Futuristic Project Becoming a Reality: Self-Driving Cars in Luxembourg

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Introduction

Once a fantasy and a script for fiction books and sci-fi mobiles, driverless cars are becoming a reality. Furthermore, the reality is closer than we think as car manufactures are currently already testing it and the change is about to be unrecognizable as "the auto industry is poised for more change in the next five to ten years than it's seen in the past 50"[1].

The change in the car industry is going to affect various aspects of our societies and the way we think of the transportation as "self-driving vehicles' market is expected to grow exponentially creating new jobs and developing profits of up to €620 billion by 2025 for the EU automotive industry"[2]. These changes are sought to be gradual and cautious. While currently in the EU tests with driverless cars are done with a close assistance and intervention of the driver, driverless vehicles with conditional automation will be manufactured on the EU market already by 2020" [3] and are expected to further improve the driving safety and comfort of private vehicles[4] before the arrival of fully automated cars[5] on the streets by 2030[6].

At the moment several different types of automated systems exist on different levels, some of them being already available to customers. One can think, for example, of the automated parking systems. Moreover, numerous other advanced technologies are being developed and tested worldwide. In order to better understand the different automated technologies in terms of technicalities but also in policy making, the Society of Automotive Engineers proposed a six level classification of road vehicles starting from Level 0 – no automation to Level 6 –

[1] Impact of driverless cars could broaden with blockchain. Cisco.com Accessed 11 June 2019.
[2] Ertrac (2017). Automated Driving Roadmap. Version 7.0. Accessed 11 June 2019.
[3] European Parliament. Self-driving cars in the EU: from science fiction to reality. 14 January, 2019
[4] European Parliament (2016). Research for TRAN Committee – Self-piloted cars: The future of road transport? Accessed 11 June 2019.
[5] European Parliament (2016). Automated vehicles in the EU. Accessed 11 June 2019.
[6] European Parliament. Self-driving cars in the EU: from science fiction to reality. 14 January, 2019

full automation. The classification takes into consideration the vehicle's capacity to control its own position, understand different situations and allow the driver to dedicate his attention to other activities during the journey. It is important mentioning the distinction between levels 0 to 2, under which the responsibility of observing the traffic environment is on the shoulder of the human driver, whilst levels 3 to 5 are capable – under certain conditions – of observing and responding to the external circumstance without the actual intervention of a human driver. These different levels of automation require, of course, different legal considerations. According to the research study published by the at European Parliament, "[w]*ithin existing rules, barriers exist against the global market launch of automation Level 3, 4 and 5 and, in some cases, national provisions could also challenge the use of Level 2*."[7]

Following the EU outlook member states are making first cautious steps towards new technologies and are being careful embracing the disrupted era of digitalisation in the societies.

Luxembourg: a country context

The process of digitalisation part of Luxembourg national objectives and priorities of the Luxembourgish government. In 2018 the newly formed ministry of digitalisation marked the new technology priorities for the economic growth and sustainable future. Luxembourg boasts to be one of the first countries in the EU to have a fast mobile Internet (5G) covering the entire territory (p. 16)(REF).

The interest of Luxembourgish government to adapt new technologies comes from its politico-economic outlooks. The current government (2018-2023) emphasises smart mobility as an integrated part of the national digital strategy."[8] [9] The Ministry of transport also has an inclusive approach towards driverless cars that are sustainable, ecological and technologically advanced. The relationship between advanced technologies and environment nonetheless pose the question to the current present. In Luxembourg, their link is prone to scrutiny by researchers as well as politicians, which requires a lot of time to understand the benefits of the first. Currently, driverless cars are in the testing phase that is realised by researchers at the University of Luxembourg. At the same time, politicians are cautious of the overwhelming spread of newest technology into the

[7] European Parliament (2016). Research for TRAN Committee – Self-piloted cars: The future of road transport? Accessed 11 June 2019.

[8] The Government of the Grand Duchy of Luxembourg (2019). Autonomous cross-border mobility tested in Schengen. Accessed 11 June 2019.

