OLSZTYN ECONOMIC JOURNAL
Abbrev.: Olszt. Econ. J., 2017, 12(1)

AUTONOMOUS VEHICLES – CHALLENGES FOR THE INSURANCE INDUSTRY

Piotr Majewski

Department of Finance and Accounting
WSB University in Toruń
e-mail: piotr.majewski@wsb.torun.pl

K e y w o r d s: motor vehicle insurance, insurance market, autonomous vehicles, road safety.

A b s t r a c t

The objective of this article is to identify and analyse opportunities and threats for the insurance industry related to the popularisation of autonomous vehicles. The analysis uses the data and forecasts included in reports of independent research institutions, which forecast the tempo of development of autonomous vehicle technologies. In the following few years, the global model of transport is going to change as it will gradually move away from the model of possessing individual vehicles and towards using a fleet of autonomous vehicles depending on current needs. The fundamental motivation for changes will be safety, comfort and lower costs. A direct result of the technological revolution for the insurance industry is a reduction of the amount of paid compensation, which is related to the improvement in the safety of road traffic. However, the new model of individual transport is going to dramatically reduce the number of vehicles on roads, and therefore it will result in a significant drop in the income for insurers coming from selling vehicle insurance policies, which currently is one of the most significant sources of income for numerous markets.

POJAZDY AUTONOMICZNE – WYZWANIA DLA BRANŻY UBEZPIECZENIOWEJ

Piotr Majewski
Katedra Finansów i Rachunkowości
Wyższa Szkoła Bankowa w Toruniu

S ł o w a k l u c z o w e: ubezpieczenia komunikacyjne, rynek ubezpieczeń, pojazdy autonomiczne, bezpieczeństwo na drogach.

A b s t r a k t

Celem artykułu jest identyfikacja oraz analiza szans i zagrożeń dla branży ubezpieczeniowej, związanych z upowszechnieniem się pojazdów autonomicznych. W analizie wykorzystano dane i prognozy z dostępnych raportów niezależnych instytucji badawczych, przewidujące tempo rozwoju technologii pojazdów autonomicznych. W ciągu najbliższych kilku lat zmieni się też model globalny transportu związany z postępującą rezygnacją z posiadania indywidualnego pojazdu na rzecz

korzystania w miarę potrzeb z floty pojazdów autonomicznych. Podstawowym motywem zmian będzie bezpieczeństwo, wygoda oraz niższe niż dotąd koszty. Bezpośrednie skutki rewolucji technologicznej dla branży ubezpieczeniowej to ograniczenie wartości wypłacanych odszkodowań związane z poprawą bezpieczeństwa ruchu drogowego. Nowy model transportu indywidualnego spowoduje jednak dramatyczne ograniczenie liczby pojazdów na drogach, a co za tym idzie znaczny spadek dochodów ubezpieczycieli ze sprzedaży ubezpieczeń komunikacyjnych, które obecnie są jednym z najważniejszych źródeł przychodu.

Introduction

Leading automotive companies have been on the market for over 120 years and since the beginning they have participated in a technological arms race. Cars have never before been so safe and easy to drive as they are today. In recent years, progress in the development of the field of electronics has brought many solutions which increase driving safety and which take over the role of the driver in a car. The vision of cars without drivers has accompanied automotive futurologists for several decades; however, only recently has technological development made it possible to fully implement this vision. Many contemporary cars are capable of independently assisting the driver in keeping the car in a driving lane and within a safe distance from the car in front as well as monitoring the level of tiredness of the driver.

A relatively small step separates the automotive industry from complete elimination of the driver from the process of driving a car. Many automotive companies, as well as IT technology leaders such as Google, already have conducted road trials. In the meantime, Tesla Motors, through a software update, introduced an autopilot function to the users of their cars, which allows them to use a fully autonomous driving mode in certain circumstances (*Tesla Press Information* 2016). According to all of the research and practical trials, it is human error and human imperfection that are the causes of most traffic accidents (*Road safety...* 2015). Railway and air transport have proven that the more automation is introduced, the safer transport becomes.

