What we are expecting from this presentation:

A. We want to inform you on the most important highlights from this topic.

B. We need you to take the time to explore the presentation carefully and with a critical mind.

C. We would like you to write down every comment or idea that emerges while reading this presentation.

D. We exhort you to share with us a constructive feedback for further improvements.

E. We invite you to dialog with us if you have any doubt or want to dive into some specific aspects.
Autonomous Vehicles
<table>
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<th>Topic</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intro to Autonomous Vehicles</td>
</tr>
<tr>
<td>Classification of different levels of autonomous vehicles &amp; different ADAS Solutions</td>
</tr>
<tr>
<td>Drivers of Autonomous Driving</td>
</tr>
<tr>
<td>Projections Autonomous Vehicles</td>
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<tr>
<td>Implications for Automotive Manufactures and it’s supply chain</td>
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<td>OEM’s perspective</td>
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<td>Automakers Initiatives in Autonomous Vehicles</td>
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<td>Pricing of Components</td>
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<td>Supplier’s Perspective</td>
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<td>Value Chain &amp; Top Suppliers</td>
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<td>Market Projection for Components</td>
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<tr>
<td>Key enablers for autonomous driving</td>
</tr>
<tr>
<td>Scenarios for autonomous driving</td>
</tr>
<tr>
<td>Possible design &amp; applications of Autonomous Vehicles</td>
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</table>
Autonomous Vehicles are a game changer

Definition:

An autonomous vehicle (AV) can drive itself from Point A to Point B with no manual input from the driver. The vehicle uses a combination of cameras, radar systems, sensors, and global positioning system (GPS) receivers to determine its surroundings and uses artificial intelligence to determine the quickest and safest path to its destination. Mechatronic units and actuators, allow the “brain” of the car to accelerate, brake, and steer as necessary.

Advantages of autonomous vehicles

- Safety: An AV should be more capable and consistent with its computer-driven ability to determine and interpret its surrounding environment and apply traffic laws
- Greater fuel efficiency: Autonomous cars with V2V and V2X communication ability will have a far greater understanding of road and traffic conditions and should be able to predict even anticipated loads on the engine allowing them to operate in “cruise” mode all the time
- Higher asset usage: Can operate up to 24 hours a day
- Traffic reduction: AV will know the position of surrounding traffic and create significantly more efficient traffic flow
- Consumer productivity: Less time spent on the road getting from Point A to Point B
- Boost to the economy: Enhanced consumer productivity could drive value creation, which could conceivably help boost the economy

<table>
<thead>
<tr>
<th>Manual Driving</th>
<th>Automated Driving</th>
</tr>
</thead>
<tbody>
<tr>
<td>Memory</td>
<td>Maps/Environmental models</td>
</tr>
<tr>
<td>Eyes</td>
<td>Machine learning algorithms</td>
</tr>
<tr>
<td>Reflexes/coordination movement</td>
<td>Actuator control</td>
</tr>
<tr>
<td>Ears</td>
<td>Sensors</td>
</tr>
<tr>
<td>Decision making capabilities</td>
<td>Vehicle to X communication</td>
</tr>
</tbody>
</table>
We are at the early stages of the rise of AVs. Autonomous features are already available while full self-driving automation will be ready by 2025-2030.

**Drivers responsibilities**

<table>
<thead>
<tr>
<th>Level 0</th>
<th>Level 1</th>
<th>Level 2</th>
<th>Level 3</th>
<th>Level 4</th>
</tr>
</thead>
<tbody>
<tr>
<td>No automation</td>
<td>Function-specific automation</td>
<td>Combined function automation</td>
<td>Limited self-driving automation</td>
<td>Full self-driving automation</td>
</tr>
</tbody>
</table>

**Degree of automation**

- **Level 0**: Driver has complete control over longitudinal and lateral dynamics.
  - Driver is responsible for the safe operation of the vehicle as well as monitoring traffic.
  - Existing

- **Level 1**: Specific and multiple automatic functions are controlled individually.
  - Specific: Cruise control, automatic braking, lane keeping, etc.
  - Combined: Concurrent use of adaptive cruise and lane keep assist.
  - Existing

- **Level 2**: A minimum of 2 main steering systems are automated and operated simultaneously.
  - Existing

