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Automated Trucks Overtake Self-Driving Cars

Background

The trucking industry is suffering from a driver shortage worldwide. The transportation of goods increases every year due to overall consumerism. More than 80,000 drivers were missing in the United States alone during 2021 according to American Trucking Associations (ATA). Why this huge driver shortage? According to Chief Economist Bob Costello at ATA, many factors contribute to the driver shortage, such as low salaries and the fact that drivers do not want to stay away from family and friends for longer periods. There is not a single solution to a single problem, according to Costello; several different aspects need to be addressed, such as increased pay, regulatory changes, and modifications to the transport industry's practices, improving conditions for drivers.

The driver shortage is what the self-driving truck technology companies target. Shippers paid US$791 billion to move goods with trucks in 2019 according to ATA, and self-driving truck technology company Aurora has estimated the automated ride-hailing business in urban scenarios to be worth US$35 billion annually. There is no doubt that, during recent years, venture capitalists have been pouring money into self-driving truck technology companies, which target to sell transport as a service (TaaS) by providing a sensor suite that can be installed in trucks. All truck brands collaborate with these companies to be the first one to launch TaaS. The focus is not on the last mile delivery but on hub-to-hub operation in highway scenarios, which is perceived as an easier environment for self-driving vehicles compared to urban streets.

During the last couple of months, several of the self-driving truck technology companies have been introduced to the stock market, which has generated a welcomed cash flow for the companies in question. The pressure on delivery and balanced financial sheets has become more important than ever. It is truly expensive to put self-driving vehicles on the market. Mass-market deployment of self-driving passenger cars is far into the future according to Aurora's CEO Chris Urmson, but automated long-haulage trucking is within reach (in approximately three to five years).

An interesting question is: What will be the cost for transporting goods with an automated vehicle? The self-driving technology truck companies will offer TaaS, implying that shippers will most likely pay for every mile driven by the automated vehicle. The company Embark has stated that it will provide a system that is 80 cents cheaper per mile to transport with an automated truck compared to a traditionally driven one. The American Transportation Research Institute publishes an annual report called "An Analysis of the Operational Costs of Trucking" [1]. In their latest update, the cost for one mile was determined to be US$1.652 in 2019, and costs associated to the driver were 42%. This would imply that automation would cut the cost per mile by almost 50% according to Embark, even more than only cutting the driver cost. The other costs for operating trucks are fuel, truck/trailer lease or purchase payments, repair and maintenance, insurance premiums, permits and licenses, tires, and tolls.

But cutting by almost 50% would imply that some of the other costs need to be reduced as well. Will TaaS offered by automated trucks really be this cheap? It will certainly operate more hours per day and decrease the time spent by goods on the road between the source and destination, but this will not affect the operational costs associated with driving, such as fuel, insurance, repair and maintenance, tires, and tolls per mile.

Another aspect never mentioned is the types of goods to be transported and how to secure them from theft. An autonomous vehicle driving from place A to place B in a highway environment without any driver will be easy to empty. This is due to the fact that an autonomous

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truck will avoid colliding into any other obstacle on the road ahead. Hence, slowing down an autonomous truck by driving in front of it with another vehicle and forcing it to stop will be easy—and then the trailer can be emptied. This will open the discussion on what type of goods can go into an autonomous truck and how more valuable goods can be secured. This is a question that also needs to be addressed. The transport industry already has problems with theft.

Connectivity

Korea Invests in Dedicated Short-Range Communication Technology

Korea has initiated a road infrastructure project for enhancing road traffic safety along the major road network by introducing dedicated short-range communication (DSRC) [2]. DSRC, which is based on IEEE 802.11p and supports vehicle-to-vehicle (V2V) and vehicle-to-everything (V2X) communication. Roadside units (RSUs) will be installed along major roads supporting road traffic safety and efficiency applications. V2X has been discussed several times throughout past columns, regarding, for example, the reduction of the available spectrum in the United States at 5.9 GHz but also because of new V2X technologies, which has made the automotive market hesitant to select technology. Vehicle manufacturers need stable legal environments because of the long product development cycles (three to five years) and long expected lifetimes of vehicles (~12 years on average).

Honda Increases City Safety

Honda in Japan is investigating the possibility of using 5G technology to warn vulnerable road users (VRUs) in urban scenarios about dangerous situations [3]. Pedestrians will receive notifications on their cell phones when a dangerous situation is about to occur. Vehicles detecting pedestrians through the onboard camera will send an alert directly to the pedestrian using 5G technology but also to the nearby base station. When a vehicle cannot detect a pedestrian because he or she is hidden behind a physical object, other vehicles can inform about the pedestrian if spotted. The system is currently being tested out at Honda's Takasu Proving Ground in Japan.

