

Mobility through transition

Disruption and impact

May 2018



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Chairman's message

With the production of Electric Vehicles (EVs) gaining importance in the country, the automotive industry in India is further expected to give a boost to the share of manufacturing in India's GDP.



The Indian automotive industry is one of the fastest-growing markets of the world, accounting for a large share in the Indian economy. In the financial year 2017-18, India overtook Germany as the fourth largest global automotive market, right behind China, USA and Japan.

With the production of Electric Vehicles (EVs) gaining importance in the country, the automotive industry in India is further expected to give a boost to the share of manufacturing in India's GDP. The country aspires to achieve the target of 30 per cent EVs by 2030 and a complete migration to EVs by 2045 or earlier. This necessitates action and commitment by automakers, suppliers (including battery manufacturers), dealers and utility players alike.

India's EV industry is at nascent stage when compared with the other international markets such as USA, China and Europe. With the objective of supporting hybrid/EV market development and the manufacturing ecosystem, the Government of India has notified the Faster Adoption and Manufacturing of (Hybrid &) Electric Vehicles in India (FAME India) Scheme for implementation. Subsequently, a few state governments have been providing incentives to attract EV manufacturing in their states and to fast-track the adoption of EVs.

The emergence of e-vehicles will create a lot of opportunities as well pose many challenges for the existing industry. Although currently the challenges seem to outweigh the opportunities in India, the right steps from the government in sprucing up the support dynamics for EVs at distinct levels are anticipated to transform into a major opportunity in the future.

E-mobility is here. The automotive industry needs to look at it not as a threat, but as an opportunity. Industry players need to adopt an action-oriented perspective, acknowledging the shift. They will have to expand into uncharted territory and reinvent the way they manage revenue and profits to be a part of the e-mobility success story in India.

Mr Rattan Kapur

**Summit Chairman & Past Chairman,
CII Haryana State Council & Immediate Past President,
ACMA & Chairman & Managing Director,
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Foreword

Today's new mobility era is characterised by powertrain electrification, digital connectivity and software integration. It is the right time for India's automotive industry to display its resilience and capability on the global stage.



The automotive industry, being a little over a century old, has witnessed significant developments within the Internal Combustion Engine (ICE) space and has been riding on the back of oil reserves at the cost of environmental pollution. As a result, governments across the globe are now starting to focus on environment deterioration and ensure compliance with stricter emission standards.

Overall, the industry is witnessing three disruptive megatrends, which are significantly impacting business models across the value chain. These are:

- 1 Powertrain migration from ICE to electric: Driven by governments' focus on reducing dependence on oil and adhering to global climate and emission standards, with technological evolution in battery performance contributing to a reduction in battery prices and making Electric Vehicles (EVs) affordable
- 2 Evolution to Mobility as a Service (MaaS) and shared mobility: Driven by the need for reducing traffic congestion and the rise of car sharing and ride-hailing services
- 3 Autonomous revolution: Where drivers will be replaced by sensors and automation, and the preparedness of the industry would be towards developing such systems globally

Altogether, the global automotive industry is moving towards an integrated data-backed intelligent and self-aware mobility platform with new powertrains, digital technology and autonomous vehicles. This disruption would challenge and also provide opportunities for OEMs, component suppliers and automotive dealers. We should witness increased collaboration between OEMs and battery manufacturers.

By and large, OEMs, auto component suppliers and dealership businesses need to assess business strengths, plug gaps

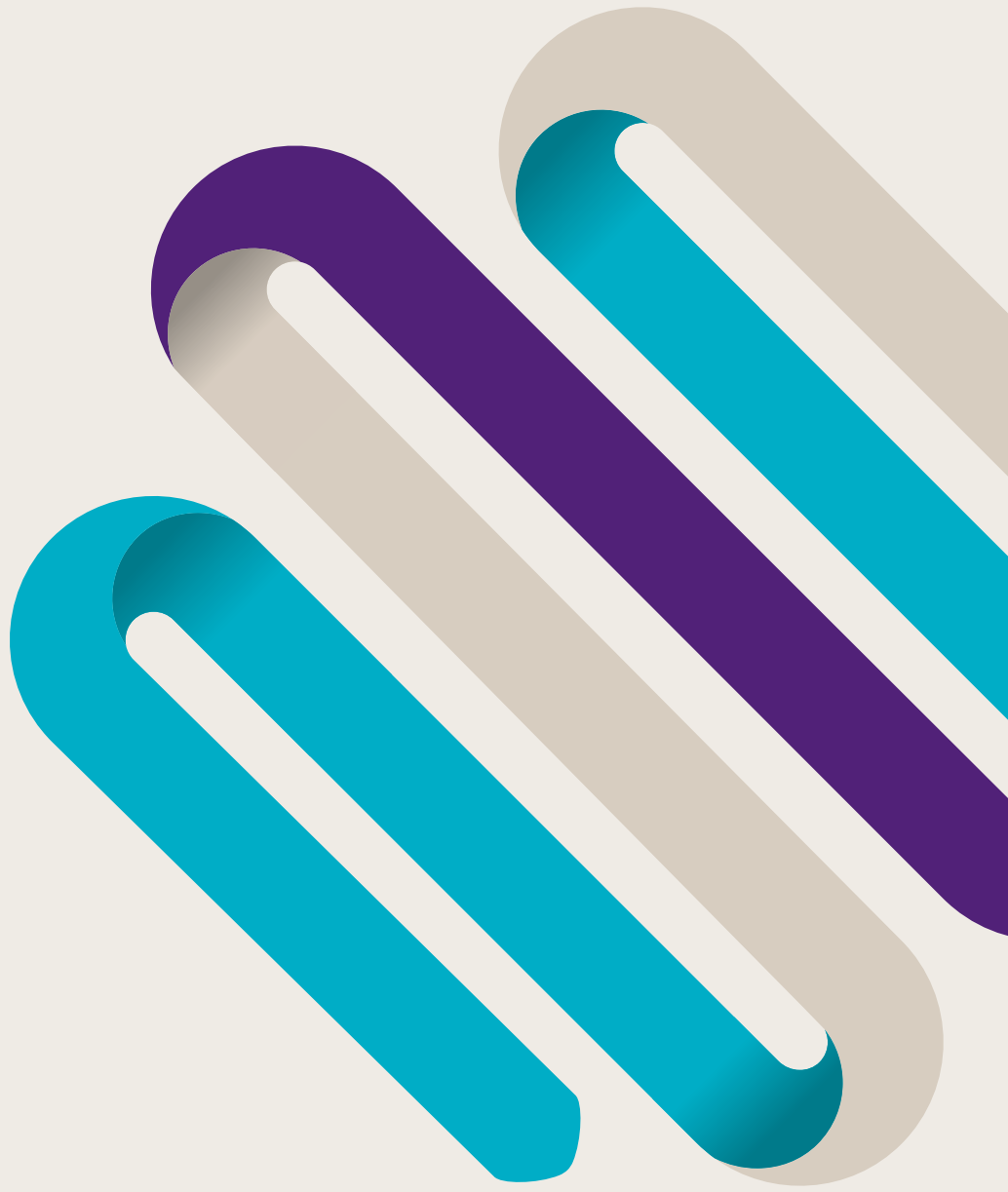
through technology acquisition and redefine business strategy, coupled with speedy execution as a key to survival in such a revolutionary phase. The component segment's share in value addition is likely to contract by 15 per cent from the existing 55 per cent due to lower component requirement in EVs. Dealerships will therefore have to focus on building talent base across software and electronics integration – a change from being a pure mechanical base – and plan for acquiring capabilities across software and analytics as an alternate revenue stream.

India, the fourth largest Greenhouse Gas (GHG) emitter in the world, is not left untouched from such disruptions. The Government of India has revised its EV penetration target from 100 per cent to a more realistic 30 per cent by 2030. However, it has withdrawn subsidy on hybrid vehicles under FAME and increased GST on hybrid vehicles (43 per cent), which could prove to be unfavourable to its vision of having emission-free vehicles on road by 2030.

The electric mobility landscape in India is currently at a nascent stage, with significant constraints to overcome such as the high cost of EV battery and the lack of a ubiquitous charging infrastructure. Therefore, the government essentially needs to focus on getting lithium from lithium-rich countries such as Chile, Argentina and Bolivia.

All in all, autonomous platforms in India will take time to become a reality. This is the right time for India's automotive industry to display its resilience and capability on the global stage.

Saket Mehra
Partner
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Global automotive industry

Henry Ford introduced the 'Model T' in October 1908, marking the birth of the automobile revolution.

Compare the Model T to the 'modern' sedan of the 80s and you will find some similarities. The engines of both cars will likely still consist of very similar technology with four pistons moving up and down in four cylinders. And although the engine capacity increased from 20 hp (15 kw) to 200 hp, the fuel efficiency only slightly improved from 13-21 miles per gallon (mpg) to 20-30 mpg.

Fast forward to the 21st century, and compare a 90s sedan to a Tesla Model S, and you will notice several differences. The car of the 21st century is sleeker and aerodynamic, made of advanced lightweight materials and incorporates a host of safety features. You open the bonnet and you will probably find not an engine but a luggage space! The engine has been replaced by a battery-powered motor at the back, capable of producing more torque and power than a traditional ICE backed by super computing power and sensors.

