Automotive Revolution – perspective towards 2030

Stanford University, PEEC Sustainable Transportation Seminar
April 1, 2016
Global megatrends are having a far-reaching impact on many industries

1. **Industrialization and urbanization** in emerging economies
2. **Sustainability regulation and policies**
3. **Changing demographics and consumer preferences**
4. **Rise of new technologies** (digitization, IoT, Industry 4.0, …)

Source: McKinsey
Global megatrends trigger trends in the automotive industry that have the potential to radically change the mobility industry.

4 disruptive technology-driven trends

- Electrification
- Connectivity
- Autonomous driving
- Diverse mobility
Driven by shared mobility, connectivity services, and feature upgrades, new business models could expand automotive revenue pools by ~30%, adding up to ~USD 1.5 trillion.
The automotive revenue pool will grow and diversify with new services, potentially becoming a ~ USD 1.5 trillion market in 2030 USD billions

Today:
Traditional automotive revenues
Vehicle sales dominant

2030:
New automotive revenues
Recurring revenues significantly increasing

One-time vehicle sales
~ 3,500

720

4.4% p.a.

+30%

~ 6,700

1,500

Recurring revenues (shared mobility, data connectivity)

Aftermarket
1,200

4,000

One-time vehicle sales
2,750

30

SOURCE: McKinsey
Despite a shift towards shared mobility, vehicle unit sales will continue to grow, but likely at a lower rate of ~ 2% p.a.
Driven by urbanization and macroeconomics, global vehicle sales will continue to grow, although at a slower pace

Current and future annual global vehicle sales, millions

- **Urbanization and macroeconomic growth**
  - 2015: 87
  - 2030: 105

- **Less private vehicles**
  - 2015: 41
  - 2030: 115

- **New shared vehicles**
  - 2015: 23
  - 2030: 10

**SOURCE:** McKinsey
Consumer mobility behavior is changing, leading to up to 1 out of 10 cars sold in 2030 potentially being a shared vehicle and the subsequent rise of a market for fit-for-purpose mobility solutions.
Today, consumers use their vehicles for every purpose; in the future, they will choose an optimal mobility solution for each different specific purpose.

**Today:**
One vehicle for every trip purpose

**2030:**
A solution for each different specific purpose

+ non-vehicle modes of mobility

**SOURCE:** McKinsey
Car sharing is a growth industry, accounting for up to 9% of new vehicles by 2030 at the expense of private use vehicle sales.

Global proportion of shared vehicles, percent:

- **2030**
  - Low scenario: 98%
  - High scenario: 91%
  - 68% of new cars sold are shared

- **2050**
  - High scenario: 72%
  - 28% of new cars sold are shared

**SOURCE:** Mobility survey data, McKinsey
Both willingness to switch manufacturer and to pay a subscription fee for connected car services has increased significantly in the past year.

Percent of respondents answering "yes".

<table>
<thead>
<tr>
<th>Year</th>
<th>Switch to another manufacturer</th>
<th>Pay a subscription fee for connected services</th>
</tr>
</thead>
<tbody>
<tr>
<td>2014</td>
<td>20</td>
<td>32</td>
</tr>
<tr>
<td>2015</td>
<td>37</td>
<td>32</td>
</tr>
</tbody>
</table>

\[ +85\% \]

\[ +52\% \]

I would switch to another manufacturer if it was the only one offering a car with full access to the applications, data, and media.

I would be willing to pay for connected services in my car with a subscription-based model.

### CHANGING MOBILITY

**OEMs are more trusted in Germany than in China in terms of data privacy and protection**

|---------|--------------------------------------------------------------------------|

#### Trust in OEMs

<table>
<thead>
<tr>
<th>Country</th>
<th>Less likely (trust OEMs more)</th>
<th>More likely (trust smartphone software manufacturers more)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Germany</td>
<td>35</td>
<td>8</td>
</tr>
<tr>
<td>China</td>
<td>21</td>
<td>50</td>
</tr>
</tbody>
</table>

1 Total of 100% per country: answers from respondents who indicated either "no preference" or "neither of those listed" are not shown
City type will replace country or region as the most relevant segmentation dimension that determines mobility behavior and, thus, the speed and scope of the automotive revolution.
A granular view of city types is necessary to understand the effects of urbanization and changes in mobility behavior.

Global population by archetype, billions

### "High-income, dense cities"
- Examples: London, New York City, Singapore
  - 2015: 0.3
  - 2030: 0.4

### "Low-income, dense cities"
- Examples: Mumbai, Buenos Aires, Minsk, Mexico City
  - 2015: 2.1
  - 2030: 2.8

### "Small towns and rural regions"
- Examples: Kansas in the US, Yunnan province in China, Provence in France, rural India
  - 2015: 3.2
  - 2030: 3.2

### "High-income, suburban sprawl"
- Examples: Sydney, Los Angeles, Nagoya
  - 2015: 0.6
  - 2030: 0.7

### "Low-income, suburban sprawl"
- Examples: Perm in Russia, Chongqing in China
  - 2015: 1.1
  - 2030: 1.5

SOURCE: McKinsey
The effects of car sharing, urbanization, and macroeconomics on vehicle sales vary greatly by region and city type

Current and future annual vehicle sales per city type, millions

<table>
<thead>
<tr>
<th>CITY TYPES</th>
<th>2015</th>
<th>2030</th>
</tr>
</thead>
<tbody>
<tr>
<td>Europe and North America</td>
<td>5</td>
<td>5</td>
</tr>
<tr>
<td>Asia and rest of the world</td>
<td>7</td>
<td>13</td>
</tr>
</tbody>
</table>

