The Macrotheme Review
A multidisciplinary journal of global macro trends

Conditions for the introduction of autonomous vehicles

Patrik Viktor
Obuda University

Abstract

In the course of my research, I researched the conditions for the economic and technical introduction of autonomous vehicles. During the literature review, I first described their spread as a historical introduction and then the degrees of introduction. Then I turn to the technical and economic conditions formulated from the secondary study. As part of the primary research, I conducted expert interviews with economic managers on economics and engineering. I formulated research results from the answers received.

Keywords: automated vehicles, self-driving, road transport

1. Introduction

As a child of the 90s, I remember the hugely successful cartoons and series in which different vehicles talked and competed with each other. I have always been a fan of the futuristic world of Pontiac Trans Am, which was part of the Knight Rider movie center. In today's world of smart devices, kids would identify them as "smart vehicles". For the modern generation, it is not an absurd fiction anymore if a car can safely park independently or it is able to get from one point to another, by collecting and storing data from its surroundings.

The introduction of fully self-driving vehicles still seems to be in the far future, but the technology is already at our disposal. The question is how much transformation its introduction will require in our current infrastructure, how much sacrifice will be needed and what benefits it promises for the society and the economy.

In preparation of my dissertation, the research will proceed along this main topic and seek answers to further questions related to automated driving.

How would the introduction of fully autonomous instruments affect the development of the labor market? Production could become more efficient in many areas because there is a shortage of labor while it will lead to redundancies in certain other sectors. Old, classical job opportunities will disappear but new possibilities will rise with new expectations and requirements. This raises the question of what changes it will catalyze in education, how is it possible to most effectively prepare and "re-educate" society, as these technologies will only benefit us if we can live with them and use them successfully to their highest potential.

How do we cope with the legal and moral issues that arise? At present, perhaps the most debatable, most complex ideas emerge in relation to ethical issues. Where will the budget revenues generated today by classical vehicles come from in the future?

How will the implementation process take place in Hungary? What impact will the changes have on public transport, which is particularly important in Hungary? Are less developed countries

will be lagging behind even more in terms of transport development, or is this an opportunity for them to catch up quickly by skipping certain steps?

The above-mentioned questions will be answered according to the results of an extensive literature review and semi-structured in-depth primary research. The use of secondary sources in the work will contained books, articles, library databases, studies and statistics on the topic, referred within the text and at the back of the article. In the following, an insight will be provided into the theoretical foundations of the dissertation.

It will be briefly summarized how seriously our world has been enriched by critical changes and inventions in the past, and what kind of era change can be expected in the upcoming years. For complete insight it is important to understand where the process started and what transformation the product itself, the service, and the economic and social structure will have to go through before each new acquis can be introduced to the general public, and most importantly accepted by them. The topic also requires a brief description of the technology itself. The study will analyze the conditions of the introduction of self-driving vehicles from a non-technical point of view, yet it is inevitable to showcase the developments of today and the expected future in a more technical manner.

2. Key aspects of automatization

2.1. Technical requirements

The second chapter will highlight the technical and technological conditions that are already available to us, which are essential for the introduction and use of self-driving vehicles.

The most basic concepts include artificial intelligence, augmented reality, and virtual reality. Artificial intelligence can be used to make decisions similar to those made by machine learning, non-interventional operation, and creatures with natural intelligence. The essence of augmented reality is that it is possible to project virtual elements into our own usual space, thus blending more realities together (codinglab.hu). Various fun games are based on this principle, in which the mission is to look for and collect the things that appear on the mobile phone screen while walking in streets and parks. Playing the game can distract the player, which has led to injuries and accidents in several known occasions in the past (Szauter et al.2020).

Virtual reality is based on simulation, where participants can get into a completely different space, play sports, travel to distant places, become Formula 1 pilots or fight a seven-headed dragon, by wearing special glasses. These inventions are also key in the automotive industry, providing, accurate mapping and authentic representation of areas.