Currently, autonomous vehicles are still relatively primitive and are ineffectual at trying to equal a human. In emergency situations, they cannot manage and require the driver to take over control of the steering wheel. However, according to the reassurance of manufacturers themselves, as well as research centres dealing with transport issues, it is just a matter of time before autonomous cars will become an everyday reality.

Eliminating the driver is not only a question of convenience, but also an announcement of great changes in many areas of life and the economy. According to available estimates, these types of vehicles are going to revolutionise individual transport within the next few, or dozen or so, years. The insurance industry will not avoid the repercussions of this process.

The objective of this article is to identify and analyse the opportunities and threats presented to the insurance industry by the development of technologies related to popularising autonomous vehicles that are capable of independent driving on public roads without a driver.

Definitions and forecast development in the field of autonomous vehicles

In order to systematise the knowledge and notions used in this article, we need to define an autonomous vehicle.

"Automated vehicle: a motor vehicle (car, truck or bus) which has technology available to assist the driver so that elements of the driving task can be transferred to a computer system.

Autonomous vehicle: a fully automated vehicle equipped with the technologies capable to perform all driving functions without any human intervention" (PILLATH 2016, p. 2).

The road to achieving autonomous vehicles will certainly not be a revolutionary process. For many years, cars have been equipped with various systems which support the driver in difficult conditions or even take over some of the driver's tasks. For example, since the 1980s leading manufacturers have equipped their cars with ABS. At the turn of the century, driving stability systems such as ESP were popularised on a large scale. Recent years have brought the further development of electronics and a drop in production costs. As a consequence, even in the mid-range class of cars, the following have been installed: driving lane assist, active cruise control capable of avoiding collisions with the preceding vehicle and automatic parking systems, among others. Nevertheless, it is the driver who makes critical decisions and takes full responsibility for how the vehicle moves. Parallel research conducted by leading automotive companies, Tesla Motors and Google, has been a breakthrough on our way to the full autonomy of vehicles. Fully autonomous vehicle prototypes have driven many kilometres on closed tracks so far. The latest software update for Tesla S cars turned out to be a breakthrough. It allows the driver to use a so called autopilot, which allows the car to drive itself fully autonomously on public roads within a limited scope. The extent of vehicle automation has been categorised in the following gradation (Tab. 1).

The classifications contained in the above table require an explanation. Individual levels of automation differ from one another in the extent to which the driver is engaged in the driving process. The lowest levels require a decision and reaction in setting the speed and the driving lane for the car to follow. For example, level 1 is an automatic parking system, and level 2 is

Table 1

Levels of vehicle automation

Level	Extent of automation
0	No automation the full-time performance by the human driver in all aspects of the dynamic driving task, even when enhanced by warning or intervention systems
1	Driver assistance the driving mode-specific execution by a driver assistance system of either steering or acceleration/deceleration using information about the driving environment and with the expectation that the human driver performs all remaining aspects of the dynamic driving task
2	Partial automation the driving mode-specific execution by one or more driver assistance systems of both steering and acceleration/deceleration using information about the driving environment and with the expectation that the human driver performs all remaining aspects of the dynamic driving task
3	Conditional automation the driving mode-specific performance by an automated driving system of all aspects of the dynamic driving task with the expectation that the human driver will respond appropriately to a request to intervene
4	High automation the driving mode-specific performance by an automated driving system of all aspects of the dynamic driving task, even if a human driver does not respond appropriately to a request to intervene
5	Full automation the full-time performance by an automated driving system in all aspects of the dynamic driving task under all roadway and environmental conditions that can be managed by a human driver

Source*: Automated and Autonomous...* (2015).

