

# Briefing document on autonomous-vehicle powered food delivery

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The scale of autonomous driving is from 0 to 5, with level 0 being a car where a human must be in control all times and level 5 being where the car is equal to or exceeds the performance of a human driver. Autonomous Vehicles are advancing and seeing rapid development as more vehicles are deemed level, which is when a driver is necessary in the car but is not required to monitor the car at all times, and level, which is when the car controls all functions for an entire trip. As cars get to level 4 and 5, the possibilities for their uses also grow. One of those possibilities is autonomous-vehicle powered food delivery. As of August 18, 2018, Kroger has partnered with Nuro, a Silicon Valley robotics and artificial intelligence startup, to launch an autonomous grocery delivery system using Toyota Priuses in Phoenix. The premise of the startup is that the customer pays a flat rate of 6 dollars for either same day or next day grocery delivery. Groceries are then packed into a car from a partnering supermarket and put on the sidewalk, where the customer would come out and pick up the groceries.

San Jose-based AutoX is another similar company, but differs by having customers set a location for delivery or have the cars come directly to them. The food comes directly from farmers and are delivered at no extra cost for now. In both ventures, a human is required in the vehicle but there are future plans to eliminate the need for humans in the car. While the technology is promising, there is limited distribution, as it is only being tested in a few cities, and there is still a need for humans to be in the car. There is more that must be done before it is widespread.

## Predictions

The cone of uncertainty depicts several predictions, three of which in detail below.

1. Grocery stores such as Kroger, Publix, or Walmart will begin to deliver via autonomous vehicles.

Time frame: Short-term

Level of certainty: Plausible

Autonomous delivery robots are already being built, and autonomous vehicles that can carry more items will be created along the same timeline. As seen in Phoenix, Kroger is already beginning testing of the automated vehicles with the help of Nuro. There is a lot of interest in the use of automated vehicles as a means to deliver groceries, and in 5 years it is projected that 70% of people will order their groceries online. As more groceries stores, like Kroger, start to pair with technology-based startups, there will be more competitors in the market, which will increase the investment in autonomous vehicles. Grocery stores are interested in this technology as well, because not only will it improve the companies' environmental footprint, since most of these cars are electric, but it will also decrease delivery costs by as much as 50%.

Despite the large interest in this technology, there are some roadblocks such as regulation, cost, and customer preference. Current testing of this technology has been limited to a single city. As the range of this service's availability increases, there will be a greater need to regulate the technology

across different states, as each state has their own laws for autonomous vehicles. The cost associated with the development and deployment of these cars across the US will be very high because an entirely new system of infrastructure will need to be put in place. Lastly, customers may still have the preference of going to a store to visually inspect and pick what they believe to be the best option from the physical locations.

2. Farmers use the technology to deliver products straight from farm to table, which could lead to fresher food and eliminate the need for preservatives.

Time frame: Mid-term

Level of certainty: Probable

The belief that more people will eat organically from these farms and buy into the idea of getting their food straight from the farms has been seen in recent years. There has been an increase in organic food sales from 6.4% in 2016 to 7.4% in 2018. With the growth of farmer's markets, it is becoming more popular to buy local, fresh food. Farmers will benefit from this because it would cut out the middleman, which could result in savings for the consumer as well. With autonomous delivery, the consumer could order food only when needed, which would decrease the need for preservatives. From a recent survey done by Andrew Zumkehr and Elliot Campbell, it is projected that 90% of Americans could eat food grown within 100 miles of their home, and 80% of people worldwide could be fed with food grown within 50 miles of their home. This proves it is a viable idea that autonomous vehicles could be the conduit to allow the distribution of food for the majority of people.

With shorter distances to travel and less store time, the risk of foodborne illnesses and other issues with keeping food fresh will also be decreased. The roadblocks for this are centered mainly around building the infrastructure to allow this to happen. Creating enough autonomous cars to reach the projection stated above would require enormous amounts of money, so it would be more reasonable for it to be concentrated in much smaller spaces than providing the entire world's produce through this method. There will also be backlash from grocery stores and larger retailers, which might impede progress and would also need a strong network linking farmers to all consumers.

