Ford Motor Company
Autonomous Vehicles

Colm Boran
Autonomous Vehicle Systems Engineering
## SAE Automation Levels

<table>
<thead>
<tr>
<th>Operating Domain</th>
<th>May Be Limited</th>
<th>Unlimited</th>
</tr>
</thead>
<tbody>
<tr>
<td>Driver’s Role</td>
<td>Perform or Supervise Driving Tasks</td>
<td>Fallback (Ab. Cond.)</td>
</tr>
<tr>
<td>Sensing &amp; Response</td>
<td>Partial Capability</td>
<td>Complete Capability</td>
</tr>
<tr>
<td>Control</td>
<td>Warnings / Support</td>
<td>Lateral OR Longitudinal</td>
</tr>
<tr>
<td>Automation Level</td>
<td>0</td>
<td>1</td>
</tr>
</tbody>
</table>

### Dual Approach

- **Bottom-Up**
- **Top-Down**
LiDAR Movie – Ann Arbor
LiDAR Movie – Nightonomy
Designed to Serve Millions of Customers
Cold chamber
facility movie
Ford Focus Winter Test movie
Ford Product Development Process

- Ford AVs are being designed to drive in the same environment as today’s vehicles.
- Large existing database from prior development.

Attributes and Noise factors:
- Vehicle performance / dynamics / ride
- Part-to-part variation
- Aging
- Vibration
- Temperature
- Weather
- Etc.

- Re-Simulation
- Closed-Loop Simulation
- Test Track Scenarios
- Real-World Driving
Snowtonomy Movie
The Importance of Collaboration

Coordinate with regulatory, government, municipalities

Objective test methods

Functional safety ratings

Safety principles for each automation level

Functional automation level descriptions