers in the high five-digits or mid-six-digits each year. According to analyses from JATO Dynamics, however, models like the MG4 are already on the Top-10 list of BEV registrations in Europe and are coming in close on the heels of Volkswagen’s ID. series models.

Other brands that are receiving attention from the media are still showing lower numbers in terms of sales, but this is often due to their very recent entry to the market. It remains to be seen how these marketplace newcomers will develop in the next one to two years. The high cost of market entry must be recuperated quickly to avoid bringing the company’s capital situation out of balance. The successful entry into foreign markets will be an essential success factor for the new competitors from China.

The fact that the new Chinese automotive brands have shown low sales numbers thus far is still no reason for existing players to rest on their laurels. Behind closed

curtains, the newer brands are working intensely to establish solid distribution and service networks. Experts give established brands only two to three more years before the gap between them and the technically innovative newcomers closes drastically. The up-and-coming brands are investing heavily in research and development and stand out from traditional brands with the latest technology and agile business models. In addition, many of the new brands are less weighed down by legacy issues, which allows them to adopt more flexible pricing models and more aggressive marketing strategies.

In addition, they specifically target younger buyers, who have a high affinity for technological developments and environmentally friendly engines. In times of change—particularly in the automotive industry—these kinds of dynamic market newcomers can quickly capture new shares of the market. In order to defend their leading positions, traditional brands should watch these developments closely and proactively adapt to the changing landscape.

Take advantage of existing assets that challengers have not yet developed



Image 15: Existing assets can be decisive in helping brands distinguish themselves from the competition

Chinese companies often distinguish themselves with their perseverance and their ability to adapt quickly—as long as they have secured sufficient financing. It can therefore be assumed that the newcomers will not give up, and that they will dynamically adapt their approach if they notice that they are not progressing with their previous approach.

At the same time, there are growing indications that select Chinese automotive companies such as BYD

Chinese brands preparing to scale



Development of **brand recognition** and **reliability** along the value chain

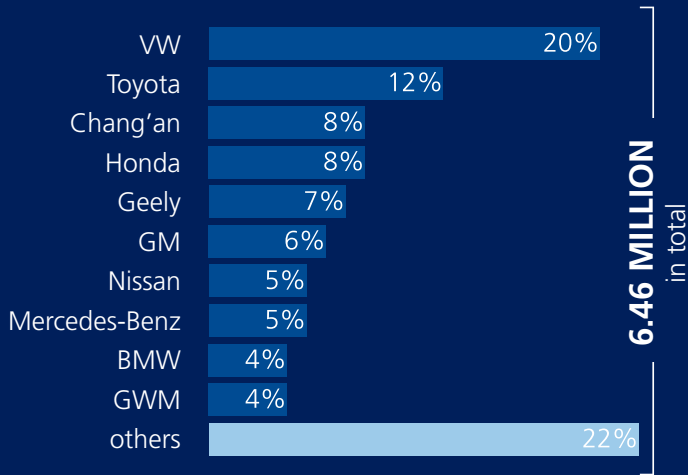
Image 16: Preparation of Chinese brands for scaling

and SAIC would like to develop their own production capabilities in Europe. The companies hope that this step will diversify their business activities and believe that they will be able to react more efficiently to local demand.

Still playing a secondary role: Status quo of Chinese automotive brands in the USA

Chinese car brands are of only minor importance in the USA. Trade tensions between the USA and China,