- **Level 3**: Designed so that the vehicle can operate safely while in automated driving mode. Driver can have full control of the vehicle.
  - Driver does not need to permanently monitor the system and traffic as long as the system is active; in the event that the system cannot maintain automated driving, the driver can safely take over.
  - 2018 – 2020

- **Level 4**: All driving functions are automated and performed safely. All conditions are detected by the system; it is capable of returning to the minimum risk scenario.
  - Driver acts as a passenger – just needs to input the destination.
  - Low speed situation: 2020-2025
  - Including complex operation: 2025 – 2030

*NHTSA (National Highway Traffic Safety Administration) classifies vehicle automation into five levels*
Autonomous functions for driving, parking & safety started 3 year ago and progressing toward full autonomy

Implementation timeline of selected autonomous driving functionalities

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<tr>
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</tr>
</thead>
<tbody>
<tr>
<td>Driving</td>
<td>Lane change assist</td>
<td>Traffic jam assist</td>
<td>Lane keep assist</td>
<td>Intersection assist</td>
<td>Urban automated driving</td>
<td>Highway pilot*</td>
<td>Highway chauffeur*</td>
<td>Fully autonomous System</td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>Parking</td>
<td>Parking assist steering only</td>
<td>“Parking with App”</td>
<td>Valet park assist</td>
<td>Fully auto valet parking (v2)</td>
<td></td>
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</tr>
<tr>
<td>Safety</td>
<td>Construction zone assist**</td>
<td>Emergency power town</td>
<td>Predictive emergency braking and predictive pedestrian protection</td>
<td>Emergency steer assist</td>
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</table>

*Highway pilot = Highway chauffeur + high degree of automation; ** Tested - date of series production not available
Factors influencing the evolution of autonomous driving

A  Technology Innovation
Major automotive companies and technology companies have already demonstrated autonomous driving through working prototypes & pilots. Significant efforts are being made to advance existing technology and to address cost-side challenges

B  Competitive Forces
The entire industry is aware of the potentially huge market emerging from autonomous driving. OEM’s, suppliers and technology players are actively competing to claim their share of this revenue pool

C  Individual consumer benefits
Autonomous driving addresses several driving pain points by reducing the commute burden in several ways: by removing the driving activity, commuters’ in-transit time is freed up to purse other activities

D  Societal & Environmental benefits
Autonomous driving could provide three major transportation-related benefits to society – decreased traffic congestion, improved road safety and reduced carbon emissions

E  Regulation
Regulatory bodies across the globe are starting to pave the way for autonomous vehicles by developing the appropriate legal framework for vehicle testing and operation
By 2035, expected to account for 25% of the total new vehicles sales; 15% partial and 10% with full autonomy

New vehicle sales represents 12M full AVs and ~ 18M partial; ~ $77B market for AV features in 2035

2025 Global Sales

Estimated global new light vehicle sales: ~ 111 M

<table>
<thead>
<tr>
<th>Share (%)</th>
<th>Volume (M)</th>
<th>Sales ($B)</th>
</tr>
</thead>
<tbody>
<tr>
<td>12.4</td>
<td>13.9</td>
<td>36</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Share (%)</th>
<th>Volume (M)</th>
<th>Sales ($B)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.5</td>
<td>0.6</td>
<td>6</td>
</tr>
</tbody>
</table>

2035 Global Sales

Estimated global new light vehicle sales: ~ 122 M

<table>
<thead>
<tr>
<th>Share (%)</th>
<th>Volume (M)</th>
<th>Sales ($B)</th>
</tr>
</thead>
<tbody>
<tr>
<td>15</td>
<td>18.4</td>
<td>38</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Share (%)</th>
<th>Volume (M)</th>
<th>Sales ($B)</th>
</tr>
</thead>
<tbody>
<tr>
<td>9.8</td>
<td>12.0</td>
<td>39</td>
</tr>
</tbody>
</table>

Note. Market Value only considers those vehicles above level 2. Results will deferred from the projections done by Goldman Sachs as they evaluated the entire global market.