Today, vehicles are equipped with sensors that can give critical data and insights about the vehicle health, driving habits, driving preferences and the lifestyle of the driver. Cars of today incorporate the latest in technology, and it is the advancements in information technology which have given the automobile industry a giant technological leap. As computer chips become cheaper, car manufacturers of today are finding new ways of integrating them with the various functions of the car. Vehicles are becoming smarter and more connected to lifestyles as ever.

While personal vehicle ownership has traditionally met our mobility requirements, the new fast-paced and ever-connected form of lifestyle of today has given rise to shared mobility, bundled around optimised cost of ownership, experience and utility. The advent of location-based mobility service providers like Uber, Ola and Didi has fundamentally disrupted the way vehicles are currently being used and how they will be used in the future.

And this is not the end. Imagine a future where a new breed of 'netizen', while scanning her mobile phone for a theatre showing her favourite movie, also gets the option of a driverless car to take her there. She decides to take the driverless car option considering she is running late for the movie and orders the cab by feeding her location coordinates. She gets into the car and is given the option of an auto check-in at the theatre to avoid the waiting line. She reaches the venue and the payments gets deducted automatically from her credit card. That is the future of mobility. The cars of the future are going to cater to various sections of the society, from young teenagers and working professionals to elderly/senior citizens, while delivering information and personalised entertainment-based experiences backed by smart and integrated data analytics.

What this means for auto Original Equipment Manufacturers (OEMs), component manufacturers, software developers, system integrators, dealers and retailers is the disruption of their business models going forward. It will pose new challenges and create new opportunities for them. They will need to adapt their business models across geographies to the varied mobility preferences and maturity levels of infrastructure.

How will OEMs get over the range anxiety of electric car customers? How will autonomous cars win enough trust of customers for them to give complete control of the vehicle to a computer backed by their personal data? These are some of the fundamental questions around which the success of such technology and its adoption will depend. There are already a dozen automotive giants investing huge sums of money in the development of electric and autonomous technology. The race has never been more intense.

We look at some of the key megatrends that are dictating the future of mobility.



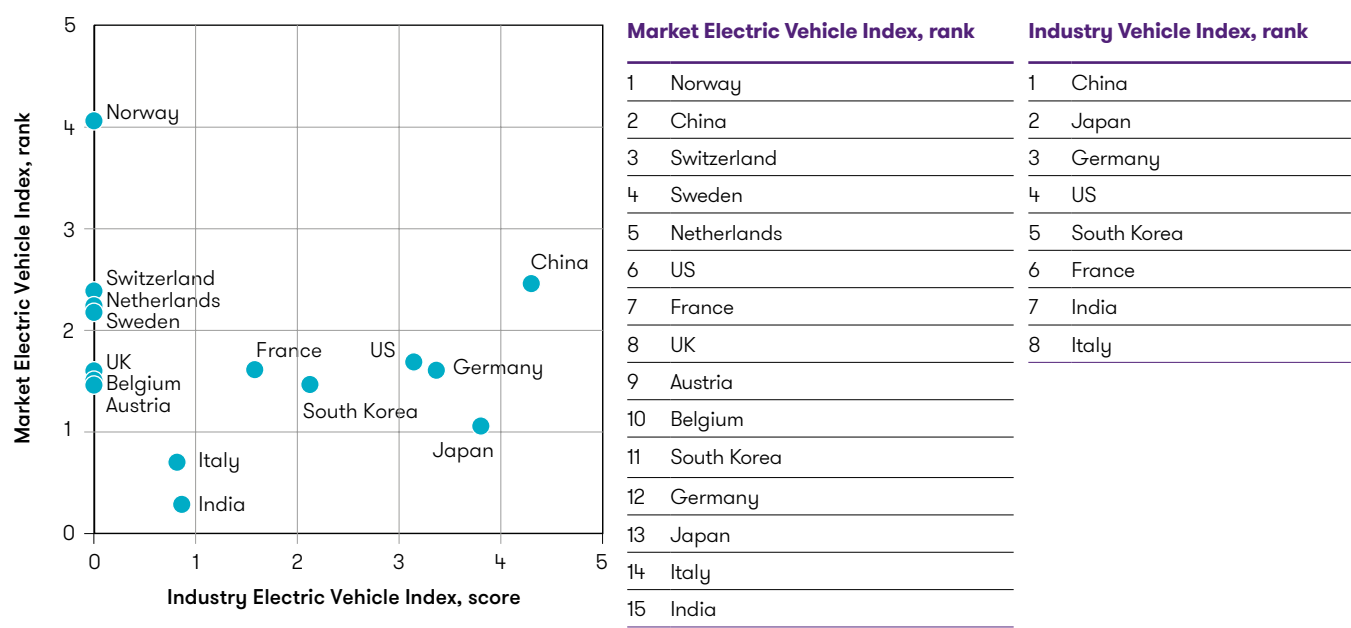
Mega trend 1: Powertrain migration from ICE to electric

Electric powertrain is poised to take over the conventional ICE powertrain in the coming years. In 2016, over 750,000 new Electric Vehicles (EVs) were sold globally.

China was the largest market for electric powertrain in 2016, with sales of over 336,000 EVs, more than double the 160,000

of USA. EV sales in Europe stood at 215,000, dominated by Norway, UK, France, Germany, Netherlands and Sweden. Globally, just 10 countries account for 95 per cent of electric car sales: China, USA, Japan, Canada and the six leading European countries.

Electrical Vehicle Index (EVI) development of selected countries, score out of five



Source: McKinsey research

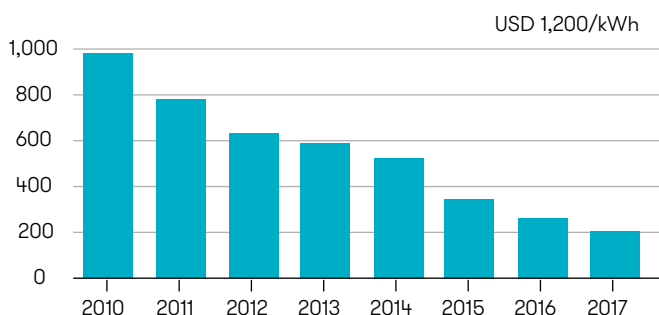
The adoption of EVs is being driven by two key factors:

- Declining battery prices**

The average price of a lithium-ion battery pack has come down to USD 209/kilowatt-hour due to a growing battery manufacturing industry with significant economies of scale. It is set to fall below USD 100/kWh by 2025 [Source:

BNEF]. This price drop is expected to be much quicker with carmakers buying batteries and renewable energy companies adding stationary storage.

Trend: Battery prices



Note: Figures are volume weighted averages
Source: Bloomberg New Energy Finance

- **Governments' focus on reducing dependence on oil, meeting Global Climate Agenda and introducing stricter emission norms**

European Union

In 2014, road transport was responsible for slightly over 20 per cent of the EU's total CO₂ emissions (cars and vans around 15 per cent and heavy-duty vehicles around 6 per cent). When it comes to fuels, EU transport is still heavily dependent on oil (nearly 94 per cent of energy consumed by transport in 2014, of which 88.2 per cent was imported).

EU policy instruments in the transport sector need to be coordinated to achieve the 2030 climate and energy targets. The target for non-Emission Trading Scheme (ETS) sectors (including Transport, Waste, Agriculture, Buildings, and Industry Energy Supply and Products) is a 30 per cent reduction of Green House Gas (GHG) emissions by 2030, compared with 2005 levels.

On 8 November 2017, the European Commission presented a clean mobility package, consisting of legislative proposals on road transport vehicles, infrastructures and combined transport of goods; non-legislative measures presented in an alternative fuels action plan; and a communication on low-emission mobility. It sets new targets for the EU fleet-wide average CO₂ emissions of new passenger cars and vans. **Average CO₂ emissions from new passenger cars and vans registered in the EU will have to be 15 per cent lower in 2025, and 30 per cent lower in 2030, compared to their respective limits in 2021 (95g CO₂/km for cars and 147g CO₂/km for vans).** The proposal also includes a dedicated incentive mechanism for zero- and low-emission cars in order to accelerate their market uptake.

Shanghai

The Shanghai Municipal Government has introduced a contingency plan to deal with the existing pollution crisis. The norm states reduction of government cars by 30 per cent once the air quality index exceeds 300. All heavy trucks are also banned in the city.

