Key Automotive Trends Impacting the North American Aftermarket

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Global Aftermarket Practice Leader
May 1, 2018
Agenda

- New Sales – *plateauing at record levels*

- Vehicles-in-Operation (VIO) – *continues to grow*

- Vehicle Mix – *rapidly evolving*

- Aging Vehicle Population – *having a major impact on repair opportunities*

- Battery Electric Vehicles – *on their way, but new ICE technology coming faster*

- Autonomous Vehicles – *on the horizon, but enabling technology is here now*
New light vehicle sales declined...
...to 17.2 million units in 2017.

Source: IHS Markit
SAAR Highlights Slowing Pace of Sales

U.S. Light Vehicle Sales Seasonally Adjusted Selling Rate

Source: IHS Markit © 2017 IHS Markit
Hurricane Impacts to Drive Replacement Volume & Scappage

Hurricane Harvey
- Impacted areas: Houston, Corpus Christi, New Orleans and San Antonio
- Total VIO: Apprx. 9.8m
- Estimated replacement: 400-500k
- Most impacted segments: Pickup (15.9%), Midsize Car (11.9%) and Compact Car 10.2%
- Most impacted OEMs: Ford (17.8%), Chevy (15.9%) and Toyota (12.5%)

Hurricane Irma
- Impacted areas: Miami, Savannah (GA), Ft. Myers, Tampa, Jacksonville and Orlando
- Total VIO: Apprx. 14.4m
- Estimated replacement: 550-700k
- Most impacted segments: Midsize Car (14%), Compact Car (13.6%) and Compact CUV (9.2%)
- Most impacted OEMs: Ford (14.5%), Toyota (13.2%) and Chevy (10.8%)
Another slight decline in 2018...  
...to 16.9 million units

Source: IHS Markit
U.S. Light Vehicle Sales

2017 = 17.2 million units

Peak at 17.6M in 2016

Source: IHS Markit
U.S. Light Vehicles in Operation

VIO will Increase 8% by 2023

Data as of January 1 each year.

History
Forecast

2018 = 272 million units

Source: IHS Markit
U.S. New Light Vehicle Sales Growth

Growth in Annual Units
2009 v 2017
+7 M

Growth in CUV Body Style
+3.8 M

54% of Growth Came from CUV Body Style Alone

Source: IHS Markit
Change in U.S. Vehicle Mix – Crossover Body Style Dominating

4 Segments represent 57% of all new U.S. registrations in 2017

- COMPACT CUV: 20%
- TRADITIONAL COMPACT: 13%
- TRADITIONAL MID SIZE: 11%
- FULL SIZE PICKUPS: 8%

Mid-Size CUV: 12.6%

Source: IHS Markit
U.S. New Light Vehicle Sales: Imports v Domestic 3
Import Makes Outpace Domestics – 2017 - 2022

Total Units Added to Fleet
+100 M

Domestic Makes
44%

Import Makes
56%

Gain of
13M Units
2017-2022

Source: IHS Markit
U.S. Light Vehicle VIO – Domestic 3 v Import Makes


IMPORT MAKES
DOMESTIC 3

28%
45%
48%
<table>
<thead>
<tr>
<th>Year</th>
<th>Total Korean Makes</th>
<th>2017</th>
<th>2022</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>13M</td>
<td>18M</td>
</tr>
<tr>
<td>2017</td>
<td></td>
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<td>2022</td>
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</table>

<table>
<thead>
<tr>
<th>Year</th>
<th>Total Japanese Makes</th>
<th>2017</th>
<th>2022</th>
</tr>
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<tr>
<td></td>
<td></td>
<td>89M</td>
<td>102M</td>
</tr>
<tr>
<td>2017</td>
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<td>2022</td>
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<thead>
<tr>
<th>Year</th>
<th>Total European Makes</th>
<th>2017</th>
<th>2022</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>20M</td>
<td>25M</td>
</tr>
<tr>
<td>2017</td>
<td></td>
<td></td>
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<tr>
<td>2022</td>
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</tbody>
</table>

