Chapter

Introductory Chapter: European Union towards Self-Driving Car Pathway. M2M Era

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1. Introduction

Europa, follows the Wim van de CAMP Euro-parliamentary initiative [1, 2], adopting *On the road to automated mobility: An EU strategy for mobility of the future*, Brussels, 2018. The communication includes the automated and connected mobility for all kinds of transport fields: underwater, water surface, on ground and underground, or by air. The main advantages of adopting Driverless vehicles are as follows: reducing transport costs, increased mobility access (by elder people or with disabilities), sharing mobility, increased safety transport and comfort, more efficient urban planning. For long term, the EU Vision Zero (2050) concept was introduced, which means no road fatalities. The EU regulatory framework has in view the deployment of interoperable Cooperative Intelligent Transport Systems.

The ethical side in EU is equal in worth with the automated mobility, as in worldwide. The driverless vehicle should be safety, socially responsible (to respect the freedom of human choice and the human dignity), efficiently, and environmentally friendly. All these aspects are coordinated and investigated by the European Artificial Intelligence (AI) Alliance. The European AI Alliance born in 2018 with the main target: AI implementation in Europe taking into account the ethics rules in Science and New Technologies.

2. Motivation

One sight over the causes of death statistics in the European Union (EU) shows that the accident occurrences take the second place (most were male population). Human error [3] is the most cause (95%) in road accidents (**Figure 1**).

As it is depicted in **Figure 2**, the number of railway accidents in EU27 decreases from 2249 (2010) to 1506 (2019). These accidents cause a total of 802 fatalities, and significant injuries for the other 600.

The number of road accident fatalities per million inhabitants was 50.5 in the EU in 2016. Sweden and the United Kingdom recorded the lowest rate, Bulgaria (99) and Romania (97) the highest rate.

Taking into consideration the statistics result from **Figures 2** and **3**, one dramatic remark can be concluded that the accident fatalities on the road, railway, or by extrapolating on sea/undersea, or by air could be avoided if the human factor can be replaced. Therefore, the European Parliament [7] takes emergent measures [1, 2] to avoid in the near future the accidents in the transport area.

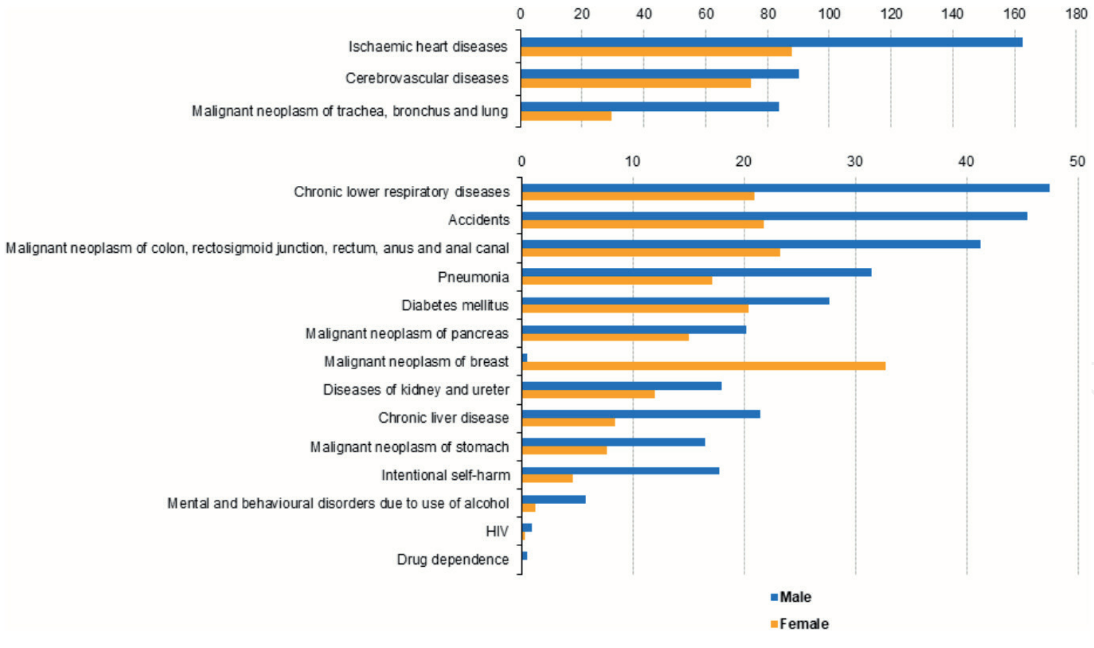

Figure 1.
Causes of death — Standardised death rate, EU-27, 2016, (per 100 000 inhabitants). Source: Eurostat [4].