active cruise control. The levels from 0 to 2 also require the human to monitor the surrounding space. On levels 3 to 5 this function is taken over by the car. Starting from level 3, the vehicle begins to do everything for the driver; however, it still requires the human to react in emergency situations. The implemented autopilot of Tesla S falls into this level. Tested vehicles use visual analysis and navigation data. Current solutions are not yet based on vehicles communicating with one another and with the road infrastructure. However, analogous systems have been available in passenger air transport for years (among others, the TCAS system). On level 4, which is in operation in some driving modes (for example in a particular agglomeration area), the vehicle is capable of controlling the car in every traffic situation even without the driver's reaction. Advanced prototypes tested by Google and some other leading car manufacturers are currently at this stage of development. However, due to legal restrictions they are not authorised to be used on public roads (*Automated and Autonomous...* 2015, p. 25). Level 5 is full automation under

any conditions, the vehicle is not equipped with any conventional control devices and the driver cannot directly influence the driving. Fully autonomous cars only leave the driver with the decision of selecting the driving route and the mode that will be used to cover it.

Introducing successive levels of automation throughout the years undoubtedly contributes to improving driving safety and to decreasing the number of accidents which are caused by a human error. However, there is a question whether the driver assisted by automation will be able to react efficiently if it is necessary. This problem is discussed later in this article.

Scientists and global consulting firms estimate that the popularisation of new solutions will take place around 2030 or later. According to available forecasts, the market share of autonomous vehicles in the sale of new passenger cars and light goods vehicles is estimated to be 20–25% at that time (VIERECKI et al. 2015, p. 20). At first, this will take place in large city agglomerations, and the first users will be today's teenagers for whom a car does not constitute such a value as it does for people who grew up in the 70s and 80s. However, the increasing pace of technological development and manufacturers' forecasts allow us to suppose that this process will proceed much faster.

Before technology reaches the level necessary to create fully reliable and safe autonomous vehicles capable of dealing with any situation on the road, legal matters need to be put in order first, which so far have been a very serious limitation for the development of this kind of means of transport. The essential issue is the necessity of the physical presence of a driver in a vehicle travelling on the road. In Europe, the legal foundation concerning road traffic is the *Vienna Convention on Road Traffic*, which regulates that a driver must be present in a moving vehicle and the driver must continuously control the movement of this vehicle (EUGENSSON et al. 2013, p. 5). Rapid technological progress has forced the law to adapt to accelerated changes in reality. Today, the law in some US states already authorises the testing of autonomous vehicles to move in public road traffic. In Europe, the work to adapt this Convention (as well as local legal acts to authorise autonomous vehicles to drive independently) is already in progress.

The inevitable quick development of autonomous vehicles has been noticed by the decision-makers from the automotive industry. Research results have proven that this tendency has been highly assessed by them and its importance keeps growing (*Global Automotive* 2016).

The consequences of the popularisation of autonomous vehicles for individual transport

Mass popularisation of autonomous cars will definitely cause huge changes in the everyday lives of city dwellers and in urban models in general. The currently prevailing model of passenger car transportation usually consists of one or several cars in a household used for travelling to work, school, to do the shopping or for recreational purposes. The car is usually the most expensive property present in a household. Its exploitation entails numerous serious costs, which (apart from fuel) include repair costs and servicing, insurance, and a considerably fast decrease in value, most of all. Research conducted by scientists from Columbia University has proven that an average car owner uses their vehicle only for a small percentage of the time. This results in a huge wastage of resources and a huge total cost of owning and using a car (TCO) measured by the cost of covering one kilometre (*Transforming Personal...* 2013). Autonomous cars can significantly reduce that cost by means of abandoning the idea of owning a car for the paid use of a fleet of autonomous vehicles. In this model, the car (autonomous) will be used whenever the need for transport arises. It will safely drive the passengers to their destination and will proceed to take the next run. Furthermore, this kind of transport will be available to people who do not have a driving licence. Obviously, such a change is not going to happen suddenly, since many people are still attached to the idea of owning a car. However, they can be easily convinced on account of