Source: IHS Markit
Average Age History

Cars & Light Trucks Combined

Source: IHS Markit
Impact on VIO Age Groups - 2017-2022

- Vehicles new to 5 yrs old grow 10%
- Vehicles 6 to 11 yrs old grow 18%
- Vehicles 12 to 15 yrs old grow -23%
- Vehicles 16+ yrs old grow 28%

The oldest vehicles – 16 years & older – will grow nearly 30% !!
### Average Age Impact on VIO Units

<table>
<thead>
<tr>
<th>Year</th>
<th>New – 5 Year Old</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>2002</td>
<td>84m units</td>
<td></td>
</tr>
<tr>
<td>2017</td>
<td>80m units</td>
<td></td>
</tr>
<tr>
<td>2022</td>
<td>88m units</td>
<td></td>
</tr>
</tbody>
</table>

*Segment remains relatively flat after decline due to recession’s impact on new vehicle sales & current plateau.*

Source: IHS Markit
## Average Age Impact on VIO Units

<table>
<thead>
<tr>
<th>Year</th>
<th>Age Group</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>2002</td>
<td>16+ Year Old</td>
<td>35m units</td>
</tr>
<tr>
<td>2017</td>
<td>16+ Year Old</td>
<td>66m units</td>
</tr>
<tr>
<td>2021</td>
<td>16+ Year Old</td>
<td>85m units</td>
</tr>
</tbody>
</table>

*20 million units will be 25 years or older by 2021!*

Source: IHS Markit
Global CO₂ & Fuel Efficiency Regulations

CAFÉ & Global Standards are Merging

- 35 MPG (2016)
- 54.5 MPG (2025)
- 86 MPG (2030)

To reach this goal, every OEM must improve fuel efficiency by 5% per year!
Compliance Gaps Emerging

OEMs are developing strategies for widening compliance gaps:
New technologies, light-weighting & electrification will all play critical roles.

Source: IHS Markit
OEMs Preparing for Transition to Electrification

**Conventional Platform**
Some conventional platforms can implement batteries, but cannot change the overall architecture to form a battery driven vehicle assembly.

**Multi-energy Platform**
Initially designed to support both BEV and conventional powertrain vehicles. Structure is not skateboard style, but is more flexible than conventional platform.

**BEV Platform**
Platform is designed only for pure BEV applications. Skateboard style architecture allows for more battery capacity and more interior space with the same vehicle size.

Source: IHS Markit
OEMs Preparing for Transition to Electrification

Major Platform Types in Use by 2024

OEM’s not well positioned to efficiently produce large numbers of EV’s well into next decade.
United States xEV Sales Volume

4.6 Million Units/Year by 2028

New Sales Forecast for 2028 = 17.3M

27% = xEV

73% = ICE only

Source: IHS Markit
North American Powertrain Analysis

Cylinder Count and Displacement Continue to Shrink

**Engine Cylinder Count**

<table>
<thead>
<tr>
<th>Year</th>
<th>2-3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>8</th>
<th>10+</th>
</tr>
</thead>
<tbody>
<tr>
<td>2000</td>
<td>27%</td>
<td>28%</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2005</td>
<td>31%</td>
<td>41%</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2010</td>
<td>23%</td>
<td>35%</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2015</td>
<td>17%</td>
<td>35%</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2020</td>
<td>14%</td>
<td>50%</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2025</td>
<td>10%</td>
<td>52%</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Engine Displacement**

