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Evolutionary & revolutionary: converging paths to autonomy and disrupting paths to motor insurance: A study of autonomous vehicles (AV) to understand why it matters, with special emphasis on liability insurance shifts

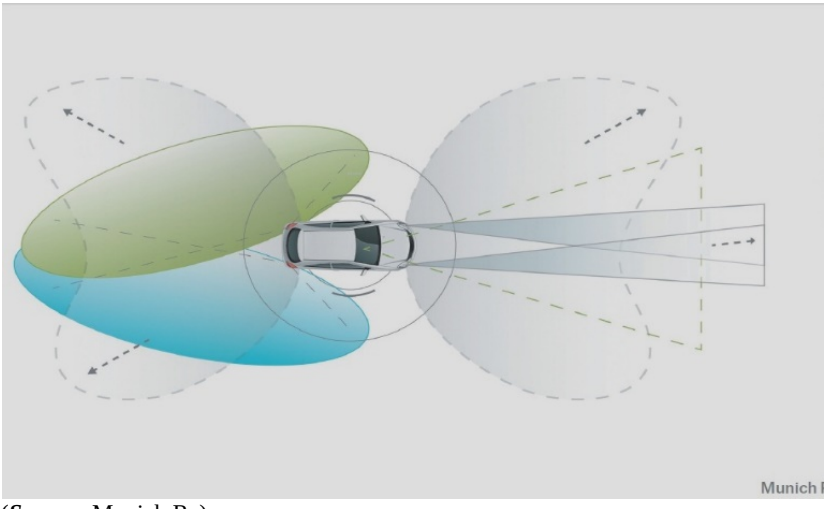
Dr. Subhasis Ghosh

Development Officer, Fellow of the Insurance Institute of India, Life Insurance Corporation of India (LIC), Port Blair, Andaman and Nicobar Islands, India.

Abstract
To drive or not to drive that is the question. AV scenario is like giving up your right to drive. Are you ready to do so? The conversion of autonomous vehicles (AVs) may bring about the most significant change to the automobile industry since its inception. As the way we drive and commute transforms, the amount, types and purchase of automobile insurance will be radically altered. The disruption to insurers may be profound and the change could happen faster than most expect. This paper synthesizes several months of research and analysis, discussions and brain storming sessions with industry stalwarts and it incorporates insights gained from these debates and incorporates graphs and pictorial representations from reports and manuals.
The advent of the autonomous vehicle era is upon us. Shifts of this scale won't happen through a singular change but will instead require foundational movements across the entire driving environment.
Research shows that over a long term, with the car stock being replaced by more and more AV, the risk profiles of vehicles on the road will substantially decrease, leading to much lower total losses for carriers. And the implications of extremely safer cars will, in our view, change the insurance landscape in general and liability lines in particular. I think the readiness is all.

Keywords: Autonomous Vehicles (AV), Driverless cars, MTPL, Liability Insurance, V2V, Motor Insurance, Loss exposures, MOV, Severity, Accident frequency, Risk Profile, Telematics, NHTSA, Distracted driving

Introduction
Visions of robotic self-driving cars may appear to be something from a George Lucas film, but in June last year this vision took a giant leap towards becoming reality when Nevada became the first state to enact legislation that allows driverless cars. The move allowed Google to begin testing their experimental driver less technology and that means the prospect of highways full of self-driving cars could only be a few decades away.
Whilst this reality will undoubtedly change our social lives in many ways, the impact of this new technology on the $200 bn automobile insurance industry will be equally profound. What we find is that there will be a narrow set of potential winners with a wide array of losers.



(***Source*:** Munich Re)

Fig 1: AV showing the use of RADAR, LIDAR, GPS devices for navigation

Led by the same Google engineer who co-invented Google Street View and whose team won an award for the development of a robotic vehicle in 2005, the driverless car system combines Google's advanced mapping technology with inputs from video cameras inside the car and various sensors and lasers outside.

Auto insurance represents the largest class of non-life insurance, with net premiums of almost $200 bn and over 250,000 employees working in the sector in the US alone. This is an industry fuelled by claims. With a motor vehicle accident occurring on US roads once every 14 seconds and a fatal crash once every 16 minutes it is clear why this has become such a big insurance market.