Another prerequisite is the highly effective connection and dialogue between device and device, device and user, and user and user. Its interface is a common network called Internet of Things. The participants form a chain where each unit is able to make contact with the others (Rechnitzer, 2019). An existing and applied invention is the 5G, i.e., 5th generation wireless network, which enables faster information flow, greater data transfer, and wider coverage. These features help participants communicate more effectively with minimal latency.

Big data organizes and evaluates the many pulses of complex composition. Under big data we mean the technological capabilities that makes it possible to collect and analyze a set of data from, a barcode, a photograph, or a voice message for example. However, the vulnerability of the system is caused by the fact that it also carries personal data and sensitive information, which can serve as a basis for unpleasant situations, unlawful abuse or even terrorist acts (Münster et al., 2020).

The data is stored in a cloud-based system (cloud), several of which can be created and connected. An example of this in our daily lives is that we often keep our documents and photos in tangible form at home or on our computer, but store them online. It can also be accessed by multiple computers or mobile phones connected by a common library. When a file is modified, the file on each connected device changes through synchronization. (Mellinger et al., 2021)

Self-driving vehicles can therefore only be used in an environment where all of the above mentioned factors are present. The so called smart cities will be a large, connected system, of which cars without a human driver will only make up a small part. Mark B. Cohen's depiction of the smart city can be considered as to be the most comprehensive and transparent. Cohen envisions the use of modern information technologies in six very important areas in smart cities and their pursuit of sustainability. These sectors are the economy, governance, the environment, transport, people and the lifestyle of the population. Developments can no longer be initiated only by companies and governments, but the involvement of ordinary consumers becomes especially important (Lados, M. Tóth, 2019, p. 162).

Finally, the research mentions the developments in the area that are partly accessible already or yet to be invented, but are specifically related and are important to the means of transport, infrastructure and self-driving vehicles. There are already stable driving assistance systems, such as the ACC5, which allows the driver to set a constant speed, as well as adapt to traffic, monitor the distance between vehicles and accelerate or decelerate accordingly (toyota.hu).

Radars monitoring the blind spot, assisting vision and parking have also appeared. The emergency brake assist and lane departure warning system, which were previously optional extras, are now mandatory accessories for trucks. The advantage of the former lies within the fact that in the event of an emergency, the emergency brake assist can break the vehicle with such force as a human driver would not been able to. The potential danger is detected by cameras and radars which then signals the driver. If no response is received, the system intervenes automatically (Rusznák, 2015). The latter equipment also scans the road with cameras and, if it detects an unreasonable lane departure, alerts the driver with sound and vibration. The device is deactivated with normal use of the turn signal. It is extremely useful as it accustoms drivers to using the turn signals, which in itself makes road traffic safer. Drivers tired during long driving hours are awakened by the vibration of the steering wheel when fallen asleep behind the wheel and not following the lane properly. The improved versions are already capable of correcting the direction of the vehicle before an accident occurs.

The introduction of self-propelled vehicles will require significant reforms to the existing road networks. Wider, multi-lane, better quality tracks will be needed, with clearer, more visible and perceptible pavement paintings and signs. There is a need for a directing principle that applies to road traffic, intersections, terminating lanes where machines have to line up behind or give way to each other. The road traffic regulations adopted in Hungary and Europe, as well as the traffic light system, may need to change and to be adapted to the needs of self-driving vehicles. Pedestrians are not to be overlooked as participants in the transport either. In the interest of greater security, intelligent pedestrian crossings have already been established in Hungary, for example in Debrecen, Zalaegerszeg and Veszprém. In front of the crosswalk, a sensor on the sidewalk detects the intention to cross and signals approaching vehicles by flashing lights built into the pavement. (Benavides, 2019)

We can see that a lot of useful and indispensable innovations have come to light, but the technological environment created so far is not yet ideal for the complete introduction of self-driving vehicles. Many software still need to be developed and made widely available in order to truly be able to connect and communicate with the necessary sources of information, and it is also

mandatory to build technology that harmonizes freight transport systems. Huge investments are needed in the production of mechanical components, in road construction and infrastructure development. With the joint and complete participation of all this, only the global spread of self-driving vehicles is conceivable.