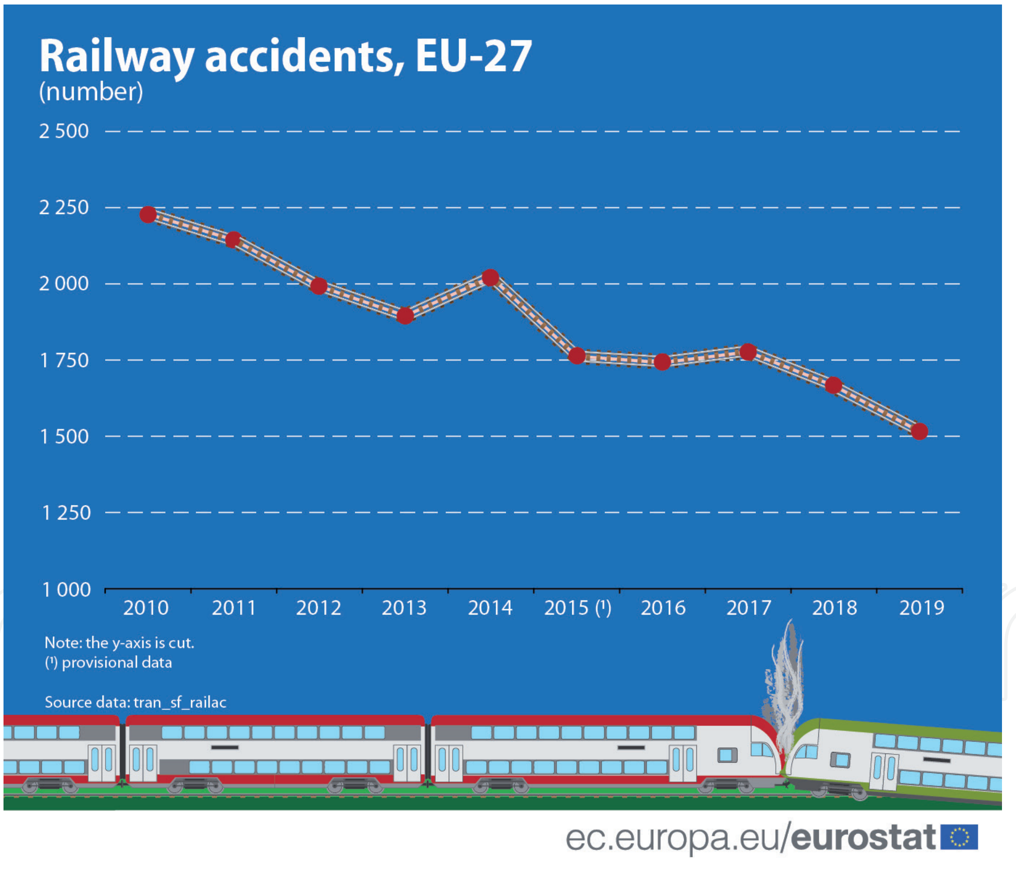

Figure 2.
Statistics of major railway accidents between 2010 and 2019, in EU27 [5].

The exponentially rise of the self-driving market is expected [8]. The main benefits of this trends is new jobs creation, involving the economic growth with safer roads, increased comfort, and more accessibility [9]. Moreover, the non-polluted self-driving cars implies a protection of the environment [9].

The challenges of introducing self-driving cars are in the field of legislation, ethics, cyber-security, maps creation, weather conditions, infrastructure technology, artificial intelligence adoption strategy by each EU country.

