

Developing a Regulatory Framework for Autonomous Vehicles: A Proximal Analysis of European Approach and Its Application to ASEAN Countries

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Abstract: Autonomous vehicles (AV), a new innovative product of the automobile industry designed on the basis of artificial intelligence (AI) technology, thereby capable of operating without direct human control, are believed to be the future of transportation. Hence, as with most great technology, the development of AVs would eventually be limited if regulatory changes are not implemented on time. ASEAN, one of the world's leading emerging automobile markets, has accepted the arrival of AVs and allowed the automobile producers to introduce autonomous and semi-autonomous cars for the customers. However, most ASEAN countries, with the exception of Singapore, have yet to enact regulations governing AVs. They are facing a number of challenges in determining the legal status of AVs, thereby creating certain restrictions for establishing the platform for production, sales and uses of this AI-driven product. This article will analyse the legal framework on AVs of four ASEAN countries—Indonesia, Singapore, Thailand, and Vietnam. It then attempts to assess the regulatory approaches toward the development of a legal framework for AVs in Germany, France, and the Netherlands, to suggest some effective solutions for ASEAN.

Keywords: *artificial intelligence, ASEAN, autonomous vehicles, civil liability, product liability, self-driving cars, transport regulations*

1. Introduction

Autonomous vehicles are one of the breakthrough inventions of humankind in the digital age. The self-mobility of the vehicle by a control system that integrates artificial intelligence (AI) and machine learning offers many benefits. First, it is to limit human-caused carelessness when driving, as 94% of serious accidents are caused by human error (European Commission, 2020), and driver assistance technologies, replacing the driver with a machine. Calculating with high accuracy will reduce the risk of accidents caused by carelessness of vehicle drivers. The economic benefits when the automation of vehicles will directly affect the way the transport network works, besides reducing the cost of repairing damage caused by accidents, are reduced travel time and increased free time from not driving. Therefore, many leading companies in vehicles and technology have joined the race to produce self-driving cars.

All those benefits are determined by the precision of the control system that each vehicle possesses. If this accuracy is not guaranteed, not only safety and economic benefits are not achieved, but, on the contrary, autonomous vehicles can cause serious damage. It should be noted that no matter how modern a computer system, when performing tasks, errors can occur, and the more complex the system, the more likely it will happen (Joamets & Chochia, 2020; 2021). The higher the error, the higher the control system of the self-driving car. This is precisely why legislators from different countries around the world are concerned about the many legal issues arising from AVs.

In South East Asia, with the exception of Singapore, most countries still face issues in developing regulations for AVs. The main challenge for ASEAN legislators is how to design a legal framework which is sufficient to promoting the application of new technology in the car without distorting the established structure of transport and traffic regulations. They must address three important questions, namely: (1) How to position AVs in the context of transportation/traffic law? (2) How to ensure the safety rules for various type of AVs? and (3) Whether or not to assign increased responsibility to AV manufacturers, or only the driver/owner of the vehicle shall be liable for

the traffic accident? Legislators are hesitant in making changes in existing traffic and transportation rules for fear that it would distort the road safety monitoring and inspection system as well as make it difficult to determine liability for a traffic accident. Many are influenced by the perception that the synchronisousness of national transport infrastructures does not warrant the deployment of AVs. However, it is believed that the absence of an adequate regulatory framework for AVs may potentially not only prevent the efficient use of advanced automation technology in the society, but also inhibit the development of automation systems in the automobile industry.

European policy makers, meanwhile, have expressed interest toward creating an ecosystem for automation technologies since the beginning of the 21st century, considering that as the main driving force to make the European Union “the most competitive and dynamic knowledge-based economy in the word” (Communication COM(2003)226 final/2). European technology platforms (ETP), the first public-private partnership in the research for implementation of leading technologies in Europe, were established in 2003 to “bring together the main stakeholders—research organizations, industry, regulators, user groups, etc.—around key technologies, in order to devise and implement a common strategy for the development, the deployment and the use of these technologies in Europe” (European Parliament, 2017). The ETP has helped the European Commission to formulate an intelligent transport system development strategy (Juhasz, 2018). A number of projects relating to the AV’s testing, i.e. Adaptive, DAVI, HAVEit, CyberCars, AutoNet 2030, have been launched in the Netherlands, France, and Germany (Brizzolara & Flament, 2015; Meyer & Deix, 2014). In 2017, the Report of the High-level Group on the Competitiveness and Sustainable Growth of the Automotive Industry in the European Union raised the issue of necessity of amending the road traffic legislation—vehicle performance requirements and behaviour regulations to meet the development of AVs (European Commission, 2017). It acknowledged that EU Member States shall develop the national rules on AVs. At the EU level, the European Commission shall support the development of harmonized EU rules when needed (European Commission, 2017). In 2019, the European Parliament adopted the Regulation (EU)2019/2144 on technical safety and traffic safety on public roads in the EU, which is based on the requirements developed and recognized by the EU Member States. This is considered the first step of the EU toward the development of technical requirements for AVs in Europe.