2.2. Economic and Social requirements

After reviewing the technical and technological conditions, the economic environment is presented in which self-driving vehicles enter and the social competencies required for their safe use. I undertake to gather the most important questions that will test and reform the well-used arrangement of today.

The development of employment is an economic and social issue. With the introduction of self-driving technologies, jobs may disappear and new ones may emerge. "The decline in demand will all affect the jobs of drivers, haulers, mechanics, maintenance workers, mechanical engineers, factory workers, dispatchers, public space keepers and public transport workers". (Gyimesi, 2019, p. 148). The new jobs and positions that will be created will require different qualifications and skills. However, preparing for this is not impossible if employees express their intention to develop in a timely manner with a flexible attitude, and companies, in cooperation with government, provide the opportunity to do so.

90% of road accidents are due to human negligence, so with the proliferation of power-driven cars, the number of accidents is expected to be kept to a minimum. This could mean a decline in component manufacturing and assembly-repair, body work, so workers in these sectors can also expect redundancies. By avoiding carnage, the number of victims of road accidents is predicted to be reduced, so that the places vacated there can be filled by patients in need of other treatment. It is possible for hospital workers to relieve their workload and perform their tasks more efficiently (Clements, Kockelman, 2017).

The importance of education is not only multiplied in the lives of professionals, but all members of the population need to be prepared for the expected changes. I think it is conceivable that the issue of safe transport will be on the agenda in kindergartens and primary schools. It has to be taught how to behave as a pedestrian or as a passenger in a vehicle in certain situations. However, young people, adults and the elderly who are no longer involved in public education should also be aware of the use of technology as participators in the everyday transportation. The invention itself must not become part of everyday life before people can accept and handle it. (Klinger et al., 2016)

In the case of vehicles, the same pattern as in the case of telephones cannot be followed. We can study and use a smartphone or television at home, and if not handled properly, it will not cause personal injury. Conversely, doing the same thing with a car on the road can cause serious damage. Everyone, not only future passengers in self-driving cars, but also pedestrians and other means of transport, need to be aware of the new traffic regime that is emerging.

Self-driving vehicles offer benefits to the average user, but of course there can be negative effects and risks. They allow for greater mobility, and groups that used to be excluded from car use, such as young children, the elderly, people with mobility or sensory impairments, can travel on their own. With the proliferation of self-driving vehicles, community-based transport and related services will become more popular. They will be less likely to stick to their own machines to save on maintenance costs.

Households will maintain a car instead of several vehicles, as a vehicle will be more optimally used if it can travel without a passenger. In addition to greater safety and comfort, there is a greater willingness to use a car - even instead of using a plane or train - even over long distances. The number of kilometers traveled is expected to increase and the physical wear and tear of the vehicle will accelerate due to more frequent use. This process may compensate for the lower demand for repair work due to the reduction in the number of collisions (Clements, Kockelman, 2017).

As it will no longer be necessary to monitor traffic closely, new demands may arise in the field of services that ensure recreation while traveling. Social and video sharing sites can also benefit from this phenomenon. On demand, the time freed up can be usefully spent either working or studying. Depending on the individual, the prolonged, non-spatial working time that becomes fragmented can have both positive and negative effects on performance.

Increased road congestion, increased traffic and associated environmental pressures and air pollution can also have undesirable effects, which can later lead to health complaints.

It is an interesting suggestion that if vehicles can travel without a passenger, there will be less demand for parking lots and garages. Decreasing parking use and fewer fines for more regular traffic will cause significant losses in government revenue, which will be offset by the introduction of new taxes.

Based on all this, we can see that comprehensive changes in almost all areas of life will be needed for the introduction and success of the new technology. There is a transformation in people's attitudes and visions towards means of transport, and companies need to operate according to new business strategies. The traditional cityscape is being transformed, municipalities and central government need to come up with up-to-date urban development plans.