How OEMs are responding

- **General Motors:** It has revealed its 'All Electric, Zero Emission' future plan, highlighting the release of at least 20 new all-electric models by 2023.
- **BMW:** The brand's corporate strategy has 'electrification' as one of the central pillars. The company has announced that all brands and model series can be electrified, with a full-electric or plug-in hybrid drivetrain being offered in addition to the combustion engine option. By 2025, electrified vehicles are expected to account for 15–25 per cent of BMW's sales globally.
- **Volvo:** Between 2019 and 2021, Volvo plans to roll out a suite of five electric cars – three of which will be Volvos and two others will be high-performance cars from its Polestar wing. The Swedish automotive brand, owned by Chinese parent Zhejiang Geely, has announced to end its combustion engine design programme by 2019.
- **Toyota:** Toyota will add more than 10 all-EV models to its global portfolio by the early 2020s, beginning with China, as part of a broader plan to catch up to Tesla, GM, Nissan and other automakers. The 10 new all-EV models will then gradually be introduced to Japan, India, Europe and USA. The Japanese automaker has focused most of its alternative fuel efforts towards hybrids like the Toyota Prius and hydrogen fuel cell vehicles like the Toyota Mirai. This new strategy aims to embed electrified vehicles throughout the entire portfolio of Toyota and its Lexus brand.
- **Honda:** Honda is aiming for two-thirds of its vehicles to be electrified by 2030. The company plans to launch two models by 2018 in the Chinese market. Honda's push to make fully electric vehicles marks a significant shift for the Japanese automaker. The company had previously focused on the development of hydrogen and hybrid cars, betting these would be the vehicles of the future.

Megatrend 2: Mobility as a Service (MaaS) and shared mobility

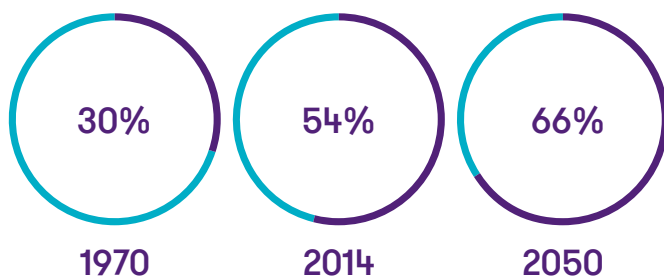
The way people are looking to travel is changing, with the challenges of urban accessibility and the influence of growing city population factoring into this trend. MaaS provides the flexibility that today's on-demand environment requires, and allows commuters to build their own journeys for their own convenience. MaaS is a growing focus for both the transportation industries and customer-facing businesses.

The term refers to a change in the way people travel, moving away from the traditional idea of owning a vehicle, towards taking advantage of various other modes of public and private transport, both existing and emerging.

The increased adoption of MaaS is driven by key factors:

- **Increase in urban density:**
Around 66 per cent of the global population is expected to live in urban areas by 2050 as against 54 per cent in 2014.

Global urbanisation trends: Per cent of population living in urban areas



Source: UN Dept of Economics & Social Affairs, Population Division

Urban planners are faced with a problem of adding new infrastructure to relieve congestion in urban cities. It will be

time-consuming and expensive. Municipal authorities and city inhabitants want to make cities more liveable and are leaning towards reducing vehicle density. MaaS provides an alternative to moving more people and goods in a way that is faster, cleaner and less expensive than current options. By adding more variability into the supply side of transportation, MaaS could transform a relatively inflexible transportation system into one that is significantly more workable.

- **Increase in car sharing**

The global car sharing market is slated to grow at 34.8 per cent, with a projected revenue collection of more than USD 16.5 bn, by 2024 (Source: Market Insider). With rapid urbanisation, cities are becoming more congested. This development, coinciding with the rapid rise of cell phones and car-pooling apps, has given rise to the concept of car sharing. Journey planning apps, which help users identify and compare different modal options for getting to their destinations, have become commonplace, with local and global offerings available in every city. The natural next step would be to bring all of these options together on a common platform. This would enable journey planning across a range of transportation modes, offering flexible payments and personalisation based on time, comfort, cost and/or convenience.

Megatrend 3: Autonomous vehicles

The vehicle automation market is worth trillions. Almost every company from technology, transportation and telecommunications, to logistics, data centre, IT and commerce is looking to capture a piece of this enormous opportunity. While companies like Uber and GM have had a fair bit of visibility in the autonomous vehicle space, there are many others creating solutions and IPs to serve automated vehicle technologies.

Automation for vehicle and fleet management will require foolproof technologies across the V2V, V2I and V2X spectrum. Most of the technologies such as artificial intelligence, hyper local and GPS are emerging from start-ups on the back of aggressive venture capital and investment.

The autonomous vehicle ecosystem

The autonomous vehicle ecosystems spans across 4 key areas:

- 1 **Vehicle development:** where OEMs and suppliers are looking at acquiring technologies across sensors, processors and software integration to be incorporated in the autonomous platforms
- 2 **Function development:** where OEMs, suppliers and component developers are working with city and town planners to deploy V2I and V2X technologies aimed at fleet, traffic and public transport management
- 3 **Service development:** where OEMs and start-ups are collaborating for offering a range of services backed by data and analytics centred around users' mobility persona
- 4 **Data centre development:** where start-ups are looking at developing data acquisition platforms and providing value-added services to OEMs

AV landscape

Vehicle	Function
Processors Software Components Sensors OEMs AV platforms	Fleet management Public transport Traffic management
Service	Data centre
Logistics Mobility services Micro services Commerce transactions Software services	Data centres Telecom Analytics OTA Security

Source: GT Analysis

Automated Mobility on Demand (AMoD)

As Mobility of Demand (MoD) evolves and switches to the autonomous mode, the degree of automation force the drivers to be replaced by self-driving technologies for mass transportation.

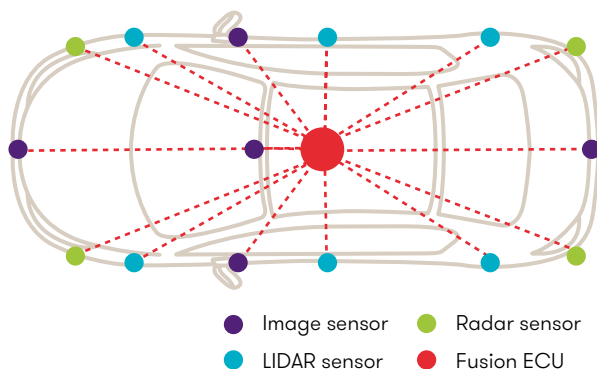
AMoD specifically pertains to robo-taxis operating as a service and operated by Transportation Network Companies (TNCs), which use smartphone apps to connect passengers and taxis. It is also known as 'ride-sourcing'.

When traditional vehicle ownership begins to transition to AMoD, fleet operators will become the new owners of vehicle assets. OEMs would need to focus on meeting vehicle specifications as per vehicle application. Autonomous vehicles would have to meet endurance standards on account of extended utilisation hours.

Sensors and data integration

Fully autonomous cars at level 4 or 5 will require multiple sensor systems. Today's systems for semi-autonomous driving use radar and camera systems. The design of high-resolution, affordable Light Detection And Ranging (LIDAR) systems with ranges up to 300m are still in the pre-development stage. Building the best sensor package will largely depend on the application.

Vehicle sensor system



Hence, LIDAR, a laser-based system, is beginning to gain traction. In addition to the transmitter (laser), the system requires a highly sensitive receiver. Used primarily to measure distances to stationary as well as moving objects, the system employs special procedures to provide three-dimensional images of the detected objects. Its downside is the cost and unusability in some weather conditions.

Radio Detection And Ranging (RADAR) involves the detection and localisation of objects using radio waves. Although RADAR is cheaper than LIDAR and getting better at detection of non-metallic actors, it still suffers from noise.

Camera is best at detection but suffers at judging distances and movements.

Level 4 applications for commercial fleet operators will require a full suite of sensors as well as localisation of assets and precision mapping. This technology will be expensive.

External ecosystem

Interaction of the vehicle with the external ecosystem will be critical for vehicle navigation. V2V, V2I and V2X system integration will be essential for vehicle mobility. The data flow will be largely dependent on secure data storage assets with an open source interface layer. This means that any vehicle from outside the network should also be able to communicate with the data assets to ensure seamless mobility and navigation.

Vehicle control and safety

In the context of vehicle control and safety, teleoperations and remote will play a key role in vehicle operations, especially for AMoD. These technologies and system integration will assist vehicle operating systems to process alternate location routes and user options in case of severe weather conditions.

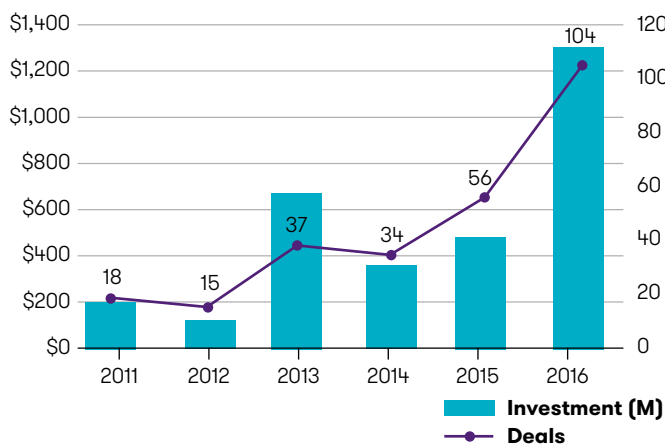
The autonomous vehicle will be backed by data, making cybersecurity critical. Teleoperations would become a threat area as operators will have access to vehicle data from the backend. The industry will require secure encryption standards and technologies to make the ecosystem secure.

