Mega Trends Impacting the Future of Mobility

Key Note

Presentation by:

Sarwant Singh
Senior Partner
Today’s Agenda

Agenda

2015 Mobility Highlights

Transformational Shifts Expected to Shape the Future of Mobility to 2025

Conclusions

Source: Frost & Sullivan
Developments in Key Mobility Markets
Traditional Carsharing’s Untapped Potential

The global car sharing market has grown by over 30% over the past year to reach 9 million members today.

<table>
<thead>
<tr>
<th>Region</th>
<th>No. of Users</th>
<th>No. of cars</th>
<th>Carsharing Cities</th>
<th>Operators</th>
<th>New Entrants</th>
</tr>
</thead>
<tbody>
<tr>
<td>North America</td>
<td>1.6 Million</td>
<td>24,644</td>
<td>~127</td>
<td>38</td>
<td>4</td>
</tr>
<tr>
<td>Asia Pacific</td>
<td>3.09 Million</td>
<td>36,660</td>
<td>~127</td>
<td>38</td>
<td>2**</td>
</tr>
<tr>
<td>Europe</td>
<td>3.16 Million</td>
<td>50,041</td>
<td>~1,305</td>
<td>197</td>
<td>6</td>
</tr>
<tr>
<td>Latin America</td>
<td>16,743</td>
<td>291</td>
<td>12</td>
<td>6</td>
<td>2</td>
</tr>
</tbody>
</table>
Over the past year there were approximately 7 key mergers, 12 new launches and almost 17 exits in the global carsharing market.

### Car sharing Market Developments, 2015

#### Market Expansion

<table>
<thead>
<tr>
<th>Service</th>
<th>City/Location</th>
</tr>
</thead>
<tbody>
<tr>
<td>zipcar</td>
<td>Boston, Los Angeles, Seattle, Denver, Turkey, France</td>
</tr>
<tr>
<td>Bolloré</td>
<td>Indianapolis, London</td>
</tr>
<tr>
<td>ReachNow</td>
<td>Seattle</td>
</tr>
<tr>
<td>GoDrive</td>
<td>GoDrive, London</td>
</tr>
<tr>
<td>DriveNow</td>
<td>Denmark, Sweden</td>
</tr>
<tr>
<td>CAR2GO</td>
<td>Spain, China</td>
</tr>
</tbody>
</table>

#### Acquisitions

<table>
<thead>
<tr>
<th>Zipcar</th>
<th>Local Motion, GM, Cruise, City Car, Divvy, Lyft, SNCF</th>
</tr>
</thead>
<tbody>
<tr>
<td>Enterprise Holdings</td>
<td>City Car, Divvy, Lyft, SNCF</td>
</tr>
</tbody>
</table>

#### New Entrants

<table>
<thead>
<tr>
<th>Company</th>
<th>Location</th>
</tr>
</thead>
<tbody>
<tr>
<td>Audi Home</td>
<td>San Francisco</td>
</tr>
<tr>
<td>Maven</td>
<td>Manhattan</td>
</tr>
<tr>
<td>Vancouver</td>
<td>Canada</td>
</tr>
<tr>
<td>Chile</td>
<td></td>
</tr>
<tr>
<td>Romania</td>
<td></td>
</tr>
<tr>
<td>Serbia</td>
<td></td>
</tr>
<tr>
<td>China</td>
<td>GX Zuche</td>
</tr>
</tbody>
</table>

#### Investments/Partnerships

<table>
<thead>
<tr>
<th>Zipcar</th>
<th>Divvy, Lyft</th>
</tr>
</thead>
<tbody>
<tr>
<td>GM</td>
<td>Enterprise Holdings, City Car, Divvy, Lyft, SNCF</td>
</tr>
</tbody>
</table>

Note: * - 2016 data; ** - Data as of 2014 year end / early 2015. Source: Frost & Sullivan
Ridesharing: The Next Hot Social Transportation Trend

The Ridesharing market is estimated at around 40 million members in 2015.