Company	Capability	Extent of automation	Implementation/ Expected introduct
Volvo[12]	Traffic jam assist	Stop-and-go up to 31 mph	2014
Mercedes-Benz[13]	Traffic jam assist	Stop-and-go up to 37 mph	2014
BMW[14]	Traffic jam assist	Stop-and-go up to 25 mph	2014
Nissan[15]	Self-parking	Vehicle that parks itself	2016
Audi[16]	Traffic jam assist	Stop-and-go up to 37 mph	2016
Tesla[17]	Autonomous driving	Auto pilot functionality	2016
Mobileye[18]	Autonomous driving	Fully autonomous technology (excluding country roads and city traffic)	2016
Cadillac[19]	Super cruise control	Stop-and-go up to 70 mph	2017
Ford[20]	Traffic jam assist	Stop-and-go highway traffic	2017
Google[21]	Autonomous driving	Fully autonomous vehicle	2020
Apple[22]	Autonomous driving	Fully autonomous vehicle	TBD
Cadillac, Mercedes-Benz, Audi, Nissan, Volvo[23]	Autonomous driving	Fully autonomous vehicle	*2020?
All manufacturers[24]	V2V communication	Pending mandate proposed by NHTSA, potentially issued by 2018	~2022

**No definitive assertion that these manufacturers will introduce fully autonomous vehicles by 2020. However, there is industry speculation that these companies could introduce fully autonomous vehicles by 2020.*

Note: Data from publicly available sources as of June 2015

Fig 2: Approximate date of launch of AV by various companies

The department of road transport earlier this year said the Government would work to provide "greater certainty around criminal and civil liability in the event of an automated vehicle being in collision. Until then these are all questions for insurers to consider."

Most insurers see the data as a way to reduce fraud, as information recorded by the car would allow investigators to determine the exact cause of an accident which could disprove fraudulent claims.

Will the motor insurance industry survive?

Every expert we spoke to was adamant that car insurance will still exist in a driverless future. There will still be a need for some sort of car insurance, no matter what happens, Mr. Baker said Insurers will have to adapt to keep up with the rapid pace of technology development. Of this there is no doubt, but calling into question their future existence is premature. Even with new safety measures, there will still be risk of theft, of hacking, of software failure—and where there is risk; there will always be a role for insurers.

Google's driverless car looks amusing, with its sensory equipment strapped to the roof. But the property and casualty insurers should not smile. Google's car is getting most of the press, but the autonomous car industry is growing far beyond Google's efforts and should greatly reduce the risks involved in driving. The current $200 billion in annual premium for commercial and private auto insurance in the United States could decrease over the next five years by as much as $75 billion.

It's hard to imagine a person voluntarily relinquishing the pleasures involved in driving their private passenger car. Driverless cars seems like might be an underwriter's dream.

What AV means in common parlance

An autonomous car/ Driverless car/ self-driving car/robotic cars are not the same. They have varying degrees of artificial intelligence built into them with Driverless cars the most advanced. They are all those subsets which have their innate capability of sensing their environment and surroundings and navigate without any primary human input. Multiple state of the art technologies are implanted to detect the surroundings using Lidar, Radar, GPS, Odometry and computer vision. Advanced control systems interpret sensory information to identify appropriate navigation path, obstacles and relevant traffic signals.

This system was implemented on 14th October 2015 in Tesla's 7.0 software release over the air updating. Another upcoming AV is the Cadillac's super cruise that will not require the driver to maintain hands on the wheel.

Why AV matters?

An increase in the use of AV would make possible such benefits

1. Avoid traffic collisions caused by human driver errors such as reaction time, tail gating, rubbernecking and other forms of distracted or aggressive driving
2. Increased roadway capacity and reduced traffic congestion due to reduced need for safety gaps and ability to better manage traffic flow