Pending the formation of harmonized EU rules on AVs, EU Member States have developed different legal regimes to regulate AVs (Anastas, 2020). Some

countries have granted authorization by administrative decisions of the transport authorities, others are focused more on modifying national laws to facilitate vehicle testing in their territory (Ardiyok, Canbeyli & Skardziute, 2020). Each of these initiatives may have strengths or weaknesses, but overall they form an important foundation for the development of AVs in Europe. It can be seen that the EU Member States have had a long journey of interest in AVs, the European legislative experience, therefore, can offer good reference for ASEAN policy makers.

2. Understanding autonomous vehicles and the liability risks associated with autonomous vehicles

Autonomous vehicles are generally understood as any motor vehicle (i.e., a car, a truck or a bus) that uses a special technology to allow the driving task of the driver to be switched to a computer system. It should be noted that the term ‘V’ refers not only to a vehicle that can operate independently without a driver, but also to a vehicle partly controlled by a computer system (Taeihagh & Lim, 2019). Modern AVs are designed with highest automation and are fully dependent on AI systems. Advanced sensor systems, such as LiDAR (Light Detection and Evaluation) and radar, along with traffic data systems from satellites, computers rhythmically process on-board digital maps using AI machine-learning algorithms, allowing vehicles to determine their position, plan and follow a route, and recognize and respond correctly to road signs and obstacles, including other road users (motor vehicles, cyclists, and pedestrians) (Altunyaldiz, 2020). Arguably, the high integration of a computer system and AI technology in the vehicles’ operation has raised various issues related to risk management in traffic safety, liability for vehicle owners, as well as manufacturer’s liability in the event of a traffic accident (Patti, 2019).

The intervention of a computer system in vehicle control is not a new topic in the history of the automotive industry. However, it can be seen that, before 2016, the systems only play a supporting role, and the driver is still fully responsible for the safety when operating the vehicle. But the liability issue needs to be revisited when more sophisticated systems completely replace the driver in a given control task. There are two possible legal approaches in deciding the civil liability for damages in the event that an AV causes a traffic accident: (1) Strict liability approach—aiming only at the human driver or the vehicle owner of the AV, assuming the liability

to compensate for damage caused by the vehicle, regardless of whether he/she was actually driving it or not. This approach is easy to implement liability for damage caused by automated systems, however, it may become a barrier for consumers to choose this type of vehicle; (2) Fault-based liability approach—aiming only at the subject that negligently or deliberately caused the damage, i.e., whoever violated the traffic rule is liable to compensate the loss. As such, it would be difficult to determine the liability for damages in case of self-driving vehicles, as it is the AI systems that control and operate the vehicles. Arguably, AVs manufacturers may be liable for damages because they design software and manufacture automation-enabled devices, ensuring the safe operation of the automated system; or it is the owner of the AV that caused the traffic accident who shall be held liable for the damage. From here, a technical issue will arise as to what are the effective criteria to determine the rights and obligations of stakeholders in the AVs ecosystem? What is the fair and reasonable division of liabilities amongst them?

The primary question here is how to measure the level of intervention of a computer system during AV's operation. Different countries, based on their preference toward automation systems, may have different ways of classifying the level of control intervention over the vehicles. Presently, the SAE J3016 Levels of driving automation classification proposed by the Society of Automotive Engineers (SAE International, 2021) has been most referenced by legislators in the United States and European countries (International Transport Forum, 2015; European Parliament, 2016; US Department of Transportation, n.d.). The SAE International proposes a 6-level classification of road vehicles: from Level 0—No Driving Automation to Level 5—Full Driving Automation (SAE International, 2019). Based on this autonomous system intervention level chart, the driver's role is diminished. In the event of an accident with class 0 to class 2 vehicles, even with the support of the computer system, the human driver is responsible for the remaining aspects of driving the vehicle and for supervising and controlling the automated systems. Thus, the drivers can be assumed legal liability caused by the vehicle. However, from class 3 onwards, the automated dynamic driving tasks are not required to be constantly monitored by the human driver, so the issue of legal liability seems to become more complicated. The proliferation of such AVs will shift from the driver to the AVs' manufacturers (Glancy, Peterson & Graham, 2016). Implantation of this standard into the law is of revolutionary significance for the development of AVs, but it is still a great challenge for policy makers in developing countries because of the concern of losing control over the "side effects" of new digital technology.