Ridesharing Market: Key Highlights, 2015

Europe
- 25 million Members
- 700,000 Members
- 700 Corporates

North America
- 350,000 Members
- 130 Corporates
- 350,000 Members

Asia
- 30,000 Members
- ~ 1 million members

Acquisitions
- carpooling.com
- AutoHop

Partnerships
- Strategic partnership through BMW iVentures
- Investment through GM Ventures (GMV)
- Corporate carpooling pilot

Investment through BMW iVentures

Source: Frost & Sullivan
Proliferation of the e-Hail Concept
One in Two taxis are now connected to a tech platform

### Taxi Industry: Snapshot of Key Taxi Apps, Global, 2015

<table>
<thead>
<tr>
<th>Region</th>
<th>Number of Users</th>
</tr>
</thead>
<tbody>
<tr>
<td>USA</td>
<td>More than 8 million users</td>
</tr>
<tr>
<td></td>
<td>631,000 users</td>
</tr>
<tr>
<td></td>
<td>lift, ARRO, curb</td>
</tr>
<tr>
<td>Europe</td>
<td>More than 4 million users</td>
</tr>
<tr>
<td></td>
<td>10 million users</td>
</tr>
<tr>
<td></td>
<td>mytaxi, taxify, leCab</td>
</tr>
<tr>
<td>SE Asia</td>
<td>250 million users</td>
</tr>
<tr>
<td></td>
<td>25 million users</td>
</tr>
<tr>
<td></td>
<td>OLA</td>
</tr>
<tr>
<td>LATAM</td>
<td>17 million users</td>
</tr>
<tr>
<td></td>
<td>1 million users</td>
</tr>
<tr>
<td></td>
<td>Easy Taxi, SaferTaxi, 99 Taxi, YAXI</td>
</tr>
<tr>
<td>Asia Pacific</td>
<td>40,000 monthly users</td>
</tr>
<tr>
<td></td>
<td>350,000 users</td>
</tr>
<tr>
<td></td>
<td>goCatch, ZOOMY, Ingogo</td>
</tr>
</tbody>
</table>

**Number of Connected Vehicles**

- **> 2,000,000**
- **500,000 - 2,000,000**
- **< 500,000**

*Source: Frost & Sullivan*
Growth in Mobility as a Service
In 2015 over 10 cities currently offered integrated, smart mobility services

- Ridescout
- Urban Engines
- Siemens – Simobility
- Indra, Medellin
- Ubigo – Gothenburg, Sweden
- Maas – Helsinki, Finland
- Syndicat Mixte des Transports en Commun (SMTC)
- Qixxit
- Moovel
- Mobility Mix
Transformational Shifts Expected to Shape the Future of Mobility
Transformational Shifts Reshaping the Future of Mobility

- Connected Mobility
- Cognitive Era
- Cars go Tech
- Digitization

- VW Dielsegate
- Health Wellness and Wellbeing
- Vehicle Leasing and Financing
- MAAS - Mobility as a Service
Transformation Shift No. 1: Connected and Automated Mobility:
5G will be rolled out from 2020 onwards

<table>
<thead>
<tr>
<th>Generation</th>
<th>1G</th>
<th>2G</th>
<th>3G</th>
<th>4G</th>
<th>5G</th>
</tr>
</thead>
<tbody>
<tr>
<td>Digital Voice Calls</td>
<td>Data</td>
<td>Video Streaming</td>
<td>M2M</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

5G Targets

- Less than 1 millisecond Latency
- 90% Energy savings
- 0 perceived down time for service provision
- 7 trillion M2M wireless connections
Sub Trend: Space Jam - There will be 1,213 Satellites launched, cumulatively, globally between 2011 - 2021.

Source: Frost & Sullivan
Implication: 5G and Satellites boom will make our cars cognitive and intelligent

High to Fully Automated Driving

Over 2 Gb data needs to be harnessed at a given point. Needs 5G speed

Over the Air Updates

Smart compression and high internet speeds will reduce update times by 50%

Augmented and Virtual Reality

Continuous processing of real-time information to windshield

Source: Frost & Sullivan
Implication: Re-thinking Automotive with Big Data
Meaningful data sets is expected to grow from 10MB to 5GB in an average connected car by 2017/2018 providing saving of $800 per car to OEM

- **Internet Aggregators**
  Price transparency, unbundling of activities

- **Real-Time Prognostics**
  Proactive maintenance, warranty management

- **Personalization & Customization**
  ‘Me-commerce’, Social media analytics and reporting for targeted ads

- **New Products**
  User-based insurance, Telematics

- **Dynamic Pricing**
  Real-time billboard pricing, Price different vouchers, Surge pricing (Uber)
Sub Trend: Autonomous Cars - $60bn per annum market opportunity in 2030

Change in Responsibility

- **Feet Off**
- **Hand Off**
- **Eyes Off**
- **Mind Off**
- **Brain Off**

### Levels of Autonomy

- **Level 0: No Assist**
  - New Vehicles:
    - 2011: 40 million
    - 2016: 15 million
    - 2018: 5 million
    - 2025: 2 million
    - 2030: 1 million