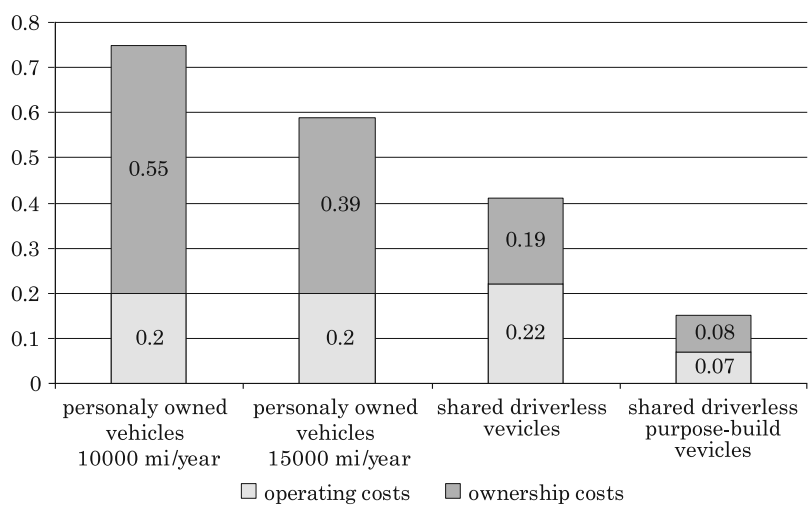

Fig 1. The cost of using autonomous and conventional vehicles
Source: *Transforming Personal...* (2013).

safety, and most of all, because it is simply more economical. In the described solution, the cost of one covered kilometre is reduced by approximately 80%. Additionally, in large agglomerations, the nuisance of finding a free parking space is of no small importance. The new idea of transportation will surely win over people who are sceptical towards public transport.

Transportation needs will be satisfied by vehicles rented for the duration of the transport, which will be owned by corporations. As a consequence of the adopted model and the increase in effectiveness of vehicle use, the number of vehicles will significantly decrease.

This new model of transportation is going to revolutionise today's urban concepts, which are still subordinated to the movement of vehicles in agglomerations. A smaller number of cars will mean less space dedicated to road infrastructure in favour of space dedicated to pedestrian traffic and recreation (*Re-inventing the wheel* 2015).

It is natural that the process of automatization will start with private passenger cars used in highly urbanised areas, which constitute a large part of the market. Those who live far away from large cities, heavy goods transport and all types of special vehicles will most likely stay away from autonomous technologies longer.

Limiting the number of vehicles and sharing them in agglomerations has been desired for years by environmentalists, among others, who are protesting the ever-progressing pollution of the natural environment in large city agglomerations. This is mainly connected with exhaust emissions. Presently, many European capitals enforce traffic restrictions for cars with combustion engines in city centres or even aim at eliminating older and less ecological vehicles entirely.

The influence of autonomous vehicles on the insurance industry

Popularisation of autonomous vehicles (in the above-mentioned scale, automation levels 4 and 5) brings many challenges for the insurance industry. They can be classified into two basic categories:

– Legal determinants,
– Market determinants.

In the first category, the question of liability for damages in accidents is particularly important. According to available statistics, it is the people who currently cause the overwhelming majority of accidents (*Road traffic accidents...* 2015). Usually, they are caused by inattention, daring or tiredness. Insurers are currently charged with the high costs of accidents; however, they