Source: BCG. Revolution in the Driver’s seat. The Road to Autonomous Vehicles
Development of autonomous vehicles is receiving increased attention
- Major focus on technology development by OEM's, suppliers, tech companies, and academic institutions
- Regulators in several countries are developing approaches to address liability, certification, and regulatory issues surrounding AVs

The autonomous vehicle is becoming a reality
- The road to autonomous vehicle starts now, with partially autonomous vehicles coming on the market this year
- Consumer demand is high with 55\% of US drivers likely to consider buying a partially AV and 44\% a Full-AV. Up to 20\% are willing to pay an extra $5,000 or more for autonomous driving features
- Lower insurance and fuel costs, along with increased safety, are the main reasons for purchasing

Different adoption scenarios where:
- Price to consumers is likely to start at or above $4,000 for one feature, suggesting gradual adoption, initially in the premium segment
- Based on market economics, the expectation is a 12-13\% global penetration of autonomous features by 2025
- The first fully autonomous vehicles should hit the road in 2025 at an increased sticker price around $10,000
- Penetration of partially and fully autonomous cars should plateau around 25\% of the market, unless strongly supported by regulation

Implications for the Industry
- With full autonomy, shared cars in mega cities will be more economical than car ownership and will reduce traffic
- OEMs will have to carefully segment the market and adapt to new trade-offs consumers will make between autonomy and other vehicle features
- New players will enter market; Samsung, Apple and Google are developing their own autonomous cars
To adapt to this new trend, automakers are rethinking their priorities and business model

**OEM’s new perspective**

**A  Driving Experience**
For more than a century, OEMs have mastered the overall driving experience, and they should continue to leverage this to their advantage. Even in automated driving, the ride experience and vehicle control will remain important to demonstrate comfort and safety. Furthermore, the vehicle’s ability to adapt to drive expectations will be crucial for winning consumer confidence.

**B  Prediction & Decision algorithms**
Companies should prepare and execute a strategy for developing prediction algorithms based on their respective sizes, access to resources and expanding core capabilities.

**C  Architecture**
OEM’s should establish their own proprietary standards and central architectures with clear interfaces. This will allow for the independent separation of specific functional areas, which will become important for design validation, an area expected to be a major cost component in the overall development of automated systems.

**D  Business Model**
OEM’s need to consider adopting new business models to address the inherent affordability challenge for early adopters, to quickly increase the base of autonomous vehicles users and to maximize value captured.

**E  Areas of differentiation**
Automakers have to rethink areas of differentiation in the full self-driving automation world today. As humans no longer partake in the driving activity, driving dynamics will be less differentiating and hence will become less important. Ride and interior comfort along with productivity/entertainment features would gain utmost importance.

**Case for Change**
Without a doubt the OEM’s will need to change their current way of doing business and adapt to a new world that is demanding better products & services. Autonomous Vehicles is an attractive market as it represents an additional revenue and a way to continue growing within the Industry. Agile adaptation and new business models will drive the change and will determine who is going to continue leading the industry and who will be out.

**Source:** Roland Berger. Autonomous Driving. Disruptive Innovation that promise to change the automotive industry as we know it.
Autonomous Initiatives are also being pursue by all major automakers; main difference is the approach, in-house development vs acquisition of knowledge

<table>
<thead>
<tr>
<th>Automaker</th>
<th>Initiative/Approach</th>
</tr>
</thead>
</table>
| Volkswagen | Goal: coverage of all relevant market segments  
Rapid market launch planned: fully autonomous vehicles with self-driving system (SDS) developed in-house from 2021  
Automation level: Semi (A7/A8/Q8) |
| Ford | Create a new division called: Smart Mobility  
With the autonomous vehicle initiative the teams are working on: tripling autonomous fleet, added testing & velodyne collaboration  
Automation level: Semi (Fusion, Escape) |
| GM | Developing technology to move towards level 4  
Current technology is being developed in the Warren TC campus  
Automation level: Semi (SRX, ATS & XTS) |
| Honda | Autonomous driving is being pushed by safety technologies  
Honda Sensing is looking to develop vehicle to vehicle/road-to-vehicle communications  
Automation level: Highly (Civic) |
| Toyota | Established a mobility teammate concept for automated driving technology.  
Planning to invest $ 1 bn in artificial intelligence to enhance autonomous driving  
Automation level: Highly (Lexus LS) |
| FCA | Limited in-house technologies for autonomous vehicles.  
Partnered with Google to build autonomous minivans together  
Automation level: Low (Pacifica) |
| Renault Nissan | Initiative for autonomous driving is being addressed by the Nissan Intelligent Driving team.  
Automation level: Highly (Leaf) |
| | Just develop the vision for the Next 100 years which contemplates development in Autonomous driving, highly automated driving and artificial intelligence  
Automation level: Semi (5 & 7 series) |
| Hyundai | Looking to improve the current stage in autonomous driving  
Planning to invest 2 trillion KRW in related technology for mass production in 2020  
Automation level: Semi (Genesis) |
| | Investing in developing new functions to enable autonomy technologies (focus on superior technology package and flexible vehicle architecture).  
Automation level: Semi (E-class, S-Class) |
Nevertheless, high tech companies (Google & Apple) are expected to be the first in reaching the level 4 in autonomous driving followed by Tesla.

