VOLVO AUTONOMOUS SOLUTIONS

JANUARY, 2023

“What are the challenges that exist and could arise when introducing autonomous vehicles in a real transport environment?"

Benjamin Vuoristo
Daniel Johansson
Lovisa Fredriksson
Ludvig Öhrnell
Tina Karlsson

TABLE OF CONTENT

GREETING

We would like to thank our commissioners at Volvo Autonomous Solutions for valuable advice and helpful guidance throughout this project. We would also like to express our appreciations to the interviewees who provided us with useful insights for the report.

EXECUTIVE SUMMARY

When talking about the digitization of cars, the subject of autonomous vehicles cannot be avoided. Today, there is great uncertainty in society about how autonomous vehicles can operate safely on public roads. On one hand, there is uncertainty about how the system works in connection with people and in different weather conditions, and on another hand a fear of job loss and cyber security breaches. Looking into the future, it seems that autonomous vehicles will provide solutions to known problems in the transport industry, such as the driver shortage and safety. However, the path to adoption presents challenges. This report is investigating what challenges that exist and could arise when introducing autonomous vehicles in a real transport environment. We identified three categories of challenges – strategic, technical and regulational.

The digital infrastructure must function to allow communication between autonomous vehicles and the physical infrastructure. Thus, it makes the transportation environment vulnerable as it relies on the 5G network and energy supply in general. The demand for materials and goods to be shipped across the country is increasing. However, there are concerns of job displacement, increased dependency on supply chains, and barriers such as cost and infrastructure requirements. The implementation of autonomous trucks can be beneficial in this scenario but need to consider the related concerns to be successful.

Recurring questions related to the technical aspects that continuously are in debate of AVs are both widespread and complex. It is not clear whether the technology is ready and on standby, or if it's just not mature enough to be implemented in a real-world transport environment. At present, the technology develops independently of the legislation, but sooner or later a shift is required where the technology instead follows the law. Thus, regulation will only be added when autonomous vehicles have been implemented on the market. This can prevent the technology in certain aspects. If the technology cannot be regulated according to the proposed legislation, it might create challenges that need to be addressed when the technology is available.

Regulatory factors have not kept pace with recent technological advancements, resulting in limited perspectives, and the potential for innovation to move outside the country. The importance of cooperation and interaction between different actors is emphasized in the context of globalization.

Keywords: digitization, autonomous vehicles, strategy, technical, regulations, real transport environment.

METHOD

The content of this report is based on facts and statistics from various types of authorities, scientific articles and articles focused on autonomous vehicles. Also based on interviews that took place in connection with the work. The people interviewed all have different types of backgrounds where several perspectives are highlighted. Visualizations in this report are both taken from web-based sources, but some are also visualized by the use of Volvo Annual Reports.

INTRODUCTION AND BACKGROUND

The first automobile was invented in the late 19th century. It was just a car with an engine, but with no steering wheel or brakes. Instead it was controlled by the driver's foot. The transformation from a conventional vehicle to self-driving, whether it's a car or an airplane, it is much more problematic than to "just implement it". The first step of this transformation was to move the vehicle by a remote controller. Since that step, computer advances have made it possible to transform analog, manually driven vehicles into fully automated self driving vehicles. Such driverless cars and trucks are still a relatively novel part of society, from a transportation standpoint. In fact, in many countries there are still laws that completely prohibit the use of these driverless vehicles. Thus, these regulations have caused a problematic situation, where the technology is on standby and can not be used at its full potential.

The increase in digitization means that society and organizations can develop faster. From a historical perspective, it is more efficient. In the automotive industry, the term digitization is used to describe all changes within an organization and in traditional business models, which is the result of increased use of digital solutions (Gray & Rumpe, 2015). With the help from digitization, production industries such as the automotive industry can evolve into more digital organizations by implementing services and creating additional value for consumers. Organizations that have dominated the market face new players that have adopted a digital approach to meet consumer needs (Rachinger et al., 2018).

The National Counterintelligence and Security Center (NCSC) gave outreach initiatives in five crucial areas of the technology sector priority in October 2021, where the autonomous vehicles (AVs) market was one of them. Although the AV market is still in its infancy, it is according to NCSC anticipated to grow to a value of $61.9 billion by the middle of the 2020s. The LIDAR sensors and the integration of 5G assisted AI-processing capacity for driver assistance software, are two crucial advanced components whose cheapening is the driving force behind this increase. The largest market today is in North America, however by 2026, market share is predicted to rise most rapidly in Asia.