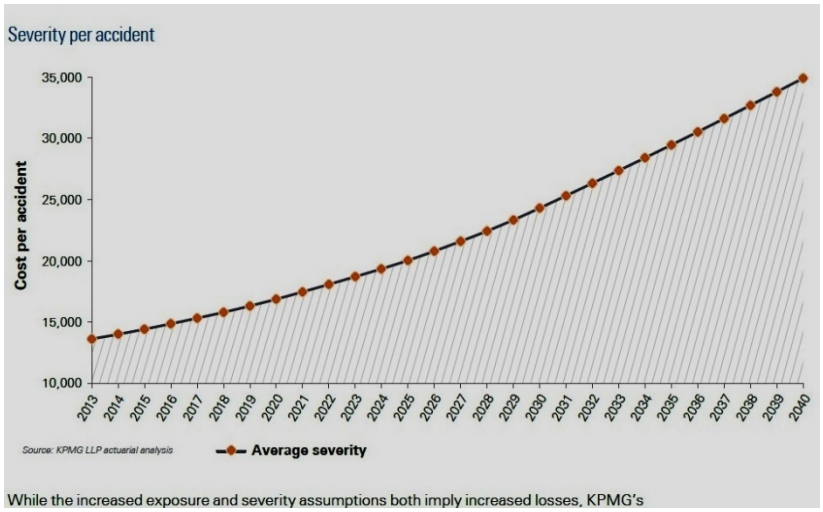


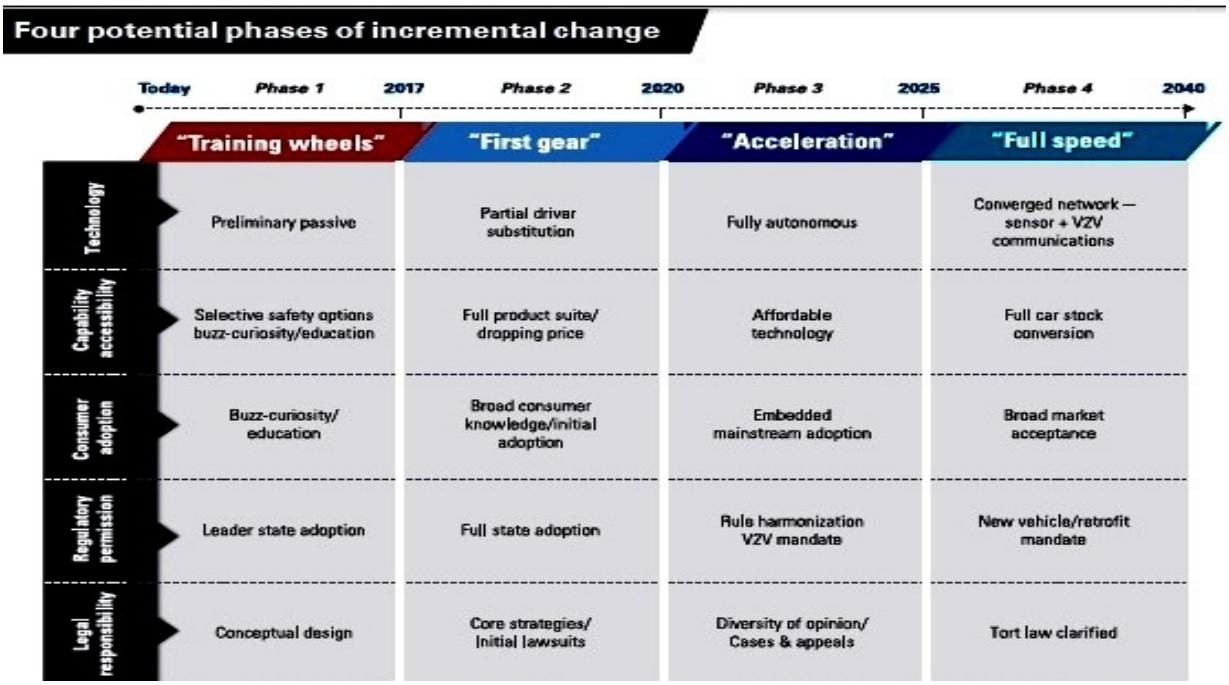
Fig 3: Represents average severity of accidents

3. Relief of vehicle occupants from driving and navigation chores
4. Higher speed limits for AV.
5. Removal of constraints on occupants' state-in an AV it would not matter whether the occupants were under age, over age, unlicensed, blind, distracted, intoxicated or otherwise impaired.
6. Reduction of physical space required for vehicle parking and vehicles will be able to park where space is not scarce
7. Reduction in need for traffic police and premium on vehicle insurance.
8. Reduction of physical road signage—AV could receive necessary communication electronically (although physical signs may still be required for any human drivers).
9. Smoother ride.
10. Reduction of car theft due to AV increased awareness.
11. Increased ergonomic flexibility in the cabin due to removal of the steering wheel and remaining driver interface, as well as no occupant needing to seat in a forward facing position.
12. Increased ease of use of large vehicles such as motor homes.

The Nevada law defines an AV to be

"A motor vehicle that uses artificial intelligence, sensors and global positioning system coordinates to drive itself without the active intervention of a human operator." This law also acknowledges the operator will not need to pay attention while the car is operating itself. Google had further lobbied from an exemption from a ban on distracted driving to permit occupants to send text messages while sitting behind the wheel, but this did not become a law. Furthermore, Nevada's regulation requires a person behind the wheel and one in the passenger's seat during tests.

.In spring 2015, the Federal Department of Environment, Transport, Energy and Communications in Switzerland short UVEK, allowed Swisscom to test a driverless Volkswagen Passat on the streets of Zurich.



