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Focus Transitioned to Electrification and Driver Support

Introduction

Public road automation has been a phrase on everybody's lips in the automotive world for more than a decade, but the challenges are misjudged, and the question is: Has public road automation only been a playground for technical nerds rather than addressing real-world pain points? Or have the real-world problems been a subterfuge for playing around with technology? For sure, increased traffic safety is something that needs to be further addressed, but will automation really be the solution to a reduction in fatalities? In December 2015, Elon Musk said that Tesla cars will drive themselves within two years [1], and still there is no self-driving Tesla car. Since then, Elon has repeated this mantra every now and then. Tesla's Full Self-Driving feature has been much debated lately because of safety flaws.

So why is road automation not taking off? I guess this is the million-dollar question, and there are a multitude of intertwined answers, but functional safety is one of the core elements that are still benighted. When is the self-driving vehicle safe enough to be ready for the public road without human intervention of some sort? Is there a business model for public road automation given the cost of developing and equipping road vehicles with self-driving technologies? One main motivator for self-driving vehicles is increased traffic safety; however, research is lacking on how many accidents and incidents drivers are avoided by being human. Given this, how efficient is the self-driving vehicle? Are customers really asking for fully automated vehicles to take them from door to door? How big is this market really? People would like to have support with monotonous driving tasks, and they do not seem overly enthusiastic about door-to-door autonomous journeys in cars.

The major trend for commercial vehicles at IAA Transportation 2022 was electrification, not automation. IAA Transportation is the leading conference on transportation worldwide; it is where heavy-duty vehicle manufacturers, trailer manufacturers, logistics companies, and the whole ecosystem around the transportation of goods and people meet and greet. None of the commercial vehicle manufacturers bragged about automation. The silence around this topic spoke volumes. This column will address that silence and discuss the shift of focus in the automotive world.

Electrification

The transportation industry is on the road toward zero emissions through electrification rather than by addressing, for example, the driver shortage for the transport industry. The driver shortage can partly be addressed by increased salaries, resulting of course in a higher cost for the end customer. People in the European Union travel on average less than 20 km (12.4 mi) per day, and 50% of these trips are performed with passenger cars [2]. There is a huge market for changing fuel-propelled cars to electric ones, but the major change needs to take place inside people's heads. The habit or the preconception that a car needs to have a range of 700–900 km (435–560 mi) must be abandoned, given the general travel patterns from statistics. The range anxiety is imaginary.

Electrification was already a major topic around 1900, especially in the United States, but, mainly because of cultural factors, electrification faded away. The first car traveling faster than 100 km/h (62 mi/h) was electrical, and it was driven by Camille Jenatzy in Belgium in 1899 [3]. At the beginning, fuel-powered cars were started with a hand crank, and this obviously dangerous maneuver was later replaced with an electric start engine originating from the development of electrically powered cars. There is a tall tale that Byron Carter, a friend of Cadillac founder Henry Leland, helped a person to hand crank a

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Cadillac and was so badly injured that he died later from gangrene. Henry did not want this to happen with his cars. In 1912, Cadillac placed the first commercially produced car with an electric start engine on the market; it was called the *Model 30*.

If electrification had survived more than 100 years ago, habits and driving patterns would look different today. The battery technology was of course immature back then, but there were already places where the battery could be swapped in minutes and the electric car could continue its travel. This idea was picked up again by the Israelian entrepreneur Shai Agassi in 2008 when he founded the company Better Place. His two main ideas were to rebuild conventional cars to electrical cars and to provide a network of battery-replacing stations. Shai failed because of unrealistic expectations given the money available; also, the focus was more on promotion than developing solid technical solutions with experienced automotive product developers. Better Place went bankrupt in the beginning of 2013.

Given the latest advancements in battery technology, the range anxiety has been addressed and increasingly more cars have ranges similar to what can be expected with a fuel-driven car. But once again, given the travel statistics, the batteries are in most cases overdimensioned to cater to the few travel excursions per year when people go on longer road trips. Since batteries require scarce minerals, smaller battery capacities and more battery-swapping locations might have been a better option, but the market has decided on a large battery capacity in each car and rapid chargers to mimic the fuel engine car's features.

