Self-Driving Vehicles in an Urban Context

Press briefing

24 November 2015

This survey on self-driving vehicles was prepared with the support of The Boston Consulting Group
Project dedicated to shaping new urban mobility with self-driving cars

**World Economic Forum project with the support of The Boston Consulting Group**

**Objective:** Develop road map for a real-world pilot of urban mobility

**In focus in this document**

**Understand consumer perspective on self-driving vehicles**
- Conduct qualitative and quantitative customer research
- Conduct city policy maker interviews

**Develop future urban mobility scenarios**
- Assess impact on key stakeholders incl. consumers and operators
- Understand larger impact on cities

**Develop roadmap for pilot implementation**
- Define action items for each stakeholder in operating model for pilot government and other stakeholders

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**Private sector**
- Uber
- Siemens AG
- Delphi Automotive Plc
- Renault-Nissan Alliance
- Toyota Motor Corporation
- Audi AG
- AB Volvo
- General Motors Company
- PSA Peugeot Citroën
- Qualcomm Incorporated
- HERE
- ChargePoint
- UPS
- DB Mobility Logistics AG

**Public sector**
- Ministry of Transport Singapore
- Land Transport Authority Singapore
- United Arab Emirates Ministry of Cabinet Affairs
- Roads & Transport Authority Dubai
- Drive Sweden

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Note: This survey was prepared with the support of The Boston Consulting Group
Source: World Economic Forum; BCG
Study provides fresh insights into consumer perception of self-driving vehicles

Extensive study of consumer and city perspective since June 2015

Step 1: consumer focus groups
- Six 4-hour focus groups conducted in Singapore, Berlin and London
- MindDiscovery technique applied to identify people's motivations and fears with respect to self-driving vehicles
- Discussion around self-driving vehicles, but also specific mobility models such as shared self-driving taxis

Step 2: consumer survey
- In-depth online survey in ten countries
- 5,500 city inhabitants surveyed with various socio-demographic profiles
- Conjoint analysis included to understand consumer preferences between different shared mobility models

Step 3: city survey
- Interview series with diverse set of cities
- 25 city policy makers interviewed
- Discussion about city priorities and challenges and potential role of self-driving vehicles and related mobility models

Note: This survey was prepared with the support of The Boston Consulting Group
Source: World Economic Forum; BCG
1. Many consumers are **very open to trying and buying** a self-driving car.

2. The key reason for this is **not having to park** a self-driving car.

3. Consumers want a **traditional OEM** to produce the self-driving car.

4. To consumers, a self-driving car is **electric or hybrid**.

5. Many are willing to pay **more than $5K extra** for a self-driving car.

6. They are slightly more reluctant to **share** a self-driving taxi, but will do it **at a high discount**.

7. Cities expect self-driving vehicles to become a **reality in the next 10 years**.

8. Key impediments to them are **public acceptance** and **technological readiness**.

9. SDVs primarily seen as **last mile solution** complementing public transport.

10. They prefer having **many private players** offering self-driving taxis.

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Note: This survey was prepared with the support of The Boston Consulting Group.

1. Many consumers are very open to trying a self-driving car

58% say they would take a ride in a fully self-driving car

<table>
<thead>
<tr>
<th>Country</th>
<th>58% of respondents</th>
</tr>
</thead>
<tbody>
<tr>
<td>Global</td>
<td>29% 29% 19% 11% 12%</td>
</tr>
<tr>
<td>China</td>
<td>32% 43% 16%  8%  2%</td>
</tr>
<tr>
<td>France</td>
<td>31% 27% 17% 10% 15%</td>
</tr>
<tr>
<td>Germany</td>
<td>21% 23% 20% 15% 21%</td>
</tr>
<tr>
<td>India</td>
<td>56% 29% 10%  2%  3%</td>
</tr>
<tr>
<td>Japan</td>
<td>12% 24% 24% 19% 22%</td>
</tr>
<tr>
<td>Netherlands</td>
<td>19% 22% 25% 16% 19%</td>
</tr>
<tr>
<td>Singapore</td>
<td>31% 31% 24%  8%  7%</td>
</tr>
<tr>
<td>UAE</td>
<td>38% 32% 18%  7%  6%</td>
</tr>
<tr>
<td>UK</td>
<td>25% 24% 20% 14% 17%</td>
</tr>
<tr>
<td>US</td>
<td>27% 25% 17% 12% 18%</td>
</tr>
</tbody>
</table>