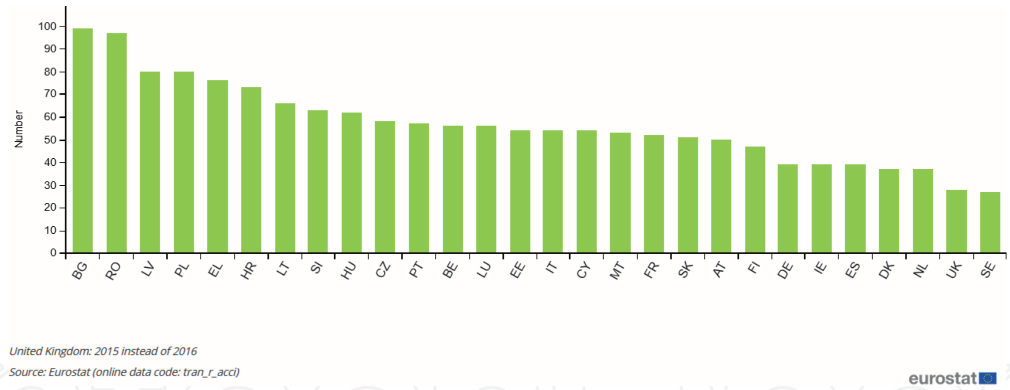

Figure 3.
The accidents fatalities in road traffic per million inhabitants in 2016 [6].

The main investment of the EU27 Companies in research and development (R&D) is in transport (automobiles) field [10]. The second investment sector is in ICT, followed by health sector (**Figure 4**).

The first two sectors are strong related to the green vehicles development. The self-driving cars development is facilitated by both telecommunication infrastructure development and adopting of artificial intelligence strategy by the most countries. Cybersecurity, safety, and ethical rules should be inside of the regulatory frameworks of self-driving car developing.

One key factor of developing is the investment in R&D. In Europe, by benchmarking EU Industry Innovation Performance, there is a step forward in the last years, the 5,6% of R&D rising only in one year, 2019, while in the rest of the world by 8,9% [11]. This demonstrates the high rate of investment in R&D in Europe (**Figure 5**).

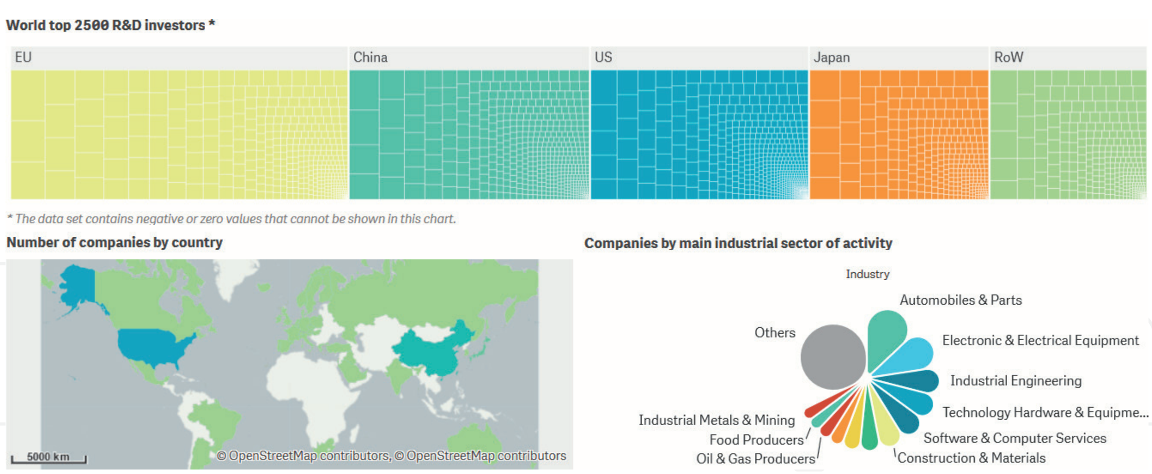

Figure 4.
Top. World top 2500 R&D investors. Down: Left number of companies by country; right: Companies by main industrial sector of activity [10, 11].

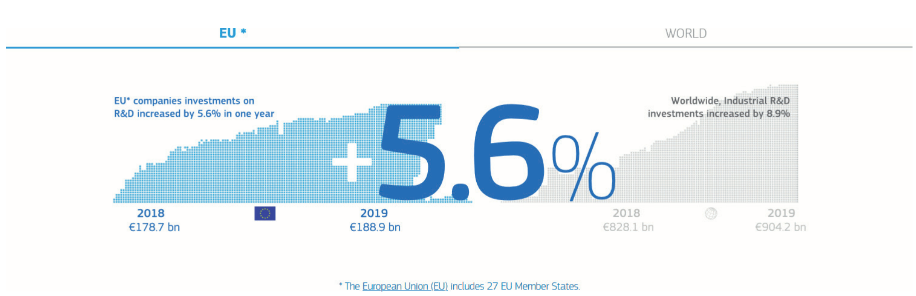

Figure 5.
R&D investment rate in Europe (2019) [12].

