In the driver's seat

How digital solutions will transform the automotive sector in the Asia-Pacific region

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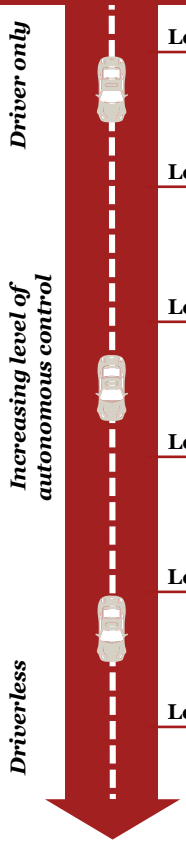
Looking at digitalisation trends in the automotive sector, this report focuses on the adoption of digital solutions within the automobile itself, rather than on the adoption of technologies impacting the production or sales of vehicles. The report looks at how digital technologies will transform the automobile of today into the connected car of tomorrow, evolving into completely driverless systems offering higher levels of personalisation, safety and comfort to passengers.

For the purpose of this report, connected cars are defined as passenger vehicles (including privately-owned cars and taxis) that are able to sense and communicate with other elements of the physical environment including in-vehicle devices, other vehicles, pedestrians and transport infrastructure, with the help of signals shared through sensors and wireless connectivity networks. The report excludes commercial applications of connected transport, and the adoption of technologies within other forms of public transportation such as in buses or urban rail systems.

As per industry convention (SAE International), connected cars can be classified into various levels based on the degree and nature of human/machine control required for driving, as highlighted below:[1]



Level 0 Driver has full longitudinal and lateral control of the vehicle. Connectivity features are limited to audio or visual information alerts, requiring human intervention for corrective action.

Level 1 Driver keeps either longitudinal or lateral control, while the vehicle controls the other function through a driver assistance system.

Level 2 Vehicle is able to take over both longitudinal and lateral control in a defined use case, with help from driver assistance systems. Driver needs to monitor both driving and traffic conditions.

Level 3 Driver does not need to monitor driving nor the environment at all times, but must be able to resume control when required by the vehicle. Vehicle has longitudinal and lateral control.

Level 4 Driverless in certain defined use cases only. Vehicle has longitudinal and lateral control in these situations, and is able to take action even if there is no response to request to intervene.

Level 5 Fully autonomous vehicle controls all driving tasks in all situations. Steering wheel and pedals are optional, with no driver required.

Understanding the connected car landscape

1

Digital adoption within passenger cars has been on the rise across global markets, with automakers striving to launch new solutions to differentiate in a highly competitive landscape. Many traditional features, such as the vehicle's instrument panel or audio system have already been digitalised, and OEMs (Original Equipment Manufacturers) are increasingly offering new solutions such as smart-device mirroring systems (e.g. Apple CarPlay, Android Auto) and safety sensors as common features within high-end car models. This race towards digitalisation is expected to intensify, having a far reaching impact on the automotive industry worldwide, including within the Asia-Pacific (APAC) region – witnessing the emergence of more sophisticated autonomous driving solutions and growing presence of non-traditional digital players (as partners and competitors) in the coming decades.[2]

Going forward, a wide range of factors including changing consumer needs, demographic patterns and urban mobility trends will drive the adoption of connected car solutions in APAC.

Drivers of connected mobility in APAC

Rising ownership costs push new mobility modes in developed markets

Commuters in developed markets in APAC are moving away from car ownership, with the existence of better public transport infrastructure, rising costs of private car ownership (including fuel, parking and maintenance costs) and policy push by national governments, reducing the incentives to own vehicles for many. Going forward, the adoption of connected cars in these markets will therefore be focused on improving the cost-effectiveness and passenger experience of new modes of mobility such as car-sharing and ride-hailing services. As per PwC estimates, fully autonomous vehicles could bring down the average cost per km of using shared transport to less than 50% of figures today. Autonomous vehicles are therefore expected to lead the shift away from ownership towards enabling 'on-demand mobility' in the future. Development of electric vehicles will also take place in parallel with autonomous cars (levels 4 and 5), with the two technologies proving to be mutually supportive. An electric drive will help reach the full potential of on-demand mobility, enabling self-driving robo-taxis to charge seamlessly without human intervention. Governments are also wary of a scenario in which vehicle usage increases due to the adoption of autonomous technology, and thus are focusing on electric vehicles to minimise the impact on emissions.[3]

Changing demographics increase the need for technology adoption

Many developed markets in APAC including Japan, Singapore, South Korea and Hong Kong are projected to witness notable growth in the share of old-age population – reaching much higher levels than most emerging markets by 2050. Rising instances of accidents involving the elderly are already a growing cause of concern for the Japanese Government. Faced with challenges of a shrinking working-age population in the coming decades, Japan now plans to focus on driverless technologies as a solution, and has already started testing autonomous transport for older age groups in rural areas. Automakers are also taking a lead in introducing solutions to improve safety. Already, more than 50% of vehicles sold in Japan in 2016 were equipped with autonomous systems to apply brakes to avoid collisions – much higher than 24% in Europe and 9% in the US.[4]