"High-income, dense cities"

- Current annual vehicle sales: 5
- Future annual vehicle sales: 5

"High-income, suburban sprawl"

- Current annual vehicle sales: 13
- Future annual vehicle sales: 22

"Low-income, dense cities"

- Current annual vehicle sales: 3
- Future annual vehicle sales: 22

"Low-income, suburban sprawl"

- Current annual vehicle sales: 3
- Future annual vehicle sales: 22

"Small towns and rural regions"

- Current annual vehicle sales: 8
- Future annual vehicle sales: 26

SOURCE: McKinsey
Once technological and regulatory issues have been resolved, up to 15% of new vehicles sold in 2030 could be fully autonomous.
## Technical, consumer acceptance and legal/regulatory barriers could hold back AV introduction

<table>
<thead>
<tr>
<th>Challenge</th>
<th>Explanation</th>
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</thead>
</table>
| Technology                       | Technology hurdles for market deployment are non-trivial:  
|                                  | ▪ Failsafe autonomous software design for immense number of situations  
|                                  | ▪ Adequate degree of system redundancy  
|                                  | ▪ Protection against cybersecurity threats                                                                                                                                                               |
| Consumer acceptance              | ▪ Risk of critical incidents affect consumer perception and slows adoption  
|                                  | ▪ Reliability more critical than for other consumer products (e.g. smartphone)  
|                                  | ▪ ‘Hindenburg moment’ could turn media support into hostility  
|                                  | ▪ Unresolved degree of human trust to cede control to car                                                                                                                                                 |
| Law and regulation               | ▪ Certification and state-of-the-art for autonomous car to be established  
|                                  | ▪ Liability distribution between OEM, driver, data provider … unclear  
|                                  | ▪ Automotive regulation typically develops a very slow pace  
|                                  | ▪ Ethical issues of automated decision making in an accident challenging                                                                                                                                 |

The degree to which these barriers materialize can serve as signposts for the rate of adoption.

SOURCE: McKinsey analysis
Subject to progress on the technical, infrastructure, and regulatory challenges, up to 15% of all new vehicles sold in 2030 could be fully autonomous

New vehicle market share of fully autonomous vehicles

Percent

High-disruption scenario entails
- Regulatory challenges overcome in key markets
- Safe and reliable technical solutions fully developed
- Enthusiastic consumers who are willing to pay

Commercial introduction of full autonomy by new tech players and premium OEMs
Manufacturing capacity for tech players ramps up gradually
Mass-market leaders introduce full autonomy
Ramp-up as AV availability spreads across popular consumer models
Slow consumer uptake driven by low perceived value proposition or negative publicity following critical incidents
Technical and regulatory barriers delay commercial-scale introduction of autonomous vehicles

DIFFUSION OF ADVANCED TECHNOLOGY

SOURCE: McKinsey
Electrified vehicles are becoming viable and competitive; however, the speed of their adoption will vary greatly at the local level.
The future of electrified vehicle adoption will be shaped by consumer pull and regulatory push factors, with electrified powertrains comprising up to 50% of new car sales in 2030

Regulatory push
- Aggressive increase in emissions targets regulation leading up to 2030
- Rising citizen concern for climate change
- New and continued xEV subsidies

Consumer pull
- High-performance EVs demonstrate growth potential of premium segment
- Oil and battery prices change total cost of ownership for mass-market segments
- High loyalty of current xEV owners

SOURCE: McKinsey
Within a more complex and diversified industry landscape, incumbent players will simultaneously compete on multiple fronts and cooperate with competitors.
The increasing complexity of the competitive landscape for individual mobility will force OEMs to fight battles on multiple fronts.
New market entrants are expected to initially target specific segments and activities along the value chain only before potentially exploring further fields.
New entrants are more focused on their product portfolio and activities along the value chain, increasing the competitive pressure on established OEMs.

### Step along the mobility value chain

<table>
<thead>
<tr>
<th>Product portfolio</th>
<th>Design</th>
<th>Product development (hardware)</th>
<th>Product development (software)</th>
<th>Production</th>
<th>Sales</th>
<th>Service</th>
</tr>
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<tbody>
<tr>
<td><strong>Automotive OEMs</strong></td>
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<tr>
<td>Established global players</td>
<td>Broad</td>
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<tr>
<td>Emerging Chinese players</td>
<td>Broad/focused</td>
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<td>Emerging specialty players</td>
<td>Focused</td>
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<td><strong>Tech giants</strong></td>
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<tr>
<td>New OEM entrants</td>
<td>Focused</td>
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<tr>
<td>New software entrants</td>
<td>Focused</td>
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<td><strong>Mobility providers</strong></td>
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<tr>
<td>New entrants</td>
<td>Focused</td>
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<td><strong>Suppliers</strong></td>
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<tr>
<td>Tier 0.5 system integrators</td>
<td>Focused</td>
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**SOURCE:** McKinsey
What now for the players in the automotive industry?
To become a driver of change and benefit from these disruptive forces, incumbent players need to make fundamental and strategically vetted decisions now.

Prepare for uncertainty
Success in 2030 will require automotive players to anticipate market trends sooner and to explore new mobility business models and their economical and consumer viability.

Leverage partnerships
OEMs, suppliers, and service providers need to partner across and beyond the industry to form open, scalable ecosystems.

Drive transformational change
Players must adapt their organizations to facilitate greater internal collaboration and reflect that software is the key enabler for innovation and new business models.

Reshape value proposition
To retain their share of the automotive profit pool, OEMs need to find the right strategy for differentiating their products and services, evolving the value proposition from "hardware provider" to "integrated mobility service provider".