When talking about the digitization of cars, the subject of autonomous vehicles cannot be avoided. An autonomous vehicle possesses the self-sensing capability to navigate safely with little or no human intervention. To map how the automotive industry is moving from fully manual cars to fully automated, Society of Automotive Engineers (SAE) define different levels.

The different degrees of automated driving are rated on a scale from 0 to 5. However, there are many gray areas where features might overlap. As the driver is still very much involved in the operation of the vehicle, Levels 0–2 are known as "driver support features" while Levels 3-5 incorporate variable degrees of "automated driving features". Level 0 signifies when a car is fully manual. However, this level is not referred to as manual and automatic gear levers.

Different solutions will be required depending on the degree of automation sought and how complex the situation is where the transport solution is to be used.

- Driver only (level 0): The driver drives the vehicle completely manually, all the time.
- With driver support (level 1): Automation of individual functions. The driver has full control but can remove his feet from the pedals, for example when using the cruise control.
- Partial Automation (level 2): Automation of multiple functions. The driver is in full control and can take their feet off the pedals and hands off the steering wheel but must keep their eyes on the road.
- Conditional Automation (level 3): Automation of multiple functions. Acting on direct call, the driver can take their feet off the pedals, hands off the steering wheel and eyes off the road but must be able to regain control quickly.
- High automation (level 4): Self-driving under certain circumstances. The driver is not expected to monitor the road and has no responsibility in automated mode.
- Full automation (level 5): Self-driving, whatever the situation. The driver has no responsibility while driving.

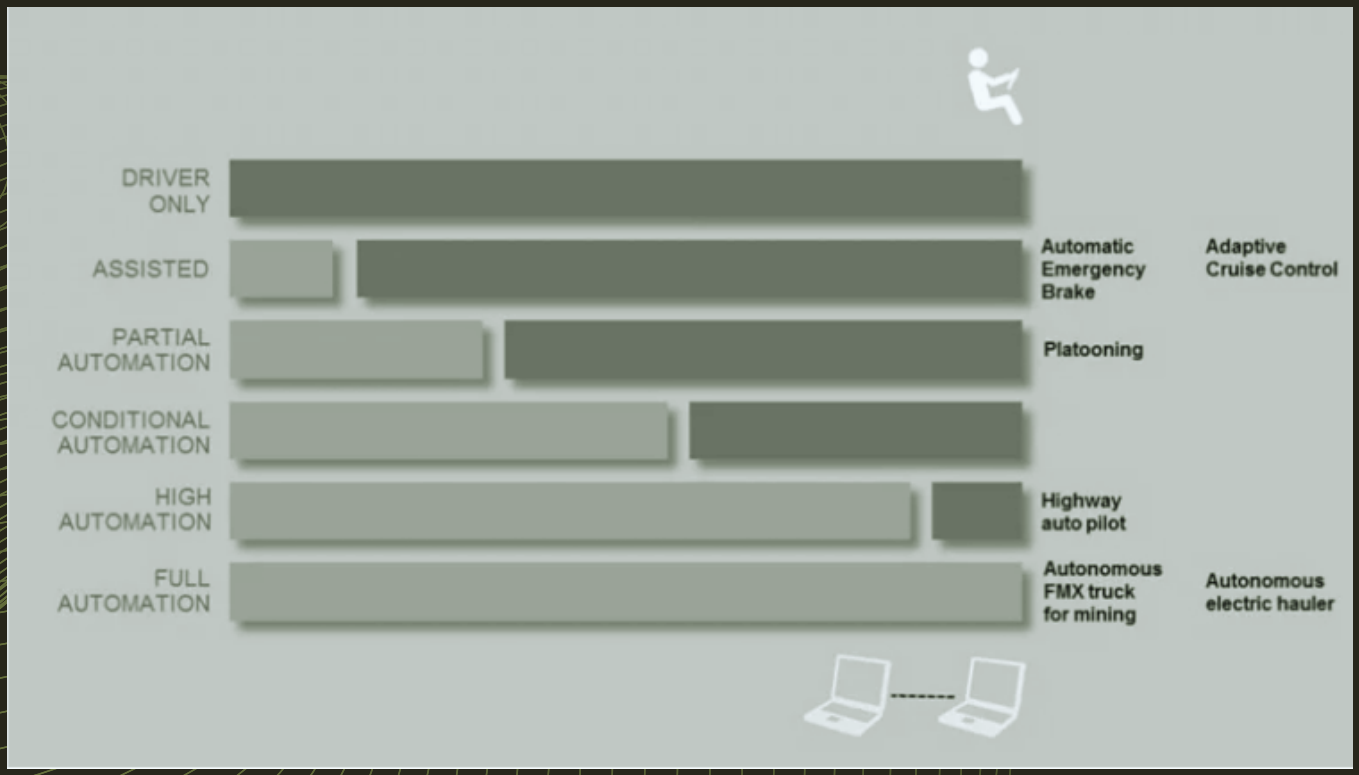


Image source: https://www.volvogroup.com/en/future-of-transportation/innovation/automation.html