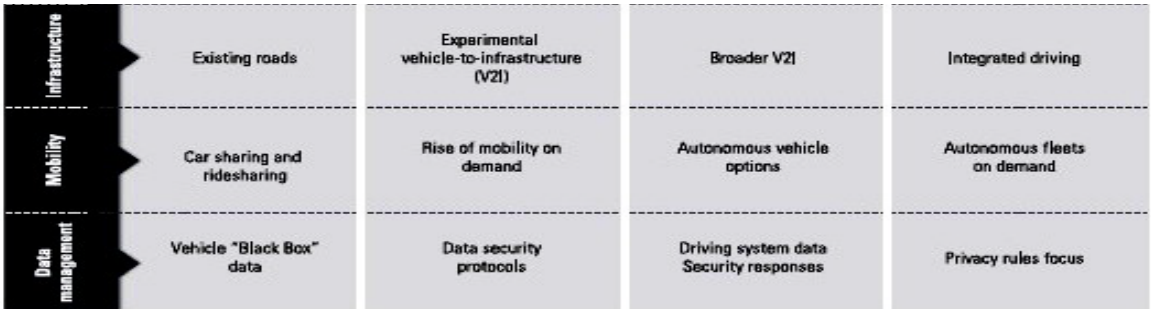


Fig 4: Represents the various changes in phases

Survival of the fittest: A new insurance landscape

While there will be a wide variety of effects on insurance from the rise of driverless vehicles, research at KPMG says that the increased safety features of these vehicles will have the most profound impact on auto insurers over the long term and will be the underlying force behind industry trends such as reduced auto insurance market size, consolidation in the personal lines space, and dramatic operational changes within carriers.

It all starts with safety. With more than 90%of accidents each year caused by driver error, well tested, road safety technology—the beginning of which we have seen in traffic jam assist, lane departure warnings and other collision avoidance technology, will partially remove the erroneous human element of driving from the streets. Furthermore, especially as "Level 4" fully AV become increasingly commercially viable over the medium term, human involvement in the driving experience will literally take more and more of a back seat.

Accident frequency could drop by 80 percent

Various research of the automotive teams and leveraging their extensive research, the insurance task force developed actuarial models to translate the technology and market changes into shifts across the core factors that drive insurance company performance.

KPMG research baseline scenario is presented with accident frequency projected to 2040, taking into consideration a variety of factors, including the increased proliferation of safety technology such as accident avoidance and parking assist commonly found in driverless vehicles until level 4 fully AV are widely available in 2025. In the final full speed phase of the conversion, from 2025 until 2040 the car stock will likely be replaced by or retrofitted with autonomous technology. The team estimated an 80 percent potential reduction in accident frequency per vehicle by 2040, resulting in roughly 0.009 incidents per vehicle. This change would result in a new normal, sooner than most in the industry anticipate.

More expensive components could increase severity, maybe

The potentially drastic reduction in incidents per vehicle would be somewhat offset by the increased severity incurred in each accident, given the greater likelihood of higher priced vehicles with more costly technology underpinning the autonomous capability. Research estimated the current accident expense could increase from almost $14k to roughly $35k by 2040. This is a conservative view. There is some debate about how expensive the future cars may actually be. An alternative view is that car, or at least a large subset, become more like transportation pods, which are inexpensive, basic vehicles used to move people in urban settings. Such a scenario could flatten or reduce severity.

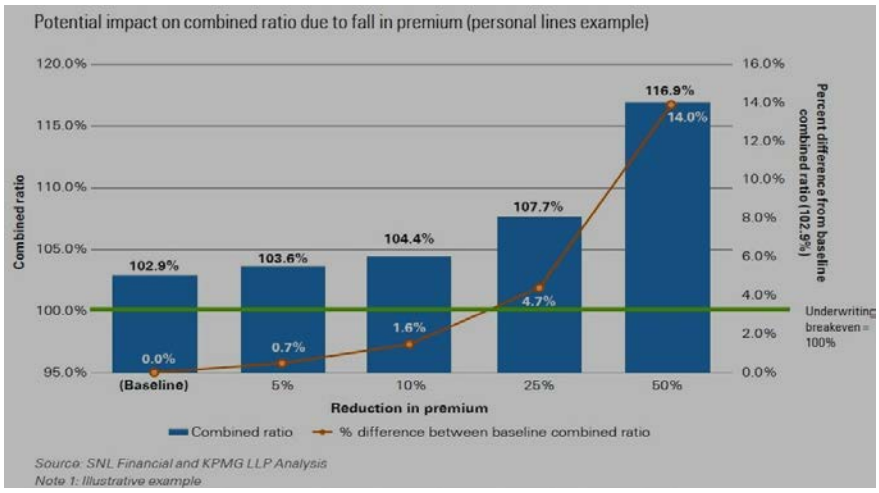


Fig 5: Impact on combined ratio due to fall in premium (Source KPMG)

Furthermore according to research, losses covered by product liability policies will most likely increase due to the fact that sophisticated technology that underpins driverless vehicles will also need to be insured.

While the increased exposure and severity assumptions both imply increased losses. Baseline scenario model suggests that decline in frequency could be even more pronounced with the average number of miles driven per accident increasing from roughly 280,000 miles per occurrence to an incident every 1.6 million miles by 2040.

Industry loss costs could drop by 40 percent.

When combining accident frequency and severity assumptions, there is a potential for a 40 percent plus drop in total loss in 2040, when compared to that of 2013. While considering such a scenario a middle ground approach was taken. For example, government mandates around the technology, including a broader and faster web of V2V technology, could further accelerate the downward trend.