...but only 35% of parents would let their children ride alone in one

<table>
<thead>
<tr>
<th>Country</th>
<th>35% of respondents</th>
</tr>
</thead>
<tbody>
<tr>
<td>Global</td>
<td>13% 22% 20% 23% 22%</td>
</tr>
<tr>
<td>China</td>
<td>16% 30% 14% 26% 14%</td>
</tr>
<tr>
<td>France</td>
<td>8% 19% 24% 24% 25%</td>
</tr>
<tr>
<td>Germany</td>
<td>3% 21% 23% 21% 32%</td>
</tr>
<tr>
<td>India</td>
<td>27% 31% 23% 11%  7%</td>
</tr>
<tr>
<td>Japan</td>
<td>7% 19% 20% 29% 25%</td>
</tr>
<tr>
<td>Netherlands</td>
<td>10% 19% 28% 40%  2%</td>
</tr>
<tr>
<td>Singapore</td>
<td>5% 16% 25% 30% 23%</td>
</tr>
<tr>
<td>UAE</td>
<td>10% 19% 25% 19% 27%</td>
</tr>
<tr>
<td>UK</td>
<td>7% 10% 23% 19% 40%</td>
</tr>
<tr>
<td>US</td>
<td>12% 15% 22% 21% 30%</td>
</tr>
</tbody>
</table>

Q: Imagine that the **fully self-driving vehicle** became available in the market. How likely would you be to consider **taking a ride in it** (for example as a test drive, taxi or rental car)?

n=5,635

Note: This survey was prepared with the support of The Boston Consulting Group
Source: World Economic Forum; BCG analysis, consumer survey August 2015

Q: How likely would you be to **let your children ride alone** in a fully self-driving car?

n=2,480
Consumers

2 Consumers see a direct benefit in not having to park and being able to do something else during their travel time

Drivers

"Drops me off, finds a parking spot and parks on its own" 43.5%

"Allows me to multi-task/be productive during my ride" 39.6%

"Switches to self-driving mode during traffic" 35.0%

Note: This survey was prepared with the support of The Boston Consulting Group
Source: World Economic Forum; BCG analysis, consumer survey August 2015
3 The most preferred producer of a self-driving car is a traditional OEM

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**OEM as primary source of trust**

In % of respondents

<table>
<thead>
<tr>
<th>Source</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Traditional car manufacturer</td>
<td>46%</td>
</tr>
<tr>
<td>Tech company</td>
<td>16%</td>
</tr>
<tr>
<td>I don’t know</td>
<td>15%</td>
</tr>
<tr>
<td>New car manufacturer</td>
<td>12%</td>
</tr>
<tr>
<td>Gov’t-owned and supervised</td>
<td>6%</td>
</tr>
<tr>
<td>Auto-motive suppliers</td>
<td>5%</td>
</tr>
</tbody>
</table>

n=5,635

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**… in cooperation with other players**

In % of respondents

<table>
<thead>
<tr>
<th>Cooperation</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>With tech company</td>
<td>69%</td>
</tr>
<tr>
<td>With auto supplier</td>
<td>17%</td>
</tr>
<tr>
<td>Alone</td>
<td>10%</td>
</tr>
<tr>
<td>I don’t know</td>
<td>4%</td>
</tr>
</tbody>
</table>

n = 2,579

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Note: This survey was prepared with the support of The Boston Consulting Group
Source: World Economic Forum; BCG analysis, consumer survey August 2015

