The Imperative to Deploy
Paths to the Car of the Future

costs  hybrid  electric motor
roaming  electrified  range
power electronics  e-bike  driving enjoyment
charging infrastructure  market  ramp-up
battery  e-scooter  smart charging
plug-in  automatic  legislation  assistance systems
emergency braking assistant  auto pilot
highway pilot  sensors  electric steering
valet parking  digital environment
redundancy  connectivity  augmented reality  electronic horizon
internet of things  connected  vehicle to vehicle  cloud
vehicle to infrastructure  services  vehicle to infrastructure
cloud  entertainment  fleet management
eCall  smartphone integration
2017 CAR MBS
Effort to mirror the human ability to reason and decide

Perceive

Think
Interpret
Plan
Decide

Move

Locate
The Imperative to Deploy
Core activities

- data fusion
- redundancy
- sensors
- electronic horizon
- sense
- perception
- localization
- radar
- lidar

- vehicle computer
- data analytics
- planner
- prediction
- decision
- safety
- security

- actuator management
- braking
- steering
- fail operational
- motion control
- driverless

(map think act)
2017 CAR MBS
Core activities

map
- data fusion
- sensors
- redundancy

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BOSCH
Surround Sensing - robust 360° coverage required

- Near-range cameras
- Mid-range radar rear
- Long-range radar rear
- Ultrasonic sensors
- Forward camera
- Mid-range radar
- Long-range radar
- Lidar
- Rear cameras
2017 CAR MBS
Assisted Driving – State of the Art

Rear Backup Camera
Ultra Sonic Sensors
• Backover Avoidance
• Park Assist

Rear Radar
• Blind Spot Detection
• Rear Cross Traffic Alert

Front Camera
• Automatic High / Low Beam
• Traffic Sign Recognition

Forward Camera
• Automatic High / Low Beam
• Traffic Sign Recognition

Rear Radar
• Blind Spot Detection
• Rear Cross Traffic Alert

Front Radar
• Adaptive Cruise Control
• Forward Collision Warning
• Automatic Emergency Braking

• Antilock Brake System
• Brake Assist
• Traction Control
• Electronic Stability Control
• Rollover Mitigation
• Trailer Sway Mitigation, ...
2017 CAR MBS Localization

- Integrated HD map with Bosch Road Signature
- Partner HD map layers
- OEM cloud
- Map partner cloud
- Bosch Road Signature Cloud
- Video Road Signature Data
- Radar Road Signature Data

Chassis Systems Control | Stepper | 2017.04.27
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The Imperative to Deploy

Core activities

sense

data fusion

map

sensors

redundancy

electronic horizon

perception

localization

radar

lidar

think

vehicle computer

data analytics

planner

prediction

decision

safety

security

act

actuator management

braking

steering

motion control

fail operational

driverless
Bosch AI Car Computer
Enabling automated driving

- Artificial Intelligence Car Computer
- Powered by NVIDIA® Xavier GPU
- AI Supercomputer for highly Autonomous Vehicles
- 30 Trillion Deep Learning Operations / Second
The Imperative to Deploy
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Chassis Systems Control | Stepper | 2017.04.27
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2017 CAR MBS
Safety – reliable actuators required

- Electric power steering
- ESP®
- iBooster

Redundant steering system
Redundant braking system

Redundant braking system
Redundant steering system

ESP®
iBooster
Electric power steering
**Partially automated**
System takes control of longitudinal and lateral guidance in specific use case
Permanent driver supervision required

**Fully automated**
System can cope with all situations during entire journey
No driver supervision required

**Highly automated**
System can cope with all situations in defined use case
Driver must always be in a position to resume control
2017 CAR MBS

Parking & low speed  Urban  Highway
Bosch Connected Parking offers car park operators* new business opportunities and suggestions for increasing the market value and range of services for drivers.

* Airports, hotels, shopping centers, towns etc.
2017 CAR MBS
Test, Verify, Validate ... Repeat
2017 CAR MBS
Testing on test tracks
2017 CAR MBS
Build, Test ... Repeat
2017 CAR MBS Build, Verify, Validate ... Repeat

- Prototype Vehicle Build
- Vehicle instrumentation & sensor installations
- Welding (e.g. Aluminum)
- Design and build Measurement Racks
2017 CAR MBS
Consumer Education

Shifting Into Gear: New Car Buyers’ Preferences and Expectations with the Automated Vehicle

New Car Buyers are Bullish on Automated Vehicle Adoption

The statistics below are reflective of responses from new car buyers in the U.S.

52% expect to own at least one self-driving automobile in the next 10 years.

35% of those who expect to own a self-driving automobile said all vehicles they own will be self-driving within the next 10 years.

Awareness of available ADAS and active safety features is low

The statistics below are reflective of responses from new car buyers in the U.S.

PERCEPTION

\[ \text{21\%} \]

believe electronic stability control is currently available on all vehicles.

REALITY

\[ \text{100\%} \]

of vehicles since the 2012 model year come standard with electronic stability control.

TODAY

Airbags: The top safety feature respondents believe is currently on their vehicle.

IN 10 YEARS

Automated/ADAS features: The top safety features respondents think will be on their vehicle in the future.

This data is a sampling of 1,000 U.S. based residents, aged 18 and older, who purchased/leased at least one vehicle within the last five model years, and intend to buy/lease a new vehicle again.

2017 CAR MBS
Consumer Education

Shifting Into Gear:
New Car Buyers’ Preferences and Expectations with the Automated Vehicle

New Car Buyers are Bullish on Automated Vehicle Adoption

The statistics below are reflective of responses from new car buyers in the U.S.

**AUTOMATED VEHICLE TOP CONCERNS**

<table>
<thead>
<tr>
<th>Concern</th>
<th>% Ranked as Concern</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lack of control</td>
<td>72%</td>
</tr>
<tr>
<td>Safety</td>
<td>72%</td>
</tr>
</tbody>
</table>

**AUTOMATED VEHICLE TOP BENEFITS**

<table>
<thead>
<tr>
<th>Benefit</th>
<th>% Ranked as Benefit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reduced traffic accidents</td>
<td>61%</td>
</tr>
<tr>
<td>More free time</td>
<td>55%</td>
</tr>
<tr>
<td>Lowered stress</td>
<td>55%</td>
</tr>
</tbody>
</table>

New car buyers see reduced traffic accidents as main benefit of automated vehicles, but concerns remain about lack of control.

The statistics below are reflective of responses from new car buyers in the U.S.

- **Lack of control**: 72%
- **Safety**: 72%

**1. Reduced traffic accidents**: 61%

**2. More free time**: 55%

**3. Lowered stress**: 55%

This data is a sampling of 1,000 U.S. based residents, aged 18 and older, who purchased/leased at least one vehicle within the last five model years, and intend to buy/lease a new vehicle again.

2017 CAR MBS