

Purpose:

- To engage youth in an exciting project that purposely blends engineering, science, math and advancing technologies
- To provide schools with an affordable and unique project focused on engineering, science and technology.
- To link excellent teaching and learning practices with increasing corporate demands for skilled, creative and energetic employees.
- To showcase the creative engineering strengths of today's students at the Square One Autonomous Innovative Vehicle Performance Day in May 2016
- To honor innovation through friendly competition

Overview:

- High School students incorporate innovation and creativity into their redesign of a "Power Wheels Jeep" vehicle to create an autonomous vehicle capable of navigation.
- Each team is funded by Square One with corporate partner support. Each team will receive the vehicle and \$1,000 cash grant. Schools are encouraged to utilize vehicles from previous years to engage more students (without add'l funding from \$1).
- Each design team is required to develop a plan to excite 100 younger students about engineering, science, and math around the IVD project in their school (Square One engineering ambassadors) and deliver the project prior to Competition Day.
- Autonomous IVD parameters are developed by Square One.

Corporate Partner Detail:

- Partnering businesses contribute guidance and expertise to the team as in-kind support.
- Corporate coaches can participate if desired to coach students and teachers in the processes of reengineering, electronics, etc.
- Coaches and teachers do NOT build the vehicles, students do.

School Design Team Detail:

- Teams/clubs should consist of at least 10 dedicated high school students, and one dedicated, certified teacher.
- Teams can be comprised of a dedicated class within a curriculum.
- Teams must develop a well-articulated professional plan toward the innovative designs of their vehicle.
- Teams must utilize 10% of their budget to creatively engage 100 middle/elementary students around the engineering lessons involved in their vehicle.
- Teams must have their vehicles complete and ready for 2016 performance day.
- Teams must meet all safety requirements as outlined in the project parameters.

- Appropriate Square One, and corporate sponsor logos must appear on the vehicle. Square One will provide the files to each team. Teams are encouraged to customize the exterior of the vehicle and include school logos.
- Teams must provide a spreadsheet documenting the materials purchased for the project.

Square One Education Network Detail:

Square One will provide:

- All coordination of the project
- Develop the parameters
- Provide necessary insurance policies for performance site
- Align schools with partners as possible
- Supply cash grant to each school upon signing of district commitment papers
- Will provide the starter vehicle for each team

Autonomous Innovative Vehicles

Square One autonomous IVD vehicles begin as pre-assembled, battery powered "Power Wheels" Jeeps. They must meet specific design and safety rules. Each team will begin with the same off-the-shelf vehicle, provided by Square One.

- The original off-the-shelf vehicle can be structurally re-engineered as long as it can be held to the allowable budget for this competition
- The programmable component of this competition is the responsibility of the design team. No "ready to go" device will be supplied.
- Square One will forward a mystery package of v2x technology that should be incorporated into this year's project. Judging parameters for this component will be enclosed.

Vehicle Control

Vehicles must be unmanned and autonomous. They must compete based on their ability to perceive the course environment and avoid obstacles. Vehicles cannot be remotely controlled by a human operator during competition. All computational power, sensing and control equipment should be carried on board the vehicle.

Performance Showcase Challenges for 2015-16

Students are to re-engineer a "Power Wheels" Jeep vehicle into a programmable "Autonomous" vehicle that will successfully meet the performance demands necessary to complete the following challenges:

1. Alpha Task Autonomous Movement:

Ideal: Vehicle starts after a time delay of about 5 seconds, moves 3 meters forward, turns right, moves forward 3 meters and stops.

Minimum Task for partial points: Vehicle Starts and moves forward.

Additional partial points for moving forward combined with turning or stopping.

2. Bravo Task: Autonomous Obstacle Sensitivity

Vehicle should move forward until it senses an obstacle (such as a team member, or judge) and stops. The obstacle will move into the path after movement begins at a distance between 3-10 meters. If no obstacle is sensed the vehicle should run at least 10 meters. Vehicle must complete three course runs for full points.

3. Charlie Task: Navigating Fixed Course

Teams will receive a map and measurements for a fixed maze. The boundaries will be marked out with cones and caution tape, chalk or tape. The path through the maze will be marked with non-continuous magnetic tape. Teams will be allowed up to three attempts to complete the maze. If the maze is not completed only the highest scoring run will be counted. There will be penalties assessed if the vehicle goes outside the course. For maximum points teams can sense the magnetic tape to provide corrections in their preprogrammed route. The tape will be used in a way to identify key points on the track.

4. Delta Task: Fixed Course, Random Obstacles

The course will be generally straight with obstacles (something like 4 meters by 15 meters OR 6 meters by 10 meters). Non-continuous magnetic type will also mark a path through the course. Obstacles on the course may consist of team members, 5-gallon pails, or opaque storage totes (18 or 35 gallon). The placement of the obstacles may be randomized prior to every run. There will be a minimum of 2 meters clearance between the obstacle and the track boundary. Example: if the obstacle is off center on the track there will be at least 2 meters of driving space for the vehicles. For full points the vehicle should reach the designated end with staying in the course boundaries and avoid hitting all boundaries. Three attempts will be allowed. If none of the attempts finish the course, only the highest scoring run will count.