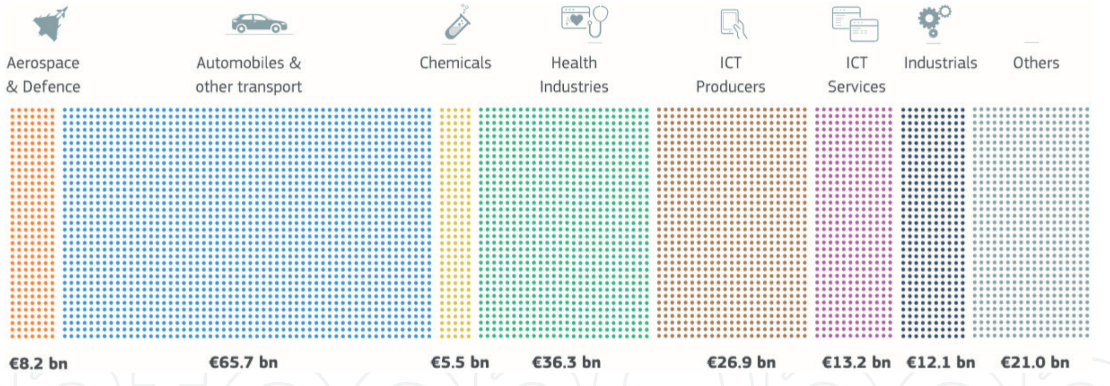

Figure 6.
The sector hierarchy in Europe of the R&D investment [12].

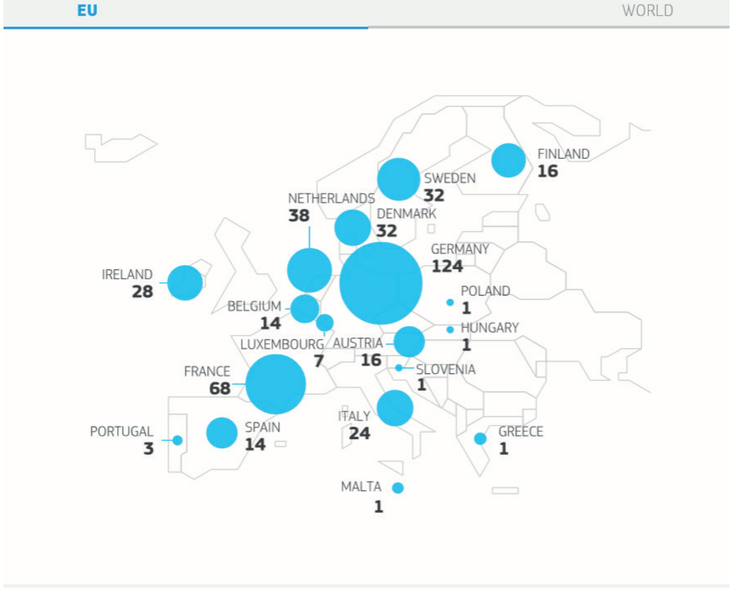

Figure 7.
The country hierarchy in Europe of the R&D investment [12].

By analysing the above-mentioned **Figures** 5–7, the main conclusion is the fast-accelerating rate by the R&D investors in vehicle development sector in EU countries.

3. Enabled actions and advanced technologies

The grow-up of the driverless-vehicles is enabled by the on-going research project on the ecosystem (smart cities) and in the transport field.

The H2020 pilot research projects are the main catalysators towards Self-driving car Pathway. AUTOmated driving Progressed by Internet Of Things (AUTOPILOT) [13] is an open source platform for IoT vehicle (containing three main ingredients: vehicles, road infrastructure, and the IoT objects). The main objective includes the self-driving safety. Additional services are investigated (self-parking, terrain mapping or vehicle-sharing).

At the same time, the already open source IoT experimental platforms represent one important tool to test the new IoT technologies before integrating in the real world. Different M2M architectures, cyber physical systems (IoT-A), standards (for example oneM2M) and open platforms (UniversAAL, FIWARE) can be exploited by the pilot projects [14].