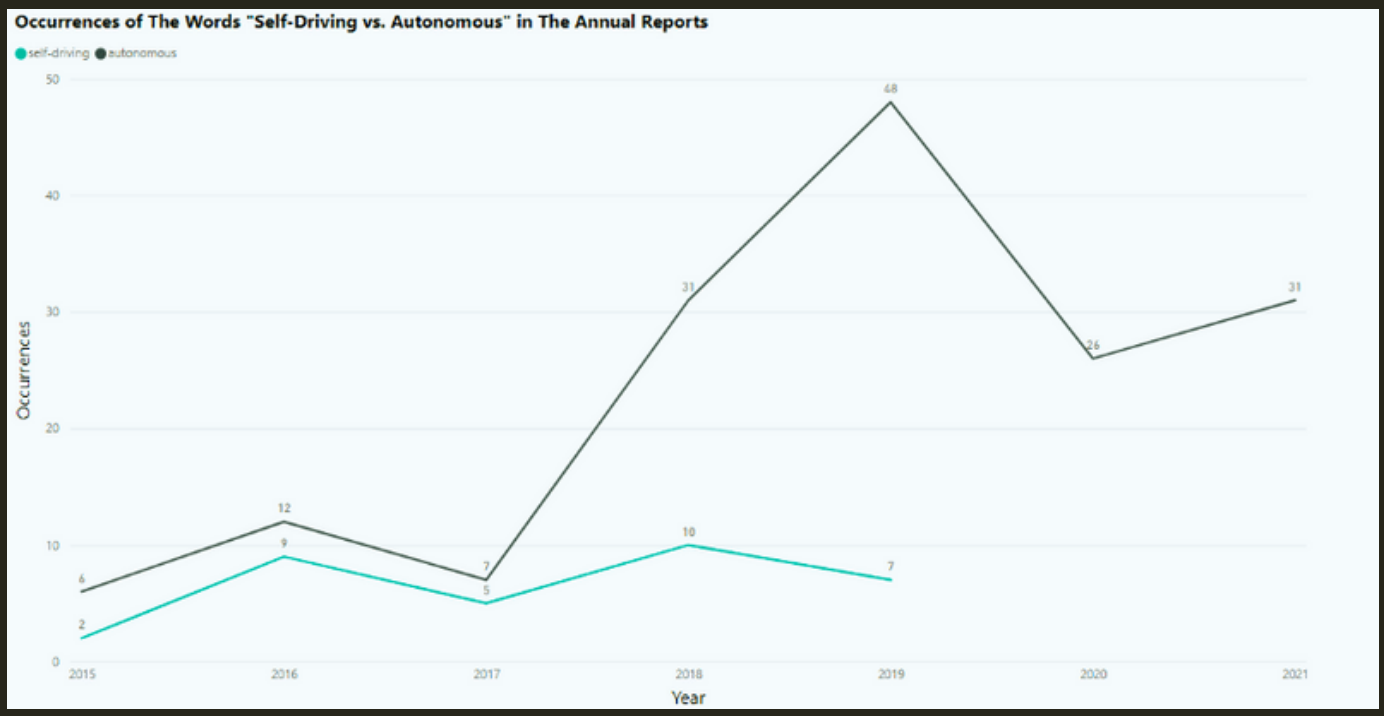
2015 was the year when autonomous was mentioned for the first time in Volvo's annual reports, since then, great development has taken place and the use of the word has increased frequently. In 2016, Volvo took an important step in development and began testing self-driving vehicles in Boliden's mine in Kristineberg. This started a process to ensure that the technology works in real conditions. The year after, the next step is mentioned as being able to use autonomous vehicles in partially demarcated areas with a slightly more complex environment. In 2018, what the report describes as "groundbreaking innovation for future autonomous and electric transport solutions" was presented with the new Vera transport system. Global development is moving towards a growing demand of transport, at the same time many roads are already heavily trafficked, which also includes major environmental challenges. Thus, the industry needs to contribute with more safe, efficient and sustainable alternatives for the future. In response to the challenge, in 2019, the next major step in development was introduced by forming Volvo Autonomous Solutions (VAS), a new business area, which was later established on January 1, 2020. VAS develops and commercializes industrial, autonomous transport solutions to improve both productivity and safety, but also to reduce emissions.