- **Level 1: Early Warning Systems**
- **Level 2: Traffic Control**
- **Level 3: Awareness for Takeover**
- **Level 4: General Awareness**
- **Level 5: Full Autonomous Driving**
Future Autonomous World
Anything That Moves, Could be Autonomous

Unmanned Vehicles
Autonomous Cars
Personal Robots
Drone Deliveries
Automated Security
Robotic Surgeries
Sub Trend: Drone Deliveries to take off
Future is all about delivery drones that are expected to transport packages to near by places within a span of one or two minutes.
Future of Delivery Case Study: Amazon Prime - Airspace

Amazon proposes a 200-foot designated airspace – between 200 and 400 feet from the ground – to be reserved for drone flights.
Implication: Future of Formula 1 Racing - Autonomous

Source: Frost & Sullivan
Transformation Shift No. 2: Cognitive Era

What is Artificial Intelligence?

Three Types of Artificial Intelligence Systems

Artificial Narrow Intelligence

Artificial General Intelligence

Artificial Super Intelligence
Cars Will Need These 6 Cognitive Technologies For AI

- Computer Vision
- Natural language processing
- Machine learning
- Optimization
- Rules based systems
- Planning & scheduling
Self Learning Cars As Enablers of Level 4-5 Automated Driving by 2025
13 OEMs via $5 Billion Investment Target 4 Levels of Self learning Cars, 3 Broad Applications, 12 Use Cases.

Whole New Ecosystem
- 13 OEMs to Invest $5 Billion by 2025

Mass Market Opportunity
- 2 Million Level 4 Self Learning Cars on-road by 2025

Phase wise Evolution
- Powered by Supercomputers, 4 Levels of Evolution by 2025

Database Availability Key
- 3 broad applications of vision, speech and user behavior

Super Computer Backbone
- Atleast 12 use cases including HAD maps, Health monitoring

Collaborative Convergence
- Technology companies as New Tier-1 to OEMs
Transformation Shift No. 3: Tech companies entering the automotive space

New OEMs entering the Market will disrupt product lines

Next EV

Faraday

Apple
Video: There will always be a market for traditional products
Transformation Shift No. 4: Digitization of the Retail Network
Unbundling of the Automotive Business - The Multi Channel strategy for the future

Bundled (Single Location, One-stop-Shop)

<table>
<thead>
<tr>
<th>New Cars</th>
<th>Used Cars</th>
<th>Finance &amp; Insurance</th>
<th>Service</th>
<th>Parts</th>
</tr>
</thead>
</table>

Unbundled (Multiple services, channels, aggregated online)

<table>
<thead>
<tr>
<th>Online Stores</th>
<th>Warehouses</th>
<th>Online Insurance</th>
<th>On-the-air diagnostics</th>
<th>E-marketplace</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pop Up Stores</td>
<td>Lifestyle Stores</td>
<td>Rental &amp; Leasing</td>
<td>Service &amp; Maintenance</td>
<td>Mobility Solutions</td>
</tr>
<tr>
<td>Flagship Stores</td>
<td>Store in a Store</td>
<td>Pay-as-you drive</td>
<td>Heavy Repairs</td>
<td>Finance Options</td>
</tr>
</tbody>
</table>
eCommerce in Automotive Aftermarket—BMW’s Global Footprint
Over the years, BMW has explored different market outreach strategies in eCommerce channel globally

- **2011**: BMW Store on eBay Motors (UK)
- **2015**: BMW Store on Tmall.com (China)
- **2016**: BMW Direct eStore (Germany)
eCommerce in Automotive Aftermarket—BMW Web Store

BMW could expand own web store channel strategy outside of Germany depending on the outcome of current pilot project.

**BMW Direct eStore (Germany)**

- **Products Coverage:**
  - Driveline, Suspension, Electricals, Systems, Exterior Body Parts, HVAC and Lighting

- **Payment Options:**
  - Online banking, PayPal

- **Fulfillment Options:**
  - Delivery at Choice of Location (shipped from dealer location)
  - Pickup from BMW dealership

- **Shipping Cost:**
  - Varies according to order weight (minimum shipping is EUR 5.99 across Germany)

**BMW Direct eStore**

- e-Catalogue: 11,000 + parts
- Order Placement: Online payment
- Order Fulfillment: Via local Dealer
  - Delivery at Customer Location
  - Pickup from BMW Dealership
Transformation Shift No. 5: VW Dieselgate reshaping the auto landscape  
VW and the global automotive Industry is shifting gears to an electrified future (2025 and beyond) as a more sustainable solution.