Lower losses lead to lower premium

Premium follows loss costs. Whether personal or commercial, auto insurance is a mature and competitive industry and given these market potential dynamics, it would be naïve to think that premium will stay the same while losses drop, thereby dramatically increasing underwriting profit for carriers. On the contrary some researchers believe that carriers could drop price in order to stay competitive. Plus consumers will no doubt demand lower premiums to reflect fewer accidents.

As the size of the market shrinks, we anticipate the potential for frenzied competition as firms attempt to maintain premium volume to cover operational expenses or market share. Carriers could potentially lose sight of pricing business for profit. This irrational pricing behaviour by either well capitalized or troubled companies could result in a dangerous downward underwriting spiral for the broader industry. Things could get ugly anytime.

Legal Implications

I have few doubts that the regulatory implications and requirements, the complexities of which at times appear somewhat exaggerated, will be addressed in a timely fashion. The liability and insurance related implications however are both interesting and challenging. One of the core aspirations of the AV concept is a drastic reduction of automobile accidents as a result of the massive reduction of the potential for human error. Currently, depending on the country as much as 95% of automobile accidents are estimated to be caused by human error. If this aspiration is realized, it is clear that insurance loss costs will diminish significantly.

Option 1: Product liability deemphasized

The first approach starts is a rather traditional way, with the human owner/ driver as the focal point. In a highly automated car, the (human) driver and the "e-driver" (the electronic array that enables the car to operate autonomously during portions of a journey) form a "team", pretty much as pilot and auto pilot in a commercial aircraft. As stated earlier, within an MTPL regime based on strict liability, it poses no difficulty whatsoever to hold the (human) owner/and driver liable for accidents caused by the e-driver (irrespective of whether the latter has a product defect or not).

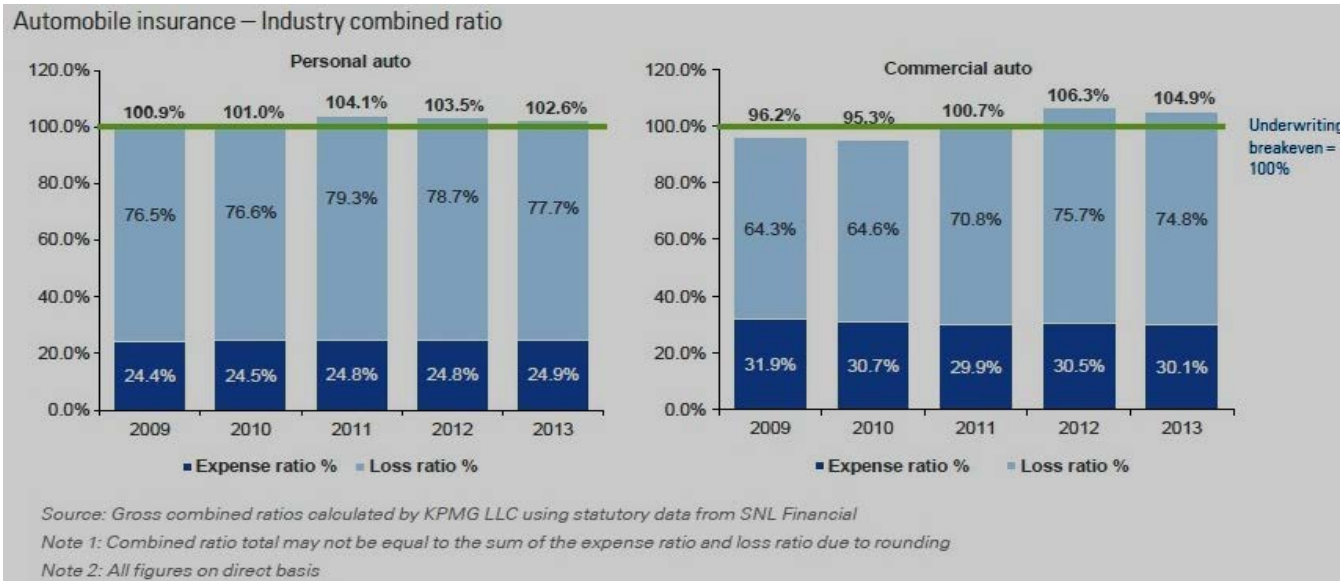


Fig 6: Represents industry combined ratio for personal and commercial auto

The question remains as to what happens with the manufacturer's liability. In order to avoid complex, expensive and possibly futile litigation, the law could exempt automobile manufacturers (as well as the suppliers relevant for AV functionality) from product liability for injury and damage that is covered under the MTPL regime and that was caused by a product defect affecting AV functionality. One may wish to make an exception to this exemption for cases where the defect is the result of gross negligence. On the other hand, and as a quid pro quo for this exemption, one could have automobile manufacturers participate in the loss cost of MTPL by mandating that automobile manufacturers contribute a portion of the MTPL premium due for each individual vehicle. Technically, one could consider implementing this by means of amending the road traffic act and introducing a contributory liability of manufacturers of highly/fully AV for accidents caused by their vehicles, unless the accident was not caused by the AV functionality of the car (the burden of proof being on the manufacturer)

It would probably be fair to limit this special manufacturer's liability within the MTPL regime to 10 years after the vehicle was put into circulation (subject to reinstatement of this

period if the manufacturer performs a full update or even a reinstallation of the AV functionality). If such a course of action is chosen, it would probably be pragmatic to include the manufacturer as an additional insured under the MTPL policy issued to the owner/driver.