<table>
<thead>
<tr>
<th>Year</th>
<th>&lt;=4 cyl</th>
<th>1-1.9L+</th>
<th>2-2.9L+</th>
<th>3-3.9L+</th>
<th>4-4.9L+</th>
<th>5.0L+</th>
</tr>
</thead>
<tbody>
<tr>
<td>2000</td>
<td>68%</td>
<td>19%</td>
<td>8%</td>
<td>32%</td>
<td>22%</td>
<td>8%</td>
</tr>
<tr>
<td>2005</td>
<td>70%</td>
<td>18%</td>
<td>16%</td>
<td>33%</td>
<td>20%</td>
<td>10%</td>
</tr>
<tr>
<td>2010</td>
<td>70%</td>
<td>18%</td>
<td>16%</td>
<td>31%</td>
<td>35%</td>
<td>35%</td>
</tr>
<tr>
<td>2015</td>
<td>70%</td>
<td>18%</td>
<td>16%</td>
<td>30%</td>
<td>35%</td>
<td>34%</td>
</tr>
<tr>
<td>2020</td>
<td>70%</td>
<td>14%</td>
<td>14%</td>
<td>39%</td>
<td>30%</td>
<td>23%</td>
</tr>
<tr>
<td>2025</td>
<td>70%</td>
<td>11%</td>
<td>19%</td>
<td>39%</td>
<td>26%</td>
<td>19%</td>
</tr>
</tbody>
</table>

68% <=4 cyl
70% <3L

Source: IHS Markit
Global Transmission Production
*Increased Complexity, Greater Speeds*

**Global Auto, DCT & AMT Trans by Speed**

- **5% >5 spd**
- **86% >5 spd**

- **94% >5 spd**

**Global Transmission Type by Share**

- **2005**
  - Manual: 65%
  - Auto: 44%
  - CVT: 95%
  - DCT: 4%
  - EVT: 4%
  - Reduction: 12%
  - AMT: 13%
  - IVT: 39%

- **2015**
  - Manual: 65%
  - Auto: 44%
  - CVT: 95%
  - DCT: 6%
  - EVT: 4%
  - Reduction: 12%
  - AMT: 13%
  - IVT: 39%

- **2025**
  - Manual: 65%
  - Auto: 44%
  - CVT: 95%
  - DCT: 4%
  - EVT: 4%
  - Reduction: 13%
  - AMT: 26%
  - IVT: 39%

Source: IHS Markit
# Levels of Autonomous Driving

<table>
<thead>
<tr>
<th>Level</th>
<th>Description</th>
<th>Example</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>L5</strong></td>
<td>Full Automation – Driverless Car</td>
<td>Fully autonomous driverless fleets</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Mobility service business model</td>
</tr>
<tr>
<td><strong>L4</strong></td>
<td>High Automation – Self-driving Car</td>
<td>Fully autonomous autopilots</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Drivers disengage longer &amp; in more situations</td>
</tr>
<tr>
<td><strong>L3</strong></td>
<td>Conditional Automation – Limited Self-Driving</td>
<td>Advanced autopilots</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Drivers intermittently re-engage</td>
</tr>
<tr>
<td><strong>L2</strong></td>
<td>Partial Automation – Multi-function Automation</td>
<td>Autopilot</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Traffic jam assist</td>
</tr>
<tr>
<td><strong>L1</strong></td>
<td>Driver Assistance – Single Function Automation</td>
<td>Adaptive cruise control</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Lane keep assist</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Autonomous parking</td>
</tr>
<tr>
<td><strong>L0</strong></td>
<td>No Automation</td>
<td>Collision warning</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Lane departure warning</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Blind spot information</td>
</tr>
</tbody>
</table>

## Technology Timeline

- **2010**: Technology is entering repair bays today!
- **2015**: First L3 in Production – 2018 Audi A8
- **2020**: 2030

**Driver Attention Monitoring**

- Hands on wheel
- Following line of sight

**Driver Wake Up Alarm**

Based on Society of Automotive Engineers levels of automation (SAE J3016)
Autonomous Vehicles on the Road Today – *but not for sale*

Regulatory/insurance, infrastructure & sensing/connectivity issues slowing progress
# The Vehicle Sensing Systems – Under Development