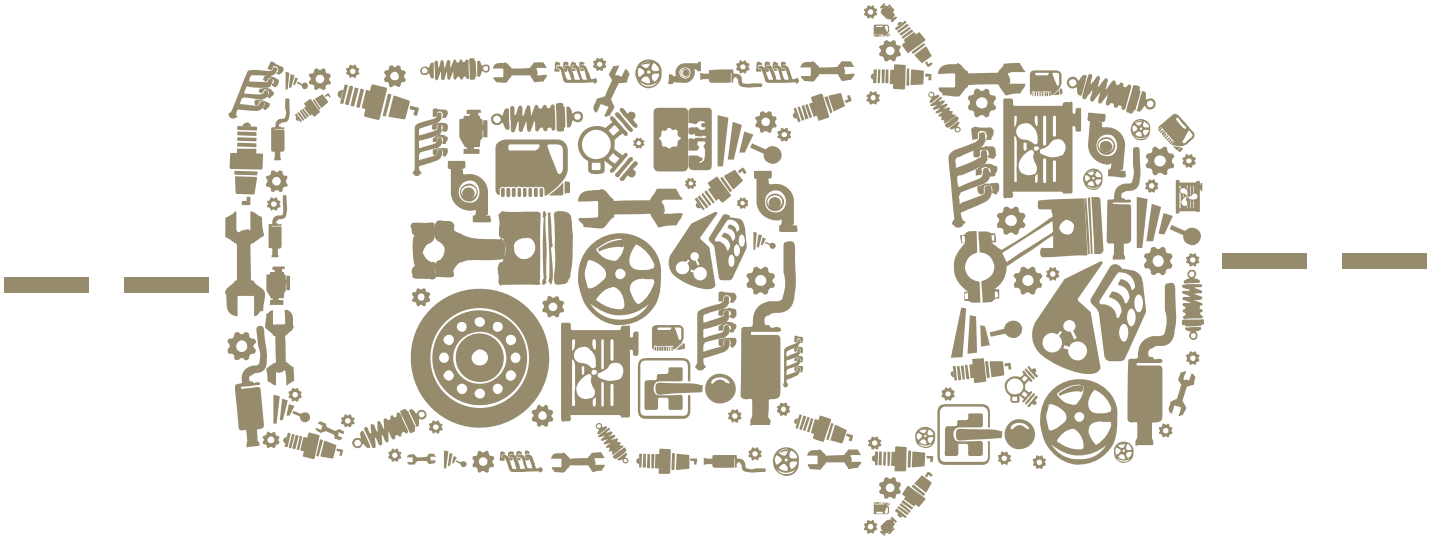
Drivers of connected mobility in APAC

Growing affluence drives demand for in-vehicle connectivity in emerging markets

Adoption in developing markets in APAC will be driven by a growing middle class (with rising affluence) and a younger digitally savvy consumer – demanding improvements in their driving experience through greater connectivity and access to services while on the move. For example, China has amongst the youngest premium car buyers worldwide, who show high willingness to adopt new digital technologies. The average age for a premium car buyer in China is around 37 years, as compared to 54 years in the US. As per a global survey, a majority 65% of Chinese consumers are willing to adopt connected car solutions, much higher than 40% in Europe and 32% in North America. Another survey indicates that more than 50% of Chinese respondents are even willing to pay 20% more to buy connected cars – mainly for road safety monitoring, vehicle health monitoring and interactive entertainment solutions. Such high acceptance rates will make it imperative for automakers to consistently launch new digital solutions to avoid losing market share.[5]

Urban mobility concerns push emerging markets towards digitalisation

Lastly, growing traffic congestion in urban centres coupled with rising road safety concerns are resulting in national governments in APAC pushing for alternative mobility options and increasing the deployment of digital technologies within vehicles (and the broader transport infrastructure). As per estimates, more than 700,000 road accident related fatalities are estimated to occur in APAC each year. A recent study further highlights the potential to significantly raise per capita GDP in key developing markets in the region (22% in Thailand, 15% in China, 14% in India, 7% in the Philippines) by reducing road traffic deaths and injuries by 50% over the next two decades. Considering this, the Chinese Government has already announced a target of reducing road accidents by 30% – by enabling 'partially autonomous' vehicles to account for 50% of car sales by 2020, and 'highly autonomous' vehicles to account for 15% sales by 2025.[6]



Adoption of connected car solutions

Driven by technological developments (e.g. 5G networks, advanced sensors) and rising consumer demand – the global market for connected car solutions is projected to almost triple in size from USD 53 bn in 2017 to USD 156 bn by 2022. Though dominated by premium car models at present, adoption in less expensive car brands will almost equal premium cars in sales value by 2022, pushed by technological improvements and growing maturity of business models.[7] While revenues from connected car solutions will remain the focus area for market players in the short term, additional opportunities will also emerge in the longer term such as next-gen mobility services and new data-driven value propositions – denoting a further revenue upside beyond 2022, as highlighted in figure 1.1.[8]

In terms of key geographies, developed regions in the West have a strong lead, with the US and Western Europe collectively having a 71% market share at present – though projected to fall to 66% share by 2022. Within APAC, Japan and China represent the two major markets, collectively accounting for an 18% global share in 2017, which is estimated to reach 24% by 2022. Over the next few years, China is expected to be one of the fastest growing markets for connected cars, driven by factors such as high passenger car sales (largest automotive market worldwide, by volume), strong government support for R&D, and the existence of a robust ecosystem of digital technology players.[9] While players in both Japan and China have announced targets of reaching higher stages of autonomous cars (level 3 and above) in the near term, mass adoption of self-driving vehicles in emerging APAC markets such as China or India could be limited in the immediate future due to infrastructure constraints and greater complexities in their driving environment. Therefore, in the near term, technology adoption in these markets will be led by specific packages or services that extend 'intelligent assistance' to the driver.[10]