Option 2: Product liability further sharpened

The second approach takes the opposite tack on the product liability side. It appears rather radical and is inspired by a proposal made by the Australian Law Reforms Commission in 1989, when a revision of Australian product liability law was under way. A distinctive, very deliberate element of this proposal was the omission of a requirement of a product defect.

Instead the manufacturer was to be held liable for injury and damage "caused by the way goods acted". A reference to "the way goods acted" was described as a "reference to any of the following"

1. The way the goods acted or behaved
2. The effects the goods had and
3. The failure of the goods to act or to behave in a particular way, or to have a particular effect.

The proposal was quite controversial, and at the end legislation essentially in line with the European Directive-requiring a product defect to be proved by the claimant was passed.

While a general product liability regime without a requirement of defectiveness still seems an outlandish proposition, one could perhaps justify such a system for highly specific contexts and limited in scope. Here the following argument could be made. While the highly and fully AV will be much safer than conventional cars, the technology in the product is so complex that there is an uncontrollable *residual risk* of "malfunctioning" even when the product is, strictly speaking, free from defects. Under these circumstances, one could argue that the manufacturer can in fairness be held liable for injury and damage, along with the owner/driver. If one favour such a solution, this would once again need to be accomplished in a uniform fashion throughout the EU by means of partly amending the Council Directive 85/734/EEC for the automotive sector, or at least making an option to that effect available to member states. A "minimally" invasive way of amending the regime in this sense would be the introduction of an irrefutable presumption of a defect in a highly or fully automated vehicle that causes an accident, unless the manufacturer can prove that the AV functionality was not the cause of accident.

Since the 1960's the insurance industry has been a major force behind the most significant advances in highway and vehicle safety including electronic stability control requirements, seat belt use and automobile crash worthiness. Now AV technologies offer an opportunity for us to advance another milestone in vehicle safety, going beyond keeping people safe in a crash to avoiding the crash altogether.

Implications for commercial and personal operators

By reducing accidents caused by human error, the market for liability coverage, and perhaps the coverages themselves, may be impacted significantly, not just for manufacturers but also for vehicle owners and operators.

Personal auto insurance providers have publicly acknowledged that advancements in vehicle technology and safety features including the development of autonomous or partially AV represents a significant business risk. Regardless of the impact on the size of the market, for liability coverage, participation in the liability market may change significantly.

Liability shifts with AV functionality.

As with the manufacturer liability, responsibility for loss will likely be assigned based on whether a human driver or the AV system was operating the vehicle at the time of loss. Exposure for loss may still be largely borne by the owner/operator during Levels 1-3, as the vehicle is more likely to be controlled manually.