Current landscape

There are over a dozen global multinationals that are actively involved in the development of autonomous vehicles and their testing for commercialisation.

While auto giants like Tesla, BMW and Toyota have gained fair share of visibility within e-mobility and autonomous car development, 2016 witnessed private companies, autonomous driving start-ups, software and hardware integrators and tech companies attracting over USD 480 mn funding in such technology development and testing. Global auto giants are looking at gaining a competitive edge through acquisitions and partnerships.

Auto-tech financing trend (USD mn)



Source: World Wide Web

Auto OEMs have been developing specific capabilities across the following areas:

- Assisted driving/Autonomous software
- Driver safety tools
- Connected vehicle/Driving data
- Fleet telematics
- Vehicle-to-vehicle communication
- Auto cybersecurity

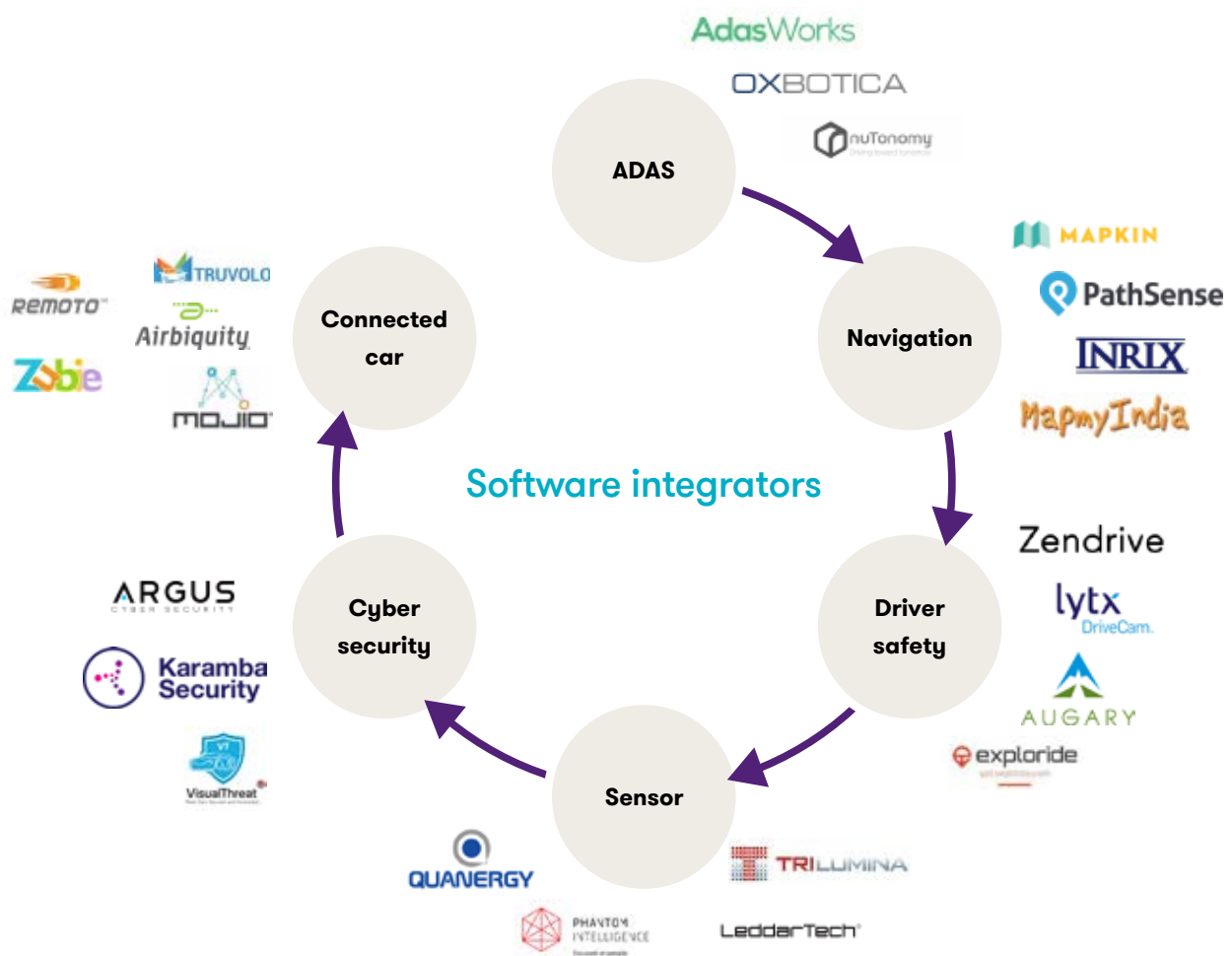
Some of the notable deals/partnerships include the following:

- **General Motors' acquisition of Cruise Automation:** Cruise Automation develops automated driving technology. It built the first highway autopilot system that can be installed in existing vehicle. It uses sensors and machine vision technology to keep the vehicles within the lane and maintain a safe distance from other vehicles.
- **Audi's partnership with NVIDIA:** While NVIDIA is known for developing graphic cards for computers, the company has increased its focus in the automotive market. NVIDIA has partnered with ZF and Bosch to gain supplier capabilities with Audi in turn partnering with NVIDIA to produce a Level 4 autonomous car.

- **Renault-Nissan partnership with Microsoft:** The partnership will see Renault-Nissan using Microsoft's cloud technology by accessing the vehicle software and data to predict maintenance as well as driver data for research, operate Microsoft's productivity services (including Office 365 and the virtual assistant Cortana) and provide real-time and contextual navigation. The data produced and collected by the platform can also be used for machine learning in autonomous driving systems.
- **Daimler's acquisition of RideScout:** Daimler, which owns the Mercedes-Benz and Smart car brands, acquired RideScout, an app for finding ride-shares and other transport options in U.S. cities, and Intelligent Apps, a German company which makes the mytaxi app for ordering taxis in USA and Europe. This will be key to gaining access to customer data across USA and data gathered for other countries after expansion of this app. This data can be used to develop autonomous technologies and connected cars.
- **BMW's partnership with Intel and Mobileye:** This partnership will help the Munich-based global giant to create an open standard-based platform for bringing self-driving cars to the market, aiming to put vehicles on the road by 2021. While Intel will assist BMW in chip designs and hardware, Mobileye will assist BMW in providing Advanced Driver Assistance Systems (ADAS).

Other notable players who have been active in this space:

Tech landscape: Autonomous vehicles



Source: Articles, News & GT Analysis; (Above illustration is non-exhaustive)

While industry players have made considerable investments in developing driver-assist and autonomous vehicles technologies, governments across the globe have also extended their support through policy mandates, funding arrangements and building the supporting infrastructure.

Some of the steps taken by governments globally include the following:

- **USA:** The Obama administration in 2016 proposed to spend nearly USD 4 bn in a decade for the development of self-driving cars. The focus will be to accelerate the development and adoption of safe vehicles automation through real-world pilot projects.
- **UAE:** Dubai has committed to have 100 autonomous vehicles on the road by 2020 and 25 per cent of all the transportation in Dubai to be smart and driverless by 2030. UAE predicts that 90 per cent of the vehicles on road will be electric, self-driving cars by 2035.
- **Japan:** As a part of the 'fourth industrial revolution' initiative, the Japanese government will aim to have 20 per cent autonomous cars by 2030.
- **China:** China aims to have 10–20 per cent highly autonomous vehicles by 2025 and 10 per cent fully self-driving cars by 2030.





India amidst transition

The Indian auto industry is the fourth largest globally. It accounts for 7.1 per cent of the country's Gross Domestic Product (GDP). The production output of the Indian automobile industry grew by 14.8 per cent in 2017–18 compared to the last year, from 25.3 mn to 29 mn vehicles.

Indian automobile production trend

Category	2012-13	2013-14	2014-15	2015-16	2016-17	2017-18	Growth rate % (2017-18)
Passenger vehicles	3,231,058	3,087,973	3,221,419	3,465,045	3,801,670	4,010,373	5.5
Commercial vehicles	832,649	699,035	698,298	786,692	810,253	894,551	10.4
Three wheelers	839,748	830,108	949,019	934,104	783,721	1,021,911	30.4
Two wheelers	15,744,156	16,883,049	18,489,311	18,830,277	19,933,739	23,147,057	16.1
Grand total	20,647,611	21,500,165	23,358,047	24,016,068	25,329,383	29,073,892	14.8

Source: SIAM

Global disruptions arising out of EVs and connected and autonomous vehicles are poised to have a significant impact on the nascent Indian automotive industry, including OEMs, component suppliers and dealers.

EV adoption

India's EV market is at a nascent stage when compared to markets such as China and USA. It was estimated at 0.4 mn units of two-wheelers, 0.1 mn e-rickshaws and 5,000 units of private vehicles in 2016. However, despite its size, it has gained considerable importance and attention among OEMs, global component manufacturers and the government.

There will be a notable shift in the power centres across the automotive value chain. OEMs will be forced to relook at their strategy for battery and battery management systems to overcome range anxiety and battery performance. They will play a larger role in integrating mechanical components with electronics and battery, accounting for almost 45 per cent of the total value addition.