3 The most preferred producer of a self-driving car is a traditional OEM

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**… with other players contributing their relevant expertise**
Picture is consistent across all regions – trust in OEM particularly strong in France, Germany and Japan

**Q: Who would be the ideal manufacturer of a self-driving car?**

<table>
<thead>
<tr>
<th>Country</th>
<th>Traditional car manufacturer</th>
<th>I don't know</th>
<th>Technology company</th>
<th>New car manufacturer</th>
<th>A government-owned and supervised company</th>
<th>Automotive suppliers</th>
<th>Other</th>
</tr>
</thead>
<tbody>
<tr>
<td>China</td>
<td>9</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>3</td>
<td>0</td>
</tr>
<tr>
<td>France</td>
<td>6</td>
<td>2</td>
<td>2</td>
<td>0</td>
<td>3</td>
<td>5</td>
<td>0</td>
</tr>
<tr>
<td>Germany</td>
<td>7</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>2</td>
<td>5</td>
<td>0</td>
</tr>
<tr>
<td>India</td>
<td>8</td>
<td>1</td>
<td>2</td>
<td>0</td>
<td>3</td>
<td>4</td>
<td>0</td>
</tr>
<tr>
<td>Japan</td>
<td>11</td>
<td>1</td>
<td>2</td>
<td>0</td>
<td>3</td>
<td>6</td>
<td>0</td>
</tr>
<tr>
<td>NL</td>
<td>3</td>
<td>2</td>
<td>2</td>
<td>0</td>
<td>3</td>
<td>5</td>
<td>0</td>
</tr>
<tr>
<td>Singapore</td>
<td>8</td>
<td>1</td>
<td>2</td>
<td>0</td>
<td>3</td>
<td>5</td>
<td>0</td>
</tr>
<tr>
<td>UAE</td>
<td>5</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>2</td>
<td>4</td>
<td>0</td>
</tr>
<tr>
<td>UK</td>
<td>7</td>
<td>1</td>
<td>2</td>
<td>0</td>
<td>3</td>
<td>4</td>
<td>0</td>
</tr>
<tr>
<td>US</td>
<td>3</td>
<td>2</td>
<td>2</td>
<td>0</td>
<td>3</td>
<td>4</td>
<td>0</td>
</tr>
</tbody>
</table>

Note: This survey was prepared with the support of The Boston Consulting Group
Source: World Economic Forum; BCG analysis, consumer survey August 2015
4 In consumers' minds, self-driving cars will be electric or hybrid

In % of total respondents

- Hybrid: 37%
- Electric: 29%
- I don't know: 15%
- Trad. combustion: 9%
- Fuel cell: 9%

Q: What type of engine do you think self-driving vehicles will primarily have?

n = 5,635

Note: This survey was prepared with the support of The Boston Consulting Group
Source: World Economic Forum; BCG analysis, consumer survey August 2015
Many are ready to pay more for a fully self-driving car

<table>
<thead>
<tr>
<th>% of consumers willing to pay more for a fully self-driving car¹</th>
<th>... of which many would pay up to $5K more</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>In % of respondents per country</strong></td>
<td><strong>In % of respondents per country</strong></td>
</tr>
<tr>
<td>Global</td>
<td>Global</td>
</tr>
<tr>
<td>43%</td>
<td>9 9 16 62</td>
</tr>
<tr>
<td>39%</td>
<td>3 16 1 28 52</td>
</tr>
<tr>
<td>50%</td>
<td>3 10 13 12 61</td>
</tr>
<tr>
<td>42%</td>
<td>6 11 8 73</td>
</tr>
<tr>
<td>50%</td>
<td>6 10 18 9 51</td>
</tr>
<tr>
<td>51%</td>
<td>4 6 8 24 58</td>
</tr>
<tr>
<td>42%</td>
<td>6 9 89</td>
</tr>
<tr>
<td>31%</td>
<td>3 8 14 3 72</td>
</tr>
<tr>
<td>47%</td>
<td>3 8 1 24 64</td>
</tr>
<tr>
<td>46%</td>
<td>10 6 6 21 57</td>
</tr>
</tbody>
</table>