<table>
<thead>
<tr>
<th>Conventional</th>
<th>Alternative/Regenerative</th>
<th>Electric</th>
<th>Fuel Cell</th>
</tr>
</thead>
<tbody>
<tr>
<td>Diesel</td>
<td>Ethanol</td>
<td>Plug-In Hybrid</td>
<td>Hydrogen</td>
</tr>
<tr>
<td>Gasoline</td>
<td>CNG</td>
<td>Electric powertrain</td>
<td></td>
</tr>
</tbody>
</table>

- MQB platform
- Vehicle-electrification toolkit

Battery pack of varying capacity, an 85-kW electric motor system, and/or a motor-integrated version of its DSG.

Flexibility in packaging afforded by:
- MQB platform
- Vehicle-electrification toolkit

2012-2015
- e-Golf (all-electric hatchback)
- Audi A3 e-tron (sporty plug-in hybrid),
- Golf GTE (companion plug-in hybrid model).

Beyond 2016
- Others (Planned PHEVs):
  - Tiguan crossover
  - Larger mid-size SUV.
Global Uptake of Electrification in Passenger Vehicles
Electrified Vehicles to go from 2.8 million in 2016 to about 14M units by 2025 (12% of global automotive sales)

Sales forecasts (Mid Scenario) for hybrid, electric and fuel cell vehicles (Global), 2012-2025

- HEV (53.4%)
- EV (45.7%)
- FCEV (0.9%)

Note: Regions include North America, Europe, China, Japan, India, South Korea and Australia
Transformational Shift No. 6: Health, Wellness and Wellbeing the Next Big Differentiation Factor for OEMs

- Built-in (Embedded)
- Brought-in (Peripheral Integration)
- Cloud-enabled (Broadcast)

Source: Frost & Sullivan
Sub Trend: 2025 Automobile Built-In Health Wellness and Well-being Technologies

- **Seat Belt**: Sensors to track driver motion, respiratory rate.
- **Headrest**: Sensors capture brain electrical activity, head motion.
- **Steering Wheel**: Sensors measure sweat, heart rate, body temperature using conductive pads embedded in steering wheel.
- **Steering Column**: Sensors to track driver motion, respiratory rate.
- **Seat**: Sensors track body temperature, pain, stress.
- **External**: Environment sensors (air, temperature).
- **Interface**
  - Connectivity (phone, wearables, medical devices).
  - High res display screen and camera.
- **Developer Spotlight**: 
  - In vehicle sensors:
  - **OLEA SENSOR NETWORKS**: Connectivity, environment sensors (air, temperature).
  - **Dashboards/ Analytics**:
  - Sub Trend: 2025 Automobile Built-In Health Wellness and Well-being Technologies
  - Developer Spotlight:
  - **OLEA SENSOR NETWORKS**: Connectivity, environment sensors (air, temperature).

* See appendix for select sensor, wearable, and mobile health tool developers.
Transformation Shift No. 7: New Mobility Trends – Emergence of Car as a Service

Example of OEMs foray into Energy Storage Market

- **Tesla Energy Storage (Launched)** – Assimilator Approach
- **Daimler (Launched)** – Assimilator Approach
- **BMW/Viessman (Planned B2B)** – Smart home/Connected Living Integrator Approach
Sub Trend: OEMs moving toward CAAS – car as a service –
Case Study: Daimler (Moovel gmbh) Daimler’s mobility services have reached over €100mn in revenue in 2014 and, the company has targeted revenues of €800mn by 2020
Conclusions
How OEMs Will Differentiate Their Brand In Future

- **DESIGN & STYLING**
- **DRIVING DYNAMICS**
- **SAFETY**
- **SUSTAINABILITY & ENVIRONMENT**
- **QUALITY & RELIABILITY**
- **COMFORT & CONVENIENCE**
- **COST OF OWNERSHIP**
- **CONNECTED MOBILITY**
- **AUTOMATED MOBILITY**
- **HEALTH, WELLNESS & WELLBEING**

**PRE 2000**

**TODAY**

**FUTURE**
Utilities and commodities of The Past

18TH CENTURY
Industrial Revolution

19TH CENTURY
Electricity

20TH CENTURY
Communication Industry

LATE 20TH CENTURY
The Internet

21st century utilities?

Source: Frost & Sullivan
21st Century Utilities: What is the Future?

Cognitive Era Enabled?

Mobility?

Healthcare?

Media?
Learn More About “New Mega Trends”

Published Book:
New Mega Trends
*Implications for our Future Lives*
By Sarwant Singh

Publisher: Palgrave Macmillan

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Mega Trends: Strategic Planning and Innovation Based on Frost & Sullivan Research

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