Component suppliers will have to re-strategise from following a print to manufacture model to a more design and R&D-focused value-addition-based business model. Their share in the value addition in EVs is expected to reduce by almost 15 per cent to 40 per cent.

Raw material suppliers, especially copper suppliers, will be expected to play a larger part in the total value addition due to the higher electrical component requirements.

Per cent value addition: ICE vs. EV

Particulars	ICE	EV
Raw Material	10-15%	15-20%
Component Suppliers	50-55%	35-40%
OEMs + Battery & Component	30-35%	40-45%

Source: World Wide Web

Prerequisites for successful adoption of EVs in India

Access to lithium for battery development

The government of India has now revised its EV penetration target from 100 per cent to a more realistic 30 per cent by 2030.

Lithium availability will be key to this mission of the government. The requirement of lithium in the Indian market is expected to be 350,000 tonnes per year (Source: SIAM). The biggest hurdle related to the adoption of EVs in India has been the sourcing of lithium as the government does not have any arrangement with any country for lithium exploration and extraction.

The 'Lithium Triangle', comprising Chile, Argentina and Bolivia, is rich in lithium. India will require a strategy designed to overcome India's relatively weak initial position in battery manufacturing while claiming an increasing share of total battery value over time. India's market for EV batteries alone could be worth as much as USD 300 bn by 2030.

FAME subsidy

The Ministry of Heavy Industries and Public Enterprises released the Faster Adoption and Manufacturing of (Hybrid & Electric Vehicles (FAME) scheme in India in 2015. The scheme aims to promote eco-friendly vehicles in the country, including hybrid and electric vehicles, across various platform segments including two-wheelers, three wheelers, passenger four-wheeler vehicles, light commercial vehicles and buses.

The first phase of the scheme was launched in 2015 for a period of two years with an overall allocation of INR 795 crore. It was later extended by one more year.

Although the government is looking at FAME 2, there is a greater need for expediting the subsidy programme over the longer term to assist OEMs with a clear roadmap on EV plans and investments.

Electricity and charging infrastructure

As per the Electricity Act, 2003 (Electricity Act), EV charging infrastructure qualifies as an 'electricity line' or 'electricity system' or 'works' or 'supply'. EV charging stations will procure electricity to distribute/sell it to the EV owners, but distribution of electricity is only permitted to a distribution licensee under Section 12 of the Electricity Act. Thus, only a distribution licensee may be permitted to establish EV charging stations under the current regulatory framework.

A non-licensee can distribute electricity under the franchisee model by entering into a franchisee agreement with the concerned distribution licensee. However, the distribution licensee will still remain responsible for the supply of power.

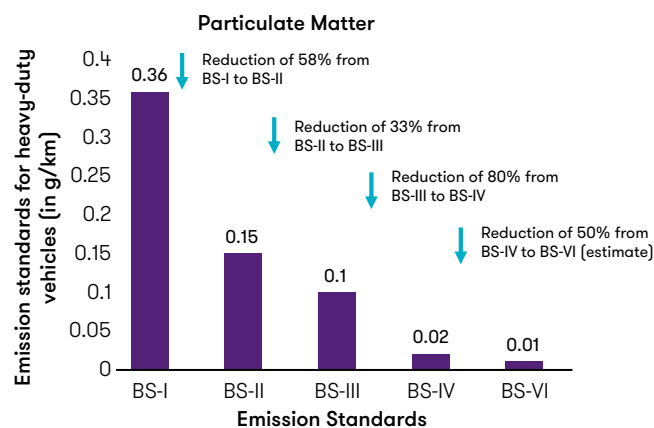
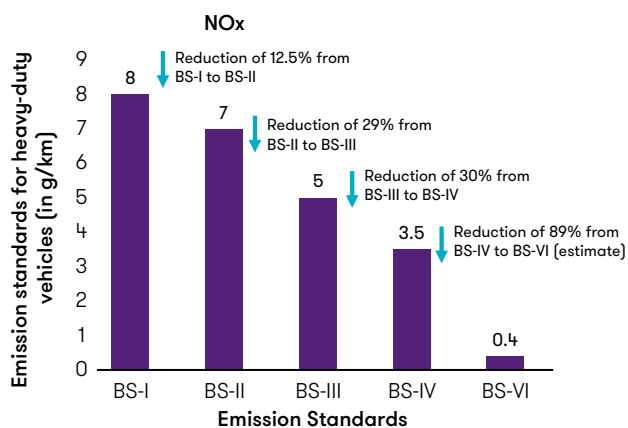
Therefore, in order to create a robust infrastructure with private participation, a speedy amendment to the Electricity Act is required.

Investment prioritisation and clarity for OEMs and component manufacturers

Indian OEMs are struggling to achieve a smooth transition to BS-VI emission norms (with a 2020 deadline) because of the current policy environment. BS-VI is an advanced technology and difficult for India to develop in-house. Therefore, the base technology might have to be taken from Europe and customised for the domestic market through domestic innovation and with the help of global firms specialising in emission-control technologies.

Early introduction of the technology would also require support from the oil companies to ensure BS-VI fuel availability.

Indian automobile production trend



Source: GT Analysis

It is important to note that BS-VI norms will address an inherent flaw in the European emission standards, which permit diesel cars to emit more particulate matter and Nitrogen Oxide (NOx). The jump to BS-VI norms will reduce NOx and particulate matter emissions in diesel cars by 68 per cent and 82 per cent respectively. Similarly, in heavy-duty vehicles like trucks, the shift to BS-VI will reduce NOx emissions by 87 per cent and particulate matter emissions by 67 per cent.

Alternative fuels

While the government has been pushing the EV agenda, there are several schools of thought on exploring alternative fuels such as methanol which are sustainable and cost efficient to drive future mobility requirements. This contradicts the earlier notion of EV roll-out, creating confusion in the minds of OEMs and component manufacturers.

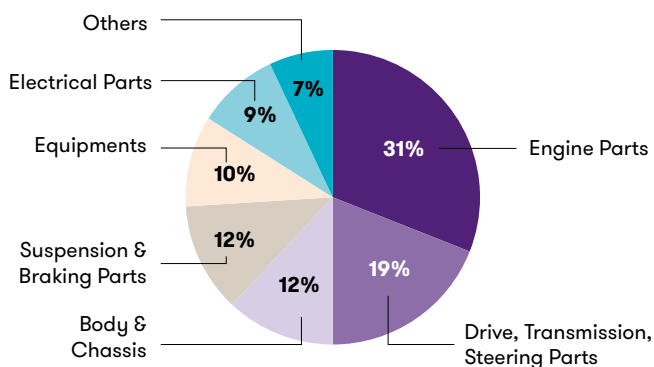
Absence of hybrid powertrains to hamper transition

The Indian government has taken a strong and selective stand on hybrid powertrains by imposing a 43 per cent duty (28 per cent GST + 15 per cent Cess) as against 12 per cent on EVs. Globally, hybrids have become the vital transition platform to EVs as a hybrid platform uses energy from electric batteries as well as conventional ICE. Although the government has revised its EV penetration targets to 30 per cent, prioritisation of investments by OEMs and tier 1 manufacturers remains a serious concern as the investments will take at least a decade to amortise.

Impact on the auto component sector

The Indian auto component sector comprises over 700 component suppliers within the organised segment and over 10,000 players in the unorganised segment. The organised segment contributes to around 85 per cent of the total sector turnover, while the remaining 15 per cent is contributed by the unorganised sector.

Component break-up: Indian auto component industry



Source: ACMA

Engine components can be broadly categorised into core engine components, fuel delivery system and others. This segment accounts for 31 per cent of the auto component market (by value) and includes pistons, piston rings, engine valves, carburettors, crank shafts, sump connecting rods etc. These critical components require a high level of precision and quality adherence. Accordingly, there is a high level of coordination between component manufacturers and OEM.

The drive transmission and steering component segment accounts for around 19 per cent of the auto component market. This segment consists of products like gears, wheels, steering systems, axles and clutches. Clutch discs, cover assemblies and kits components are the key sub-categories in the clutch sub-segment.

The migration of ICE to EV powertrain will mean that OEs will no longer require engine parts and drive transmission components or will have reduced demand for them. Component suppliers will have to relook at their product offerings, R&D efforts for developing and supplying electric motors (Permanent Magnet [PM] and induction motors), inverters, converters, rectifiers, Engine Management Systems (EMS) (powertrain components).

Impact on automotive dealers

The average ratio of car sales to car service in India is 1:15, which means that for every 1 car sold, 15 cars are serviced. Aftersales and servicing is crucial for dealer profitability as they bring footfalls and significant revenues. However, the powertrain migration from ICE to electric will have a significant impact on the serviceability of the platforms as there will be fewer moving parts.

The country's top two OEMs, Maruti Suzuki and Hyundai Motor India, together service over 66,000 cars daily. There will be significant downsizing of technicians in the coming years as the viability of dealerships will be questioned.



Shared mobility in India

With congestion in mega cities turning into a big challenge, shared mobility provides a clear vision for the future of cities. It creates alignment between the city governments, private companies and NGOs in making cities more liveable. City streets are a finite resource that are getting increasingly congested and polluted.