VAS plays an important role in the work to constantly improve in terms of sustainability and thereby, among other things, reduce the environmental footprint. Volvo is considered convincing that electrified and autonomous vehicles are part of the solution to creating a more sustainable society, which also promotes higher safety and is more productive. 2021, development continues at an increasing rate. Volvo begins collaboration with Aurora to accelerate the development of autonomous transport solutions.

In 2021, expected change factors to 2030 are also mentioned, including that autonomous solutions have the potential to provide radical increased efficiency, that digitization and connectivity enable optimization and that sustainability equals profitability. Thus, the development meets current requirements and trends. If misjudgments occur, are discovered too late or cannot be adapted to market, legal requirements, or other types of changes, it can have a significant negative impact on results and financial position. Thus it is very important to consider societal changes and to be responsive to customers' needs.

While analyzing annual reports from Volvo by the occurrence of specific words, it is clear that autonomous vehicles are being discussed more and more frequently throughout the reports. We can also see that the word “self-driving” has been replaced by “autonomous” in the last couple of years.

Until 2017 both words show up about the same number of times, but from 2018 “self-driving” is phased out while “autonomous” shows up much more frequently. This could indicate a caution when communicating, to not create misunderstandings about what “self-driving” actually means. When instead talking about “autonomous” vehicles it gives a wider spectrum, including more of the different levels of automation (SAE). Despite the rise of the word “autonomous”, “cybersecurity” does not quite catch up in terms of occurrences, which might be worrying since it is high of interest in this sector.



THE THREE PILLARS

Looking into the future, it seems that autonomous vehicles will provide solutions to known problems in the transport industry, such as the driver shortage and safety. However, the path to adoption presents challenges. This report is investigating what challenges that exist and could arise when introducing autonomous vehicles in a real transport environment. We identified three categories of challenges – strategic, technical and regulational. Each category is affecting the implementation of AVs in a real transport environment. Through these three categories we find that social acceptance is an important element for successful development of autonomous vehicles.

Today there is great uncertainty in society about how autonomous vehicles can operate safely on public roads. On one hand, there is uncertainty about how the system works in connection with people and in different weather conditions, and on another hand a fear of job loss and cyber security breaches. We define acceptance as acceptance of the technology at an individual and societal level. Thus, to reach a level of approval, the technology must be considered an approved incentive. Stakeholders can define acceptances in different ways, which means that distinctions between different stages in the implementation process must be taken into account.

Acceptance occurs in the interaction of subject, object and context. Briefly explained, this means not only what is accepted, but also by whom, in which areas, in which situations or for what reason. Acceptance-subject refers to what attitudes exist or develop and their actions connected to the object. This includes individuals, groups and the society in whole. The acceptance object does not only mean the product itself but refers to what is offered. This includes, among other things, what functions autonomous driving can offer and what significance the technology has for people in society. When these two components interact in relation to each other, we can then look at acceptance context, which refers to the environment they relate to (Fraedrich & Lenz , 2016).

In this context, the question is thus asked whether autonomous driving fits into society or whether change will be required?

STRATEGY

Volvo Group's mission is to contribute to increased prosperity with transport and infrastructure solutions, which could, in the long run, contribute to Volvo Group's vision of becoming the world's most sought-after and successful supplier of transport and infrastructure solutions. Strategy helps to define the business, gives it a set of values and gives it purpose. Volvo Group's commitment to development without exceeding the planet's limits includes all 17 UN Sustainable Development Goals. The UN's Sustainable Development Goals were established in 2015 and voted through in the General Assembly of all member states and therefore often called a common global agenda for 2030. This global agenda for 2030 affects the technological and regulatory development and expectations from customers, investors, employees and other stakeholders where the company operates. When developing and setting goals for the future, it is important to try to discover what strategic challenges that might arise.

"Transform the Volvo Group to become a leading end-to-end integrator as well as offering easy to integrate products and services through strong brands".

This is on top of the list of priorities when it comes to Volvo Group's strategy. This goes hand in hand with Volvo Autonomous Solutions strategic industry segment, which is to offer "a seamless and scalable package with everything your business needs to transition to autonomy". The strategic challenges could be how to make the autonomous solution scalable by preparing for the outside world.

ENERGY AND INFRASTRUCTURE

When it comes to implementation of AVs in transport environments, the importance of a well developed and reliable 5G network is inevitable. Communication networks play a vital role in solving evolving challenges. Deploying 5G is essential for the current development and control of autonomous vehicles. The digital infrastructure must function so that vehicles can communicate with the physical infrastructure, such as light signals and road signs as well as with each other. The use of advanced software that communicates with other vehicles and also allows the vehicle to be controlled remotely therefore make the 5G network a very important building block. This makes the AV transport environment very vulnerable because of its reliance on the 5G network. If it is not working for some reason, due to weather conditions or other disturbances, the system around the AV could be disrupted. Also, the energy supply in general could become a problem since more and more vehicles are electrified. Electrification of vehicles is in line with the UN sustainability goals, but also dependent on the energy resources available. According to a senior expert in microsystems, currently working on a project with focus on developing technology for future mobility, the technology and the infrastructure has to adapt to the energy resources that are available, and not the other way around.