[9] The Government of the Grand Duchy of Luxembourg (2018). Accord de Coalition 2018-2023. p.15-16. Accessed 11 June 2019.

society preferring that the technology "[…] adapts to the environment, not the other way round. [10] [11]

Luxembourg has one of the highest numbers of the cars per citizens. For 2017 466 472 cars were registered in the country with a population of 575 474, which makes 840 cars per 1000 residents [12]. The country has a high population growth (2.5% per year) and it is expected to continue to grow in the coming decades. The urgency to implement autonomous cars is thus pressing the country.

Furthermore, the country is strongly relying on the incoming workers from other countries workers, particularly from cross border countries. Currently, there are 72% (323 000 people) of non-nationals working in the country[13]. About 190 000 (44%) are cross border commuters who use private and public transport to come to Luxembourg to work each day[14]. The country is projected to reach 1 million people by 2060-2070[15] [16]. The number of cross border commuters has been steadily growing over the last 30 years and has increased six-fold.[17] it has not regressed even during the economic crisis in the 2010s.In the future the working population is also thought to increase by the incoming from neighbouring countries: France, Belgium, Germany. That is why the challenge of the sustainable transport that could assure transportation of people to their work particularly across countries is considered incremental and needs to be addressed by international and national stakeholders.

What has been done so far: research outlook

With regard to autonomous driving most heavy work is done on the research level. In Luxembourg the major one is under the framework of Cross-border Digital Test Bed Luxembourg. The framework includes other research on driverless cars in the country and links its objectives and results with other EU member countries. In 2018 together with Germany and France Luxembourg set up the framework for cooperating in respect of a common digital experimental site for automated and connected driving. The project has thus become a

[10] The Government of the Grand Duchy of Luxembourg (2019). Parliamentary question N 508 .

[11] EPRS, European Commission. Levels of driving automation. Accessed 11 June 2019.

[12] World Health Organization (2018). Global status report on road safety p. 183. Accessed 11 June 2019.

[13] Centre d'étude et de formations interculturelles et sociales (2019). Statistiques Accessed 11 June 2019.

[14] Centre d'étude et de formations interculturelles et sociales (2019). Statistiques Accessed 11 June 2019.

[15] Eurostat. Population projection. Accessed 11 June 2019.

[16] Statec (2017) Plus d'un million d'habitants en 2080? Accessed 11 June 2019.

[17] Luxinnovation (2019) Organising the cross-border mobility of tomorrow. Accessed 11 June 2019.

milestone in the development of the concept of automated driving.[18] These research efforts explore and test "various communication technologies in combination with automation functions and assess what added value they can contribute to specific applications, different driving situations as well as different traffic environments (Motorways, Urban roads, Sub-urban/Rural roads).[19]

Under the Cross-border Digital Test Bed framework another project 5GCroCo (5G Cross-Border Control) was set up to test 5G technologies in the cross-border corridor along France, Germany and Luxembourg. In addition, 5GCroCo also aims at defining new business models that can be built on this unprecedented connectivity. The introduction of the latest telecommunication technologies is considered vital for autonomous driving to guarantee uninterrupted transfer of data of the highest quality. Ultimately, 5GCroCo is seen to impact relevant standardization bodies from the telecommunication and automotive industries.[20] The project involves the provision of 5G coverage of certain sections of the motorway linking Metz, Merzig and the Grand Duchy to carry out life-size tests of 5G technology applied to the needs of autonomous and connected driving. Involving several major European players in the automotive and mobile communications sector, the project will focus on three concrete case studies: remote driving, real-time generation and real-time broadcasting of high-definition maps, and early collision avoidance. The first tests are scheduled for 2019.[21] H2020 Terminal project is another ambitious project that tests driverless cars is in Luxembourg in partnership with other EU countries. The Terminal project is integrated into the cross-border digital testbed for automated and connected driving. [22]

Since 2018, H2020 Avenue project[23] tests autonomous driving on short distances in three areas in the country. Two shuttles operate in the lower valley of the capital (Pfaffenthal). The bus has in total three stops and connects a railway station in with the elevator[24]. Another shuttle runs in the industrial area of Contern and assists people in reaching work from the railway station located 10

[18] Luxinnovation. Collaboration internationale Conduite autonome transfrontalière. Accessed 11 June 2019.