<table>
<thead>
<tr>
<th><strong>Ultrasonic</strong></th>
<th><strong>Camera</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>• Sound wave</td>
<td>• Colors and fonts identification</td>
</tr>
<tr>
<td>• Short-range (0–2m)</td>
<td>• Short and long-range (0–125m)</td>
</tr>
<tr>
<td>• Applied in very low speeds</td>
<td>• Traffic signs, lights, &amp; lane markers identification</td>
</tr>
<tr>
<td>• Relatively inexpensive</td>
<td>• Requires significant computing resources</td>
</tr>
<tr>
<td>• Snow and rain interference</td>
<td>• Weather condition interferences</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Radar</strong></th>
<th><strong>Lidar</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>• Electromagnetic wave</td>
<td>• Laser beam</td>
</tr>
<tr>
<td>• Short and long-range (0–250m)</td>
<td>• Short &amp; long-range (0–200m)</td>
</tr>
<tr>
<td>• Other car speed and distance in real time</td>
<td>• Obstacles identification</td>
</tr>
<tr>
<td>• Relatively high cost</td>
<td>• Even more expensive than radar (cost coming down)</td>
</tr>
<tr>
<td>• Robustness to rain, snow and fog interferences</td>
<td>• No interference or metallic material reflection</td>
</tr>
</tbody>
</table>
Latency Time

Waiting time for signal from vehicle to detect a road obstruction and start communication with the car to avoid the obstacle

LT = 50 milliseconds

LT = 1 millisecond*

* In development
Connectivity – Telematics Control Unit (TCU) Bandwidth Group

TCU Bandwidth – Global Light Vehicle Production

- 2G+
- 3G
- 3G+
- 4G LTE
- 4G+
- 5G

Source: IHS Markit

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IHS Markit Forecast: Fully autonomous driving cars global forecast

Fully Autonomous Global Light Vehicle Sales

<table>
<thead>
<tr>
<th>Year</th>
<th>L4 Self-driving cars</th>
<th>L5 Driverless cars</th>
</tr>
</thead>
<tbody>
<tr>
<td>2020</td>
<td>0.6M</td>
<td></td>
</tr>
<tr>
<td>2021</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2022</td>
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<td>2023</td>
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<td>2030</td>
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<tr>
<td>2031</td>
<td>4.5M</td>
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<td>2032</td>
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<tr>
<td>2039</td>
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</tr>
<tr>
<td>2040</td>
<td>20.7M</td>
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</tr>
</tbody>
</table>

Source: IHS Markit
Heads Up Display Evolution...or Revolution?
Head-Up Display volume surpasses 11m units in 2023

- HUD volume will more than triple over 7 year period (2016-2023)
- HUDs will reach nearly 13% global penetration
- Windscreen projection and Combiner will essentially split the market
As HUDs proliferate, supplier opportunity emerges

- **$908m HUD market**
- **Top 5 represents 85% of total revenue**

- **$2.6b HUD market**
- **Top 5 represents 72% of total revenue**

  +1.7b  +188% in 5 yrs
ADAS - Advanced Driver Assist Systems Growing Rapidly
Building Blocks of Autonomy Offer Compelling Near-Term Growth Prospects

Full Driver Control → Driver Assisted → Fully Autonomous Car

Source: IHS Markit
Aftermarket Outlook Includes both Challenges & Opportunities
Aftermarket Outlook Includes both Challenges & Opportunities

**Medium Term:**
- **VIO growth continues**
- **Aging vehicle population** – selling to 3rd, 4th, 5th owner
- **Electrification coming** – but will see more ICE & transmission technology coming on even faster
- **ADAS technology already here and accelerating**
- **Must convince consumer we have parts & trained technicians to repair the next generation vehicles**
Aftermarket Outlook Includes both Challenges & Opportunities

**Longer Term:**

- Personal vehicle ownership replaced by fleet services
- Reduced VIO as mobility model changes
- Much higher VMT per vehicle
- Repair model shifts from consumer making decisions to fleet contract service
- Threat from lack of access to vehicle generated data