In India, vehicle ownership has traditionally been associated with 'status'; however, the trend is gradually changing. The urban young commuters need to optimise ROI and time and are more conscious of the environment. For them, mobility is a utility.

Shared mobility is being successfully adopted in India through:

- 1 ride-hailing apps
- 2 car pooling

With the focus of auto makers shifting towards EVs, OEMs such as Mahindra & Mahindra are partnering with ride-hailing cab aggregators like Ola for their EV sales.

Fleet operators will become a key customer segment for OEMs, who will need to realign financing, insurance and business resources to remain competitive in this segment.



Autonomous vehicles in India

India has a long way to catch up with developed countries in the autonomous vehicle space due to slow infrastructure growth in the country. Most developing countries including India will witness a calculated phase-wise roll-out of autonomous technology based on infrastructural growth, changing consumer mind-set and price sensitivity.

Some examples of Indian OEMs testing select autonomous technologies are as follows:

- Mahindra Reva, an electric car subsidiary of Mahindra & Mahindra, has submitted proof of concepts for autonomous cars in the UK and Singapore and has already begun experiments in its R&D facility in Bengaluru.
- Tata Elxsi, the Tata Group's design and technology firm, has been working on an autonomous car framework and is planning to test autonomous cars.
- In India, a robotics engineer, Dr. Roshy John, has designed and launched India's first autonomous car by altering Tata Nano, the entry level car from Tata Motors.

Indian OEMs will be challenged to reduce their 'time to market' from 'design to roll-out' as compared to foreign OEMs primarily due to their narrow product portfolio; it is easier for foreign OEMs to homologate global platforms (such as downsizing ICEs, suspension etc.) as compared to developing an altogether new platform for a specific country.

India is host to over 25 R&D centres, and the Indian automotive industry accounts for 10 per cent of the country's R&D expenditure.

Indian OEMs would need to focus on three key areas in order to be competitive:

- creation of domestic IP by attracting the top talent base and experts from matured markets for R&D capability development, especially the development of battery, powertrains and hardware and software integration
- acquisition/alliance with companies engaged in software development, microchip development, GPS and navigation critical for autonomous vehicles
- developing a network of industry, academia and government bodies for building R&D capability

Grant Thornton conducted discussions with select automotive professionals in the Indian auto industry to take their point of view on connected cars. The key insight we gathered indicated that India is far below western countries in the roll-out of connected car features (V2V and V2I). Although select features are currently available in a few high-end Indian luxury car platforms, only a small section of the available customer base has access to them.

The key reasons attributed to the lower adaptation of V2I and V2V technology were as follows:

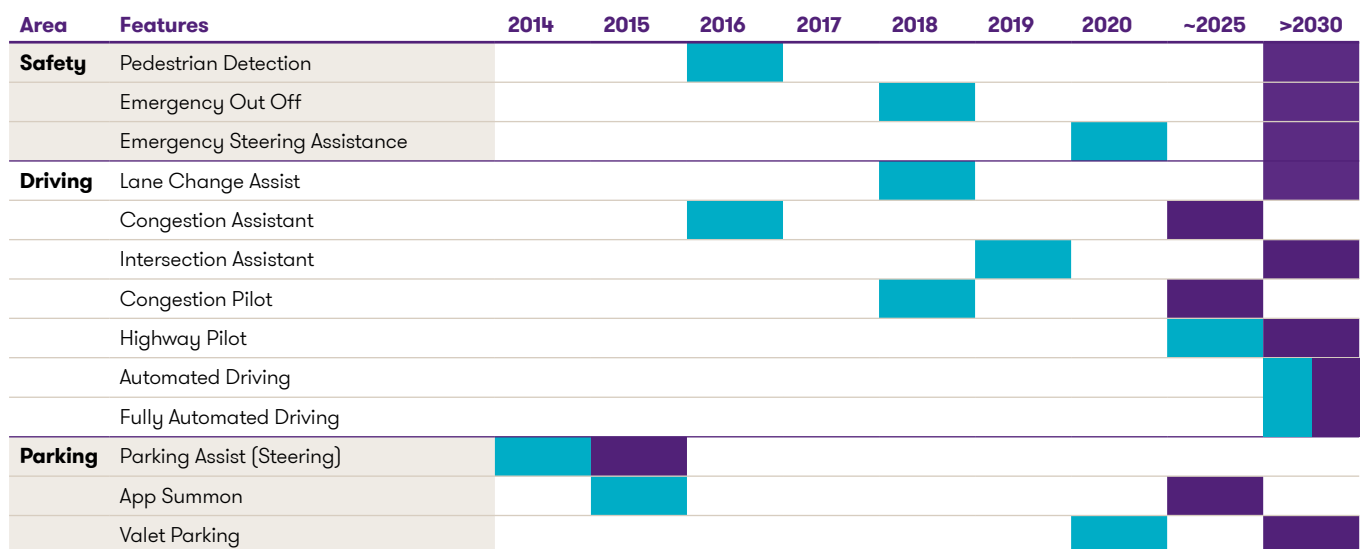
OEM side: Challenges in developing adaptive machine learning algorithms based on existing driving and road conditions due to:

- erratic and dangerous driving habits of drivers on roads
- non-functional or semi functional traffic lights

- driving conditions: integrating V2V and V2I technology with the existing road and traffic conditions, with roads varying from well-made black top to dirt tracks, abandoned signage, broken road and traffic lights, and animals and pedestrians venturing into busy roads

Fact: India ranks 60th among 79 developing economies in the World Economic Forum's Inclusive Development Index as of 2017. Connected car deployment would need to have a well-developed and an 'integrated' infrastructure (physical and digital). India accounts for the highest number of road deaths in the world with more than 1.46 lakh fatalities annually. This accounts for 10 per cent of global road accidents.

Connected car roll-out landscape: Global vs. India (V2V and V2I)



Source: GT Insights

■ India Deployment (Forecasted)
■ Global Deployment (Forecasted)

Most of the offerings in the coming three to five years will be 'connected features' inside the car cabin, for example, advanced audio, video, telematics, infotainment and payments. Although OEMs will be selective in sourcing such components,

the premium segment will have the first-mover advantage as customers of the segment will be more willing to pay a premium for new features. The roll-out of such features across platforms in the mass segments will take time.



Challenges and considerations for the automotive industry

As the future of mobility evolves, it will be critical for OEMs, suppliers and dealers to relook at their business and set priorities to ensure long-term sustainability and market leadership.

The evolution of vehicles will happen in two phases (absolute commercialisation levels):

- **Phase 1:** where there will be a drastic shift of vehicles from ICE to pure electric
- **Phase 2:** where vehicles will evolve from pure electric to electric autonomous with varied levels of autonomy

This disruption will present challenges as well as opportunities across the automotive value chain.

In the following section, we have tried to capture 'what will change' and the 'imperatives' to deal with such a change.

Phase 1: Where vehicles evolve from ICE to pure electric

OEMs:

Secure the back-end side of the business

For Indian OEMs, the fundamental change will be across the battery and powertrain segments. Battery currently accounts for over 50 per cent of total EV cost. While **battery availability** in India is a challenge, it will be critical for OEMs to collaborate with battery manufacturers and undertake joint R&D projects to improve battery performance and vehicle integration and efficiency. A cornerstone for driving the battery costs down for OEMs is local production and sourcing as against importing and assembling.

Investing in supplier diversity including supplier identification, development and collaboration will be key to survival.

Investment in R&D, academia and research collaboration and active lookout for potential acquisition targets for battery design and development will be key.

Securing the front-end side of the business

Timely replacement of defective batteries will play a big part in gaining customer confidence and trust, especially in the context of shared mobility, where a downtime from battery malfunction could have a huge impact on driver earnings.

OEMs will be tested in addressing 'customer range anxiety' to justify the total cost of ownership for the EV platform.

Component suppliers:

The strategy for component suppliers has been traditionally governed by OEMs, who give component designs to the suppliers.

OEMs will be **forced to look at modularisation of features, develop alternative powertrains and introduce ADAS and connected features**. Therefore, they will need to make selective calls on vendor tie-ups, focusing on pricing, supplying capacity, quality, technology and supply chain alignment with OEMs.

Manufacturers of powertrains and transmission will be under pressure as they will be forced to invest in R&D, develop technical capability as well as reduce time to market; the ability to invest in powertrains will be largely governed by the level of alignment and scale of operations that supplier have with OEMs (both in India and globally).

Suppliers will also be forced to look at acquiring software development and integration capabilities. Medium- and smaller-level suppliers will be finding themselves amidst a cash crunch in R&D. Absence of hybrid powertrain will further squeeze breathing space for component suppliers. Traditional suppliers will find increased competition from technology and consumer product companies to match quality and pricing.

Impact on select components categories

Segment	Old technology	New technology
Powertrain	ICE	Electric
Casting and forging	Steel	Aluminium and carbon composite
Precision powertrain	Turbochargers and fuel-injection equipment	Electric drive module and system integration
Electrical components	Wiring harness and switches	

Source: GT Analysis

Component suppliers

Traditional auto dealerships and their viability will be challenged as the penetration of EVs pick up. EVs, with fewer moving components, will have lesser need for servicing, which accounts for over 50 per cent of dealer profitability.