[19] Franco-German-Luxemburgish cooperation on automated and connected driving (2018). Concept for the Cross-border Digital Test Bed p.6. Accessed 11 June 2019.

[20] Official website of The 5G Infrastructure Private Public Partnership. Accessed 11 June 2019.

[21] The Government of the Grand Duchy of Luxembourg (2019). Le site expérimental transfrontalier en matière de conduite autonome et connecté permet à POST Luxembourg de se positionner au niveau européen dans le déploiement de la 5G . Accessed 11 June 2019.

[22] Luxinnovation (2019). Organising the cross-border mobility of tomorrow. Accessed 11 June 2019.

[23] Official website of the avenue project. Accessed 11 June 2019.

[24] Official website of the city of Luxembourg. City Shuttle. Accessed 11 June 2019.

km away. Both spaces aim at including a wide range of people who could benefit from it, such as commuters going to and coming from work, tourists and local residents. [25] In May 2019 a new space for testing autonomous driving has been added under the project in Bascharage. During the 4 days driverless cars have been tested for the first time without a driver, who controlled the vehicle at a distance[26]. These tests aimed at obtaining maximum results from the situation of driverless cars at level 5[27].

Legal concerns

Due to a rapid technological development, the regulatory regime concerning driving a vehicle has to deal with new challenges. It has however become imminent to establish practical and sufficient rules for technologies that have never been used before, with a special accent on the automated cars. In particular, appropriate safety requirements have to be implemented, whereas traffic rules and the regulatory framework need to be adapted as well.

Rules of the road

On international level, currently there are two framework agreements that concern road traffic and safety regulations. The 1949 Geneva Convention on Road Traffic[28] has been ratified by 98 states in order to create unified international rules to advance road safety. It provides that every vehicle in circulation shall have a driver who is at all time in control of that vehicle. Thus, for the moment this international instrument seems not flexible enough to open the door for the driverless technologies. On the other hand, in respect of the 1968 Vienna Convention on Road Traffic[29] that aims at establishing standard traffic rules, an important improvement took place in 2014. An amendment of the Convention's text had been approved with an aim to ensure that safety regulations do not impede the advancement of new the technologies. According to the amendment, "systems which influence the way vehicles are driven", as well as other systems that can be overruled or turned off by the driver, are considered to be in accordance with the provisions of the Vienna Convention. This latter amendment, entered into force in 2016, may obviously create a more welcoming regulatory

[25] Official website of the Avenue project. Luxembourg site description Accessed 11 June 2019.
[26] Lëtzebuerger Gemengen (2019). La conduite autonome complète. Accessed 11 June 2019.
[27] Paperjam. Sales-Lentz fait descendre le chauffeur. 13 March 219. Accessed 11 June 2019.
[28] United Nations Treaty Collection. Convention on Road Traffic, Geneva, 19 September 1949. Accessed 11 June 2019.
[29] United Nations Treaty Collection. Convention on Road Traffic Vienna, 8 November 1968. Accessed 11 June 2019.

environment for the existing and future automated driving solutions. The actual legal framework, however, should be elaborated in national and/or EU level.

For the time being, the Grand Duchy has been facing only a small piece of this complex legal challenge. In Luxembourg, there are no debates on adopting and amending the legislative framework suitable for driverless cars yet. The current law prohibits driving a vehicle without a driver. The Grand ducal decree foresees to allow, under certain conditions, to liberate a driver from driving, but only for scientific purposes. [30] Nevertheless, as politicians admit themselves, the Luxembourgish legal system is tightly linked with international and European legislation "serving as a basis (...) for the legislative and regulatory frameworks on the national level". [31]

It is therefore a good moment to think of the next steps and develop a roadmap for the future. What needs to be done is the following: Firstly, a common ground has to be found as to the testing phase of the automated vehicles' safety features.[32] Then the further development of vehicle automation will probably demand an adaption of driving education and licensing, criminal and civil liability rules and several other fields of law.