When a supply chain is disrupted, it could cause hindrance to further progress. Disruptions halt the delivery process, often starting a chain reaction that cascades all the way down to the customer. Cybersecurity, financial viability, geopolitics, natural disasters, and compliance are typical categories for these kinds of problems. The AV industry is dependent on cheap semiconductor chips to function. A typical AV has more than 3500 semiconductors installed, whereby a global supply chain disruption could cause a lot of inconvenience. If a country like China would take strategic actions to inhibit the supply of critical equipment to other countries, it could affect the manufacturers and create a risk of delay.

BUSINESS AND ECONOMICS

One barrier for AV adoption has been the cost and the infrastructure required to support it. While the price of AVs has been decreasing every year, they are still more expensive than non-automated vehicles (Ryan, 2019). It has also been expensive to implement policies to accommodate AVs, so the development of AVs has largely been adopted by wealthier countries. In many of the world's poorer nations, they have mostly gone untested, which is turning out to be a major problem in international AV and social justice circles.

Concerns about the job situation is another key barrier to AV adoption and the distress of displacing people reliant on driving as a job have grown in recent years. Many organized labor groups and trade unions have protested against replacement of workers in the transport industry. A researcher and juristical expert mentions a concern about educational changes among the younger generation regarding how the transport industry will change. As many do not see a future as, e.g, truck drivers, they instead choose to look elsewhere for their education. This has caused a great shortage of workers in that occupational category. Another aspect of the shortage could be that the work involves inconvenient and irregular hours and risks. The transport industry is one of the most accident-prone industries in Sweden. According to statistics from the Swedish Work Environment Authority , 66 truck drivers died at work in the last 10 years. This has happened in connection with traffic accidents where drivers lose control of the vehicle or are hit, but also in connection with unloading and loading. As the world is growing at a rapid pace, the demand for materials and goods to be shipped across the country is increasing.

In summary, the introduction of autonomous trucks is likely to create a range of new professions and opportunities within the transport industry. While it is difficult to predict what these professions will look like, it is clear that there will be a need for a diverse range of skills, including technical expertise, analytical thinking, and an understanding of data and cybersecurity.

TECHINCAL

Recurring questions related to the technical aspects that continuously are in debate of AVs are both widespread and complex. When looking at the questions further, and analyzing what experts have to say about the technical perspective, there are answers that are contradictory. It is not clear whether the technology is ready and on standby, or if it's just not mature enough to be implemented in a real-world transport environment.

One juristical expert, with a background in law, claims that the technology is not quite ready, and that the domain is more important for the development of these vehicles. Thus, the expert states that the environment around the AVs, the domain, is far more complex and important because of how the vehicles interact with one another. Also by how they could, possibly, interact with technical-geological aspects, such as geofencing. For the technology to become more mature and to become more readily available and functional, the expert claims that the solution is a testing environment called "*Policy Lab*". However, laws and regulations stand in the way of making this an effective way of testing AVs. This further moves the innovative industry outside of Sweden, to countries where the testing environment is more liberal e.g, USA. This migration of technology, and innovation means that while other countries can quite literally, "play around with the tech" and test trucks effectively, companies in Sweden are held back by complex and lengthy legal processes.

PLATOONING

Furthermore, whenever these vehicles of higher autonomous level (SAE) start to appear on civil roads, the question is asked – whether they can communicate in a smooth, seamless and safe way? One answer could be Platooning, which in essence means that multiple driverless vehicles "communicate" with each other, and in a way drive together, even if they are not necessarily doing it. The same juristical expert offers two different ways of platooning, either cloud-based, or by occasionally placed road stations, but also mentions that no-one actively drives platooning, which states a concern, although this could be done through the UN. In this day-and-age, where this technology is developed, we see increased interest in doing a "infrastructural transformation" eco-consciously, which platooning in some way would contribute to. By using platooning, vehicles drive very close to each other using digital control systems, which would reduce air resistance, but also reduce energy consumption. This in turn would lead to a decrease in carbon dioxide emissions and increase transport efficiency.