The pioneer project 5GCAR: Fifth Generation Communication Automotive Research and innovation [15–17] has in view connectivity and testing of V2X network by an 5G-based system architecture and new V3X services.

The future generation communication infrastructure and connectivity standards will be handled by the 5G Public Private Partnership (5G PPP) [18], in the framework of The European Union Program for Research and Innovation, Horizon 2020 program. The Public Private Partnership is formed by the European Commission and Infrastructure Association (5G IA), the private side [19].

There are ambitious objectives to take care of 5G infrastructure development, and Key Performance Indicators (KPI) to be reach, including 1000 times higher wireless data volume than of 2010, large access (10 to 100 times more connected devices) to low-cost applications and services with a high reliable (End-to-End latency of <1 ms; 10 times to 100 times higher typical user data rate), secure Internet with low energy consumption (10 times lower energy consumption) [20].

ENabling SafE Multi-Brand pLatooning (ENSEMBLE) for Europe large scale research project has in view the multi-brand truck platooning in real world of the Europe traffic to ensure a safety road, low fuel consumption [21]. One of the project outcomes will be the standardisation of the communication protocols between the trucks platoon, in which each truck is followed by the other by respecting the traffic rules (speed, distance, traffic signs) [22].

The safe distance is mentioned from the preceding vehicle to lead vehicle by using radar or/and laser sensor systems.

According to European Commission Decision 2008/671 (named '5.9 GHz ITS Decision') there is specified for the safety-used communication technologies in Intelligent Transport Systems (ITS) the availability of the 5875–5905 MHz spectrum use for IS applications in the EU [23].

4. Cooperative intelligent transport systems. Towards M2M

In 2016 European Commission adopted European Strategy on Cooperative Intelligent Transport Systems (C-ITS), rising cooperative, connected and automated mobility (CCAM) [24]. In order to develop C-ITS services, the European Commission has in view to strength of the relationship between the investments and regulatory frameworks. The outcomes of the large pilot projects in intelligent transport will enable the specific standards within C-ITS. In USA, Society of Automotive Engineers (SAE) introduce the level of driving automation in 2014 [25], and updated in 2019 [26].

One year later, on 21st of May 2020, SAE International comes with the new standard, SAE J3216: Taxonomy and Definitions for Terms Related to Cooperative Driving Automation for On-Road Motor Vehicles [27].

The cooperative driving of the self-driving vehicles is the next level of full automation. The new called Cooperative Driving Automation standard was introduced by the SAE on May 2020 through the SAEJ3216 standard. This standard is based to the predecessor SAE J3016 which stipulates the six levels of driving technologies (from 0 to 5).

This new standard, J3216, defines the progress of cooperative control, from A to D classes, enabling machine to machine (M2M) communication systems.

The self-driving vehicles should include both e-safety systems and vehicle safety communications. The e-safety systems comprise at least: Advanced driver-assistance systems (ADAS), automatic emergency braking systems, forward and reverse collision warning (FCW, RCW) system, adaptive cruise control, lane-keeping technology [28–30].

Figure 8.
The 3 trucks platoon formation [21].

The safety of the vehicle communications becomes a critical safety point. This is a complex task due to the diversity aspects: ethical, legislative framework, technology, governance. The solutions to this task are offered by the cybersecurity and data protection rules [31].

Practically, the J3216 standard improves the level of full automation by facilitating the car road traffic in platoon formation, as in **Figure 8**. This concept is named by SAE as Cooperative Driving Automation (CDA).

Connected eco-driving concept is based on the V2I real time communication to advice the drivers about the traffic congestion or other infrastructure conditions [32, 33].

5. Conclusion

The content of this chapter is structured within 4 Sections. The first Section, there is an Introduction in the European initiative of self-driving technology. The Second Section includes the main motivation of enabling such technologies, the Vision Zero accident fatalities. The third Section, Enabled Actions and Advanced Technologies, includes the main catalysators of implementing self-driving car: the H2020 pilot research projects. The last Section, "*Cooperative Intelligent Transport Systems. Towards M2M*", presents both the promoted EU tools, i.e., cooperative, connected and automated mobility (CCAM), and USA tools, SAEJ3216 standard, to enable self-driving car pathway towards M2M level.

Acknowledgements

The project leading to this application has received funding from the Research Fund for Coal and Steel under grant agreement No 899469.

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