Adoption of connected car solutions

Figure 1.1: Evolving connected car landscape worldwide

	1 Connected car packages		2 Connected car services		3 New data-driven propositions	
	Near-term revenue generators			Long-term value creators		
	Safety solutions **$58 bn (2022)**	Autonomous driving **$55 bn (2022)**	Consumer services **$43 bn (2022)**	Next-Gen mobility **++ (post 2022)**	Performance improvement **++ (post 2022)**	Customer loyalty **++ (post 2022)**
Overview	• Vehicle management features improving the safety of drivers, passengers, other vehicles and pedestrians.	• Vehicle management features that enable the vehicle to operate with lesser or no human intervention.	• Digital services focused on improving the driver/passenger experience and vehicle performance.	• On demand mobility realised by combining existing digital service model with autonomous driving.	• Using connected car/customer data to consistently improve vehicle performance, product and service quality, and to build new products that help differentiate.	• Using data to improve stickiness. Cloud-based services could generate customer lock-in as switching to a new player could lead to loss of data on personal preferences.
Examples	• Emergency call assistance • Automation collision detection/ prevention • Lane management	• Adaptive cruise control • Traffic sign recognition • Self-parking	• Connected vehicles: Diagnostics, usage-based insurance • Connected device: Entertainment, social media, payments	• Driverless car - sharing/ride - hailing, integrated with other forms of public transport for end-to-end connectivity.		
Characteristics	• Currently offered as built-in solutions, bundled with the list price of more premium car models. • Many are expected to become standard features as the industry matures - especially safety solutions (the largest segment by 2020).		• OEMs lack required capabilities and are entering into revenue sharing agreements with digital content providers.	• OEMs are making large investments in digital companies to cover capability gaps and target a share of the mobility market.	• Connected cars establish a direct link between the OEM and the end consumer. • Digital solutions will significantly increase the volume of data available across the product lifecycle (and not only at the time of purchase) to enable ongoing improvements.	

Source: PwC Strategy&, 'Opportunities, risk, and turmoil on the road to autonomous vehicles', 2016; PwC analysis

Next-generation digital solutions

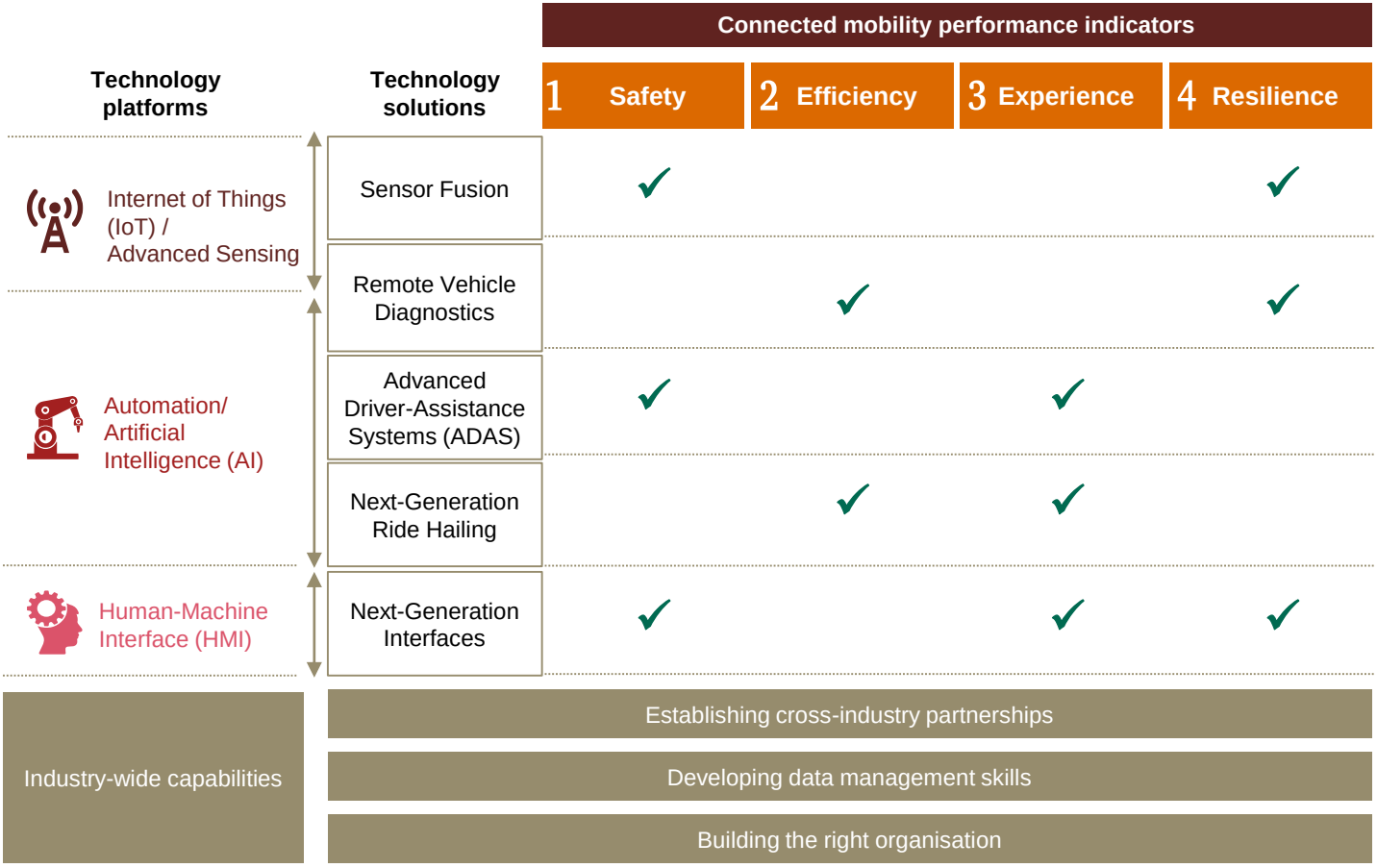
2

Next-generation digital solutions

Automotive companies are increasingly looking at new digital solutions and services to enable connected mobility in APAC – driven by the emergence of technology platforms such as the Internet of Things (IoT), Advanced Sensing, Artificial Intelligence (AI) and improved Human-Machine Interfaces. As highlighted in figure 2.1, these new solutions and services will impact different dimensions that collectively improve the performance of connected passenger vehicles. These performance attributes including safety, efficiency, experience and resilience, are defined as under:

1. Safety: Ability to safeguard against traffic collisions or minimise the impact of accidents on different participants including drivers, passengers and other external parties (e.g. cyclists, pedestrians).
2. Efficiency: Ability to reduce travel time and/or cost, by optimising vehicle performance or overall traffic movement.
3. Experience: Ability to improve driver/passenger comfort and convenience, or provide a more personalised in-vehicle environment.
4. Resilience: Ability to minimise the occurrence or the impact of unanticipated disruptions caused due to issues with vehicle performance.