For the time being, a unified European legislative breakthrough is still not on the table in this respect. Even though in Luxembourg the test phase would be covered by the individually granted permissions, the future spread of self-driving cars will still need to be handled from a regulatory point of view. Since the technology is present in more and more jurisdictions, the best way to solve the problem would probably be a common European, or even international approach.[33]

Question of liability

An even more pertinent issue being closely linked to the new automated driving technology is criminal and civil liability. Today there are complex legal regimes governing liability in car accidents. Considering that so far there have been no specific legal regimes regulating autonomous vehicles, we can only analyse the issue on the basis of the existing rules applicable to "classic" vehicles.

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[30] The Government of the Grand Duchy of Luxembourg (2018). Résumé des travaux du Conseil de gouvernement du 20 avril 2018. Accessed 11 June 2019.

[31] The Government of the Grand Duchy of Luxembourg. Parliamentary question N 3650. Accessed 11 June 2019.

[32] Pillath, S. (2016). Automated vehicles in the EU. European Parliamentary Research Service Accessed 11 June 2019.

[33] Pillath, S. (2016). Automated vehicles in the EU. European Parliamentary Research Service Accessed 11 June 2019.

In the event of an accident, the priority consideration of the legislator has always been the protection of the victims. Accordingly, under the existing liability rules the physical driver would remain to bear, in principle, civil liability for any damage caused by the vehicle. The insurance companies would continue to play their role in the process as well. In the event of a proven failure of an automatic system, a recourse action against the manufacturer would most likely be initiated; the law already providing for this possibility.[34] However, we might equally consider the scenario where the vehicle was completely empty. In this case, the damage claim could not be lodged against the non-existent driver and the direct liability of the manufacturer would probably prevail.

Criminal responsibility is just as problematic. It involves a driver himself committing the crime while driving the vehicle. Nevertheless, in the case of a "passive" driver or an empty vehicle, the assessment of criminal responsibility would definitely be more challenging. If the law allows passengers to completely abandon driving, it seems unfair for them to be held liable in the event of an accident. On the other hand, forcing drivers to be ready to regain control over the car at any moment might eventually limit the interest in the new technology. At the same time, criminal liability of a legal person (i.e. the manufacturer) is an existing legal concept, but it would expose these enterprises to such a high legal risk which could just as well slow down the project, or even put an end to it.

Overall, it is certain that there are important policy choices to be made and it is by no means self-evident that the responsibility standards traditionally applied to ordinary human drivers would provide the most suitable basis for assessment[35]. The legal aspects are apparently more and more interesting for the entire legal community. In 2018 the Association of Insurance and Reinsurance Companies (ACA) in collaboration with the University of Luxembourg and Schiltz & Schiltz Law Office organized a fictitious trial on an accident involving an autonomous car. The invented case takes place in 2030 in Luxembourg. The circulation of autonomous vehicles on the roads has been authorized already for five years. The driver, despite the car's signal thereon, refuses to take over the control considering that there is no danger around. The car then turns sharply to the right and hits the cyclist on the sidewalk. The moot court was performed by law students of the University of Luxembourg and revealed several important legal questions. For example, could artificial intelligence be found "guilty" and

[34] Legitech (2015) Quand la voiture conduira pour vous. Accessed 11 June 2019.

[35] Yeung, K. (2018). A study of the implications of advanced digital technologies (including AI systems) for the concept of responsibility within a human rights framework. Council of Europe. Accessed 11 June 2019.

condemned, among other things, to "algorithmic re-education with test in simulator"?[36]

Big data, data privacy and cybersecurity

Equally important concerns have been raised in respect of big data usage, data privacy and cybersecurity.