Generally, giving robots responsibility for transporting human passengers on the public road network may cause enormous safety implications (Altunyaldiz, 2020; NHTSA, n.d.). This poses a huge “trade-offs” challenge for governments when making policies and laws on AVs, as they must balance between ensuring freedom for an automobile manufacturer to develop a new type of vehicle and developing a strict surveillance system to ensure the AI product safety. Yet, introduction of a regulatory framework for the management of AVs shall shape the acceptability of this type of vehicle in each country.

3. Regulatory landscape on autonomous vehicles in ASEAN countries

ASEAN is considered one of the world’s most attractive automobile markets, given its huge population, rapid urbanization, and high economic growth. According to Mordor Intelligence (2021), the ASEAN automobile market is valued nearly 45.55 billion US dollars in 2021 and is expected to reach 67.97 billion US dollars by 2027. It is observed that the AVs manufacturers are keen to promote their products to the market, while the ASEAN consumers are also open to new technology-based products (Mordor Intelligence, 2021). In recent years, various projects on developing smart vehicles have paved the way for AVs to enter the market. In Thailand, in June 2020, the Chinese technology giant Huawei cooperated with Thailand National Broadcasting and Telecommunications Commission (NBTC) and Siriraj Hospital to deploy a self-driving delivery vehicle to bring about a contactless delivery solution of medical supplies (*Bangkok Post*, 2020). Indonesia recently started allowing self-driving cars to be tested on public streets of a newly developed smart city near Jakarta (*Jakarta Globe*, 2022). VinFast, a Vietnamese electric car manufacturer, has just started selling Level 2+ advanced driver assistance system, and Level 3–4 autonomous driving features for future models to the US and EU markets (*Quang Ninh News*, 2022). Paradoxically, the development of a regulatory framework for AVs in ASEAN is quite contrasting. On the one hand, Singapore, a country without the automobile industry but a developed transport system, is one of the world’s leaders in developing AVs specific regulations (KPMG, 2020). Meanwhile, the rest are struggling in developing regulations for AVs. The analysis below will clarify the status of legislative development in Singapore and in three ASEAN countries of Indonesia, Thailand and

Vietnam, thereby clarifying the problems of ASEAN countries in developing regulations for AVs.

3.1 Singapore

Singapore is known as one of the world's leading nations in creating a favourable environment for AVs. It should be noted that Singapore does not produce AVs; however, Singapore government is strongly supportive of electric cars and an AVs system in consideration that it will help to improve the efficiency and safety of the public transport system. In 2014, Singapore government proposed strategic initiatives to build a Smart Mobility 2030 and a "car-lite" society (Norton Rose Fulbright, 2018). The same year, the Land Transport Authority (LTA) established the Committee on Autonomous Road Transport for Singapore (CARTS) for the goal of transforming Singapore's land transport through the deployment of AVs. For the purpose of that policy, in 2017, Singapore amended the Road Traffic Act 1961 (RTA 1961) to trial and use AVs equivalent Level 3, 4, 5 SAE J3016 on Singapore roads. The most notable change here is the recognition of AVs as one type of motor vehicle. Accordingly, the RTA 1961 expressly defines AV as "a motor vehicle equipped wholly or substantially with an autonomous system (also commonly known as a driverless vehicle), and includes a trailer drawn by such a motor vehicle".

Several important concepts related to the state management of AVs were adopted under the RTA 1961, namely (i) trials and use of autonomous motor vehicles (section 6C), (ii) exemptions and modified application of laws to approved trials and special uses [of autonomous motor vehicles] (section 6D), (iii) sanctions against acts of unlawful interference with autonomous motor vehicle trial (section 6E). This legal framework created a "sandbox" regime for AVs in Singapore. Accordingly, an AV must meet the standards and requirements of the LTA for approval in the trial or use process. It is required that AVs' participants apply and obtain approval for the deployment of AVs on public paths, which can be issued by the LTA on a case-by-case basis (Application form..., n.d.). Any AVs shall pass stringent safety assessments conducted at the Centre of Excellence for Testing & Research of AVs—NTU (CETRAN)—before exemptions for their use on public paths can be considered by the LTA (Norton Rose Fulbright, 2018). These conditions are intended to enhance the responsibility of the manufacturer before being officially put into trial operation.