Figure 2.1. Technology-driven mobility solutions and services in APAC



Source: PwC analysis

The following pages detail these new digital solutions and services expected to gain significant traction in APAC markets:

Sensor Fusion [11]

Connected car challenge:

- Currently, connected cars use information from independent sensors such as cameras, radar, ultrasonic and Lidar. These individual sensors have their strengths and shortcomings. For example, ultrasonic is suited for judging a car's distance to objects, but only at short ranges; radar can detect objects at long ranges regardless of the weather but has low resolution; while Lidar has high resolution but loses sight in poor weather conditions.
- Existing sensor system also does not have fail-safe mechanisms in place if a sensor does not work as it is meant to. As sensors impact the way a connected car views and navigates its environment, a failure in this technology could compromise commuter safety.

Smart solution:

- Sensor Fusion is a technology that analyses data from a variety of sensors (camera, ultrasonic, radar and Lidar), to provide a more comprehensive, 360-degree insight to the driver.
- Instead of each sensor system independently performing its own warning or control function in the car, a fused-system allows the final decision to be made centrally by a single system. This can help the system identify if one of the sensors is not working as it is meant to.
- Currently, the lack of a high performance Lidar solution at mass market price and limited sophistication of internal data networks, remain the main obstacles in the way of large scale adoption of Sensor Fusion. OEMs have introduced several solutions in recent times, but the technology remains in the nascent stage. As the price-performance equation improves, Sensor Fusion technology is bound to see greater adoption in the coming years.

How it helps:

Safety:

Improves passenger safety allowing for more accurate and faster interpretation of sensor data – resulting in lower risk of vehicle collision and accidents, especially in adverse weather conditions.

Resilience:

Enables the system to detect anomalies in sensor data when comparing it to data from other sensors – thus reducing the number of false positives and negatives, and improving overall system robustness.

Remote Vehicle Diagnostics [12]

Connected car challenge:

- At present, drivers are required to schedule their vehicles for regular check-ups, and any diagnostics of a vehicle's condition is undertaken only during these scheduled sessions. This proves to be an inefficient method of delivering maintenance, as in some cases no interventions may be required. Drivers are also unable to consistently monitor the health status of their vehicles by themselves, other than by accessing the signals on the dashboard. This lack of information leads to unforeseen vehicle breakdowns and inconvenience for commuters.

Smart solution:

- Remote Vehicle Diagnostics solutions allow for the continuous monitoring, evaluation and reporting of vehicle data through a wireless network – shifting the traditional 'scheduled maintenance' model towards 'maintenance-on-demand'. With more cars being equipped with sensors and wireless communication technologies, vehicle owners have access to more detailed and timely information on vehicle health than ever before. However, most of the prevalent diagnostics systems remain reactive in nature.
- Next-generation solutions are looking to aggregate data across vehicles, and correlate it with failure history, road conditions and environmental factors to better project the service life of components and predict maintenance events – thus optimising service time and costs for the owners, while providing valuable inputs to manufacturers for improving component quality. Emerging solutions allow for diagnostics to be combined with Artificial Intelligence (AI), with the on-board AI software constantly monitoring vehicle health and scheduling service appointments, as needed.
- Besides impacting the maintenance aspect, remote diagnostics is also enabling new data-driven business models such as usage-based insurance, which analyses driving patterns to offer more competitive and targeted quotes to vehicle owners. Through this, companies are also promoting safer driving by incentivising owners to adjust driving behaviour for discounts – potentially reducing accidents and the number of claims paid in the long term. Data gathered from accidents (e.g. weather, time, date, and location of accident, car speed and direction, sudden stops or acceleration) helps to better fix responsibility, making it easier for insurance firms to move chosen claims towards subrogation, seeking repayment from the party at fault.

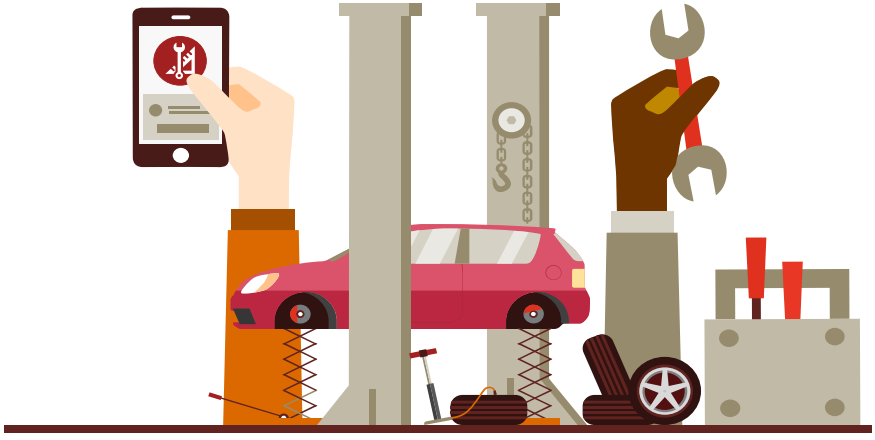
How it helps:

Efficiency:

Allows for reliable, real-time monitoring of vehicles. These systems are able to warn of impending failure, prompting owners to get their vehicles serviced, as required. This helps avoid untimely breakdowns and optimises maintenance time and costs for vehicle owners.

Resilience:

Improves resilience by detecting faults early and by enabling product improvements. Data collected by service providers can make use of predictive analytics to pre-empt and fix faults before failure, while providing insights to manufacturers to design better products.



Advanced Driver Assistance Systems (ADAS) [13]

Connected car challenge:

- Human error remains the leading cause of road accidents today. This is due to behavioural issues such as driver distraction, tiredness and unsafe lane changing practices, among others. Currently, the driver needs to be highly attentive towards the vehicle and his/her surrounding environment while driving – performing most of the key tasks such as lane management, headlight adjustment and parking. On the other hand, most assistive technology solutions available today (especially in less premium car models) only provide discrete warning signs and information.