have developed regulations concerning mutual liability for causing accidents. In the case of fully autonomous vehicles, eliminating the human factor is surely going to contribute to a reduction in the number of accidents. Despite the main objective of developing autonomous transport, which is the improvement of safety, accidents cannot be eliminated, simply due to technical reasons. Presently, a human is liable for what happens with the vehicle and the risk is covered by motor vehicle Third Party Liability (OC). The development of technology will gradually limit the role of the driver, until the human is entirely eliminated from the process of controlling the vehicle. The driver will become a passenger, whose role will be limited to choosing the destination and route, and optionally the mode of covering the route. In conventional road traffic, it is the driver who makes a large number of decisions in a very short time. Some of those decisions may have tragic consequences. Especially if a sudden change in the situation on the road will make it impossible to avoid an accident. For example, if a pedestrian suddenly appears in the roadway and the only choice would be to either hit the pedestrian or avoid the pedestrian collision by choosing a tree on the shoulder or a bus full of passengers coming from the opposite direction. At present, the law cannot determine liability if this critical decision is made by a computer controlling the vehicle. New dilemmas will arise, which are going to be difficult for artificial intelligence to resolve. They will concern fully automatic vehicles (level 5). The computer will need to decide whether to save its passengers or other road users. Each possible choice will have legal consequences; both if passengers of the autonomous vehicle or third parties will suffer as a result of the selected manoeuvre. This poses a new serious challenge for insurance companies in the context of paying claims under motor Third Party Liability (OC) (*The future of the car* 2015). In the future, this liability will most likely be transferred from the driver onto the vehicle manufacturer or the provider of a transport service. This shows the scale of the problem which will need to be dealt with in the very near future. This will need to be dealt with not only by insurers, but also by legislators and the law, since the system does not yet provide for settling dilemmas of this type.

Moreover, other new risks will appear. One example is perhaps the first fatal accident in automotive history in a Tesla S car that was moving in the autonomous mode, which happened in 2016 (*Tesla Press Information* 2016). The cause of the accident was a software failure of the Tesla autopilot, which interpreted the side of a truck trailer blocking the road as a part of the sky, and therefore it concluded that there was no obstacle in the road. This accident also reveals another problem. As was presented above, before autonomous vehicles become common, lower levels of automation will be functioning first, which require the driver to pay attention in critical moments. We cannot however

expect anyone to be capable of reacting immediately after the vehicle has travelled without the driver's assist for a few hundred kilometres, and suddenly the situation on the road exceeds the adaptive capabilities of the autonomous vehicle. It is only the driver's reflexes that can prevent a disaster. The tragic example of the Tesla accident is the best proof of that. Insurers will be forced to establish liability in complicated situations by determining the cause of the accident as well as human or machine liability.

The second group of challenges results from the change in the model of individual transport mentioned above. They may turn out to be some of the most serious dangers that the insurance industry will need to face in the near future (*The insurance industry*... 2015). On the one hand, increased safety of road traffic will contribute to limiting costs, but on the other hand, a dramatic shrinking of the motor vehicle insurance market on the global scale will be a considerable factor for generating profits. Presently, in Europe they constitute about 27% of insurers' profits (*European Motor*... 2015).

Decreased profits are not the only problem. The obligatory character of Third Party Liability (OC) currently constitutes an essential factor in obtaining new clients. The emergence of autonomous vehicles will force changes in sale models in the retail customer sector.

Instead of the disappearing Third Party Liability (OC) for individual clients, a new market for Third Party Liability (OC) will emerge for providers of transport solutions based on autonomous vehicles, who will most likely take the liability for accidents. However, at this stage it is difficult to foresee how this market segment will be formed. It is highly probable that this market will be much smaller than it is now, partly because of the smaller number of cars and the frequency of claims.

Apart from typical liability for accidents, it will be necessary to evaluate the cybernetic risk connected with the purposeful taking over of control, sabotage or disrupting the functioning of a single autonomous vehicle or a larger number of them at the same time (*The future of the car* 2015). The motivation behind these types of actions could be, for example, a new form of a terrorist attack or another kind of crime driven motivation.

The market for comprehensive motor insurance (Autocasco) will also experience a thorough transformation. Most likely, it will also be reduced rapidly, due to the above-mentioned factors and also due to the elimination of the risk of car theft.

Calculating and diversifying contributions will become a new challenge, for example, depending on whether the car is driven by a human or a computer. A large part of personal income, which so far has been spent on the purchase and use of cars, will be spent on something else, which is also an opportunity for insurers.

