

Machine Autonomy: What Is Right For You?

Machine autonomy....what does that mean, and does it apply to your machine? Let's start with the automotive industry, as that market has been driving autonomous technology.

The 5 recognized levels of vehicle automation

There are 5 recognized levels of vehicle automation that have become the standards for the automotive industry. They are as follows:

- **Level 0** – No automation
- **Level 01** – No automation, but the vehicle can assist with providing driver warnings. This is what most current consumer vehicles come equipped with. An example would be a visual or audio alarm for “emergency braking – collision warning”.
- **Level 02** – Partial automation includes more driving assistance such as adaptive cruise control, lane departure steering, and autonomous emergency braking. At this level, the driver continues to remain in control of the vehicle. Most 2020 consumer vehicles are incorporating this level of autonomy.
- **Level 03** – Conditional automation controls primary functions of the vehicle such as steering and braking, but driver intervention may still be required. Under certain hazardous traffic and weather conditions, the driver must take control.
- **Level 04** – High automation requires no assistance from the driver, but driver intervention may still be required. Usually, this level of automation is restricted to specific conditions and geographical areas.
- **Level 05** – Complete automation requires no driver at all. Control elements such as the steering wheel and pedals are not required or needed. The goal is for the vehicle to drive as well, or theoretically, better than a human.

So, how does this apply to off-road vehicles? This same technology and complexity is making its way to the off-road market. This includes machinery in various sectors such as the agricultural market, ground support equipment, construction, terminal tractor market, municipal vehicles, and more.

For the on-road automotive industry, most industry experts agree that going above Level 03 will be too expensive to implement for the general automotive market. They feel that some combination of autonomy along with driver oversight will be the main market driver. We believe that this will be the case for most off-road vehicle markets as well, however, there are other market drivers in certain industries that incentivize additional automation.

For instance, the agricultural sector has a shortage of qualified machine operators, so combined with the ability to work without rest, and the ability to harvest at night could drive some OEMs to target Level 04 (high automation) or even Level 05 (complete automation). We are already seeing this level of automation being introduced into this market space. Examples include automated

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strawberry pickers, and “driverless” tractors being developed by OEM’s such as John Deere . Each market has different market forces that will help determine the appropriate or needed level of automation.

Off-road machine autonomy – what level of automation is right for you?

For most off-road mobile machinery OEMs, a self-driving vehicle is probably not realistic or needed. The market likely will not support the costs associated with this, nor is the market demanding this level of automation. Something that is more realistic and needed; Level 01, Level 02, with certain aspects of Level 03 such as self-braking, that will most likely meet most, if not all, current and future requirements.

One of the first steps in machine autonomy is collision avoidance. Whether that be for a leaf-vac truck working in your neighborhood or the bulldozer in the field across from your office, it is likely that these machines already utilize some type of collision avoidance technology. It could be as simple as utilizing a traditional analog 2D camera with a display mounted in the cab for improved operator machine awareness. Or, it could include more complex systems that utilize ultrasonic sensors, radar, sonar, lidar, 3D time of flight, and/or stereo (using multiple cameras in concert with each other to develop point clouds). All these options do, however, have their pros and cons.

With 2D camera technology, the operator must take their attention away from operating the machine to look at the camera in order to take action. Ultrasonic, radar, and sonar sensors all have relatively short sensing distances, and they can’t predict the path of moving targets that might collide with your vehicle. Lidar sensors and 3D time of flight cameras can be affected by the weather conditions which have to be accounted for with software tools. When using stereo, multiple cameras, the issue becomes installation and implementation costs as well as the complexity of the software required for each individual application. Each of these solutions vary in cost with ultrasonic technology and 2D camera technology being the least expensive to implement. Radar, sonar, lidar and time of flight are more costly, with stereo being the most expensive.

So, what does this mean to you, the off-road machine manufacturer who builds 250 machines a year? In the automotive industry, they have solved these shortcomings by combining multiple technologies onto a vehicle platform. In addition, they have used their economies of scale to drive down the large installation and implementation costs of the more expensive technologies. These same economies of scale that are at work in the automotive industry will help drive down the costs of components to you, the small to mid-sized OEM company.

This is where you have to know your market, and what factors are driving future technologies. How much is the market willing to accept from a cost standpoint? Can you justify the ROI of these investments in maintaining and hopefully increasing market share? Can you develop a whole new market by automating your machinery?

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These very same questions are being asked in the off-road vehicle electrification market, and you can see the investments that are being made there. Off-road machinery automation will continue to grow and adapt as technologies change, become less expensive, and become easier to customize to your machines needs.

Here at Cross Mobile Systems Integration, we have been involved in integrating different levels of machine autonomy for our OEM customers. We continue to develop our own in-house expertise, and expand our external partnerships in order to offer you a complete automated solution. Our strength is in understanding your needs, designing a quality solution, and implementing this solution to differentiate your vehicle in your marketplace. Should you want to explore some of these technologies, and different levels of autonomy, please contact us today.

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