Barriers to Technology Validation On-Road

✓ “Unlimited” number of possible scenarios to test
✓ System-critical situations rarely happen with normal driving
✓ Scenarios often not reproducible or too dangerous
✓ Millions of miles would be need to be driven to develop the full functionality necessary for validation
Product development & validation:
Structured combination of three testing methodologies

- Controlled track testing
  - Safely validate and control; test interaction; fault injection / limit tests
  - Identify edge cases / evaluate performance & decisions in complex environments

- Virtual Simulation
  - Test, apply fixes, and accumulate “miles;” examine impact of controllable variables
  - (+) Real-world likeness

- On-road testing & operation
  - Build Scenario Database
  - Test Method Database

The American Center for Mobility Willow Run, Ypsilanti, Michigan
ACM: a new type of proving ground

Optimized for validating Connected and Automated Vehicles (CAVs):

Next Generation facilities test:
- Sensing, situational awareness
- Variable challenges
- Real traffic conflicts
- Decision making
- Competitor interoperability

Traditional proving grounds test:
- Durability, ride and handling
- Steering, braking, stability
- Thermal management
- Standard challenges
The American Center for Mobility?

Non-profit, Purpose Built, Next Generation Connected and Automated Technology Proving Ground focused on:

1. Product development, testing and validating connected and automated technologies and their security

2. Accelerating voluntary standards, establish path to self-certification

3. Educating and training the workforce, public, and tech sector
Public-Private Partnership

Non-investors are testing at ACM everyday too

Founders
- AT&T
- Ford
- Hyundai Motor Group
- Toyota
- Visteon

Sponsors
- Siemens
- Subaru

Partners
- Microsoft
- Deloitte
- Intertek
What makes ACM Unique?

Purpose Built for CAV Testing and Product Development
✓ High Tech State-of-the-Art Proving Ground
✓ Real World Test Environments and Infrastructure
✓ Simulation of authentic Driving Scenarios
✓ Ability to Replicate Environmental Effects

Programs Complimentary to Test Activity
✓ Supporting Standards Development with industry
✓ Leading Edge Research
✓ Impacting the Workforce of the Future
✓ Expanding the Facility Footprint and Services
Future mobility testing and development
ACM Real World Test Environments

All test environments with access roads
1.5 miles EW x 1.0 mile NS, approx.
550+ acres
[July 2018 satellite imagery]
No ‘easy’ miles

*Real world complexity*

- **Blind** crests, curves, corners
- Blocked GPS
- Gores
- Potholes
- Trees/leaves
- Worn and faded lines
ACM Real World Test Environments

Low Speed Environments
- User-defined area, 8+ acres
- Urban canyon
- Pedestrian & bicycle corridor
- Intersection network
- Parking
- Roundabout
- Rural
- Residential
- Off-road
ACM Real World Test Environments

User-defined area, 8+ acres
Reconfigurable
Replicate any intersection, e.g.: Washington, D.C.
Massachusetts Ave NW and 4th St NW, April 2014
ACM Real World Test Environments

Urban Canyon

Reconfigurable

Real world building façade materials – under development (wood, brick, glass, aluminum, paint)
ACM Real World Test Environments

Low Speed Environments

Under development:
- Rural, 2 mile
ACM Real World Test Environments

Low Speed Environments
Under development:
- Rural, 2 mile
ACM Real World Test Environments

Low Speed Environments
Roundabout, 2-lane
0.5 mile pedestrian & bicycle corridor
ACM Real World Test Environments

Network & other infrastructure
- DSRC (15 RSUs)
- 4G LTE (private) & 5G sub-6 cellular
- Cloud - Data Management & Analytics Platform
  (Ingest massive data, securely, at high speed, for simulation)
- Fiber optic cable backbone
- 90MW substation (1MW off-grid backup)
- Lvl2 (240V, to 19.2kW) & DC FC (50-120kW)
Test equipment

AB Dynamics SR60 Torus – Steering Robot

AB Dynamics CBAR600 – Combined Brake and Accelerator Robot

AB Dynamics GST – Guided Soft Target carrying a Soft Car 360 vehicle target;
Creating weather simulation