5. Echo Task: Parking Shark

. Teams are challenged to autonomously parallel park their vehicles.. The parking spot will be 1.8 meters by 1.1 meters. The other spots will have vehicles simulated with other jeeps, storage totes or something similar. Vehicle should indicate when it considers itself “parked.” This could be by emitting a sound or some visual signal. For full points teams could park their vehicles autonomously following the same directions as a student driver—the vehicle may pull forward parallel to the designated “parking space”. The vehicle must move in reverse to fit within the chalked out space without hitting the car parked in front of and behind the outlined space.

6. Foxtrot Task: Light Plight

Ignoring traffic signals and signs is the cause of many injury accidents on our roads each year. The team's Autonomous IVD vehicle should demonstrate its awareness and

attentiveness to the rules of the road by responding to the red, yellow and green traffic signals (represented by three different colors of 2-inch duct tape on the road's surface)-
- red: turn right 90 degrees, yellow: turn left 90 degrees, green: go straight. These will be randomized at simulated intersections presented in succession.

7. Hotel Task - Navigation Course

Navigation is a practice that is thousands of years old. It is used on land by hikers and soldiers, on the sea by sailors, and in the air by pilots. Procedures have continuously improved from line-of-sight to moss on trees to dead reckoning to celestial observation to use of the Global Positioning System (GPS).

The challenge in this event is for a vehicle to autonomously travel from a starting point to a number of target destinations (waypoints or landmarks), given only the coordinates of the targets in latitude and longitude. Vehicle should indicate when it considers itself to have reached each point. This could be by emitting a sound or some visual signal. Coordinates for the end-point will be given in decimal degrees format before the start of the task, teams should have some way of entering the coordinates into their control system.

Bonus Task: Platooning

The armed services are at the forefront of autonomous vehicle research and development. The ability to platoon military vehicles into danger zones will save human lives. Teams are challenged to work cooperatively with each other to apply the ability to platoon this year's cadre of Autonomous IVD vehicles. Many teams already have more than one AIVD vehicle in stock from previous years to initiate planning for this challenge. Additionally, teams are encouraged to bring these additional jeeps to participate in this challenge (if applicable). Square One encourages teams to designate a communication specialist to be a part of this potential online or virtual community of Autonomous vehicle specialists.

Project Parameters

- **Design:** Must be a ground vehicle (propelled by direct mechanical contact to the ground such as wheels, tracks, pods, etc).
- **Length:** Maximum length six feet.
- **Width:** Maximum width four feet.
- **Height:** Not to exceed 2 meters (excluding emergency stop).
- **Propulsion:** Vehicle power must be generated onboard. Fuel storage or running of internal combustion engines and fuel cells are not permitted.
- **Speed:** For safety, a maximum vehicle speed of five miles per hour (5 mph) will be enforced. All vehicles must be hardware governed not to exceed this maximum speed. No changes to maximum speed control hardware are allowed.

Showcase Awards:

1. Ambassadorship:

A requirement of the Auto IVD project is for high school teams to share the basics of the technology with which they are working with 100 younger students. This could be through four middle school science classes or several local Girl Scout troops and Cub Scout packs, etc. At least 10% of the cash grant supplied from Square One must be utilized in the ambassadorship component. Teams might make presentations and provide a hands-on project relative to an autonomous vehicle, engage younger students in some aspect of the high school team's project. Imagine that you are trying to "sell" or recruit students on joining this project next year!

2. Presentation

The presentation should tell your story. Relate the highlights of the project with special regard to those that're difficult to assess on competition day (innovation, design, software, ambassadorship). Graphic aids may be presented by video, power point, tabletop display, etc. but are not required (teams should bring their own computer and projector if desired). Teams should provide the judges with a team information document. This should include at a minimum a team roster describing team members participation, information about their vehicle and details on how the budget was used. The presentation must be made by student members of the team (no coaches) and should not be more than 7-10 minutes. After the presentation, judges will spend about five minutes asking questions. Any/all team members are encouraged to answer. Imagine that you are selling this device to your audience!

3. Design/Innovation

Although the ability of the vehicles to negotiate the competition courses is the ultimate measure of product quality, the officials are also interested in the design strategy that teams followed to complete the challenge. Design innovation judging will be conducted separate from and without regard to vehicle performance on the test course. In addition design innovations that never made it onto the vehicle can be presented during the team's presentation for consideration of this award. Design innovation is a primary objective of this competition and will be given special attention by the judges. Innovation is a technology (hardware or software), style element, or design that is unique, out of the ordinary, something used in an unexpected manner or that sets one team's vehicle apart from another. The innovation needs to be noted clearly in the oral presentation.

4. Engineering/Craftsmanship:

Although the ability of the vehicles to negotiate the competition courses is the ultimate measure of product quality, the officials are also interested in the engineering and craftsmanship that teams followed to complete the challenge. Engineering will be

judged by a panel of experts and will be conducted separate from and without regard to vehicle performance on the test course.

Engineering includes construction, safety and appropriate choices ssafety features, such as an emergency stop, electrical safety, and material safety.

5. Vehicle Performance

Scoring levels will be relative to the level of autonomy each vehicle possesses and how many of the tasks it is able to participate in and successfully perform.

6. Square One Award

The team that best represents the “whole package”. While not necessarily the best in each area, they are highly competent in each category and possess an excellent team dynamic that produces a high quality product and successful outcome.

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