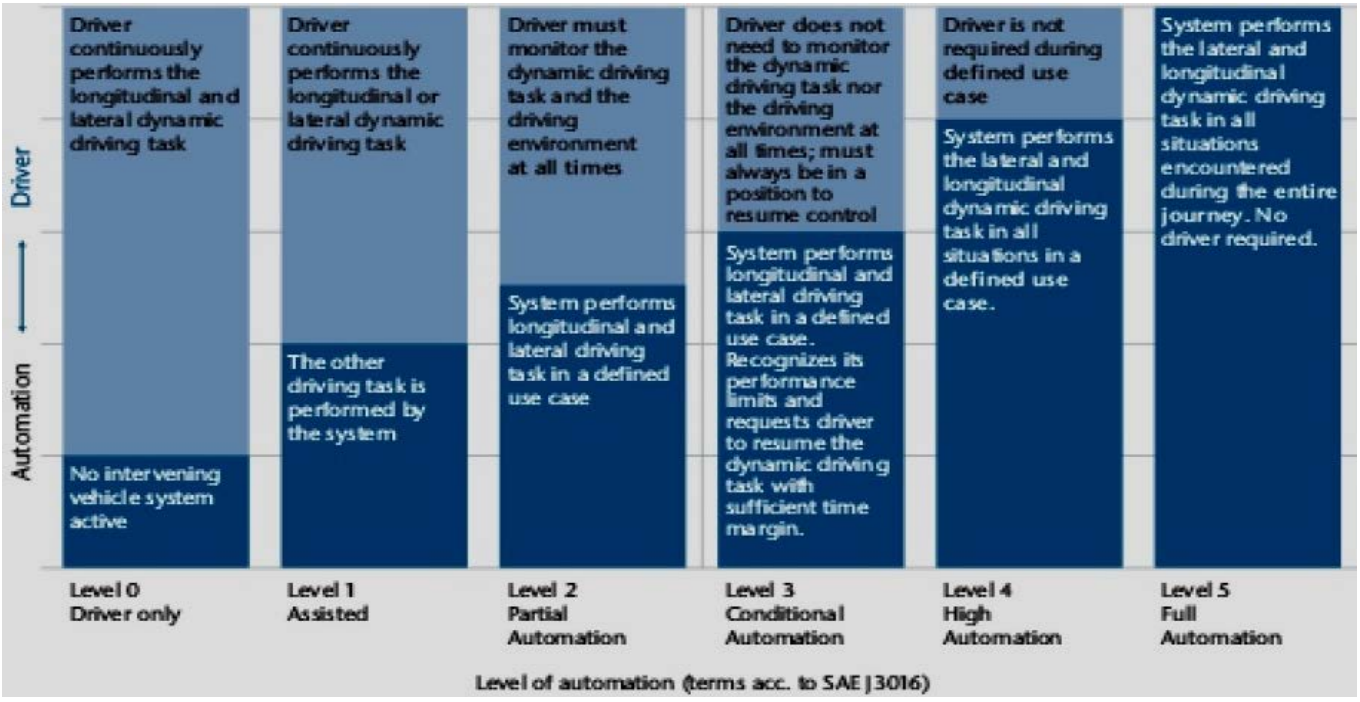


Fig 7: Levels of automation

No substantive change in the coverage for the driver/owner of the vehicle is anticipated. At Level 4, the majority of the responsibility will likely shift to the manufacturer in circumstances where the operation of the vehicle is handled solely by the AV system. However, the operator may still be required to maintain the vehicle, and liability could attach to the operator for a loss arising out of failure to maintain it properly.

There is also a potential for the vehicle to be considered a permissive user or an agent of the operator, thus making the operator responsible for the loss.

As with manufacturer liability, personal and commercial liability ultimately will be decided by the courts on a case-by-case basis, and as such is difficult to predict with certainty.

Coverage shift with liability

As vehicle safety improves during levels 1-3 of AV development, traditional bodily injury and property damage liability coverage as well as optional and mandatory physical damage coverages, uninsured/underinsured motorist coverages and personal injury protection (no fault) coverages may not change significantly. This is because it may still be necessary to determine whether the driver, the component part/technology or some combination of the two, caused an accident.

One may envision that any shift in the coverages may not occur until automation reaches Level 4.

During this phase liability to the operator or owner may decrease significantly. Auto physical damage coverage may increase due to costlier aftermarket replacement parts.

Development of this phase and the nature of insurance coverages will likely be heavily regulated, perhaps bolstering coverage requirement.

New coverage options may emerge

Physical damage covers are designed to protect the vehicle owner from losses that cause damage to the vehicle, including collision, theft or vandalism and other perils. Some notable coverage considerations that may emerge as vehicles add parts and systems that make them more autonomous include.

Physical damage coverages (First party)

1. **Stated amount physical damage coverage:** This valuation method, which pays the lesser of actual cash value, repair cost or limit listed as a result of a covered accident, may become more prevalent due to the potentially high replacement and / or repair cost as a result of an accident.
2. **Exceptions to the "mechanical or electrical breakdown or failure exclusion:** Traditional personal and commercial auto policies generally exclude loss due and confined to mechanical and electrical breakdown.
3. **Revamping of the audio, visual and data electronic equipment coverage exclusion:** Traditional personal and commercial auto policies generally exclude any electronic equipment that reproduces, receives or transmits audio, visual or data signals, with an exception for equipment permanently installed. The original focus of this exclusion was sound system and communication devices(i.e. citizens band radios, cellular phones, etc.) however, since visual and data signals are a major component of AV's and will likely be costly to replace, revisions to the exclusions are likely.
4. **Custom Equipments / Furnishings:** As the technology evolves and less input from an operator of the vehicle is necessary for safe operation, the living space of the vehicle could start to resemble living quarters, complete with entertainment systems and furnishings not typically associated with a traditional auto.

Liability coverages and physical damage coverages (Third party and first party)

1. **Weather related exclusions:** Due to potential weather related limitations of AV's on snow or ice covered roads, insurers could implement weather related operations limitations and exclusions.
2. **Radius of operation and road type limitations and restrictions:** Insurance coverage may specify certain distances or types of roads, such as public roads.
3. **Failure to maintain or adhere to self-driving AV protocols:** Since these vehicles are highly technical and complex, they will likely to be held to rigorous technical standards that might require maintenance on a routine basis.
4. **Cyber-Liability coverages:** AVs employ wireless communications system to communicate with other vehicles or networks. Manufacturers may need coverage for the risks of cyber-attacks, hacking and breaches of data privacy.
5. **Resurgence of no-fault type coverage:** If assigning fault in an auto accident involving AV proves difficult and time consuming, resulting in delays in compensating injured victims of auto accidents, there could be a resurgence of no-fault type coverages.