The development and sustainability of transport organization in Europe is ensured by the European Commission and the European Platform on Sustainable Urban Mobility Plans. (SUMPs) (Lados, M. Tóth, 2019, p. 164).

3. Material and method

In the research phase, ten business leaders were interviewed online at logistics companies. The research is not considered representative. In-depth, semi-structured, expert interviews were conducted in the form of primary research, which consisted of 27 questions.

The questioned companies are engaged in road haulage and civil engineering. They mainly undertake the construction of motorways and other roads, as well as the transportation and construction services that maintain them. In addition to concrete elements, paving stones, building materials and machinery, the companies surveyed also transport agricultural products, bulk food and sugar. In the cold seasons, they also undertake snow and frost removal mandates. The processes take place mainly in Hungary, but the transports also affect Austria, Germany, Slovakia, the Czech Republic, Poland and Italy.

The first asked topic was whether the interviewee saw an opportunity or problem in introducing self-driving vehicles. He believes that while innovation will certainly generate undesirable problems, he certainly sees an opportunity in it. They consider it necessary to develop technology in this direction, and they believe that combining the traditional and autonomous systems will solve the issue of employment and labor shortages. Similar to the introduction of lane keeping and dead space monitoring equipment, a kind of increase in safety efficiency is expected due to the lower possibility of machine failure. They also see the challenges in an unclear legal and liability approach. It does not matter whether economic or human interests come first in the event

of an emergency, as in the future an algorithm will decide whether to protect those waiting at the bus stop or the goods being transported.

In the following, It was asked how, as the head of a freight company, they feel about the change in the material supply chain and transportation processes. In their view, it will fundamentally change the processes, making the flow of information more efficient, traceable and secure. The future will also bring more predictable and controllable communication at shorter time. 70% of the economy is related to transport, so the increase in efficiency is also reflected in economic performance. He expects, as with any emerging development, to be an expensive innovation in the short term that, will pay off in the long run. Previously unseen, unpredicted logistics issues may arise in this area (Valls, 2021).

In their opinion, although the throughput of roads will not increase with the introduction of self-driving vehicles, algorithms may choose more favorable routes, modifying the direction based on feedback from other technical equipment. This phenomenon is already present today when using the Waze navigation application. If three of us start from the same starting point with different vehicles to the same destination, we may get there on three different routes, as the application considers what traffic is expected on the given route sections.

They concluded that it is likely that in the initial period, in a mixed environment, the reaction of people could disrupt the algorithm, but in the long run we would also experience efficiency gains. The use of technology can be culturally diverse. Most likely will not be a problem in more disciplined, systematic societies for the integration of autonomous vehicles into the market, while for more undisciplined, impulsive nations it may be a challenge to accept widely the new technology. According to this, it will have the best chance of being successfully adopted first in Norway, Sweden, Japan, Hong Kong, Beijing and Australia, where algorithmization is no stranger to transport today.

We have also moved forward with this vision for the future design of car parks. In areas where people are more undisciplined, parking will also become more difficult initially. In their view, the number of vehicles in circulation will continue to grow until car dealerships see the market in self-driving. In the future design of car parks, a distinction will presumably be made between stopping, disembarking and driving lanes, as well as a separate space for the increased number of charging stations for electric cars.

In the following, questions in which my interviewees may be directly involved were asked. It was asked whether there will be more vehicles on the roads and in the fleets of haulers if drivers are replaced by self-driven vehicles. According to their experience and view, due to the increase in capacity and more efficient utilization, the number of vehicles in the fleet will not increase and the number of vehicles on the roads will decrease. The application of the technology will also depend to a large extent on its price and the quality of the roads.

They believe that the issue of driver shortages will not be resolved in the next 3-5 years, and changes in this area are expected in ten years at the earliest. The development of technology will not stop. There will be a social reorganization as some point in the future. Most of the occupations will be robotized, in transport the route of the shipments will be followed on monitors from the controlling headquarters.