Source: Frost & Sullivan (2016). Future of Mobility
A fully autonomous car will imply at least $2,846 USD of premium pricing due, opening up opportunities for suppliers.

<table>
<thead>
<tr>
<th>System</th>
<th>Description</th>
<th>$ Content per vehicle</th>
<th>Suppliers</th>
<th>Providers</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cameras</td>
<td>Core vision systems for object recognition, traffic sing and signal recognition, and path detection</td>
<td>L1: 150, L2: 200, L3: 300, L4: 255</td>
<td>Conti, Denso, Delphi, Magna</td>
<td>Mobileye, Bosch, Toshiba, Conti</td>
</tr>
<tr>
<td>Radar</td>
<td>Long range forward radar systems typically used to provide range, angle, and doppler velocity</td>
<td>L1: 125, L2: 375, L3: 400, L4: 300</td>
<td>Conti, Delphi, Denso, Valeo</td>
<td>In-house</td>
</tr>
<tr>
<td>LIDAR</td>
<td>Laser based scanning device that creates 3D images of surrounding objectives with a 360 degrees field of view</td>
<td>L1: 0, L2: 0, L3: 800, L4: 900</td>
<td>Bosch, Delphi, Conti, Denso</td>
<td>Quanergy, Velodyne, Ibeo, Leddartech</td>
</tr>
<tr>
<td>Embedded controls</td>
<td>Domain controllers / ECUs used to tie together multiple electronic sub-systems, enhancing communications</td>
<td>L1: 130, L2: 125, L3: 200, L4: 200</td>
<td>Delphi, Magna, Conti, TRW</td>
<td>NVidia, Intel, Infineon, Elektrobit</td>
</tr>
<tr>
<td>Electrical/ tronic Architecture</td>
<td>Electrical connection and distribution content between systems with more redundancies and fault tolerances</td>
<td>L1: 71, L2: 98, L3: 112, L4: 120</td>
<td>Delphi, Leoni, Lear, Yazaki</td>
<td>TE, Molex, Nippon</td>
</tr>
<tr>
<td>V2X</td>
<td>Communication using a dedicated DSRC module</td>
<td>L1: 0, L2: 0, L3: 350, L4: 300</td>
<td>Delphi, Denso</td>
<td>Cohda, Qualcomm</td>
</tr>
<tr>
<td>HMI</td>
<td>Monitors drivers status, signals mode changes, etc.</td>
<td>L1: 0, L2: 100, L3: 200, L4: 200</td>
<td>Conti, Delphi</td>
<td>Lemoptix, Luxoft</td>
</tr>
<tr>
<td>Mapping</td>
<td>High definition mapping services</td>
<td>L1: 0, L2: 175, L3: 200, L4: 225</td>
<td></td>
<td>TomTom, Luxoft</td>
</tr>
<tr>
<td>Embedded modem</td>
<td>Offers on-board connectivity functions through the network</td>
<td>L1: 0, L2: 10, L3: 10, L4: 10</td>
<td>Most tier 1 ADAS suppliers</td>
<td>Qualcomm, Intel</td>
</tr>
<tr>
<td>Security software</td>
<td>Ensuring the integrity of on-board communications and software through firewall and anomaly detection</td>
<td>L1: 0, L2: 50, L3: 100, L4: 225</td>
<td></td>
<td>Towersec, Argus, Escript</td>
</tr>
<tr>
<td>Passive components</td>
<td>Other components used in AV such as those used in wireless, radio, and capacitor systems</td>
<td>L1: 9, L2: 11, L3: 16, L4: 25</td>
<td>Most tier 1 ADAS suppliers</td>
<td>Murata, Nippon ceramci</td>
</tr>
</tbody>
</table>

| Total system cost    | 370, 1,160, 2,764, 2,846 |
Automotive suppliers will need to invest in full-spectrum solutions and focus on technology innovations if they want to capture the new opportunities