**COMBUSTIBLE ENGINE VEHICLES
TOP 10
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**NEW ENERGY VEHICLE,
INCL. BEV AND PHEV TOP 10
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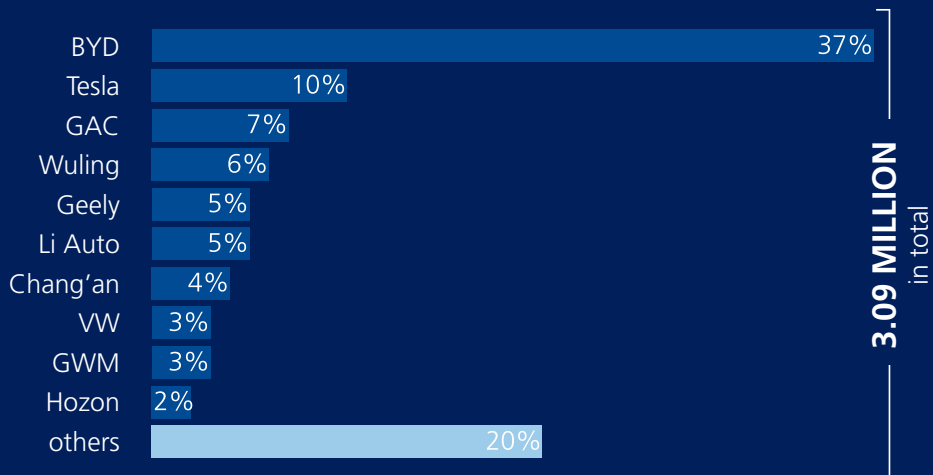


Image 17: Market share of the brands in the ICE and NEV segment

particularly during the Trump administration, made it more difficult for Chinese car brands to enter the US market. Customs, trade restrictions and regulatory checks have made direct investment difficult.

BYD is present in the US market, but is concentrating primarily on electric buses rather than on passenger cars. The brands Volvo and Polestar, which belong to the Geely Group, are sold in the USA. Some of the leading automotive companies and tech corporations have development units in the USA, which are developing the next iteration of digital solutions.

Software technology as a must-have: Status quo of Chinese automotive brands in China

The transformation of China's automotive industry is occurring at a speed that is unmatched in any other region of the world. Driven by the ever-growing range of electric vehicles, Chinese manufacturers have made impressive progress in recent years—in terms of technology as well as design and range. In addition, municipal regulations have also accelerated the transformation. Because air pollution has reached critical levels in many Chinese cities, politicians have implemented a number of measures to limit the use of vehicles with combustion engines—or to forbid them entirely. The combination of technological progress and regulatory interventions has put China at the forefront of the global mobility revolution.

The Western automotive brands may have achieved a dominant place in China's combustion engine segment, but they lag behind when it comes to electric vehicles. However, as a result of the previously described developments, the market for combustion engines is on the decline, which is becoming a problem for Western brands. In contrast, the demand for electric vehicles is growing steadily. That makes it clear: the future of mobility is electric. Brands that cannot adapt quickly enough could lose market share. That means that it is critical for Western manufacturers to rethink their strategies and invest in the growing electric market.

Software-enabled features and the focus on high-tech are setting the tone in China. Without digital vehicle features, no car will sell in China—now or in the future. New local brands can meet these customer expectations, while traditional brands lag behind.

This has erupted into a veritable contest. The first phase was characterized by ever-larger displays; since then, things have progressed to a race to create the most powerful driver assistance systems.

In China's progressive automotive market, local brands are constantly striving to distinguish themselves from international competition. They do this by delighting their customers with innovative technology and services.

Here are some of the functions that Chinese brands are currently using to win over consumers:

1. ADAS (Advanced Driver Assistance Systems):

These advanced driver assistance systems are used in many Chinese vehicles. They help drivers in a variety of situations, from parking to lane-keeping assistance and collision warning systems. Their integration improves not only driver comfort, but also safety. In the last six months, the Chinese automotive industry has displayed remarkable dynamism. Almost a dozen companies in the industry have announced ambitious plans to launch a Navigate on Autopilot (NOA) product in numerous cities around the country. Due to current regulations, the assistance systems are certified as L2 for use on the highway as well as for city centers. These developments reflect the growing interest and faith in the technology. Experts believe that this not only heralds a revolution in the Chinese transportation landscape, but that it could influence the global automotive market as well. The rapid expansion and the dedication of these companies indicates that China could play a leading role in the area of NOA technology in the near future.