PROPIETARY SYSTEMS

Another crucial technical aspect that is not as widely discussed is proprietary systems. Since the technology being developed is still rather novel, everyone wants to be first, everyone wants to break the barrier and win the most market shares possible. For instance, it means that every company develops their own proprietary systems, which will make it significantly harder for AVs to develop connections between one another, e.g, platooning. In another perspective, it is important that there is competition in the market. This is what drives innovation and new thinking, but we must remember that how we shape these massive systems now, will most likely affect the way these vehicles will connect and communicate with each other in the future.

CYBER SECURITY AND GEO-TECHNICAL ASPECTS

Yet another significant challenge of this new infrastructure is security, or more specifically cybersecurity. It will be crucial to ensure that data is protected from cyber threats and that it is used in a responsible and ethical manner. Thus, the importance of professionals with expertise in cybersecurity and data privacy is becoming more vital. By analyzing the environment, every single road-line, car and truck passing by, the chips designed for these AVs will interact with colossal amounts of data which possibly could lead to faulty decisions by the AI. Faulty decisions might be minor flaws, like crossing the line on an empty highway at midnight, but it might as well be more significant flaws like losing control, or faulty detection of red lights or pedestrian crossings. This is where geofencing might be a solution. Geofencing can regulate factors on the road, such as speed in specific, geological areas, which the AVs system comprehends. This is another example of where the technology is not necessarily in the AVs systems, but in the domain. Despite its many useful features that geofencing could contribute to, e.g, slow-zones in school areas, there is also a question of control. Would it be socially acceptable for the car to take control, to not speed, even when one is late for an important appointment? Instinctively many would probably say no, which leaves room for improvement and discussion. Should fencing zones be implemented, if yes, should one still be able to bypass them, in what sense should they be implemented, every other highway or everywhere?

ELECTRIFICATION

When looking at the top competitors in the AV industry, including both cars and trucks, it is generally expected that AVs are electrical, despite Volvo having electric autonomous trucks, usually driven on short distances, e.g, in mines, where the battery will not have time to drain as much as for longer rides. As stated, companies are undergoing an eco-conscious transformation, but for this transformation to be converted into trucks, the domain needs to be invested in. Even if electrical autonomous trucks were to be implemented in five, or even ten years, their use of potential would be minimal, as long as there are no chargers readily available. Even if AVs of higher levels are implemented, trucks might not be able to take the same routes as usual.

It could be small roads with minimal road signs, which in essence mean that they would need to re-route, which could mean longer routes, leading to greater increase of carbon emissions. Furthermore, with the increasing reliance on data and analytics in the trucking industry, there will likely be a need for individuals who are skilled in extracting insights and trends from large datasets. These professionals could help optimize routes, predict maintenance needs, and identify opportunities for cost savings.

SAFETY AND ACCEPTANCE

The safety of autonomous vehicles is the most primary aspect in terms of social acceptance. The rationale behind this is that people do not trust the technology in its early stages and especially not if it will affect their own safety. Generally, people prefer to wait until the technology is fully mature before accepting it, which can take up to several years. To understand how technology changes and affects people, other social technological achievements can be analyzed to see how society has adapted to change. Thus, one can gain insight into which factors contributed to acceptance. Society has higher demands on a technical driving system than on people in general. This means that the technology must demonstrate high security to reach acceptance. This means not only that autonomous vehicles should prove to be safer than human driving but work towards achieving zero vision. When autonomous vehicles are involved in accidents, legitimacy is drastically reduced and creates a bigger uphill climb to reach potential acceptance, at the same time, withholding information about accidents can be just as harmful. To reach acceptance, testing processes require transparency where companies communicate clearly with customers.

REGULATIONS

It is unclear how the regulations for fully autonomous vehicles will look like if allowed on public roads. There are countries that are significantly further in the process of regulations compared to Sweden. According to experts, there are many aspects that might explain the reason for this.

ROAD TO REGULATORY CHANGE

As early as 2015, the Swedish government started the investigation (dir. 2015:114) to identify what regulatory changes that are needed for the introduction of driver support technology and fully, or partially self-driving vehicles on the roads. In 2017, Ordinance (2017:309) on experimental activities with automated vehicles was promulgated for developing testing environments. The same year, The Swedish Transport Agency approved the first experimental operations on public roads for AVs in Sweden. With this approval it seemed that Sweden would be one of the countries to lead the way towards the driverless society. Several years have passed since, and a regulatory framework for autonomous vehicles has not yet been established, despite the goal from the government to enable fully automated vehicles, level 4-5, on public roads by 2023.

A juristical expert, states that regulations are the main reason why AVs are not operating on public roads. There are clear regulations of what is required of vehicle manufacturers in order to be allowed to launch manual vehicles on the market, however, there are no direct regulations for AVs, which creates difficulties for vehicle manufacturers to know what should be included. Another legal expert, gives a different approach to the challenge.