Suppliers perspective

A. **Major System suppliers providing full-spectrum solutions**
Suppliers should look to make major investments in prediction & decision algorithm technologies, including machine learning, and to actively screen specialists / start-ups with strong experience in “deep learning” capabilities as acquisition targets. This will allow suppliers to participate and remain relevant for autonomous vehicles by offering, complete solutions to smaller OEM’s and by delivery highly safety critical systems (e.g. Continental, Delphi, Bosch, Denso & Magna).

B. **Specialized suppliers (Components)**
Suppliers of single assistance systems, or components, will face tremendous pressure from ongoing trends, such as the centralization of ECU architecture. These suppliers should focus aggressively on cost and cater to the volume/budget segment of the market (e.g. Bosch & Denso). On the other hand, components suppliers will have to follow similar trends as cost will continue to be the main driver to participate and gain market share (e.g. Valeo, Delphi).

C. **Suppliers focused on technology innovation**
These players will need to focus on their technology, while simultaneously making required investments to attain a global top-3 positions in their respective domains. Examples of opportunities include greater functional integration of actuators to reduce cost, or on the camera side, a push towards low-cost hardware supported by artificial neural network technology.

**Case for Change**
Similar to the automakers, the suppliers will also need to adapt and continue pursing opportunities within the autonomous driving market. Opportunities will rise for those that are capable to focus on specific developments and that have the ability to deliver solutions to support the vehicles autonomy. All suppliers (hardware or software), no matter were they are in the value chain, will need to collaborate in this ecosystem to allow the full autonomous vehicle become a reality.

At the end of the day, a supplier can participate by developing hardware (components), software, solutions (hardware + software) & services for end user.

Source: Roland Berger. Autonomous Driving. Disruptive Innovation that promise to change the automotive industry as we know it
Currently, the value chain around Autonomous Vehicles is a combination of both, new and consolidated suppliers, while the solutions and services around autonomy are in its infancy.
It's chips and software enable autonomous driving. In more detail, it develops software algorithms, system-on-chips and customer applications that are based on processing visual information for the market of driver assistance systems (DAS). Partnership with BMW and Intel with goal of having a fully autonomous vehicle on the road by 2021

Magna is one of the most diversified suppliers, US based. Has a number of “near field” technologies like rear cameras and ultrasonic sensors, and “far field” forward cameras and domain controllers (ECU). Invested in Argus Cyber Security to offer secure connectivity solutions

Bosch is a diversified German supplier. Produces radar, video (including stereo video camera) and ultrasonic sensors that help the car monitor its surroundings and provide signals to help perform functions like following the car ahead in slow moving traffic or automatically break if the car in front slows down. Current solutions: Traffic Jam and Parking Assistant

Continental is a diversified German supplier. Produces radar, video, cameras and sensors which it integrates to develop ADAS solutions such as Traffic Jam Assist, Parking Companion, Cruising Chauffer and Remote Garage Parking

Denso is a diversified Japanese supplier that has products for Industrial and Home Markets. Develops different components for ADAS systems: Radars, Sensors, ECU, Seatbelt ECU and Driver Status Monitor

Valeo is a diversified French supplier. Has 4 business groups + aftermarket activity. Develops cameras and sensors that it integrates in Full ADAS solutions such as: lane guide, lane change assistance, park 4u, and cruise 4u. It also has telematics and display solutions