Autonomous vehicles are operated on the basis of the data provided to them from several different sources (for example sensors, cameras, radars, GPS data, traffic data, weather data, etc. [37]). Big data covers as much information as possible in order to give guidance to the car in finding the best decision in the given traffic situation. However, even big data fails sometimes. That was the case when in 2018 an Uber vehicle collided with a woman pushing a bicycle with shopping bags hanging from its handlebars. The car had been operating in self-driving mode for 19 minutes before it confused the woman with another car and expected it to take an evasive action. It only recognised its mistake and handed back control to the vehicle's human driver seconds before the crush and thus the driver was not able to prevent the fatal injury. Certainly, it must have been hard to foresee that the car's AI sensing system would mistakenly believe that a woman pushing a bicycle with shopping bags hanging from its handlebars could be seen by the car as another vehicle. At the same time, the car's sensing technologies should be able to correctly classify unusually shaped objects appearing during normal driving conditions in order to prevent similar fatal collisions[38].

Concerning the cybersecurity aspects, it is important to note that automated vehicles have external software and hardware extensions. The manufacturer develops, implements and manages these extensions. Therefore, the connection between the car's internal system and the manufacturer's central server needs to be secure in order to ensure that data transfers are not exposed to any manipulation or unauthorised disclosure. Uncontrolled access to these data by third parties could risk directly or indirectly the safety of the vehicle, passengers and others[39].

Automated vehicles and their rapid improvement in a strong correlation with other new technologies trigger heavy debate on data privacy issues as well.

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[36] Paperjam. La voiture autonome à la barre. 10 December 2018. Accessed 11 June 2019.

[37] Cheruvu, R. (2015) Big Data Applications in Self-Driving Cars Accessed 11 June 2019.

[38] Yeung, K. (2018). A study of the implications of advanced digital technologies (including AI systems) for the concept of responsibility within a human rights framework. Council of Europe. Accessed 11 June 2019.

[39] Pillath, S. (2016). Automated vehicles in the EU. European Parliamentary Research Service Accessed 11 June 2019.

Evidently, the new autonomous cars are operating in a digital environment that provides, as well as collects endless data. Connected vehicles have therefore the capability to create, store and transfer users' personal data, such as their regular way to work, other driving routines, as well as their favourite radio station or restaurants. These data are being used to further improve the AI sensing system and thus the efficiency of the self-driving car. At the same time, they can have a considerable potential for other usages and thus they are exposed to phishing. National or even European legislation is envisaged to make sure that third parties cannot access and use sensitive driver and driving data[40].

Conclusion

We are observing a big change in the transportation area. Beyond doubt, the future has arrived, and the very futuristic project of driverless vehicle is indeed becoming reality. The objectives are noble: improving driving safety and the comfort of passengers, creating sustainable, ecological and technologically advanced transport systems, reducing travelling time through coordinated traffic circulation, and minimizing accidents on the roads by excluding human error.

The benefits of the new technological products already now seem intriguing and attractive to the societies facing environmental and global challenges. Governments, looking for new opportunities for sustainable and economic growth are also ready to step in to support the know-how.

However, here is still a long way to go before citizens use the fully automated driverless cars on the streets. Apart from the enormous technical difficulties, the self-driving vehicle accommodated to appropriate legislative framework. As long as the driverless transportation is not completely risk-free and guarantees the security of the users, the project risks to be hold back by critical voices.

In order to reassure these doubts, it is essential to propose a unified European set of legislation, covering all relevant fields of law. This would include the amendment of the relevant provisions of the rules of the road, as well as the adjustment of the applicable laws on driving licensing requirements. Moreover, a comprehensive reshaping of the civil and criminal liability regulations would be required. It is easy to presume that the insurance companies would need to completely redesign their policy schemes as well in order to adjust to the new situation. Prudent and carefully coordinated legislative work is desired in order to safeguard the future of this remarkable project.

[40] Pillath, S. (2016). Automated vehicles in the EU. European Parliamentary Research Service Accessed 11 June 2019.