Collective Perception Saves Lives

A recently finalized research project conducted by the University of Sydney shows promising results for saving lives in urban environments [4]. The project installed RSUs equipped with cameras and lidars detecting VRUs. The information about detected VRUs was communicated by the RSU using DSRC technology at the 5.9-GHz band. The collective perception message protocol currently being standardized in ETSI's Technical Committee Intelligent Transport System Working Group 1 conveyed the information about the VRUs. This application enables vehicles with X-ray functionality in urban scenarios; i.e., information about VRUs blocked by physical objects for both drivers but also for line-of-sight sensors will be visible on the radio horizon.

Automation

Locomation's Autonomous Relay Convoy Decreases Greenhouse Gas Footprint by 22%

An autonomous relay convoy (ARC) is a concept developed and promoted by the self-driving truck technology company Locomation, established in 2018. Locomation takes a slightly different route to reach hub-to-hub operation of autonomous trucks by first revisiting the concept of truck platooning, which they call *ARC*. The first step involves using direct V2V communication between trucks, where both trucks still contain drivers, but the trucks are relying on sensors, such as a radar, lidar, and camera. In the next step, the driver will be removed from the second truck in the two-truck platoon (or the driver will at least not be involved in the driving task); hence, the truck will be operating in Society of Automotive Engineers (SAE) level mode 4 following its leader. Then, after these two steps, hub-to-hub operation with no drivers engaged is envisaged.

Locomation's ARC system shows promise for reducing the greenhouse gas footprint by 22%, operating costs by 19%, and fuel consumption by 21% [5]. These results have been published in their environmental impact report and reviewed by an independent research and analytics firm. Locomation is currently the only company taking the route via truck platooning before hub-to-hub operation of individual autonomous trucks.

EasyMile Authorized to Operate Level 4 Shuttle

EasyMile is the first company in Europe to be authorized to operate an SAE level 4 vehicle without a driver in a mixed-traffic scenario on a public road [6]. The driverless shuttle will take visitors between the parking lot and the entrance of the Oncopole service in Toulouse, France (Figure 1). It will be driven on a 600-m stretch of road shared with pedestrians, bicyclists, cars, and buses. V2X adds mouth and ear to the shuttle, which communicates, for example, with traffic signals in the area.

EasyMile also collaborates with the vehicle manufacturer Industrial Vehicles Corporation (IVECO). Together they have developed an autonomous bus for public transport in urban environments. It has been tested at speeds of up to 70 km/h. To allow for smooth driving and lower the energy consumption, the bus also utilizes V2X communication to receive information from traffic signals. EasyMile's shuttle has also been deployed in Australia, Germany, and Norway.

Autonomous and Electric Hauler

Volvo Autonomous Solutions and Holcim Switzerland have partnered

FIGURE 1 EasyMile's autonomous shuttle.

FIGURE 2 Volvo's autonomous and electrified hauler Tara.

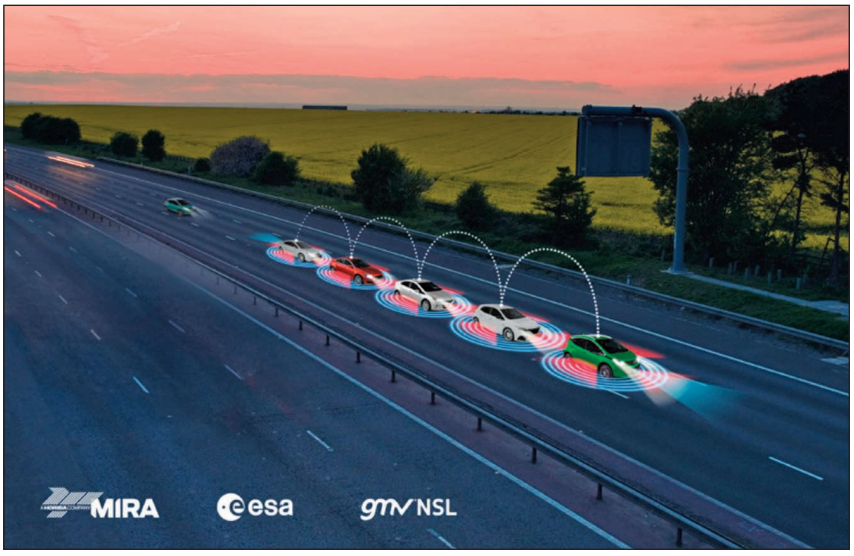

FIGURE 3 U.K. Car Platooning Trial.