The above legislative developments have facilitated solutions for many legal issues related to AVs, including the methods for determining civil liability upon accidents by AVs. It should be noted that Singapore does not facilitate the claims for damages against the AV manufacturers on the basis of product liability (Tan & Taeihagh, 2020; Constantine, 2020). However, these damages can be substantially covered by insurance as the AVs trial participants must have bought an AVs insurance policy, covering injury to persons, death, and property damage as required by Section 6C (1)(b)(i) of RTA 1961.

The existence of a regulatory framework governing AVs has allowed Singapore to develop pilot AV projects for public transport. Since 2017, the LTA has approved a three-and-a-half-year trial of driverless bus services on selected feeder and trunk service routes within an industrial area of Jurong Island and the campus of the National University of Singapore during off-peak hours, with two 40-seater electric autonomous buses involved in the testing. CETRAN has been also mandated to implement self-driving buses in three townships in Singapore by 2022 for use during off-peak hours.

However, the main problem that makes it difficult for Singapore to represent other ASEAN countries is that this country is too small in both area and population compared to the rest of the region. With its small data pool, developed infrastructure and highly urbanized environment, Singapore can easily manage the transportation system as well as control the problems arising from the transportation system in its territory.

3.2 Other ASEAN countries

Contrary to the situation in Singapore, other ASEAN countries generally have yet to develop an adequate legal framework for AVs, despite the fact that their governments support automobile industry to cooperate with foreign partners and integrate advanced technologies to make automobile products.

3.2.1 Thailand

The Thai government has openly acknowledged the significance of transforming the national economy into a digitally powered ecosystem, with the goal of having over 100 smart cities by 2036 (The 20-Year National Strategy & Summary..., n.d.). In 2017, the Office of Transport and Planning Policy (OTP) of the Ministry of Transport adopted the intelligent transport

system (ITS), which shall serve as an important element of the framework to improve traffic control and road infrastructure in the smart cities, and facilitate the development of AV system.

To date, the use of motor vehicles on the public paths of Thailand shall be subject to the regulations applicable to regular vehicles under the Motor Vehicle Act B.E. 2522 (Vehicle Act) and Road Accident Victims Protection Act B.E. 2535 (Road Accident Act), adopted in 1992. Both legislations were adopted long before the introduction of AVs but have not been amended to address these aspects of AVs. According to Kanyaphat Thadaornwong, this resulted in inappropriate implementation of fully automated driving technology in Thailand (Thadaornwong & Naluang, 2022). Since the Vehicle Act allows only human-driven vehicles, the registration of a car as an “autonomous vehicle” is not legally permissible. The absence of specific rules on AV also creates legal issues related to the adoption of insurance policy for AVs. According to the Road Accident Act, vehicle owners must purchase and maintain vehicle insurance to ensure compensation for damage and loss of the victim caused by the vehicle. At the same time, the AVs’ manufacturers are not subject to procure any AV insurance scheme, as they are not identified as relevant parties to the use and operation of AVs in Thailand by law. Overall, the laws and regulations only focus on forcing the driver and the owner of the vehicles to be responsible for operating the vehicle as well as assume the civil liabilities for damages by traffic accident on them.

3.2.2 Indonesia

Indonesia has also encountered a similar situation as Thailand. The legislation governing road traffic and vehicles in Indonesia, at the time of their enactment, were not intended to apply to AVs. The Law no. 22 of 2009 on Road Traffic and Transportation (Law 22/2009), adopted in 2009, and the Government Regulation no. 55 of 2012 on Vehicles (Regulation 55/2012) detailing the implementation of the Law 22/2009, adopted in 2012, regulates road traffic management in Indonesia, including vehicle specification, vehicle testing and other industrial and technological developments of transport infrastructure. Their regulations, however, were designed by the lawmakers without notion of self-driving motor vehicles. Article 1.8 of the Law 22/2009 defines “motor vehicle” as “any vehicle activated by mechanical equipment in the form of engine except for those operating on a railway track”. The regulations do not differentiate AVs from other motor vehicles, thus, require them to comply with the general requirements for all motor vehicles operating in Indonesia.

As a matter of fact, motor vehicles operating in Indonesia must fulfil the technical and operational quality requirements imposed by the Road Transportation Division (RTD) of the Ministry of Transportation. Thus, importers and manufacturers of motor vehicles must obtain the vehicle's test certificate and register the approval of vehicle production type. Since RTD's testing system does not make any specific requirements for AVs, the concerned parties face increasing difficulties in registering their AVs.