Smart solution:

- ADAS solutions aim to provide the driver with essential information while automating difficult or repetitive tasks. While less complex driver assistance technologies have been around for some time (e.g. cruise control, lane departure warning), these systems are increasingly becoming more sophisticated and integrated – enabling cars to evolve into partially autonomous, and eventually into fully autonomous systems.
- Safety systems are evolving from solutions that could only detect imminent forward collisions with other vehicles, to those that can better recognise pedestrians or cyclists – and also initiate counter actions (such as braking, lane changes) at greater speeds, autonomously. Sensor-based detection has line-of-sight limitations and fails to detect pedestrians behind an obstruction. Therefore, advancements in wireless technologies (for vehicle-to-vehicle, vehicle-to-pedestrian and vehicle-to-infrastructure communication) are being made to foster safer, fully autonomous driving in the future.
- Besides safety, ADAS systems are also looking to enhance the convenience of driving. Smart parking is evolving from assistance-based to self-parking solutions. These cars will drop passengers, park by themselves and then be summoned back at the drop-off location. Other solutions seek to combine fintech services with autonomous vehicles, enabling the car to make payments on ones behalf at fuel stations or for drive-through orders.

How it helps:

Safety:

Advanced safety systems that combine sensor detection with wireless communication technologies will help reduce traffic collisions by providing more comprehensive information to the driver in real-time, while also reducing the system's reliance on the driver's judgement.

Experience:

New ADAS solutions being developed such as self-parking systems aim to make driving more autonomous and comfortable, while others target improvements in the driving experience by automating repetitive and less convenient tasks such as on-the-go payments.

Next-Generation Ride Hailing [14]

Connected car challenge:

- Recent mobility concepts such as ride-hailing or car-sharing apps have been gaining acceptance over the past few years, providing consumers with an alternative to driving personal cars. However, the services offered by these solutions are not yet priced for mass adoption, and come at a premium as compared to the cost of vehicle ownership in many APAC markets. Also, these services are not highly efficient in routing cars to waiting passengers, as drivers often accept rides based on their drop-off location preferences.

Smart solution:

- Next-generation ride hailing refers to the movement of people and goods using a combination of intelligent and fully autonomous (and possibly electrified) vehicles that will enable existing app-based services to be offered on an 'on-demand' basis.
- Combining ride-hailing services with autonomous driving will lead to on-demand mobility, with no driver necessary. This emerging fleet of self-driving robo-taxis will enable a sharp drop in passenger price per kilometre, effectively competing with private vehicle ownership – with the trend being more pronounced in developed markets worldwide, where consumers are increasingly drifting away from car ownership.
- Robo-taxis with electric propulsion will be able to drive themselves to charging stations and could be used as energy storage buffers. Connectivity between vehicles will help guarantee that enough of these self-driving taxis are available to satisfy the needs of all customers.

How it helps:

Efficiency:

These services will improve vehicle utilisation and fuel efficiency by better connecting supply with demand, and through optimal routing based on road and traffic conditions. This will lead to lower passenger price per kilometre (efficiency gains, lower labour costs) – pushing the adoption of self-driving taxis over privately-owned vehicles.

Experience:

Improves user experience by reducing travel time and by ensuring better availability of vehicles, based on dynamic changes in demand. It also offers the possibility of extensive customisation – with the connected car selecting a user's pre-set preferences for temperature, music and other similar settings.

Next-Generation Interfaces [15]

Connected car challenge:

- While there have been improvements in car user interfaces in recent years, the majority of vehicles available today still struggle in enabling easy and secure connectivity. Current in-vehicle interfaces are not as intuitive and easy to use as those in other media platforms such as smartphones. Moreover, with increasing use of mobile phones and in-vehicle entertainment, the number of points at which a driver could be distracted has increased. This poses significant risks to commuters.
- Lastly, with increasing amount of personal data flowing through car-based apps and services, connected cars are increasingly facing data security risks. However, building highly complicated and time-consuming authentication processes could prevent solutions from becoming mainstream.

Smart solution:

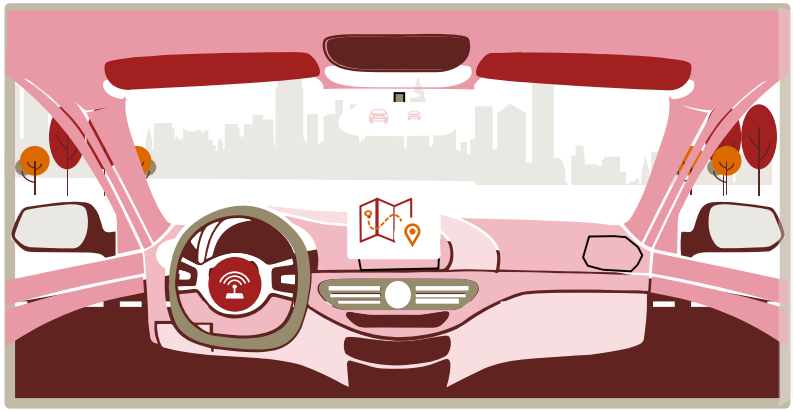
- Next-generation interfaces are based on new verbal, haptic and visual technologies (such as voice control, natural language processing, interactive displays and augmented reality) enabling more advanced in-car controls. These interfaces are more intuitive and automated, combined with better video, connectivity and camera capabilities.
- These new interfaces also support the adoption of stronger authentication technologies (such as biometrics) that enable more accurate driver identification, to safeguard data usage in self-owned vehicles. They also ensure that only authorised drivers are offering rides through app-based services to customers – a major safety concern for service providers at present.

How it helps:

Safety:
Allows drivers to experience in-car features and perform tasks without getting distracted. It provides the necessary warning signals and simplifies communication between vehicles and emergency services, in case of an accident.

Experience:
Offers a more personalised experience with music, temperature and other parameters customised for an individual. Also enhances experience through features such as interactive displays, augmented reality and voice controls.