Insurers will be forced to deal with the need to adjust to the shrinking market of classical motor vehicle insurance. About a decade ago, such a scenario was a complete abstraction.

Summary

In the near future, the insurance industry will face a revolution as significant as the invention of the car. It is not possible to stop the automation of transport, which is the direct result of technological development and the common pursuit of safety, economy and comfort in transportation. The insurance industry still has time to adjust to these inevitable changes, which bring both opportunities and risks. Furthermore, the scale and the manner of mass usage of vehicles will change drastically.

To sum up: the biggest threat for the industry is the reduction of the motor vehicle insurance market and a change in the retail sale model. This is confirmed by the following factors:

– leaving the model of owning a vehicle, and therefore, the marginalisation of individual obligatory motor Third Party Liability (OC),

– transferring the liability for caused accidents from the driver to the broadly understood transport services provider,

– the possibility to take over risks covered by comprehensive motor insurance (AC) by the owners of large fleets of autonomous vehicles,

– disappearance of the classic risk of vehicle theft.

These changes create many opportunities and possibilities for developing new markets and insurance products.

The problems presented in this article require further research. It will also be necessary to monitor the subsequent directions set for the development of the technology of autonomous vehicles as well as the effect this development will have on the automotive and transport industries.

Translated by Adam Wroniecki
Proofreading by Michael Thoene

Accepted for print 31.03.2017

References

Automated and Autonomous Driving Regulation under uncertainty. 2015. International Transport Forum. International Transport Forum Policy Papers, 7, OECD Publishing, Paris, doi: http://dx.doi.org/10.1787/5jlwvzdfk640-en.

Eugensson A., Brännström M., Frasher D., Rothoff M., Solyom S., Robertsson A. 2013. *Environmental, safety, legal and societal implications of autonomous driving systems*. The 23rd Enhanced Safety of Vehicles Conference Research Collaboration to Benefit Safety of all Road Users. Paper number:

13-0467, Crash Avoidance #3: Vehicle Electronic System Safety: Controls, Cybersecurity and Automated Vehicles. http://www-esv.nhtsa.dot.gov/Proceedings/23/isv7/main.htm.

European Motor Insurance Markets. 2015. European Motor Insurance Markets. Insurance Europe.

Global Automotive Executive Survey. In every industry there is a :next' – See it sooner with KPMG. 2016. KPMG's 18th consecutive. KPMG.

PILLATH S. 2016. *Automated vehicles in the EU*. EPRS, European Parliamentary Research Service, Members' Research Service, PE 573.902, p. 2–12.

Re-inventing the wheel. Scenarios for the transformation of the automotive industry. 2015. PwC. https://www.pwc.com/gx/en/automotive/publications/assets/reinventing-the-wheel.pdf.

Road safety in the European Union, Trends, statistics and main challenges. 2015. European Commission. https://ec.europa.eu/transport/road-safety/sites/roadsafety/files/vademecum_2016.pdf.

Road traffic accidents in Europe and North America. 2015. UNECE. https://www.unece.org/fileadmin/DAM/trans/main/wp6/publications/RAS_Leaflet_2015.pdf.

Tesla Press Information. 2016. https://www.tesla.com/press.

The future of the car. Who's in the driving seat?. 2015. KPMG. https://assets.kpmg.com/content/dam/kpmg/pdf/2015/12/the-future-of-the-car-report.pdf.

The insurance industry in 2015. Top Issues. 2015. PwC. https://www.pwc.com/us/en/insurance/publications/top-insurance-industry-issues-2016.html.

Transforming Personal Mobility. 2013. Ed. L.D. Burns. The Earth Institute. Columbia University.

VIERECKL R., AHLEMANN D., KOSTER A., JURSCH S. 2015. *Connected Car Study. Racing ahead with autonomous cars and digital innovation*. Strategy&, PwC.