The expert claims that the main reason is regarding ODD (Operational Driving Domain), i.e, what environment the vehicle operates in, which sets the guidelines for what the vehicle should be able to manage. Historically, it is the vehicle manufacturer who sets the guidelines for what the vehicle is intended for, and the driver itself is trained to handle the different environments. However, with AVs, the responsibility falls on the manufacturer of what conditions the vehicle must be able to cope with. As mentioned earlier, this leads to companies building different systems for their vehicles. The expert means that this could be a challenge when customers wish to purchase heavy autonomous vehicles (HAVs) from multiple companies. This could lead to customers having vehicles that are not able to manage the same environmental conditions, which makes it difficult for the vehicles to cooperate efficiently.

"Does the legislation follow the development of the technology or the technology the legislation?"

It is difficult to see what the regulation will look like in the future as technology develops independently of the legislation. Thus, regulation will only be added when autonomous vehicles have been implemented on the market. This can prevent the technology in certain aspects if they cannot be regulated according to the proposed legislation, which later might create challenges that need to be addressed when the technology is available. At present, the laws follow the technology, but sooner or later a shift is required where the technology instead follows the law. Another juristical expert, raises another point of view, "beg for forgiveness or ask for permission". Meaning that one can either ask for permission to launch, or proceed launching new technology without asking for permission and later on apologizing and facing the consequences. When it comes to the automotive industry, actors usually choose to ask for permission. However, this might include risk of rejection which could be costly and time consuming.

REGULATORY CHANGE IN OTHER COUNTRIES

Several countries, e.g parts of the US and Germany, have been given permission to test HAVs on public roads to a greater extent than in Sweden. The permissions of performing extensive testing on public roads in Sweden is still very limited. In fenced, controlled and more restrictive areas the nature of testing is more liberal due to higher safety in these areas. Furthermore the expert claims that the country that is taking the lead in terms of AV regulation is Germany. In 2021, Germany introduced new definitions in their legislation, which enabled them to become the first country in the world to have regulations supporting AV level 4 on public, but predetermined routes. The juristical expert claims that this does not come as a surprise, since the automotive industry is large and has strong lobbying activities.

CHALLENGES WITH REGULATORY CHANGE

As stated before, geofencing is currently a well researched topic with many possible areas of use, but at the same time, the vast amount of use cases could also create challenges. From a regulatory perspective, public authorities could require companies to “geofence” their vehicles in order to participate in public procurement. The juristical expert claims that, if an authority, such as The Swedish Transport Agency, purchases a lot of transport it could affect businesses that do not geofence their vehicles. This could mean that businesses are not allowed to participate in tenders. Furthermore, it can lead to large costs for businesses that have to adopt and maintain the technology, while also having to share data.

The issue of liability is a recurring aspect when talking about autonomous vehicles. Who is responsible when accidents occur with autonomous vehicles? Through interviews with experts with legal backgrounds, it is revealed that this could be a challenge in the future. One of the juristical experts illustrated responsibility from different "decision loops".

- Inside the decision loop - the person has full control over the technology and thus becomes fully responsible.
- Outside the decision loop - passengers in autonomous vehicles who do not have control of the vehicle and thus are not responsible in the event of an error
- Above the decision loop - human monitoring where data needs approval in certain types of choices, where the human becomes responsible if the error is in connection with the approved choices.

Due to unclear legislation, it is difficult to decide whether the responsibility for an accident should be transferred to the driver, the owner of the vehicle or the manufacturer. Liability then might depend on the cause of the accident. If caused by inattention when steering, accelerating or braking, both the system and the driver are responsible, although the responsibility may differ. Ultimately, the driver is responsible for monitoring driving conditions and correcting errors in the system. However, if the system does not allow error correction, the system operator is responsible.

DISCUSSION

By analyzing the challenges that might arise in connection to implementing autonomous vehicles in a real transport environment, we concluded that the process will be complex in many aspects. Through interviews with people from different professional backgrounds, these perspectives are highlighted. The insights come from, among other things, legal backgrounds, test operations, energy systems and strategic viewpoints. By looking at a wider perspective, we therefore see that a challenge will be to bring various important components of society to work together. Globalization increases the relevance of cooperation, which states an important point in why it is so crucial to have interaction between different actors. Through cooperation between different actors, we see that we can work towards a more sustainable society.