3. Infrastructure expands to have “ autonomous vehicle only” lanes/highways for faster delivery.

Time frame: Long-term

Level of certainty: Possible

As consumers' demand for autonomous vehicles delivering their groceries, there may be enough autonomous vehicles on the roads to cause traffic issues on major highways or other major roads. To alleviate this problem, extra lanes might be added to the highway to ease traffic. Adding extra lanes to highways has been done before with the construction of HOV lanes, with the purpose of allowing only a certain population to use the lanes. These extra lanes would be added so that autonomous vehicles would be apart from regular commuter traffic, which would in turn decrease food delivery time. As previously discussed, there are different levels of autonomy in autonomous vehicles, and only at level 5 do vehicles truly have the

capability of dealing with every problem driving on a highway with other, unpredictable human drivers. If the cars were placed separately, this problem would be avoided and traveling on the highway for the autonomous cars would be much safer and more efficient. The vehicles could be able to communicate with each other through vehicle to vehicle (V2V), which is a system where the vehicles “ talk” to each other constantly. This allows for information, for example a crash over a hill, to be seamlessly transferred from car to car to avoid any extra problems. It can be used to create a network of cars that know exactly what every other car is doing, allowing optimal speeds and formations to improve fuel efficiency while also making travel safer.

A large issue would be creating infrastructure to support this system. In urban areas, widening highways by two to four lanes could cost as much as 2. 6 million dollars per mile. In addition, 28% of major urban roads that are in substandard condition dictate that large amounts of time and money would be needed to create the infrastructure to support this system. It would take years and billions of taxpayer money to create this, and would only have support if autonomous vehicles for food delivery or other services are in high demand.

## **Implications**

### 1. Positive Implications

This technology would have many positive implications. It would streamline the entire process of buying groceries and make it easier for the consumer to get what they want with less effort. This would help grocery stores reach

other consumers that would not normally visit, due to distance or ease. The ability to get anything you want from anywhere without having to put in more effort would allow consumers to get items from places that are considered distant for them. This revolution may give more emphasis on specialty shops as it would be just as easy for one to order from a specialty shop than order a generic branded item from the grocery store. As less customers visit the grocery stores, these stores may turn more into a distribution center, which would increase the stock of the items the consumers want and create more efficient ways to store and deliver items. With all of these changes, people would be the main beneficiaries as less time would be spent doing grocery shopping and more time would be given to either enjoying life or doing something productive. This also expands the reach of the stores to people, such as the elderly or handicapped, who are unable to make weekly trips to get groceries, while also expanding the selection of food to those who do not have easy access to fresh produce. Autonomous vehicles have the potential to give people more time in their lives, while also providing food in an easier and more efficient way.

## 2. Negative Implications

This technology would likely have many negative and unintended consequences. One of these consequences is that without the funding or deep pockets, smaller brick and mortar stores may be phased out as it becomes more inconvenient to go and do shopping in person. This can reduce competitiveness and create a high threshold to be able to compete in the business. In either case, as more stores turn into distribution centers,

there would be less need for employees to do tasks like grocery checkout, so it might lead to either different jobs or the complete elimination of some jobs (cashiers, etc. ). The large increase of vehicles on the road to make all of these deliveries would also increase traffic, which could result in all the time a person saves from not going grocery shopping being spent in traffic trying to do other activities.

Another unintended consequence would be the dependency on autonomous vehicles doing chores for people. People will no longer visit grocery stores to buy food and will be solely reliant on the grocery stores to supply them food through these vehicles. This could put the consumer in a holdup position where the stores could raise prices and availabilities as the consumer will have fewer options. Based off the over reliance on this technology, there is a certain level of uncertainty in its ability to deliver in severe weather storms or other extreme conditions, which could hurt the consumer. In cases of extreme flooding, for example, the sensors of the cars might not be able to function properly and unlike if a human were driving, there may be more potential hazards as the car thinks it knows what it is doing but is actually impaired in some way.