<table>
<thead>
<tr>
<th>Products</th>
<th>Capabilities</th>
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<tbody>
<tr>
<td>Value Added Solutions, Cameras, ECU</td>
<td>Deep Learning Software Development Chip Design &amp; Production</td>
</tr>
<tr>
<td>Value Added Solutions, Radar, LIDAR, HMI, Actuation, ECU, V2V</td>
<td>Software development Electronics Expertise design, assy &amp; prod of sensors, cameras &amp; ECU</td>
</tr>
<tr>
<td>Cameras, Radar, LIDAR, HMI, Actuation, ECU, V2V</td>
<td>Software development Electronics Expertise design, assy &amp; prod of sensors, cameras &amp; ECU</td>
</tr>
<tr>
<td>Cameras, Radar, LIDAR, HMI, ECU, V2V</td>
<td>Software development Electronics Expertise Design, Assembly &amp; Production of Sensors, Cameras &amp; ECU</td>
</tr>
<tr>
<td>Value Added Solutions Cameras, Sensors</td>
<td>Software Development Electronics Expertise design, assy &amp; prod of Sensors &amp; Cameras</td>
</tr>
</tbody>
</table>
Autonomous vehicles offer opportunities for the complete ecosystem, being cameras, radar, lidar & V2X the most attractive technologies.

Addressable market is made up of:
- **Component & Software Supplier**
- Semiconductor Providers ($89.2B in 2035)
- Vehicle Sales & Autonomous Solutions
- Aftermarket Services

$379b 25%

By 2035, Component, Software & Semiconductors Suppliers Market

The market offers high potential growth for at least the next 20 years

Source: Goldman Sachs Research. 2015

Note. Market opportunity is based on global sales and not only autonomous Vehicles as presented by BCG. This projections differed from BCG due to different assumptions within the market.
Lidar, Radar and Cameras are the components that will have the biggest markets by 2030

Technologies around autonomous vehicles

Other market opportunities
- Embedded controls
- Actuation
- Electrical & electronic architecture
- V2X: Vehicle to infrastructure communication
- HMI: Human machine interaction
- Mapping: AV will required maps that differ in important ways
- Embedded modem
- Security software
- Passive hardware

Market opportunity ($ US M)
Although basic components for autonomous vehicles already exist, there are still areas to be developed before having fully self-driving cars.

**Required areas of Mastery**

<table>
<thead>
<tr>
<th>Required Area</th>
<th>Details</th>
</tr>
</thead>
</table>
| 1 | **Vehicle’s location and environment**
| | - 3D image processing with artificial neural networks (ANN)
| | - Multiprocessor graphics hardware (GPUs)
| | - Current competency leaders: unmanned aerial vehicles, medical technology, videogames |
| 2 | **Prediction & decision algorithms**
| | - Artificial neural networks (ANN)
| | - (unsupervised/deep learning, machine learning)
| | - Specialized multiprocessor hardware
| | - Early, independent hardware validation based on Virtual HiL
| | - “Non-statistical” validation
| | - Current competency leaders: pattern/image recognition, automatic translation, voice recognition |
| 3 | **Vehicle Driver Interface**
| | - Smooth control to/from the driver
| | - Current competency leaders: advanced search engines, consumer electronics |
| 4 | **High accuracy real-time maps**
| | - Environmental/spatial modelling
| | - Simultaneous localization & mapping (SLAM)
| | - Current competency leaders: map provisioning, location-based services |
A big holdup for AVs could be regulation, data security and customer’s perception

<table>
<thead>
<tr>
<th>Action fields</th>
<th>Impact on Road safety</th>
</tr>
</thead>
<tbody>
<tr>
<td>Social Acceptance</td>
<td>Low</td>
</tr>
<tr>
<td>Cybersecurity</td>
<td>Low</td>
</tr>
<tr>
<td>Vehicle Registration</td>
<td>Low</td>
</tr>
<tr>
<td>Security &amp; accident avoidance</td>
<td>Low</td>
</tr>
<tr>
<td>Data privacy protection</td>
<td>Low</td>
</tr>
<tr>
<td>Liability</td>
<td>Low</td>
</tr>
</tbody>
</table>

Source: Roland Berger. Autonomous Driving. Disruptive Innovation that promise to change the automotive industry as we know it
Potential consequences due to driverless revolution (est. 2040)

A  Transportation

A1  Predominant Ridesharing, less car ownership
Generation Y drivers value customer experience three times as much as vehicle design. As ridesharing becomes cheaper and omni-present, most customer could opt out of buying their own vehicle