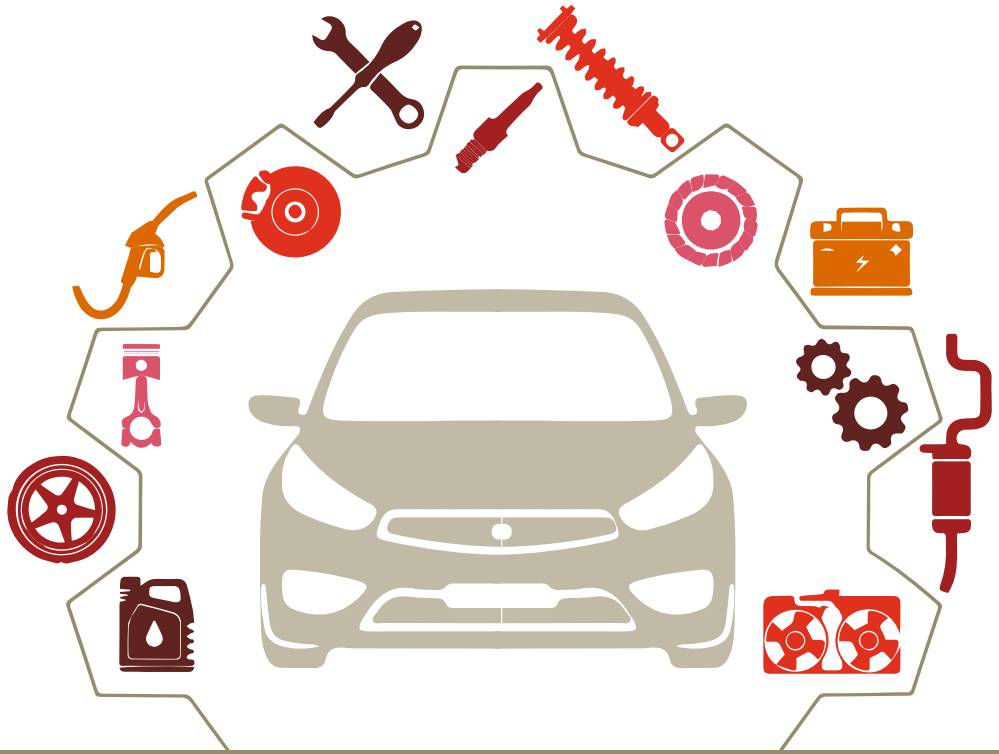
Resilience:
Provides a more robust but easy to use authentication interface, to improve data security. This is essential for traditional car owners and mobility service users to gain trust in connected car technologies, and thus push adoption.



Capabilities for success

3

While consumer demand for connectivity is continuing to grow, traditional auto players lack many of the capabilities required to run a digital business, such as faster product development cycles, stronger customer relationship management and robust data analytics skills. Deploying new digital solutions will therefore not be enough, and auto companies will also need to build a set of supporting capabilities to benefit from the ongoing wave of digitalisation. These capability requirements (establishing new partnerships, developing data management skills and building a digitally-aligned organisation) will be essential to drive an optimal digital transformation strategy for automotive players.



Establishing cross-industry partnerships

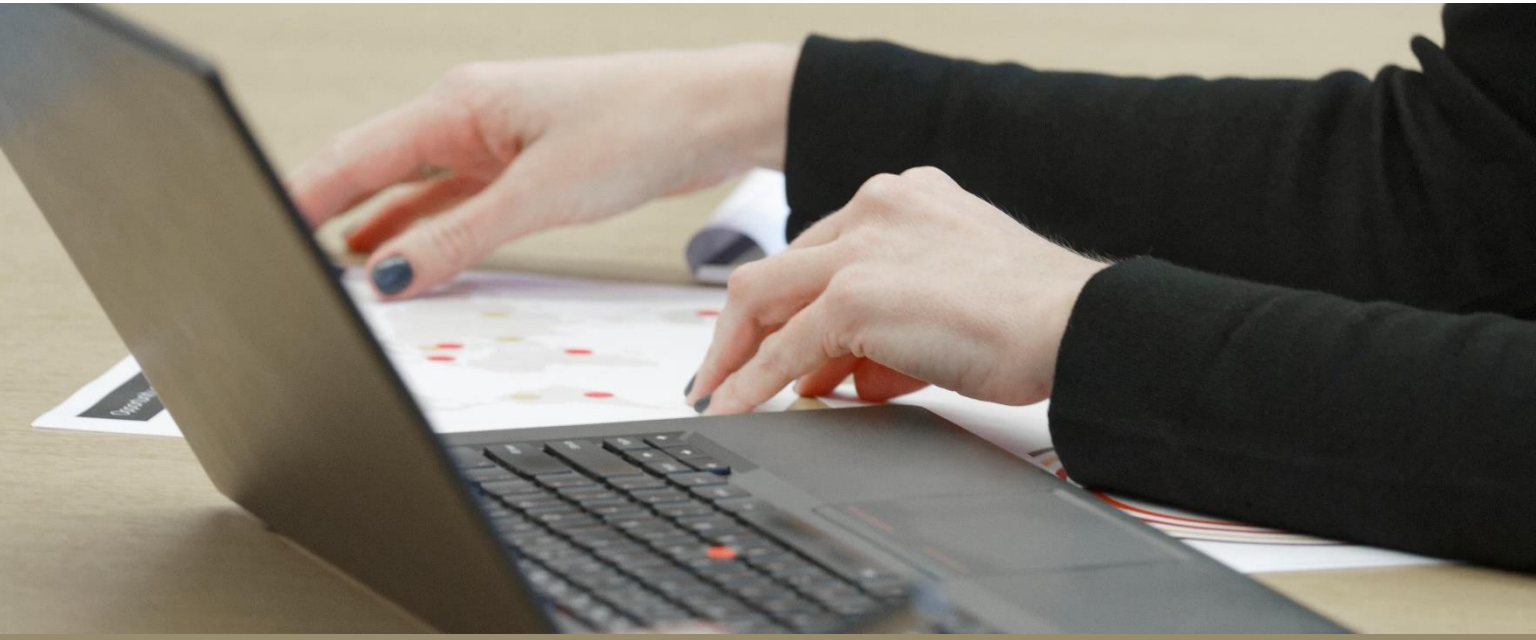
Going forward, running a successful auto business will require traditional auto firms to work closely with a new set of industry players – including software developers, digital service providers, telecom networks, technology hardware suppliers and stakeholders from other services sectors (e.g. insurance firms, payment networks) – to accelerate their speed-to-market and avoid losing customers to competition. Not surprisingly, a vast majority (73%) of auto executives worldwide, consider cross-industry collaboration as the most viable strategy to push the adoption of connected cars in the future.[16] On the other hand, even digital technology firms will find it difficult to compete by themselves in the automotive space. Auto companies continue to enjoy significant amount of trust with customers, and it will be difficult for digital entrants to match established carmakers in terms of product quality and reliability. A recent survey conducted across leading connected car markets worldwide, highlights this trend. As per survey results, customers trusted established auto brands the most with the development of autonomous vehicles, over other industry participants such as technology firms, new carmakers and ride-sharing companies. Leading internet firms in APAC (especially in China) are accordingly expanding into the connected car space mainly through partnerships with auto companies. These technology firms are focusing on aspects such as the connected car operating system, data analytics, network security and other digital services, while the OEMs are extending expertise in automotive design, testing, sales and aftersales services – together accelerating the industry's pace of development through complementary capabilities.[17]