Using electricity to propel a vehicle is cheaper today than using diesel and petrol, but this will shift as more electrified vehicles enter the market. Governments throughout the world collect a lot of money on fuel taxes, especially in the Nordic countries. This will change, and the price tag for traveling in an electrified car will increase dramatically in the coming years. Taxes pay welfare. A too-rapid shift to electrification of the road transport is not fully cheered on by governments because of the loss in tax income, and they do not want to tax electrified cars too heavily in the beginning to hamper the uptake of electrification. Of course, this is not explicitly stated but implicitly understood. It is a careful balancing act.

Electric cars are heavier compared to conventional petrol cars because of the number of batteries on board (in place to address the imaginary range anxiety). This weight contributes to more road and tire wear, leading to more frequent changes of the rubber tires as well as to more road maintenance, such as replacing asphalt. Safety is also impacted by heavier cars.

Electrification of buses has been around for some time, and in urban environments, amazing figures in the reduction of pollutants and emissions have been reported. The city of Gothenburg in Sweden has 145 electric buses, and during 2020 the following reductions were achieved: health-damaging nitrogen oxides almost halved from 108 tons in 2020 to 58 tons, CO_2 emissions decreased by 10% from 16,500 tons to 14,500 tons, and particulate emissions decreased by 19% from 900 to 730 kg [4]. Buses do not carry the same amount of load as trucks are supposed to; hence, they are easier to electrify. Addressing the range for the long haulage of goods is a hard nut to crack for trucks.

The European Union has decided to ban diesel and petrol cars and vans starting from 2035, to reach CO_2 neutrality in 2050. This is in line with what is happening in the rest of the world. At the same time, the European Commission (EC) is further restricting the emissions for all vehicle categories, regardless of the propelling technology, through a new proposed legislation under the working name *Euro 7* [5]. The new proposal is not only talking about tailpipe emissions; it also regulates emissions from brakes and tires, battery durability, market surveillance of emissions, and so on. There is a fear in the automotive industry that the new legislation will take many resources from the voluntarily ongoing electrification, especially for commercial vehicles. There will be diesel-powered trucks on the roads for the foreseeable future for certain transports where electrification is not possible because of, e.g., heavy weight. Electrification of goods transport is already taking place in urban environments, where the EC wants to reduce pollutants. A better approach would be to mandate the whole world to implement the current European emission legislation, Euro 6, instead. This would have a far greater impact on the environment than further restricting the tailpipe emissions on the last trucks in Europe. Electrification is a success, and the market is self-regulating on this topic. Legislation should support this rather than put up unnecessary barriers.

Autonomous Vehicles

Much research and technical development have been invested to reach Society of Automotive Engineers (SAE) Level 4 for autonomous vehicles on public roads. Early on, the automotive industry wanted to skip SAE Level 3 because of the challenges in the handover of control between vehicle and driver. But as time goes by, more automotive manufacturers are once again revisiting this level, given the difficulties in reaching SAE Level 4 in, for example, a highway scenario. Mercedes-Benz launched its SAE Level 3 system in Germany a year ago. It received a permit to operate up to 70 km/h in dense traffic scenarios on German motorways for their DRIVE PILOT system in S-class cars [6].

Mercedes-Benz is addressing a tedious driving task, namely, low-speed driving in dense traffic scenarios. Who would not fancy such an autonomous system when stuck in a traffic jam? Imagine if you could spend your precious time while commuting working on reading and writing when the traffic speed is low. You could take your eyes off the road. Such a system would reduce frustration among drivers and decrease the number of rear-end accidents due to shockwaves through dense traffic. For high-speed scenarios when the traffic intensity is low, commercial car platoons could be offered when commuting, where the first car contains a professional driver who is the brain, eyes, and ears for the followers. The followers pick up the breadcrumb trail of the leader, allowing the drivers of the follower cars to lean back and do something else.

In November 2022, Mercedes-Benz launched an automated parking service at Stuttgart Airport in Germany [7]. Parking can be a stressful exercise, and this support is welcomed by many people. This is the first commercially available SAE Level 4 feature in the whole world.

The focus for self-driving technologies is shifting to be a support addressing the needs of drivers and not a replacement of drivers. People want to have the freedom to choose when to drive manually and when to have their driving task supported. From a regulatory point of view, there are several tools in the toolbox that have not yet been used in an attempt to reduce accidents. One such tool is to mandate an alcohol lock in all vehicles. It cannot cater to all situations, but it would reduce the number of drunk drivers causing accidents.