to bring autonomous and electrified haulers to confined areas [7]. Holcim produces building materials, such as cement, clinker, concrete, lime, and aggregates. Volvo provides an electrified, connected, and autonomous hauler called *TARA* to be used in one of Holcim's quarries in Switzerland (Figure 2). This will substantially decrease the emissions on the site. Holcim is dedicated to reducing its environmental impact. Since 2019, all of its sites are running on 100% renewable electrical energy. The manufacturing of building material and products accounted for 11% of all CO_2 emissions during 2018 [8]. Producing one ton of concrete generated 72.2 kg of CO_2 emissions in 2019, and concrete is pivotal for the construction industry. The efforts for reducing emissions start in the quarry. Electrifying machinery and using renewable energy will contribute to a substantial CO_2 reduction.

Automation in confined areas is already happening. The operational design domain can be controlled compared to automation on public roads since people can be kept out of the areas where automated vehicles are operating.

Car Platooning Trial

The European Space Agency funds a car platooning project conducted by the U.K.-based automotive engineering consultancy Horiba MIRA and global navigation satellite system specialist GMV NSL (Figure 3). They will move into trials during the first quarter of 2022. The intention with the project is to alleviate projected road traffic congestion in the United Kingdom due to the rapid increase of electric vehicles (EVs) [9]. Internal combustion engine vehicles will be around for many years to come, even though manufacturing of them will decrease and eventually stop within a decade.

The focus of the project is to advance cooperative positioning and exchange of information directly

between the cars in the platoon (i.e., V2V communication). Ensuring data integrity for the car platoon operation is essential and is the focal point of the project.

Autonomous Electric Container Ship

The Norwegian company Yara, specializing in agriculture products, has exchanged transport by trucks to an autonomous electrified container ship [10]. Starting next year, the 80-m-long ship, named *Yara Birkeland*, will travel autonomously between Porsgrunn and Brevik, replacing 14 km of road transport. One thousand tons of CO_2 emissions will be cut by using the ship every year, corresponding to 40,000 road journeys with trucks running on diesel. *Yara Birkeland* can carry 120 containers, and it will load and offload the cargo autonomously. The batteries installed are equivalent to those for 100 Tesla cars.

Gatik Removes Its Driver

The self-driving technology company Gatik focuses on autonomous middle-mile delivery between distribution centers and stores. They have had a partnership with Walmart since 2019. Gatik has removed the driver on a 7.1-mile-long route in Bentonville, Arkansas, where two autonomous Gatik vehicles travel between Walmart's distribution center and a store [11]. The tests without a driver have been ongoing since August. There is a passenger in the vehicle, who could press a stop button, but other than that, the vehicle needs to solve the traffic situation on its own.

TuSimple Close to Remove Its Safety Driver on Public Road

The race is on to be the first one testing autonomous trucks without a safety driver on public roads. TuSimple states that it will test Class 8 truck operation without safety drivers between Phoenix and Arizona in the United States before the end of the year [12]. The route is 80 miles long. If it succeeds, TuSimple will be the first among the self-driving truck technology companies Embark, Kodiak Robotics, and Aurora to reach this major milestone, putting pressure on the others. TuSimple identifies that the availability of components from Tier 1 suppliers is affecting the time plan for launching autonomous trucks.

Tier 1 suppliers are not willing to invest in autonomous technologies if they do not have orders.

Wrap-Up

Automation, connectivity, and electrification are three core technologies that hold major promise to make the world greener. They are utilized across several industries to reach ambitious environmental goals set up by individual companies, industries, or policy making.

Autonomous goods transport using self-driving trucks is receiving by far the most attention (and money) since trucks play a vital role for delivery of goods to people, but automation is also very tractable for the mining and construction industry. The transport sector is responsible for 23% of all CO_2 emissions, and the construction and mining industry for 11%. The introduction of autonomy, connectivity, and electrification in confined areas will go faster than in other scenarios since the environment is controllable with few stakeholders. By contrast, building a charging infrastructure for EVs across a country or continent, for example, requires many more stakeholders, thus slowing down the process.

Given the business prospect for transporting goods autonomously, the interest and the investments are great for the moment for the self-driving technology truck companies compared to initiatives for cars. Platooning for both trucks and cars is once again revisited given its benefit for increasing road safety and efficiency, but also because it is considered as a steppingstone toward SAE level 4 vehicles.

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