Partnerships will also be essential to develop the broader ecosystem for a nascent and dynamic sector such as connected cars – and collaboration between private sector players and entities such as research institutions and industry think-tanks will be important in this regard. These alliances enable stakeholders to share infrastructure and market development costs, while increasing the pace of adoption through joint development of core technologies and standards. As an example, a leading global automaker has established partnerships with multiple entities including an internet firm, a technology platform developer, a sub-system manufacturer, a space research agency and a global non-profit organisation – to launch a driverless vehicle meant for urban traffic by 2020. In another example, some of the leading automotive firms worldwide have joined forces with technology companies, non-governmental organisations and academic institutions to form the Mobility Open Blockchain Initiative (MOBI). The consortium is focused on developing common standards to enable applications such as payments and data-sharing between cars through blockhain solutions.[18]

Developing data management skills

Data is expected to become the new fuel powering the connected vehicles of tomorrow. To date, automotive brands have had limited touch points with the end consumer, which will change significantly with the arrival of connected cars, transforming the vehicles of today into mobile data centres of the future. As per estimates, over 200 data use cases have already been identified within connected cars, though only 15% of these are being monetised at present, indicating huge potential for growth. Digital solutions will enable the OEM to establish a more direct relationship with the end consumer, with the multitude of touch points enabling companies to better understand driving behaviour, product usage patterns, traffic conditions and vehicle performance – evolving over time into using dynamic real-time information to pre-empt and suggest optimal choices to the consumer (such as predictive maintenance). This will allow OEMs to make continuous improvements through more personalised products, targeted sales strategies and efficient aftersales operations.[19]

Automotive players will need to work with external value-chain partners to co-develop and adopt more sophisticated processes for information-exchange – ones that create the incentives for data sharing while addressing concerns over data confidentiality. With a plethora of data feeds being accessible, companies would need to significantly strengthen existing data governance standards by establishing codified practices around data ownership (who is internally responsible for the data), data sharing (when to share data, when to withhold) and dispute resolution (data-related issues with partners). Lastly, adoption of non-invasive ways of gathering and collating user data, and more robust risk management frameworks will also be essential to secure consumer trust. Auto players will accordingly need to hire and develop talent that understands evolving cybercrime risks – focusing on areas such as intrusion detection, security architecture and analysis, and incident response and recovery among others.[20]



Building the right organisation

Besides industry partnerships, many premium automotive brands are also looking at developing certain capabilities in-house, and are therefore acquiring technology start-ups to gain control over systems considered critical for success. However, traditional operating models in the automotive industry are not well-aligned to the requirements of a digital business, and thus these parent companies would need to re-align organisational structures to enable greater agility and flexibility in their business models.[21] Automotive players are accordingly setting-up 'two-speed' organisations in the near term, separating their digital subsidiaries from the conventional business – while targeting to integrate the two as the industry matures and converges in the longer term. While operating under the parent brand, these new connected car units require independent and decentralised decision-making structures to aid innovation. Organisations will also need to build suitable infrastructure (e.g. by adopting advanced analytics platforms, unified communication solutions) to make an effective transition to the new digital landscape. Detailed skill development plans, outlining hiring and retention strategies will need to be developed, building cross-functional teams of engineers (both automotive and software), data scientists and marketers to achieve the desired impact.[22]

The private sector will also need to work together with government stakeholders to develop the connected cars industry – considering it relies heavily on factors under government control for growth (such as state of transport infrastructure, mobility-related regulations). APAC governments will need to commission targeted research to understand the socio-economic implications of technology adoption, draw out the vision for connected mobility for their respective markets, and then create the right conditions for the private sector (large corporates and start-ups) to move in that direction. It will be essential for government stakeholders to take a lead in promoting alternative mobility solutions such as autonomous vehicles, and work closely with other ecosystem members to facilitate testing of new technologies, create industry standards, educate consumers and address concerns over safety and data privacy. Given this significant role, auto firms will also need to learn skills to collaborate more effectively with the government. While companies will need to work with national governments to co-develop major policies and standards, leaders at connected car firms must also engage with heads of local smart-city initiatives and other government agencies (e.g. urban planning, transportation) to jointly structure the right service model for a particular region, and design and implement suitable pilot programmes.[23]

Case example:

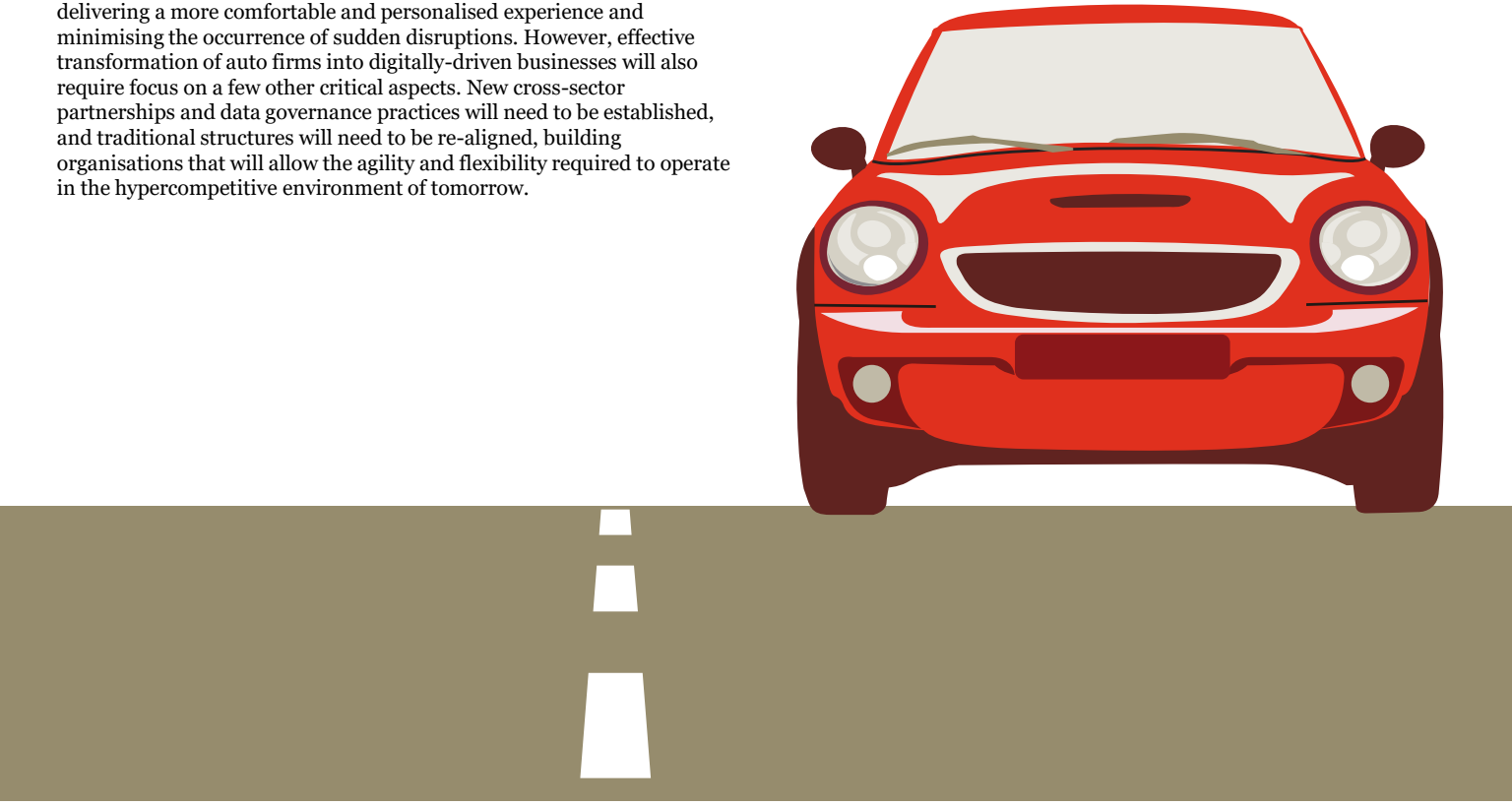
Private sector firms and industry institutions are working in collaboration with the Singapore Government to foster the adoption of autonomous vehicles in the country, focusing on both personal and commercial mobility solutions.

A cross-industry body, the Committee on Autonomous Road Transport for Singapore (CARTS), has been given the responsibility to build and oversee a phased roadmap for technology deployment – seeking representation from multiple private sector firms, government agencies and academic institutions. Technology start-ups and research institutions have also entered into alliances with government bodies to develop and test new solutions. As an example, Nanyang Technological University and Singapore's Land Transport Authority have collaborated to establish the Centre of Excellence for Testing and Research of AVs-NTU (CETRAN) – to facilitate the drafting of industry regulations and develop technical skills for testing and certification of autonomous vehicles. CETRAN has in turn partnered with a global auto OEM, a leading auto components manufacturer and multiple other industry bodies to understand global practices and facilitate trials at its test circuit.[24]

Conclusion

The connected car market in APAC is running in high gear at the moment. Multiple factors including growing demand for in-vehicle connectivity (in emerging markets), shift towards on-demand mobility (in developed markets) and the need to improve traffic safety and congestion (across APAC), will push automotive players to work in collaboration with digital companies and governments to develop more sophisticated connected mobility solutions. Connected cars are widely predicted to become the next major platform for media consumption, with leading markets in APAC (Japan and China) expected to register strong growth for digital solutions. Auto firms in the region will accordingly strive towards making improvements in consumer experience and vehicle performance, launching new digital offerings to earn premium margins.

These new digital solutions will impact mobility performance along four key attributes, including safety, efficiency, experience and resilience – enhancing safety against collisions, optimising travel time and cost, delivering a more comfortable and personalised experience and minimising the occurrence of sudden disruptions. However, effective transformation of auto firms into digitally-driven businesses will also require focus on a few other critical aspects. New cross-sector partnerships and data governance practices will need to be established, and traditional structures will need to be re-aligned, building organisations that will allow the agility and flexibility required to operate in the hypercompetitive environment of tomorrow.



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Contacts

Mohammad Chowdhury
Phone: +61 405 620 733
Email: mohammad.t.chowdhury@pwc.com

David Wijeratne
Phone: +65 6236 5278
Email: david.wijeratne@sg.pwc.com