As mentioned, many are worried about the jobs that will be replaced by machines and robots in the future. By using autonomous vehicles, we can see many benefits for future professions. Through the use of autonomous vehicles, we therefore see great opportunities for safer work in the transport environment. The development of autonomous trucks has already created new types of services and jobs. This includes safety drivers and vehicle operation specialists in test areas. It is also expected to increase with additional professions in field engineering and teleoperations. One potential role that may emerge is that of an autonomous truck “supervisor” or “coordinator”. These professions would be responsible for managing and coordinating the fleet of autonomous trucks, ensuring that they are operating safely and efficiently. This could involve tasks such as monitoring the trucks performance, troubleshooting any issues that may arise, and managing the data and analytics that are collected from the trucks.

The fact that companies are in a “first to moon race” type scenario but with AVs, also creates proprietary systems, which creates a much bigger challenge to introduce technical-geological aspects like geofencing, since all systems, most likely, will not be compatible with one another. If platooning, or similar, were to be implemented, proprietary systems might make it more difficult to create communication between vehicles. If a logistics company were to do long haul trips with 10 AVs and their fleet is of multiple truck manufacturers, what challenges would arise when platooning these different systems?

Another relevant discussion, is the debate about platooning, but, most importantly, geofencing, and how it affects who is in control of a vehicle. When technical-geological aspects control the speed, or any other factor of the vehicle, at what level should it be controlled? An important appointment might be coming up, and the only way to get there in time is to speed, would it be acceptable for the driver to not have the ability to operate the vehicle above the speed limit? Instinctively, for many, the answer would probably be no. Should fencing zones be implemented, if yes, should one still be able to bypass them?

In what scale should they be implemented, every other highway or everywhere? Could an answer for this be a standardization around the environment where the vehicle resides, i.e. the domain? It might be, but then again, proprietary systems would make this standardization harder and more complex. One important aspect is that regulations, e.g, from the government, are free to make, but when these regulations take action, it will cost manufacturers colossal amounts of money to adopt these standardizations. In some cases standards are good but in other cases they are not, it is all about who the customer is. Trying to find a harmonized regulatory framework for AVs at a EU level to meet the challenge is seen by the expert as a requirement.

CONCLUSION

In summary it is clear that the regulative factors are not yet caught up with the technological advancements that have been made during the last couple of years. Because of this, multiple perspectives are limited to further efficient development, which causes the innovation to move outside the country, which leads to loss of control from an innovative standpoint. Furthermore, many are worried about jobs that will be replaced by machines and robots in the future. By using autonomous vehicles, we can see many benefits for future professions. Globalization increases the relevance of cooperation, which states an important point in why it is so crucial to have interaction between different actors.

FURTHER READING

Arbetsmiljöverket (25.8.2021), https://via.tt.se/pressmeddelande/over-400-doda-i-arbetsolyckor-pa-tio-ar?publisherId=3236033&releaseId=3304697

Federal Ministry for Digital and Transport (2021), Germany will be the world leader in autonomous driving https://bmdv.bund.de/SharedDocs/EN/Articles/DG/act-on-autonomous-driving.html

Fraedrich, E., & Lenz, B. (2016). Societal and Individual Acceptance of Autonomous Driving. Autonomous Driving, 621–640. https://doi.org/10.1007/978-3-662-48847-8_29

Gray, J., & Rumpe, B. (2015). Models for digitalization. Software &Amp; Systems Modeling, 14(4), 1319–1320. https://doi.org/10.1007/s10270-015-0494-9

National Counterintelligence and Security Center (NCSC), 2021, Supply Chain Risk Management, https://www.dni.gov/index.php/ncsc-what-we-do/ncsc-supply-chain-threats

Rachinger, M., Rauter, R., Müller, C., Vorraber, W., & Schirgi, E. (2019). Digitalization and its influence on business model innovation. Journal of Manufacturing Technology Management, 30(8), 1143–1160. https://doi.org/10.1108/jmtm-01-2018-0020

Ryan, M. (2019). The Future of Transportation: Ethical, Legal, Social and Economic Impacts of Self-driving Vehicles in the Year 2025. Science and Engineering Ethics, 26(3), 1185–1208. https://doi.org/10.1007/s11948-019-00130-2

Society of Automotive Engineers (SAE), https://www.sae.org/blog/sae-j3016-update

Sveriges Riksdag (2017), Förordning (2017:309) om försöksverksamhet med automatiserade fordon, https://www.riksdagen.se/sv/dokument-lagar/dokument/svensk-forfattningssamling/forordning-2017309-om-forsoksverksamhet-med_sfs-2017-309

CONTACT INFORMATION

Benjaminb.vuoristo@gmail.com
TinaKarlsson90@gmail.com
Lovisa.f.fredriksson@gmail.com
Luddeohrnell@gmail.com
Daniel.johsnsson@gmail.com