Recently, in an effort to develop the Bumi Serpong Damai area, a planned community located in Greater Jakarta, into a smart city (known as BSD City), the Indonesian government has approved the city development plan with various high-tech elements, including the AVs. As such, the use of AVs on public road of the BSD City has been approved on a trial basis. In May 2022, the Minister of Transportation of Indonesia officially inaugurated the Autonomous Electric Vehicle Trial in BSD City (*Bangkok Post*, 2020).

Another issue related to AVs in Indonesia is the application of insurance policy for AVs. There is no mandatory insurance policy requirement for the use of private vehicles in Indonesia. The Law 22/2009 only requires mandatory insurance for public vehicles and public transportation service providers. Hence, given the nature of AVs, ensuring the vehicles' safety and guarantee the civil liabilities against traffic accident is of high importance. The laws of Indonesia assume the liability to the driver of the AVs (regardless of whether he/she drives the vehicle or not) for the damages caused by the vehicle.

3.2.3 Vietnam

The Vietnamese leaders also demonstrate quite an open view toward new technology and support the development of its fast-growing automobile industry. The government especially demonstrates high interest in electric vehicles with the notion to control vehicular pollution and fuel consumption. In recent years, some local electric car manufacturers have started to produce semi-autonomous electric cars. It is observed that the interest in electric cars increased significantly when a smart electric car named Phenikaa appeared in Hanoi in 2021. (*Vietnamnet*, 2021) VinFast, the national champion in electric car manufacturing, has also announced an aggressive plan to produce AVs for export (*Quang Ninh News*, 2022). However, as far as AVs are concerned, Vietnamese policy makers seem to be quite cautious about adopting specific regulations on AVs.

The Law 23/2008/QH12 on Land Transport (Law 23/2008), adopted in 2008, and its implementing regulations regulate all types of motor vehicles operating in public roads in Vietnam. These regulations only indicate the requirements for vehicles with human driver/control. As such, partial driving automation or assisted driving, i.e., cruise control or assisted parking systems, seems to an extent permissible as the driver is assumed to have effective control of the vehicles at all times. Nevertheless, fully autonomous vehicles are not permitted by law because the automated systems of the vehicles would completely suppress the human driver's ability to drive. To that end, the AV manufacturers in Vietnam shall accept that the fully self-driving function of the car is not taken into account upon registration and, therefore, must ensure that the functions of the operation manual of the vehicle are similar to those of other non-autonomous vehicles. In other words, whether the vehicle is equipped with an autonomous system or not, it would be subject to the same regulations as a regular motor vehicle. The introduction of AVs in Vietnam, thus, will require substantial amendments in the current land transport laws and regulations.

For countries that do not have specific regulations for AVs, the legal issue is not only related to registration of the vehicle and implementation of insurance policy, but also the settlement of liability for damage caused by the vehicle when the driver is using the self-driving function on the road. In Thailand, Indonesia and Vietnam, the main concept on determination of liability in traffic accident is to tie the vehicle's owner or the driver with responsibility to compensate for damage(s) upon an accident. In Vietnam, motor vehicles are even defined as a "source of extreme danger". Article 601.3 of Vietnamese Civil Code 2015 regulates that "[t]he dangerous nature of assets such as motor vehicles during operation requires the possessor and user to strictly comply with the related legal provisions, otherwise they will have to compensate for damage if this property causes damage to others, regardless of fault or not." However, it should be noted that for AVs, sometimes damage resulting from an accident can be caused by the design of the vehicle's autonomous system, or by a random glitch or wrong decisions made by AI that the vehicle's owner cannot know and cannot control even when strictly following the operation manual of the vehicle. Thus, it is assumed that AV manufacturers' liability for product liability shall also be assessed in the context of traffic accidents caused by AVs. However, in order to apply the laws on product liability, it is necessary to resolve the issue of recognition of the self-driving function of the AVs. In the present context, this question remains unanswered in most ASEAN countries.

4. How AVs' matters are resolved in some European countries

The EU has adopted two main legislative acts to govern liability concerning automobiles and also autonomous vehicles, namely Directive 2009/103/EC on the insurance against civil liability in respect of the use of motor vehicles, and the enforcement of the obligation to insure against such liability, and Directive 85/374/EEC on the approximation of the laws, regulations and administrative provisions of the Member States concerning liability for defective products (Chatzipanagiotis & Leloudas, 2020; Punev, 2020). However, both legislations only cover product liability when the motor vehicles are defective. The regulations on registration, management, and control of the safety of autonomous vehicles is beyond the scope of these provisions.

