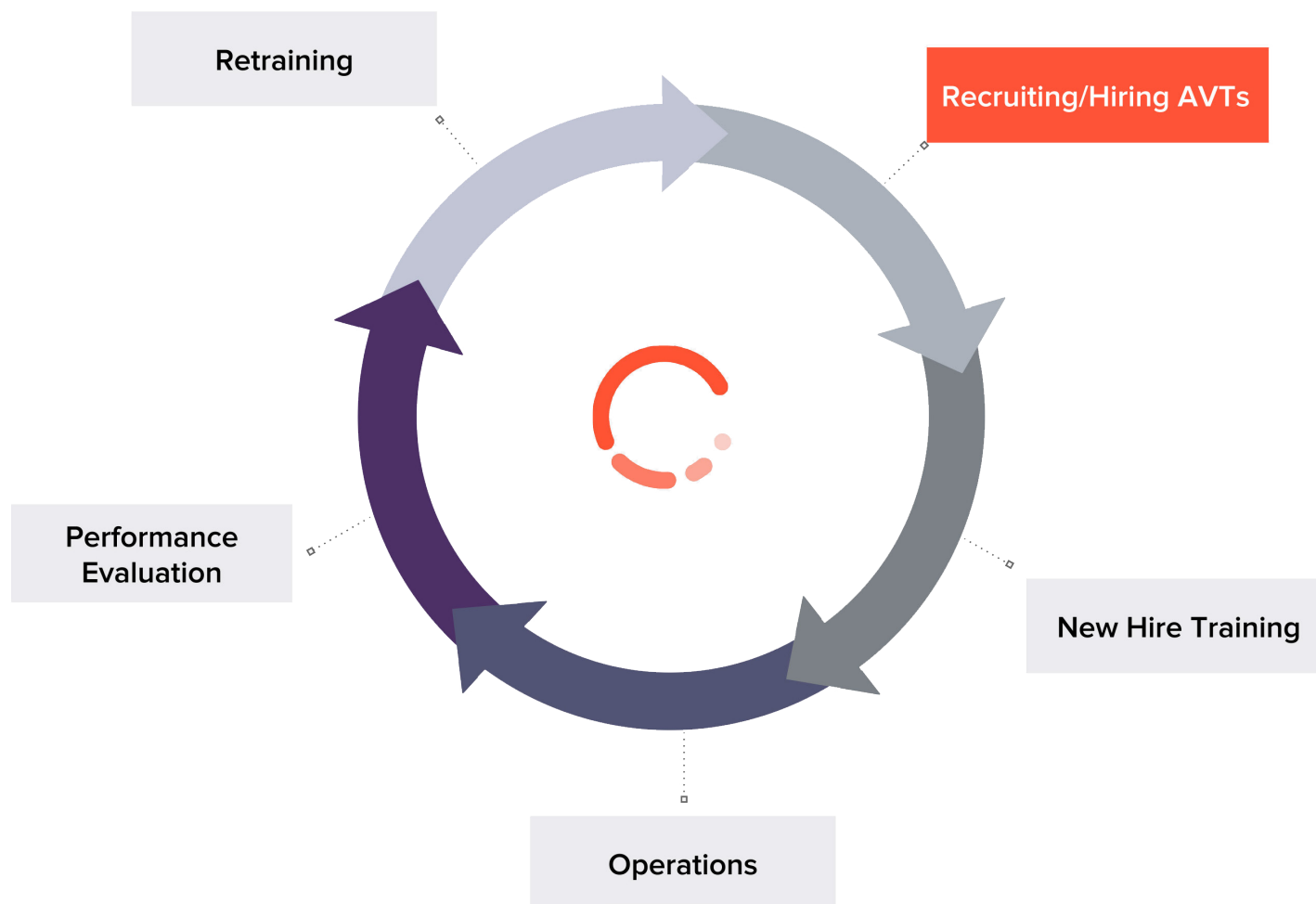**2018 SELF-DRIVING SAFETY REPORT:**

APPENDIX A

On the way to a world with zero car crashes, we continue to learn from the on-road experiences of our self-driving test vehicles. As we move closer to commercialization, more of our test vehicles will be on the roads continuing to gain experience in dense urban environments. Each of our current test vehicles has human driver controls and (i) a human driver known as an Autonomous Vehicle Trainer, or AVT, in the driver's seat; and (ii) an additional support AVT in the front passenger seat. We will operate our self-driving vehicles with AVTs until they are capable of safe, fully driverless operation. We continue to maintain a rigorous focus on safety in the design and development of our self-driving technology and all our operations, including AVT training and operating procedures.

GENERAL MOTORS

TRAINING OUR AVTS: THE HUMANS WHO TRAIN OUR SELF-DRIVING VEHICLES

We use specially trained people to monitor the operation and performance of our self-driving test vehicles. When putting together a training program for our AVTs, we started by analyzing the tasks of monitoring and training our vehicles, then created roles and procedures that support safety in that process. Our specialized AVT training program includes three key elements: our people, our procedures, and our training course. Additionally, the training course includes reinforcement of lessons and updating of training materials as needed. Together, these key elements allow our AVTs to safely monitor our self-driving vehicles as we train the vehicles and collect performance data.