The gap between the profitability of large and small businesses will widen, with larger economic entities in possession of developments and information. The leaders of the asked companies predict that, there will not be visible change in the next five years, but there will be perceptible changes in about fifteen years. For the time being, everyday life is defined by more practical, up-to-date questions, so they do not fear that the process will affect their subcontractors.

The driver's wage costs and contributions are the second largest expense for haulers and a significant revenue for the state. Companies may be able to cut their expenses by unfortunately replacing their drivers with self-driven vehicles, while the government will lose its income on labor taxes. There is a good chance that these taxes will be applied elsewhere, charged after the purchase of the vehicle or as a toll based on the kilometers traveled, as new regulations. It is predicted that In the event that fees for a vehicle are not paid, they will not be able to enter certain areas or be redirected. Of course, the activities of all Eastern European carriers are strongly influenced by the market protection measures of Western countries. The obligation to spend MiLoG and the 45-hour rest outside the cab. However, in the case of trucks without a driver, they have to impose different, foreign-specific restrictions. In fact, the wage advantage in developing countries without traveling staff is declining somewhat. Employment in the logistics area may lower at one end but will increase on the other. Even without a driver, transportation needs to and will be controlled by live workforce. Without the need for completeness: the need for salespeople, freight forwarders, data loggers, billers, accountants, mechanics and IT professionals may increase. The latter are likely to become increasingly indispensable in the future. As a result of lower wages paid for these jobs, as well as lower price levels in these countries, local carriers will continue to put pressure on their Western counterparts.

My interviewees believe that the introduction of self-driving vehicles will not happen in the next 10 years. Although cars currently on the market have some self-driving functions already, they are still far from complete autonomy. Most leaders repeatedly stressed that the development of technology will continue, resulting in social and economic structural changes. Fewer cars will be maintained by households at 2-4% occupancy and interest in community car-sharing will increase. The ideas of uniqueness and variety will be pushed into the background and the car will be less suited to self-expression.

Their ideas about the relationship between cultures, modes of transport and the future development of professions particularly were found to be interesting. It is believed that any work that can be completed by machines and AI will be used widely and replace humans only if profitability from the new technology is heavily worth the investment. Representatives of trades that have no economic interest will be able to feel secure in their position. An example is archeology.

4. Conclusion

In preparing my research, a comprehensive presentation was undertook of the theoretical and practical difficulties and effects of the introduction of self-driving vehicles. Scenarios were studied related to employment, labor shortages, education, and the development of responsibilities. It was decided to dedicate a separate chapter to Hungary's role and opportunities in the development and application of self-driving technologies. The characteristics of Hungary's automotive industry were presented. In the last stage, transformations, problems and their alternative solutions in the freight transport sector were showcased.

It has become clear that the introduction of self-driving vehicles has not yet taken place due to technical shortcomings, as most of the necessary sensors, cameras, software, and communication channels between the machines have already been established. The most serious obstacle is the differing positions regarding the definition of responsibilities. There are two approaches that can be overshadowed by different factors. One believes that self-learning machines endowed with artificial intelligence are to blame for any misfortune that may occur on the roads. Their programmers and distributors cannot be held responsible, as they only install the basic settings in

the system. According to other beliefs, without exception, in every situation, one is responsible for the behavior of assets "created" or possessed.

The wide spread of self-driving technology will result in a transformation of jobs, leading to a change in desired skills and mass redundancies. Employees in the area of hauling, loading and ordering cargo will be presumably most affected. The vehicle's journey will be monitored in offices, and the demand for IT professionals will increase significantly.

The research summed up the expectations in terms of social utility, which territory is facing contradictions as well. More rational and consistent machine decision-making and stricter compliance with traffic rules will reduce accidents and make roads safer. Groups that have not previously been able to do so, will be able to take part in transportation on their own. These include children, the elderly, the unlicensed, and those with limited mental or physical activity. Vehicle utilization will be higher, fewer cars will be needed per household. Instead of driving, the time spent traveling can be spent relaxing or engaging in other useful activities, making longer trips by car more convenient. Based on the previously mentioned reasons, as of now it is difficult to predict whether this will lead to more or less vehicles on roads.