Dealers will have to relook at their business model and focus on data and value-added services to remain competitive in the industry.

Phase 2: Where vehicles will evolve from pure electric to electric autonomous with varied levels of autonomy

OEMs:

As-is state (L1 and L2)

The business model under this stage will not be impacted much, and vehicles will be bought by individual buyers. Customers will ask for privacy, flexibility, security, and convenience-based features, and auto OEMs will need to focus on improving the features in terms of infotainment and mechanical and digital safety. Auto OEMs will also need to focus on developing robust platforms for capturing data through vehicle sensors and acquiring customer data to use it real time to improve their market responsiveness and CRM effectiveness.

Critical parameters for auto OEMs under this stage will be rolling out products with minimum time to market, building relevant market-specific value propositions, improving CRM effectiveness and building digital connectivity and data analytics capability essential for responding to real-time market changes and trends.

Driver-assist state (L3)

OEMs will need to focus on developing technologies that are reliable and robust, especially with respect to monitoring technology as the driver under this phase can choose to automate vehicle control under specific conditions such as heavy traffic.

It will be critical for auto OEMs to earn customers' trust with regard to the new technology through product demos and experience-based marketing efforts.

Cost of ownership will be a major factor governing the commercial success of products equipped with such technology. It will be critical for auto OEMs to focus on bringing the cost down as much as possible to match the perceived value to ensure commercial success and long-term sustainability of their business.

Auto OEMs will have to prioritise on markets with support infrastructure required for the smooth functioning of V2V and V2I communication.

Fully autonomous state (L4 and L5)

This is the most disruptive stage for auto OEMs as the vehicles will be fully autonomous.

Auto OEMs will have to ensure the highest levels of integrity in cars with regard to monitoring, safety and navigation, combined with adaptive machine learning capabilities and rich adaptive infotainment-based features.

Auto OEMs will also have to form alliances not only with component manufacturers and software developers and integrators, but also with connected mobility and infrastructure service providers to ensure V2V and V2I connectivity.

Data will be the fuel for future auto OEM business models. It will provide insights into various customer preferences and

their digital service usage. Auto OEMs will have to develop capabilities for real-time data processing, which will be critical for preventive and predictive asset maintenance, optimised marketing and upselling. Auto OEMs will have to transform from

traditional mechanical/automobile companies to mechatronics companies.

Component suppliers

Component suppliers for autonomous vehicles will have opportunities across three broad areas:

Body parts: The business model for body parts and panels will change significantly as most body parts will be made up of aluminium, reinforced plastics and carbon composites. Auto suppliers would need to develop designing capabilities to actively partner with OEMs on future models. Aggressive suppliers will focus on R&D programmes on light-weighting and design efficiency through academia collaborations.

Interiors and digital hardware: The future battles of the automotive industry will be fought in the vehicle interior. Future autonomous platforms will require sturdy interiors coupled with interactive hardware across visual, touch and speech formats. Auto component suppliers would need to focus on building interior design capabilities and on integrating such hardware for OEMs as a module. Modularisation will be key to business profitability. M&As in this space are expected to be high.

Digital and software integration: Suppliers will be presented with a diversification opportunity across AI and software development and integration as per OEM requirement across visual, touch and speech formats. M&As in this space are expected to be high.

Auto dealers

As-is state (L1 and L2)

The business model under this stage will not be impacted much, with vehicles being bought by individual buyers through the existing channels. Auto dealers will need to focus on enhancing the overall customer experience and satisfactions levels. They will have to build competencies in CRM and create an omni channel.

While fleet sales will continue to rise, auto dealers will need to focus on improving B2B alliance effectiveness for improving sales through competitive pricing and efficient after-sales service responsiveness.

Critical parameters for auto dealers under this stage will be building relevant market-specific value propositions, improving CRM effectiveness and building digital connectivity and data analytics capability essential for enhancing the customer experience.

Driver-assist state (L3)

Auto dealers will need to establish integrated service offerings (maintenance, software upgrades and customisation, and insurance) by forming alliances with technology companies to maintain brand recognition and customer connection.

They will have to demonstrate new technology through product demos and experience-based marketing efforts.

Fully autonomous state (L4 and L5)

This is the most disruptive stage for auto dealers as the vehicles will be fully autonomous. Aftermarket sales, which account for a major chunk of the total revenues for auto dealers, are likely to decline with the growth of autonomous vehicles.

The fully autonomous state will also give rise to a new breed of retailers offering services around digital and hardware platforms. For example, auto dealers could offer customised user interface or quick access software functionalities on company-fitted infotainment systems.

Dealers could also offer custom-built infotainment and navigation software. It will be critical for auto dealers to restructure their aftermarket business model to address this new retail competition.

They will need to establish integrated service offerings (maintenance, software upgrades and customisation, insurance and charging stations) by forming alliances with connected mobility and infrastructure service providers.

There may be new service opportunities for dealers in this stage, such as autonomous vehicle driver training and certification.



Conclusion

Since the invention of the first ICE by Henry Ford in 1903, the automobile industry has witnessed incremental performance improvements and inventions within the ICE space, primarily around efficiency, power and emission compliance.

Today, governments globally are focusing on reducing carbon footprint and pollution, which in turn has made auto manufacturers relook at the mobility powertrain strategy and migration to cleaner technology, i.e., EVs.

The global automotive industry is witnessing three megatrends:

- **Shift to electric powertrain from traditional ICE**, with China becoming the largest EV market globally recording double the sales in USA in 2016. This trend is being driven by falling battery prices and government interventions to move away from oil toward green technology.
- Challenges of urban accessibility and influence of growing city populations have given rise to **MaaS**, which is redefining mobility needs. Around 66 per cent of the global population is expected to live in urban areas by 2050 as against 54 per cent in 2014. Urban planners will be faced with a problem of adding new infrastructure to relieve congestion in urban cities. MaaS will provide an alternative to move more people and goods in a way that is faster, cleaner and less expensive than the current options.

Increased mobile phone usage has also contributed to the rise of ride-hailing services, carpooling and shared mobility concepts. The global car sharing market is expected to witness a 34 per cent y-o-y growth, with a projected revenue of more than USD 16.5 bn by 2024 (Source: Market Insider).

- **Autonomous vehicles** will be the future of mobility. Almost every company, from technology, transportation and telecommunications to logistics, data centre, IT and commerce is looking to capture a piece of this enormous opportunity.

As mobility requirements evolve and technology becomes more robust and reliable, MaaS will eventually get transformed into Automated Mobility on Demand (AMoD), commonly known as robo-taxis. **When traditional ownership begins to transition to AMoD, fleet operators will become the new owners of vehicle assets.** Under this model, traditional auto companies will

serve fleet operators, who eventually will become the primary customers of the vehicles.

Capability development across **sensor and data integration** (LIDAR) and car external ecosystem in the form of V2V, V2I and V2X technologies will be critical. Technology for **vehicle control and safety** will be key to the successful deployment of autonomous vehicles. Fleets of automated vehicles will require teleoperation and remote monitoring. Teleoperation will be based on monitoring services that optimise flow and traffic, or provide a fall-back when environment conditions are unpredictable.

There is also a high level of cyber security necessary to support AMoD. Teleoperation becomes a critical threat area since an outside services provider has the authority to reach deep into the control commands or take over control entirely. The industry is going to require the most sophisticated application of security when highly automated vehicles reach critical mass.

Auto OEMs in line with such disruption have been focusing on developing specific capabilities across assisted driving/ autonomous software, driver safety tools, connected vehicle/ driving data, fleet telematics, vehicle-to-vehicle communication and auto cybersecurity. M&As in the sector will be driven by a need and intent for acquiring skill and technology with notable M&A by GM (Cruise Automation), Audi (NVIDIA), Renault-Nissan (partnership with Microsoft), Daimler (Ridescout) and BMW (Mobileye).

India, the fourth largest automobile market globally, is witnessing disruptions across EV powertrain migration, while having to deal with its own set of challenges across industry capability and policy. The Government of India has revised its EV penetration targets to 30 per cent. However, prioritisation of investments by OEMs and tier 1 manufacturers remains a serious issue. Moreover, it poses a significant challenge for local auto suppliers due to low R&D capability and investment appetite. However, sourcing of lithium is considered to be the biggest hurdle for EV adoption in India

The powertrain migration from ICE to electric will have a far-reaching impact on the serviceability of the vehicles as there will be fewer moving parts and servicing accounts for a significant share in the overall dealer profitability. The migration will also lead to a momentous demand contraction for engine, drive and transmission related components, putting businesses under pressure as engine components account for over 50 per cent of the industry's output.

Manufacturers of powertrains and transmission will be under pressure as they will be forced to invest in R&D, develop technical capability as well as reduce time to market; the ability to invest in powertrains will be largely governed by the level of alignment and scale of operations that suppliers have with OEMs (both in India and globally). Suppliers will also be forced to look at acquiring software development and integration capabilities. Medium- and smaller-level suppliers will be finding themselves amidst a cash crunch in R&D. Absence of hybrid powertrain will further squeeze the breathing space for component suppliers.