In 2021, the self-driving truck technology companies Aurora, TuSimple, and Embark went public on the stock market in the United States. The value of the three companies has completely plummeted since their introduction until today. Aurora and TuSimple are down more than 80%, and Embark has lost a staggering 97% of its value since the initial public offering. Companies dealing with lidar technology have also seen a dramatic decrease in value [8]. The self-driving car technology startup Argo AI was closed at the end of October 2022 by its two major backers, Ford and Volkswagen. Some employees will be offered positions at Ford or Volkswagen, and others will receive a generous severance package. There is no good explanation for why the companies are running downhill because investors knew from the beginning that increasing revenues were not right around the corner. The hype around self-driving vehicles on public roads is coming to an end, and there will be a sober awakening.

The Swedish self-driving truck technology company Einride is still attracting financial support, and in the beginning of December 2022, it secured US$500 million [9]. But it should be noted that it has also diversified its business to include not only self-driving pods but also electrified manually driven trucks offering transport as a service. It has also successfully finalized a public road pilot with its electrified, connected, and autonomous pod for GE appliances in Tennessee (Figure 1). Einride is the first company in U.S. history to receive a permit to operate an autonomous vehicle on public roads without a safety driver [10].

Uber has launched a robotaxi service together with Motional in Las Vegas (Figure 2) [11]. Motional is a joint venture between Hyundai and Aptiv. There are safety drivers still in place in the taxis, but the plan is to remove them during 2023, and there are further plans to expand to more cities in the near future.

FIGURE 1 Einride's pod operated at GE appliances in Tennessee.

Confined Areas

Automation is a completely different story in confined areas. For the moment, electrification and automation are taking place at full speed, especially in the mining and quarrying industry. Confined areas, such as open pits, underground mines, and harbors, have a great potential for increasing productivity by using new technologies and at the same time reducing their environmental impact. The confined area can be controlled in a fashion that will never be possible for public roads. The preceding example of automated parking can also be categorized as a confined area since the access to the parking space can be controlled.

Connectivity

The use of 5G private networks is gaining momentum. 5G private networks imply the usage of 5G technology locally for connecting devices, for example, in a manufacturing plant or a confined area. The major advantages of using private 5G are better

Figure 2 Robotaxi service provided by Motional and Uber in Las Vegas.

quality of service control as well as better privacy and security compared to using the public cellular network. It is also cheaper to add new devices to a private network without involving monthly subscriptions.

In the United States, band 48 (3.55–3.7 GHz), also called the Citizens Broadband Radio Service (CBRS), has been available since 2015 for 4G and 5G private networks. A product certification program has been established by the OnGo Alliance for radio equipment to be used on the CBRS band to facilitate interoperability among different vendors.

The European Conference of Postal and Telecommunications Administrations (CEPT), including 46 European countries, is the overarching organization working on harmonization of the frequency spectrum across Europe. CEPT is larger than the European Union with its 27 member states. The EC has tasked CEPT to study the possibility of harmonizing the 3.8–4.2 GHz band across Europe for 5G private networks. The work in CEPT has been ongoing for a year and will be finalized in the fourth quarter of 2023. The United Kingdom and Norway have already opened the possibility for 5G private networks in the 3.8–4.2 GHz band. Germany and Sweden provide access to 3.7–3.8 GHz, and The Netherlands is allowing private networks in 3.4–3.45 GHz and 3.75–3.8 GHz. France is currently allowing 2.56–2.62 GHz.

The new spectrum regime for 5G private networks, where property owners for a small fee every year can use the licensed spectrum and increased output power compared to an unlicensed spectrum, is an advantage compared to using, for example, Wi-Fi on an unlicensed spectrum.

Wrap-Up

There is a major shift from automation to electrification among heavy-duty vehicle manufacturers, given the much longer time frame for bringing self-driving trucks to public roads for hub-to-hub operation than anticipated. I have discussed in earlier columns about how the passenger car industry was overtaken by the heavy-duty vehicle industry on automation at large on public roads a couple of years ago, and now this industry also faces challenges. The passenger car industry is focusing on providing support for drivers rather than removing the driver, and Mercedes-Benz is leading pioneering work in this field through their highway pilot in speeds below 70 km/h and the automated parking service. They are addressing real-world pain points. Robotaxi services are relentlessly being pursued among different actors in the United States.

The new spectrum regime for operating 5G private networks will be a major facilitator for automation in confined areas.

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