A2  Blurred line between individual & public transportation
Not only could there be autonomous buses as well as other autonomous transportations modes, but all of this could fit in an integrated system. A possibility is that an individual could move seamlessly between public transportation and autonomous vehicles with a monthly transportation budget

B  Impact on Automotive Industry

B1  Business Model Transformation
There are two main changes:
1. Customer Change: From individuals to ridesharing companies and/or governments
2. Revenue Model: Full Vehicle Sale to price per mile of use or monthly use

B2  Substantial Volume Decrease
Due to higher usage of vehicles and less car ownership, vehicle sales could decrease substantially in the future

B3  Greater standardization of vehicles
Since the customers stop being individuals but corporations, be it ridesharing entities and/or governments, there is less need to make unique vehicles. What will matter will be full ownership cost and experience provided to final user. Thus there will be a trend to simplify vehicle architecture to reduce cost, and focus on building the customer interface

B4  Purpose Built Vehicle (Premium Segment)
As mass customization tools, like Additive Manufacturing, become cheaper, demand for tailored products could increase, especially for individuals willing to pay a premium to have a differentiated product. Customization of experience and built to order

In addition, vehicles with steering wheels and pedals, might still exist but purely for recreational use, creating another niche market

Source: Deloitte University Press. The future of auto retailing
This is how we see the scenarios for OEMs and suppliers playing out

**Traditional OEMs**

**Business as Usual (A1, B1)**
- Traditional players remain in driver’s seat
- OEM’s are able to develop key technologies and leverage their brands to offer mobility-on-demand services
- Technology development will be shared in cooperative partnerships similar to today

**Power to the technology suppliers (A2, B2)**
- OEM’s will likely be dependent on 2 – 3 technology companies providing key technologies
- OEM’s margin’s would come under pressure from the relatively small population of technology providers leveraging their bargaining power

**New Mobility-On-Demand Players**

**Fleet Business 2.0 (B3)**
- Significant increase in share of fleet sales to mobility providers – resulting in marketing cost reductions
- New power balance as mobility providers depend on a few OEMs that control the key technologies
- Combined effect could lead to higher OEM margins

**OEMs become Tier 1’s (B4)**
- OEM’s could be reduced to contract manufacturers for the mobility-on-demand players
- Could result in greatest pressure on OEM margins - biggest threat to today’s mid-sized OEM players

**Ownership of Customer Relationship**

A = Personal Vehicle Ownership  
B = Mobility-on-demand

Source: Roland Berger. Autonomous Driving. Disruptive Innovation that promise to change the automotive industry as we know it
At the moment, there are several possible vehicle designs that will depend in the primary usage and focus of the vehicle.

<table>
<thead>
<tr>
<th>Primary uses</th>
<th>Primary focus</th>
<th>Average trip distance</th>
<th>Design</th>
<th>Capacity</th>
<th>Ownership</th>
<th>Areas of use</th>
<th>Important Attributes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Short trips within cities, suburbs or for last mile transportation to/from public transit such as the nearest subway station</td>
<td>Easy maneuverability and low cost</td>
<td>Mostly under 10-15 miles</td>
<td>Mini-vehicle</td>
<td>1 or 2 passengers, limited cargo space</td>
<td>Share mobility</td>
<td>Cities &amp; suburbs</td>
<td>Fuel efficiency, low emissions, low maintenance, reliability</td>
</tr>
<tr>
<td>Medium-to-long-distance trips in suburbs and cities</td>
<td>Higher comfort for longer trips</td>
<td>Mostly over 10 – 15 miles</td>
<td>Medium to large vehicle</td>
<td>4+ passengers, large cargo space</td>
<td>Share mobility</td>
<td>Cities &amp; suburbs</td>
<td>Comfort, Fuel efficiency, low emissions, low maintenance, reliability &amp; infotainment</td>
</tr>
<tr>
<td>Personalized and/or leisure travel for multiple passengers</td>
<td>Personalized travel experience and comfort</td>
<td>Any range</td>
<td>Medium to large vehicle</td>
<td>1-4+ passengers</td>
<td>Limited / large cargo space</td>
<td>Personal ownership</td>
<td>Cities, suburbs and rural</td>
</tr>
</tbody>
</table>