As mentioned in the previous section, Regulation (EU) 2019/2144 has opened up a new opportunity for technical safety assurance for AVs operating on public roads in the countries of the European Union. However, these regulations still have to be detailed by the European Commission. Meanwhile, some member countries have developed separate legal frameworks for AVs. The case of the Netherlands, France, and Germany will be analysed in the following section, aiming to find some solutions for ASEAN countries in developing a legal framework for AVs.

4.1 Netherlands

Netherlands is believed to possess an ideal ecosystem for AVs due to its developed digitalized infrastructure, advanced research facilities, and institutions such as Automotive Campus, TASS, TNO Automotive, and TU Eindhoven. This stems from the Dutch government's laws and policies to promote the development of automatic features for motor vehicles during the last decade (Norton Rose Fulbright, 2018; Vellinga, 2020). According to KPMG (2020), the Netherlands is one of the world's most prepared jurisdictions for the future development of AVs. As a matter of fact, the country started developing regulations on AVs since 2015. However, the approach of the Dutch government is not to adopt a new law nor amend the existing law but develop exemptions on the technical requirements in order to experiment with certain automated features on public roads (*Exemptions Model*) (Decree of 15 June 2015).

In the Netherlands, the Road Traffic Act 1994 constitutes the main legal basis of the road traffic regulations, while the Traffic Rules and Signs Regulations 1990 stipulate traffic rules and regulations within the country. Under the Road Traffic Act 1994, cars with automatic features, i.e., adaptive cruise control, self-parking assistance, automatic lane keeping, are only permitted on the public road under the conditions that they are controlled by a [human] driver. The Exceptional Transport (Exemptions) Decree, adopted in 2005, which is based on the Road Traffic Act 1994, has introduced a system to allow the Dutch Vehicle Authority (RDW) to grant exemptions for certain automated driving functions. However, the system for granting exemptions did not cover tests with driverless vehicles, as a driver must still be able to regain full control over the vehicle in a conventional way. To that end, the Dutch government amended the Exceptional Transport (Exemptions) Decree on 15 June 2015 to make it possible to derogate from the general requirements of the Road Traffic Act 1994 and Traffic Rules and Signs Regulations 1990 for the purpose of issuing a qualified safety permit after the vehicle's automated systems pass the test's requirements. Such a permit shall be prepared by the RDW and granted by the Minister of Infrastructure and Water Management. This regime has significantly enlarged the scope of the exemption powers of the RDW in relation to AVs (Vellinga, 2020).

In 2016, in the effort to further clarify the admissibility of experiments with driverless vehicles on public roads, the Dutch legislators have proposed an amendment to the Road Traffic Act 1994 which shall allow fully autonomous vehicles to roll on public roads without a driver. The Draft Law Governing the Experimental Use of Self-Driving Vehicles to replace the existing rules on the human control over vehicle under Article 149a of the Road Traffic Act 1994 was announced on the internet for public consultations. Consequently, the Road Traffic Act 1994 was amended in 2018 to officially enable experiments with automated systems in motor vehicles. The new Article 149aa of the Road Traffic Act 1994 openly stipulates that “[t]o carry out an experiment on the road with motor vehicles for which provisional or temporary approval is required on the basis [...] of which the driver is not in the motor vehicle, a permit is required from [Our] Minister after consultation with [Our] Minister of Justice and Security.” (Act of 26 September 2018 amending the Road Traffic Act 1994). With this new legislative development, the Netherlands has taken another step in completing the legal basis for AV experiments on public roads.

4.2 France

France has been active in developing an ecosystem for AVs. In 2015, PSA was the first company to receive authorization to test AVs on motorways in France (Norton Rose Fulbright, 2018). In 2017, NAVYA, a well-known French AV manufacturer, was granted permission to launch “Autonom Cab”, the first robot-taxi in the world (Bergerolle, 2017; Norton Rose Fulbright, 2018). In the same year, KEOLIS, a subsidiary of France’s national railway SNCF, launched the first public autonomous vehicles on experimental basis at the business centre of La Défense in Paris (*Le Parisien*, 2017).

In 2016, the French government issued Ordinance no. 2016-1057 of 3 August 2016 relating to the experimentation of vehicles with drive delegation on public roads. This legislation has the same effect as a law document and has created a floor for AV testing in France. The efficient implementation of this legislation was limited, however, because the regulations on application process were not in place. To overcome the obstacle, the government has created *ad hoc* authorizations under the “exceptional registration certificate” procedure applicable for limited roads and highways.