Rain and Fog simulation
Snow and sleet simulation
Weather Chamber
On site engineering
On site fabrication

Expanding Testing Support Services
Dynamic Rain Simulation in a Structured Physical Environment

Top View

Side View
Dynamic Rain Simulation in a Structured Physical Environment

Top View

Rear View
Pillars of Activities

TESTING

STANDARDS

SAE INTERNATIONAL®

ITE

IEEE

EDUCATION

practice instruction Training mentor advising development education
AV Validation – Policy & Standards

Unanswered questions:

• How safe is safe enough?
• When is a test vehicle safe enough to go out on the public roads?
• How will we validate that an AV is ready for public sale and use?
• How are in-service updates, repairs, and aftermarket solutions validated?

Timelines:

• Regulation: US DOT/NHTSA (10 years)
• Standards: SAE (2-3 years)
• Shared methods: ACM (6-12 months?)
Standards

We want to go fast:

Proving Grounds accelerate this process

Time scale: months?

- technical expertise
- shared methods
- ACM IAB Standards Committee

Time scale: years

- voluntary standards
- regulation

NHTSA

www.nhtsa.gov

The American Center for Mobility
Willow Run, Ypsilanti, Michigan
AV Platooning Research

U.S. DOE Office of Energy Efficiency and Renewable Energy (EERE)

FOA: DE-FOA-0001919

AOI 3d: Fuel efficient platooning in mixed traffic highway environments

Award: DE-EE0008470, 3Q2018, $2.4M x 2 years

PI: American Center for Mobility

Partners: University of Michigan-Dearborn
          Auburn University
          Michigan Department of Transportation
          U.S. Army Tank Automotive Research, Development and Engineering Center
          U.S. Department of Energy, National Renewable Energy Laboratory

Function: autonomously control a fleet of vehicles—steering, throttle, brakes

Goal: optimize fuel efficiency, safety and greater roadway vehicle throughput
**ADS Demonstration**

U.S. DOT: Federal Highway Administration  
Project: Automated Driving System Demonstration Grants  
NOFO: 693JJ319NF00001  
Funding: $60M, $10M max/project, $15M max/state, 1-4 years  
Proposal stage

**Team:**  
*Michigan Mobility Collaborative*

**PI:**  
City of Detroit

**Partners:**  
American Center for Mobility  
Mcity & UMTRI, University of Michigan  
Wayne State University  
Ford Smart Mobility, LLC  
Deloitte LLP  
MEDC  
MDOT

**Goals:**  
Safety, Data for Safety Analysis and Rulemaking, Collaboration

**Focus:**  
Significant Public Benefit(s)  
Addressing Market Failure and Other Compelling Public Needs  
Complexity of Technology – SAE Level 3+  
Diversity of Projects  
Transportation-challenged Populations  
Prototypes
Automated Street Sweeper Research

Grantor: Federal Republic of Germany
Brokers: Transatlantic Automated Driving Alliance
         AMZ Saxony & Ann Arbor SPARK
Project: Automated Street Sweeper (proposal)

Funding: €1.1M over 3 years, 50% match

PI: AMZ Saxony (proj. mgmt.)
Partners: ACM (test & validation)
         Dekra (test & validation)
         FAUN (spec, sweeping sys)
         FusionSystems (sensors, auto-drive, controller, mapping, intelligence)
         Mcity (tbd)
         New Eagle (actuation)
         Trillium Secure (cybersecurity)

Goals: Improve ‘Dull, Dirty, Difficult, Dangerous’
Focus: Performance, time, energy efficiency
Four Key Education Needs

**Workforce**
- Professional development
- "NextTraining" for displaced workers
- Veterans Next Training
- Ongoing Training & Certification
- “Boot camp”

**Public & K-12**
- General Public
- Seniors
- STEM Students
- Disabled & Underserved Communities
- Dealers
- First Responders

**Higher Ed**
- Direct hands-on experience for students
- Co-ops, internships, summer jobs, recruitment opportunities

**R&D**
- Collaboration in pre-competitive research
- Joint funding opportunities and research

*The American Center for Mobility | Willow Run, Ypsilanti, Michigan*