Retraining

Recruiting/Hiring AVTs

Performance Evaluation

New Hire Training

Operations

OUR PEOPLE

For all our personnel, we seek people who share our vision of a world with zero crashes, zero emissions and zero congestion. When recruiting our AVTs, we look for a passion for technology and a genuine interest in autonomous vehicles, then we provide training and evaluation, and we select only people who pass robust driving and written tests. They also must demonstrate the ability to work with other team members, have a high attention to detail and perform with high integrity at all times.

Our AVTs are important eyes and ears for our operations. They help to collect accurate, live data that supports development of the best self-driving vehicle we can create. The additional support AVT in each vehicle is an extra set of eyes and ears to help with monitoring and training.

OUR PROCEDURES

Our first rule, always and everywhere, is safety first.

Our AVTs and support AVTs supervise the performance of the self-driving vehicle during test drives and document performance information. More specifically, their responsibilities include:

Initiating self-driving operation.

Monitoring vehicle operation and taking driving control when our procedures require, as well as any time the AVT decides it is necessary.

Recording observations of driving behavior.

Providing feedback on vehicle performance.

Communicating with our back-office personnel.

Setting routes and waypoints.

Following test-drive schedules.

Once our trained AVT is in the driver's seat and our self-driving vehicle is on the road, the AVT must be always ready to take control of the vehicle. We design all other tasks so as not to divert the AVT's attention from this primary responsibility. All other tasks must either (a) not interfere with the AVT's ability to take over, or (b) be performed by someone or something else.

By implementing these robust procedures, we continue to improve safety. For example, our AVTs have pre-drive and post-drive checklists. When the vehicle is safely stopped, they set destinations and waypoints. The self-driving system is engaged only when all systems and persons in the car are ready and the vehicle can safely enter the flow of traffic. On-road data collection is performed either automatically or by the support AVT. The driver's seat AVTs provide verbal observations and feedback that the support AVTs capture for our developers to review. Support AVTs communicate with our back office if remote assistance is needed. To help our AVTs stay alert, they have mandatory breaks from driving during shifts, and their shifts are limited on a daily basis. We select routes that allow our AVTs to complete test drives within their shifts.

These procedures are covered in our training program, which includes both initial and ongoing training as needed. We also analyze test data to update or create new training modules.

TRAINING OUR PEOPLE

With the AVT tasks defined, we developed training to teach our AVTs how to perform them reliably and safely. The training program progresses through in-class, at car, in-car, private environment and public environment stages. The program begins with a vehicle overview that covers the technology of self-driving operations as well as the capabilities and limitations of the various systems. Throughout the various stages, AVTs also are trained and updated on rules of the road, safe driving, how to engage and supervise the vehicle, how to create useful feedback, and when to take over. We encourage AVTs to take over any time they decide it is necessary.

In addition, our training focuses on five key aspects of defensive driving: knowledge, skill, alertness, foresight and judgment. We reinforce the need for caution, especially in potential interactions with pedestrians and bicyclists. Even when our vehicle is driving itself, our AVTs have two hands on the steering wheel.

On private sites, our AVTs practice driving, reacting and taking over when we stage a situation in which a vehicle system stops operating properly (a practice known as "fault injection").

Our training also includes responding to other potential incidents, such as a flat tire, or another vehicle bumping into our self-driving vehicle. Our AVTs have an in-vehicle binder with procedures for responding to these incidents, and are instructed on how to interact with first responders.

Training and Technology

We use technology to support the goals of our safety-based AVT program in two key ways. First, the technology provides the tools to the AVTs so they can perform their tasks safely. Second, the technology provides data to confirm that our safety-based AVT program is operating as designed.

In the vehicle, our AVTs can monitor the performance of certain in-vehicle systems. For example, a display allows our support AVTs to see other road users and potential road hazards that the self-driving system has identified. If either AVT wants to confirm that the self-driving vehicle has detected a pedestrian in the crosswalk or a bicyclist up the street, the support AVT can view this screen for the confirmation.

We currently have two AVTs in each of our test vehicles. We will continue to have AVTs in our test vehicles until we achieve our safety requirements and are ready to deploy in driverless mode.

Reinforcing Training

We have implemented a process to measure quality and reinforce proper procedures for each AVT task. Our AVTs reinforce safe behavior and perform tasks as a team. We make sure our team members are comfortable with each other, but periodically rotate AVT teams to help ensure consistency and keep our AVTs at their best. We conduct periodic evaluations, audits, and analyses of AVT performance and adherence to training. We continue in-car training and each AVT is enrolled in the state DMV's electronic pull notice (EPN) program, which continuously monitors the integrity of each individual's driving record. Through a combination of procedures, data tracking, observations and reviews, we reinforce all the key aspects that help make our AVT program safe for our AVTs and for other road users.

Updating Training

As we analyze our data, feedback from our AVTs and new experiences, we develop new training. For example, if an AVT took over driving because of anticipated behavior by the self-driving system, we follow an escalation process. We also follow the escalation process to review unsafe actions by other road users, such as a car cutting off our vehicle when our vehicle had the right of way. That escalation process includes high-level analysis of the event and further detailed analysis if warranted. This may lead to development of a software update to improve the self-driving control system and could also lead to new training or procedures for the AVTs. Because the experiences of our AVTs are not static, neither is our training. We have teams dedicated to the AVT program and its safety, and the AVTs themselves are empowered to improve the program. In all, we are proud of what we have created and intend to continue to set the standard for responsible self-driving vehicle development, testing and deployment.