2. Native app environments: Integrating apps into the infotainment system that were developed to meet the needs of the Chinese market allows users to access traffic information in real-time, stream music or even order food, just to name a few examples.

3. Artificial intelligence and avatars: Some of the most advanced Chinese vehicles are equipped with intelligent avatars that are capable of communicating with the occupants. These AI systems offer a personalized user experience and can adapt to their preferences and habits.

4. Incorporation into leading digital ecosystems in China:

The seamless integration with the Chinese digital ecosystem of apps like WeChat, AliPay or Baidu allow users to easily incorporate their daily digital activities into their driving experience.

To summarize, Chinese automotive brands not only demonstrate their technological superiority by integrating these modern systems into their vehicles; they also satisfy the needs of an increasingly digital and networked Chinese population. The digital systems designed by many brands still place a strong focus on the domestic market and the needs of Chinese citizens. But we should also anticipate that they will adapt the digital ecosystems to meet European needs in the very near future.

Western brands in China: Challenges and need to adapt

The registration statistics from the first half of 2023 make the dilemma clear. Automotive brands and companies continue to dominate the shrinking market for combustion engine vehicles. VW has a market share of 20%, followed by Toyota with approx. 12%. When it comes to New Electric Vehicles (NEV), traditional brands play only a secondary role. The NEV segment, which includes BEVs, PHEVs and cars with fuel cells, is dominated by challengers like BYD, Tesla and GAC. Western automotive brands, which have shaped the global market for decades, face significant challenges in China. There are multiple reasons for this:

1. Inadequate offers: Although traditional automotive brands are dominant in many regions of the world, they seem unable to satisfy the current needs of the market in China.

2. Slow to adapt: A 48-month product development cycle, which is typical for many Western brands, is too long for the dynamic Chinese market. These long cycles prevent the quick adaptation and changes that would be required to keep pace with local brands.

3. Digital services not competitive enough: Digital services from Western brands are often unable to keep pace with their competition in China. The local brands better understand the specific needs and preferences of Chinese consumers, which allows them to offer more targeted digital solutions.

4. Lack of integration with local ecosystems: The Chinese market is known for its unique digital ecosystems. It is difficult for Western brands to effectively integrate them into their vehicles, which puts them at a disadvantage to local providers.

5. Software not state of the art: The software used in Western vehicles frequently fails to meet the expectations of Chinese customers. Regardless of whether these failings are found in the user interface, functionality or integration, there is considerable need for improvement.

It is clear that Western brands need to reconsider their strategies and offers and adapt to the Chinese market if they want to remain competitive. They need to understand local preferences more deeply and adapt more quickly to changes in the market.

Hidden champion: Status of Chinese car manufacturers in other regions

Chinese car manufacturers are focusing on the up-and-coming brands in South America, ASEAN, and Africa. China is using its geopolitical influence to accelerate the development and distribution of electric vehicles. This could result in many developing countries in which China has a presence transitioning to electric vehicles sooner than originally predicted. A trend of this nature could make things difficult for traditional auto manufacturers that are concentrating on combustion engines.

Countries such as Thailand, Indonesia, Costa Rica and Mexico are already showing sales numbers for electric vehicles that are far higher than expected. At the same time, countries in the ASEAN region are trying to convince Chinese car manufacturers to build local factories to produce products for the local market. This would increase their economic strength.

We should also not overlook the rapid developments in Middle Eastern markets. The BYD Atto 3, for example, is very popular in countries such as Jordan, the United Arab Emirates and Israel. The governmental support and dedication give Chinese manufacturers the confidence to fully invest their resources in electromobility.

In light of this development, traditional Western automakers should not assume that their past success is enough to succeed in the future. Instead, they should make a dedicated effort to introduce modern software that allows them to keep up with the pace of Chinese expansion in the automotive industry.



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