¹ Percentage of respondents that quoted an acceptable price for fully self-driving car in excess of base price quoted for regular car

Note: This survey was prepared with the support of The Boston Consulting Group
Source: World Economic Forum; BCG analysis, consumer survey August 2015

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Consumers are more reluctant to share a self-driving taxi with strangers

In % of total respondents

<table>
<thead>
<tr>
<th>Very likely</th>
<th>Likely</th>
<th>Neutral - neither likely nor unlikely</th>
<th>Unlikely</th>
<th>Very unlikely</th>
</tr>
</thead>
<tbody>
<tr>
<td>12%</td>
<td>25%</td>
<td>25%</td>
<td>18%</td>
<td>19%</td>
</tr>
</tbody>
</table>

Q: How likely are you to consider using a **shared self-driving taxi**?

n = 5,635

"It is not safe for a lady to share with strangers."
Janice, 39

"Who will maintain the car if it gets dirty?"
Keryn, 32

"Me, as a woman, I would never want to share a ride with three drunk guys at night"
Jennifer, 26
6 Highest willingness to use a shared self-driving taxi in China and India

In % of respondents per country

Q: How likely are you to consider using a shared self-driving taxi?

n=5,635

Note: This survey was prepared with the support of The Boston Consulting Group
Source: World Economic Forum; BCG analysis, consumer survey August 2015
But at a sufficiently steep discount, they all opt for sharing their taxi

% of respondents **opting for shared self-driving taxi**
vs. regular taxi priced at $20

1. Based on a shared taxi configuration of 2 additional passengers, 5 additional minutes of wait time and no selection choice of other passengers

Note: This survey was prepared with the support of The Boston Consulting Group

Source: World Economic Forum; BCG analysis, consumer survey August 2015
7 Cities believe that self-driving vehicles become a reality in the next 10 years

Most cities expect commercialization in next 10 years

<table>
<thead>
<tr>
<th>In % of total interviewees¹</th>
<th>2016-2020</th>
<th>2021-2025</th>
<th>2026-2030</th>
<th>2031-2035</th>
<th>2036-2040</th>
<th>2041-2045</th>
</tr>
</thead>
<tbody>
<tr>
<td>48%</td>
<td>40%</td>
<td>8%</td>
<td>0%</td>
<td>0%</td>
<td>4%</td>
<td></td>
</tr>
</tbody>
</table>

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"We are very supportive of self-driving vehicle testing in our city."
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And many of them have specific SDV related initiatives under way

- **Singapore**
  - Extensive multi-year SDV trials announced in October 2015

- **Milton Keynes**
  - Trials of autonomous pod cars starting in 2016 as part of project UK Autodrive

- **Gothenburg**
  - DriveME project with 100 self-driving Volvo cars on public roads to start in 2017

- **London**
  - Project GATEway to start trial of pod cars in Greenwich area in 2016

- **Pittsburgh**
  - Uber and Carnegie Mellon University developing and testing SDVs in Pittsburgh

- **Toronto**
  - Started exploring impact on city; plans to develop two-year roadmap by year end

- **Amsterdam**
  - Promotion of self-driving vehicles development as part of Dutch EU presidency 2016

¹ Due to small sample size results are not statistically representative; Note: This survey was prepared with the support of The Boston Consulting Group

Source: World Economic Forum; BCG analysis, city policy maker interviews 2015
8 Key impediments to realization are societal acceptance and technology

Homogeneous picture across most cities

<table>
<thead>
<tr>
<th>Top impediments (multiple counts possible)</th>
<th>In % of total interviewees¹</th>
</tr>
</thead>
<tbody>
<tr>
<td>Consumer acceptance</td>
<td>56%</td>
</tr>
<tr>
<td>Technology</td>
<td>44%</td>
</tr>
<tr>
<td>Regulation</td>
<td>20%</td>
</tr>
<tr>
<td>Governance</td>
<td>8%</td>
</tr>
</tbody>
</table>

Rationale

"This requires a significant cultural change"

"We will need to get the public used to self-driving cars gradually."