During the last three years, after a six-year trial period starting in 2016, French government has started vigorously developing a legal framework for AVs. It has become the first country in Europe to adopt the road and traffic regulations to allow the operation of fully automated vehicles on public roads (*Connected Automated Driving Europe*, 2021). Decree no. 2021-873 of 29 June 2021 and Ordinance no. 2021-443 of 14 April 2021 (Ordinance no. 2021-443) define the conditions of circulation of the AVs and the associated liability regime (Decree no. 2021-873 of 29 June 2021). This “conditional model” requires an AV to satisfy the requirements of the functional design domain; conditions and modalities of recovery, safety, and emergency manoeuvre (Ministry in Charge of Transport, 2021). For semi-automated vehicle, a human driver is required to be in a vehicle when it is in operation and its automation system must be designed to allow the driver to make “take-over request” to regain control of driving in a traffic environment. A remote intervention, i.e., “no driver on board”, can be permitted in case of a “highly” automated vehicle and a “fully” automated vehicle only within pre-defined paths or zones by the authorities, named Automated Road Transport System (“ARTS”).

A special feature of the Ordinance no. 2021-443 of 14 April 2021 is to enhance the criminal liability on the AVs’ manufacturer in the event that

the manufacturer fails to ensure the safety requirements of the AVs, leading to traffic accidents or serious consequences. Accordingly, during the periods when the automated driving system exercises dynamic control of the vehicle, the vehicle manufacturers or its agents are deemed liable for clumsiness, recklessness, inattention, negligence, or violate the safety obligation required during an AV manoeuvre, affecting the life or integrity of any person, and shall be subject to criminal penalties (in the form of monetary fines) (Ordinance no. 2021-443). This strict liability rule is considered as an important basis to ensure the safety of AVs in France.

4.3 Germany

Germany is the EU's market leader in the AV segment. German vehicle manufacturers and automotive suppliers own the most patents in the world (Bardt, 2017). Level 3 AVs have actually been on the road in Germany since 2017 thanks to the Eighth Act amending the Road Traffic Act (*StVG—Strassenverkehrsgesetz*). Hence, Germany continued amending the Road Traffic Act by means of introducing the Autonomous Driving Act 2021 (Ebers, 2022).

It is worth noting that the Autonomous Driving Act 2021 has taken a new approach to determining who is responsible for AVs. The old rules assumed the driver is responsible for the civil liabilities for damages caused by an AV. Even Section 1a(4) of the Road Traffic Act, designed for fully automated Level 3 cars, still stipulates that the responsibility for the vehicle's accident remains with the driver. The Autonomous Driving Act 2021 has taken a new approach in line with the reality of Level 4 AVs, where a driver is not necessary liable for this level of automation. Instead, the term 'technical supervisor' is used to refer to a natural person who can deactivate the motor vehicle during its autonomous operation and approve an alternative driving manoeuvre (Road Traffic Act, Section 1d(3)). This approach has substantially solved the issue of who shall be responsible for the AV operating on the road rather than just assuming this to be the driver.

Recently, the German Federal Council (*Bundesrat*) has passed the Ordinance on Autonomous Vehicles Approval and Operation (*Autonome-Fahrzeuge-Genehmigungs-und-Betriebs-Verordnung, AFGBV*), which regulates the technical implementation for AVs and took effect on July 1, 2022. The AFGBV supplements the Autonomous Driving Act by stipulating the technical requirements for AVs and the procedure for obtaining the operating permit of the AV.

- (i) The manufacturer must obtain a permit from the Federal Motor Vehicle Administration for a motor vehicle with an autonomous driving function (*AFGBV*, Art. 3).
- (ii) Motor vehicles with autopilot function may only be operated on public roads in a defined operating area if the following requirements are met:
 - Independently manage the driving duties within the respective designated operating range without the vehicle driver interfering with the control or the control of a motor vehicle under regular technical supervision.
 - Independently comply with traffic regulations aimed at vehicle control and have an accident avoidance system.
 - Independently put the motor vehicle in a state of minimal risk if the continuation of the journey is possible only in violation of the road traffic law.
 - Check the driving manoeuvres assigned by the Technical Supervisor and do not perform such actions, but to independently put the motor vehicle in a state of minimal risk if the driving operation would endanger the participants traffic or someone else.
 - Immediately report any deterioration of AVs function to Technical Supervisor; recognize their system limits and when the system limit is reached, when a technical failure affects the performance of the autopilot function or when the limit of the specified operating range is reached, to put the motor vehicle at risk independently.
 - Disable at any time by technical supervision or by occupants and, in the event of disabling, independently switch the vehicle to a minimum risk state.
 - Ensure that sufficiently stable radio connections are protected from unauthorized interference, especially technical supervision, and automatically place the motor vehicle in a state of minimal risk if the radio connection is damaged or unauthorized access...
- (iii) Responsibility for the safety of manufacturers, owners for the operation of AVs (*AFGBV*, Art. 12, 13):
 - AVs manufactures shall ensure regular vehicle repair and maintenance; ensure the feasibility of recurring technical vehicle inspections; and obligations related to information safety and confidentiality of AVs...
 - AVs owners shall check regularly the vehicle systems for the active and passive safety of the motor vehicle with autonomous driving function based on the repair and maintenance information provided by the manufacturer; an overall check is carried out every 90 days from the day of admission to road traffic in accordance with the specifications of