Battery availability, investing in supplier diversity and capability, R&D and academia collaboration all aimed at addressing customer range anxiety and battery performance maximisation will be key for OEMs' success.

There is also a need for expediting the FAME 2 subsidy programme over the longer term to provide OEMs a clear EV and investment roadmap. The country also requires amendments to the Electricity Act to facilitate charging infrastructure creation.

An immediate **challenge for auto OEMs** in India is addressing the BS-VI deadline (2020). Early introduction of the technology would require support from the oil companies to ensure BS-VI fuel availability. Auto companies would have to develop the requisite technologies and capabilities locally as against importing them because of the scale involved.

The urban young commuters in India are now realising the need to optimise ROI and time, and are more conscious of the environment. For them, mobility is a utility. This has resulted in the rise of **shared mobility and ride hailing apps**. Consequently, fleet operators will become the key customer segment for OEMs, who will need to realign financing,

insurance and business resources to remain competitive in this segment.

India is fairly nascent in the autonomous vehicle space. The challenge this poses for the country is developing adaptive machine learning algorithms amidst erratic and dangerous driving and integrating V2V and V2I technologies with the existing road and traffic conditions.

Most of the offerings in the coming three to five years will be 'connected features' inside the car cabin, such as advanced audio, video, telematics, and payments as this segment has latent consumer aspiration both within the luxury and mass segments.

The migration to autonomous vehicle from pure electric will be a tectonic shift in the industry. Business models across OEMs, dealers and suppliers will not change much in L1 and L2 stages but will significantly shift post that.

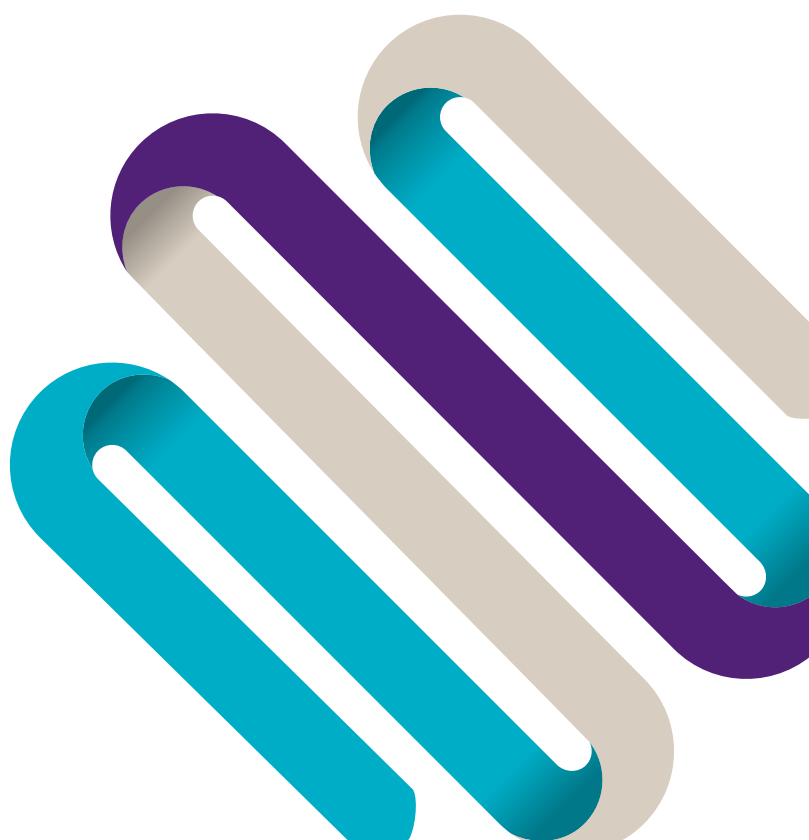
For example, for L3 deployment, auto OEMs will have to prioritise markets with support infrastructure required for smooth functioning of V2V and V2I communication. Auto dealers will need to establish integrated service offerings (maintenance, software upgrades, customisation and insurance) at this stage.

Similarly, in L4 and L5 stages, data will be the fuel for future business models of auto OEMs. Data will provide insights into the various touch point preferences of customers and their digital service usage. Auto dealers will need to establish integrated service offerings (maintenance, software upgrades, customisation, insurance and charging stations) by forming alliances with connected mobility and infrastructure service providers. Some dealers could also offer their own custom-built software for infotainment and navigation. It will be critical for auto dealers to restructure their aftermarket business model to address this new retail competition. India is still far from the L4 and L5 stages.

Assessing business strengths, plugging gaps through technology acquisition and redefining business strategy coupled with speedy execution will be key to survival for OEMs, suppliers and dealers.

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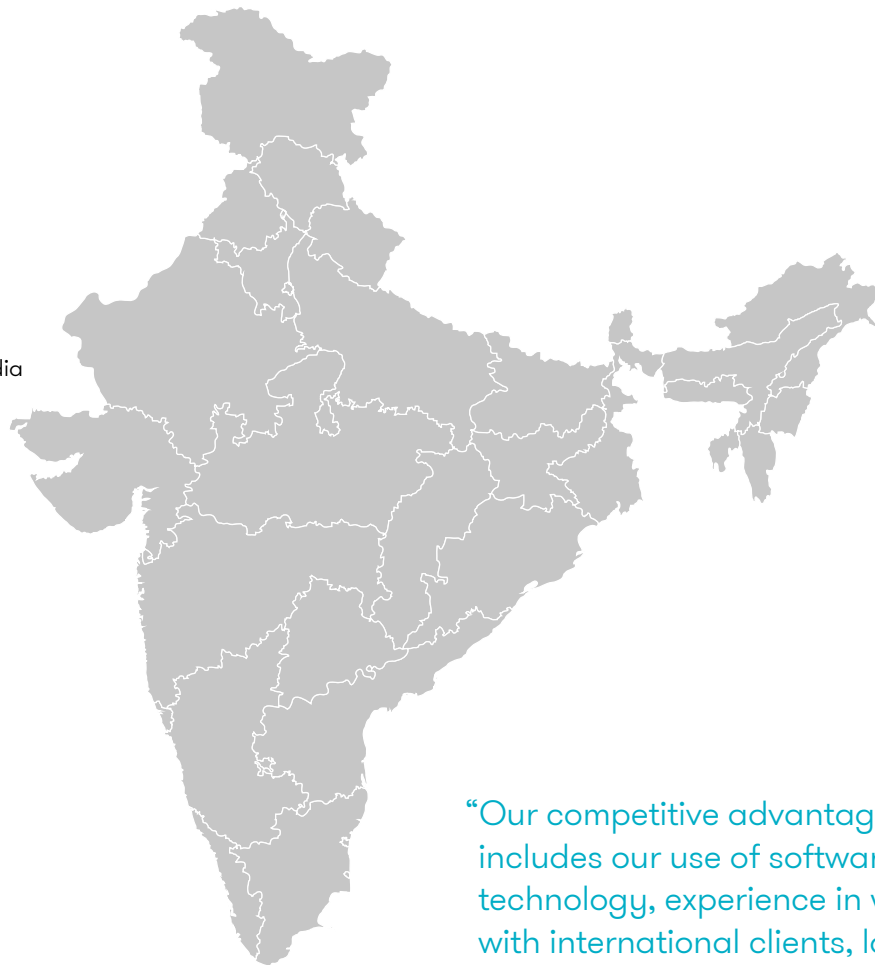
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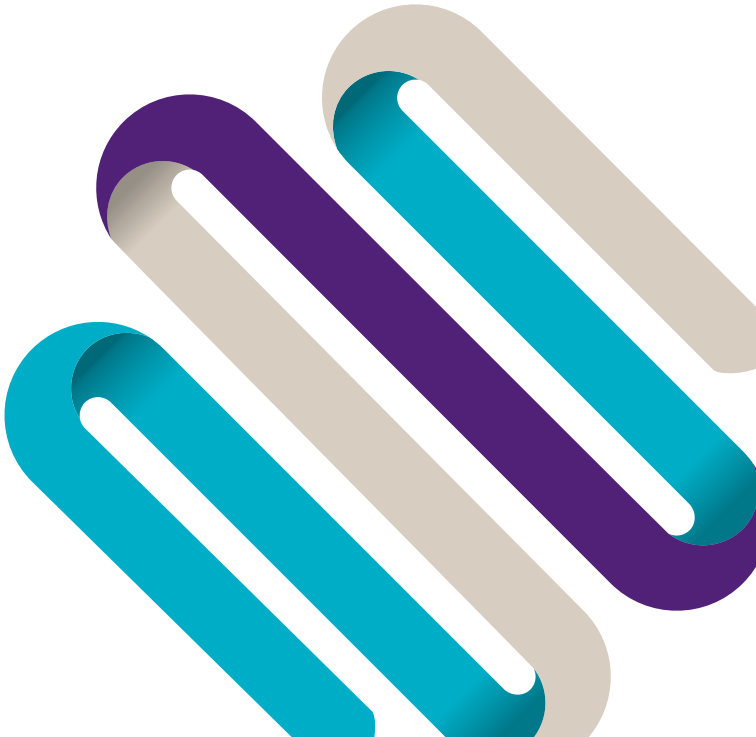
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