The subject of the research was the future of the freight transport sector and the issue of driver shortages after the introduction of self-driving vehicles on the roads. Driver demand and supply are unlikely to be fully matched, so truck drivers may have to look for other types of work in the future, however, according to professionals, demand will always exceed supply in the next 10-15 years.

Credible estimates for the introduction of self-propelled vehicles are roughly the same, expected to appear around 10-15 years after 2022-2024, a general prevalence after 20-30 years, and a majority presence in circulation in 40-50 years.

It gives me pleasure to witness a development that was previously the subject of only interesting fictions. According to the pattern observed in history, decades-old machines will be part of our everyday lives, and the grandchildren and great-grandchildren of today's young generation will only know the times before self-driving vehicles from storytelling.

References

Cartró Benavides, J. (2019). Desenvolupament Del Control D'un Vehicle Autònom En Un Entorn De Simulació (Master's Thesis, Universitat Politècnica De Catalunya).

TOYOTA.HU: Adaptív Sebességtartó Automatika.Https://Www.Toyota.Hu/World-Of-Toyota/Safety/Adaptive-Cruise-Control-How-It-Works.Json Letöltve: 2021. 10. 23.

Rechnitzer János (2019): A Járműipar Kihívásainak Társadalmi És Gazdasági Dimenziói. Tér Gazdaság Ember 2019. VII. Évfolyam 1. Szám.

Rusznák András (2015): Anyukám Is Érteni Fogja – Vezetői Asszisztens Rendszerek. Http://Www.Autoszektor.Hu/Hu/Content/Anyukam-Erteni-Fogja-Vezetoi-Asszisztens- Rendszerek Letöltve: 2021.11.17.

Gyimesi Áron (2019): Az Autonóm Gépjárművek Hatása A Kormányzati Költségvetésre És A Foglalkoztatásra. Tér Gazdaság Ember 2019. VII. Évfolyam 1. Szám.

Clements, M. – Kockelman, M. (2017): Economic Effects Of Automated Vehicles. Transportation Research Record No. 2602, 2017.

Https://Www.Caee.Utexas.Edu/Prof/Kockelman/Public_Html/TRB17EconomicEffectsofAVs. Pdf

Lados Mihály – Tóth Marcell LÁSZLÓ (2019: Autonóm Járművek Az Okos Városokban. Tér Gazdaság Ember 2019. VII. Évfolyam 1. Szám.

Vera Valls, A. (2021). Disseny Del Sistema De Direcció D'un Vehicle De Competició Elèctric I Autònom (Bachelor's Thesis, Universitat Politècnica De Catalunya).

Klinger, W. B., Bertaska, I. R., Von Ellenrieder, K. D., & Dhanak, M. R. (2016). Control Of An Unmanned Surface Vehicle With Uncertain Displacement And Drag. IEEE Journal Of Oceanic Engineering, 42(2), 458-476.

Mellinger, N., Eichholz, L., & Manz, W. (2021). Urban Cycling And Automated Vehicles (Rad-Auto-Nom Project) (No. Eres2021_176). European Real Estate Society (ERES).

Szauter, F., Dániel, P. U. P., Kőrös, P., & Szakállas, G. (2020). A Közlekedés Energiahatékonyságának És Környezetterhelésének Kérdései Az Elektromos Járműhajtás És Az Autonóm Közlekedési Rendszerek Tükrében: Energy Efficiency And Ecological Footprint Of Transport In The Context Of Electric Vehicle Drive And Autonomous Transport Systems. Nemzetközi Gépészeti Konferencia–OGÉT, 260-263.

Münster, M., Kopp, G., Schäfer, M., & Sturm, R. (2020). Structural And Safety Concepts Of The DLR Urban Modular Vehicle. Auto [Nom] Mobil Und Safetyweek 2020.