the operating manual for the motor vehicle with autonomous driving function, this results of the overall check, including a description of all defects found and repairs carried out, are documented in a report and sent immediately to the Federal Motor Transport Authority and the competent authority on request, if this is necessary...

AFGBV also sets out minimum requirements for the ‘technical supervisor’ of self-driving vehicles. When the journey cannot be continued due to a traffic situation, the technical equipment of AVs puts the motor vehicle in a risk-minimum state with the support of the technical supervisor (*AFGBV*, 14.1 in Part 4, Appendix 1). In addition, the requirements for safe data storage of AVs are also detailed (*AFGBV*, Part 3, Appendix 1). When this data is stored, in any situation, problems related to automated systems can be clearly identified. From there, the division of legal responsibilities between the parties involved can also be easier (Tropp *et al.*, 2022).

5. Some policy considerations for ASEAN countries in developing a regulatory framework for AVs

The development of autonomous vehicles is inevitable in the light of the fourth industrial revolution. Among ASEAN countries, it seems that only Singapore is ready to embrace this kind of smart vehicle. The primary issue that needs to be considered is how to make AVs legally circulated. If AVs are not yet accepted by national legislation, analysing other legal aspects seems pointless.

Firstly, it is essential to create a legal operating space for AVs. For each country, depending on the development of infrastructure as well as the acceptance of the people, it is possible to choose an appropriate AV management model. The Netherlands is implementing an ‘exemptions model’ by giving the authority to the national transport authority to consider whether a specific AV can be exempted from the general laws and regulations, while France with the ‘conditional model’ is creating a new regulation to set binding or non-binding conditions for operating an autonomous vehicle. The Dutch way seems to motivate AV manufacturers to participate in the experiment widely. Only when the condition is no longer met will these exemptions be withdrawn. However, this method is only suitable if the country’s infrastructure is really complete. For the French model, only areas that satisfy the technical and safety conditions of the competent authority

can be allowed for AV experiments. It is believed that this approach will be more suitable for ASEAN countries, due to their uneven development of infrastructure.

Secondly, limiting the risks arising from AVs will spur this industry to grow. Specifically, it is imperative to create a mechanism to share liability for damages between AV's owners and AV manufacturers because attributing the complete civil liability for the damage to the 'owner/operator' will discourage any customers from buying and using AVs, whereas assigning it fully to the manufacturer will subsequently demotivate research and creation of AVs. There are three suggestions that need to be further exploited for ASEAN countries:

- (i) The management requirements that the manufacturer of a motor vehicle with autonomous driving function must meet based on the model of German Road Traffic Act (Road Traffic Act, Section 1f) and Ordinance *AFGBV*. The first problem that needs to be solved is that an automated vehicle when participating in traffic on public roads is to ensure safety and be able to solve dangerous situations and put the car at minimum risk. And even if the self-driving system can not do these tasks, the technical supervisor will be the last resort to ensure safety.
- (ii) The issue of determining liability between the parties: manufacturer, driver, owner, etc. in the event of an accident of autonomous vehicles will be much easier to resolve if the proof tool is always available. Storing the operating data of AVs under all conditions will solve this problem.
- (iii) Criminal liability or high monetary remedy for serious defects in the production of AVs by the manufacturer should also be considered. France's initiative on criminal liability for self-driving car manufacturers and parties with remote control of self-driving cars will increase responsibility for designing and manufacturing products right from the factory can be considered a strong deterrent measure, with early prevention of errors caused by negligence of the manufacturer that could have serious consequences for human life and health.

European countries have developed legal frameworks to facilitate the development of AVs and therefore help their consumers to benefit from automation technology. The disparity in legislative level on innovative technology in ASEAN is still a big problem. Hence, development of the technology is a general trend that no country can avoid. To that end, the experience of European countries in managing the development of AVs can serve as good examples for ASEAN countries.

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