"The technical challenge of interacting with pedestrians in the city cannot easily be solved"

"Technology needs to be safe and approved and consumers need to feel safe using them"

"How will crashes be programmed? Who decides on the right priority for saving lives?"

Regulation not considered the most significant roadblock

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Source: World Economic Forum; BCG analysis, city policy maker interviews 2015
9 Self-driving vehicles primarily seen as last mile solution

<table>
<thead>
<tr>
<th>Medium-sized cities 1</th>
<th>Car-centric cities 2</th>
<th>Established megacities 3</th>
<th>New megacities 4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gothenburg</td>
<td>Miami</td>
<td>New York City</td>
<td>Singapore</td>
</tr>
<tr>
<td>Last mile solution</td>
<td>Last mile solution</td>
<td>Last mile solution</td>
<td>Fixed and scheduled services</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Last mile solution</td>
<td>Last mile solution</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Last mile solution</td>
<td>Last mile solution</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Freight transport</td>
<td>Freight transport</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Utility</td>
<td>Utility</td>
</tr>
<tr>
<td>Mostly complementary</td>
<td>Mostly complementary</td>
<td>Strictly complementary</td>
<td>Complementary and enhancing</td>
</tr>
<tr>
<td>Mostly complementary</td>
<td>Mostly complementary</td>
<td>Mostly complementary</td>
<td>Complementary and enhancing</td>
</tr>
<tr>
<td>Outside city center</td>
<td>Both in city center and outside</td>
<td>Outside city center</td>
<td>Both in city center and outside</td>
</tr>
<tr>
<td>Substitution of some low frequency bus routes</td>
<td>Substitution of some low frequency bus routes</td>
<td>Substitution of some low frequency bus routes</td>
<td>Substitution of some low frequency bus routes</td>
</tr>
</tbody>
</table>

Note: This survey was prepared with the support of The Boston Consulting Group; Source: World Economic Forum; BCG analysis, city policy maker interviews 2015
Benefits perceived are both at societal and at individual level

- "Access to elderly and disabled"
- "Better access in low density areas"

Equitable access to mobility

- Improved road safety
  - "Reduction of accidents"
  - "More safety for all road users"

Individual benefits

- "Increased convenience"
- "More & better mobility choices"

Better service

- "Cheaper mobility for end consumer"
- "Lower cost of travel to city & consumer"

Decreased transport cost

- Decrease in pollution
  - "Less car travel at low occupancy"
  - "Fewer cars on the streets"

Freed up space

- "Less parking space needed in city center"
  - "Possibility for new city planning"

- "No need to add new car-focused capacity"
  - "Less congestion, better flow"

Source: World Economic Forum; BCG analysis, city policy maker interviews 2015

Note: This survey was prepared with the support of The Boston Consulting Group
Most cities prefer having many private players offering shared fleets

Free market economy most desirable

<table>
<thead>
<tr>
<th>In % of total interviewees¹</th>
<th>City</th>
<th>Private player</th>
<th>Multiple private players</th>
<th>Peer-to-peer</th>
</tr>
</thead>
<tbody>
<tr>
<td>88%</td>
<td>0%</td>
<td>8%</td>
<td>4%</td>
<td></td>
</tr>
</tbody>
</table>

Rationale

The city is not best suited to operate shared self-driving fleets

— Long decision making processes
— Long and rigid investment horizons
— Decisions influenced by political considerations
— Difficulty funding required investments

Rather, the city should assume an enabling and regulating role

— Enable development of new technologies and provide testing environment
— Ensure safety at trials
— Regulate the market
— Safety and security
— Reach
— Definition of service levels

Most cities open to working with third parties for provision of on demand services

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Source: World Economic Forum; BCG analysis, city policy maker interviews 2015