Tools of the trade may change

Underwriting tools will also likely to be impacted as AVs become more common. Today's underwriter relies on a number of tools to evaluate a risk. One such resource, a driver's motor vehicle record (MVR), is very important when underwriting an account requiring motor insurance.

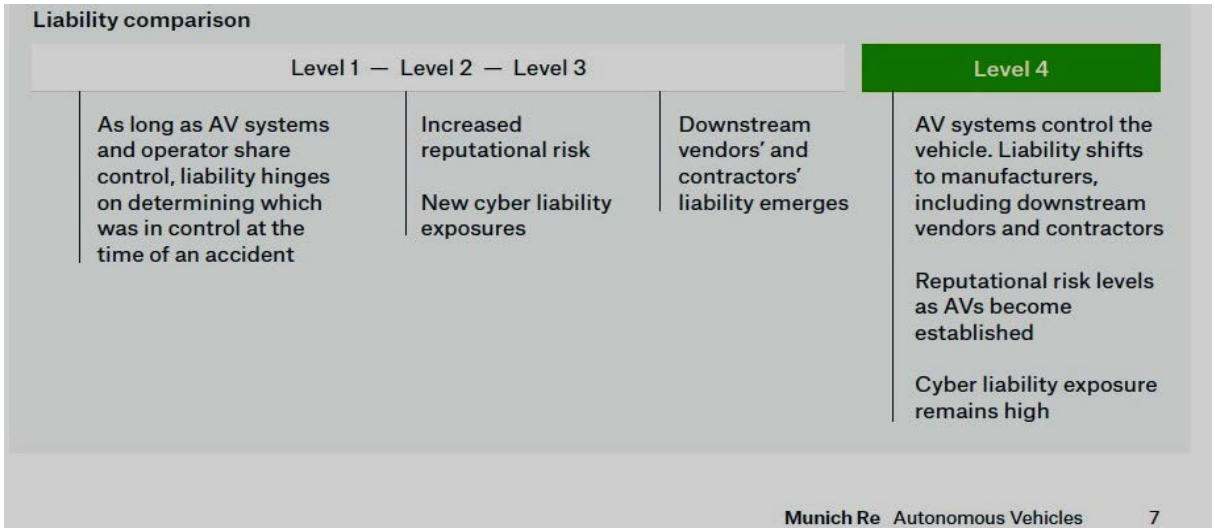


Fig 8: Liability comparison at various levels (Source Munich Re)

As manually operated vehicles (MOV) and AV technologies merge, will certain infractions shown on an MVR be seen more frequently? Will others decline? Is a traffic violation such as running a red light treated differently for an MOV versus an AV? Until vehicles become completely autonomous, MVR's will likely remain a key tool in analyzing the exposure any driver presents.

Just as certain losses among today's MOV's may lead an underwriter to decline an account, the same will likely be true of AV's in the fleet of future. Is a fender-bender between two MOVs is different from one between two AVs? What if, when MOV meets AV, the AV is at fault? Does this claim indicate a systemic problem that the underwriter should analyze further? Careful observations and analysis of any emerging trends will be critical to expanding or restricting the underwriter's appetite.

Like any new technology, the cost of repair or replacement is typically higher initially which, in theory, will increase the cost of coverage. However this will likely be offset by the drop in the frequency of claims. Over time the cost to produce the technology should decline. In the long run many analysts agree that safer roads will likely lower the cost of insurance significantly.

Data remains the key

Industry analyst seems to agree that an AV will be inherently safer than an MOV and, as such, would generate a lower frequency of crashes. Assuming severity remains stable or declines, pure premium (the product of frequency and severity) would decline and it would cost less to insure the vehicle.

However in order to properly determine how much safer an AV is and to calculate the appropriate insurance premium, one needs to analyze a sufficient sample of accurate historical data to compare to MOVs.

Recent advances in Telematics system, which record driver behaviour and other data electronically, offer new and more reliable sources of data compared to driver-reported information. In order for these new data to successfully translate safety enhancements into lower insurance rates there must be a sufficient amount of quality data available for analysis.

Conclusions

AVs represent a potentially disruptive and beneficial change to the way in which we travel around.

This new technology has the potential to impact personal travel across a wide array of impacts including safety, congestion and travel behaviour. All told major social AV impacts in the form of crash savings, travel time reduction and fuel efficiency and parking benefits are likely of the order of $2000 per year per AV to nearly $5000 when comprehensive crash test costs are accounted for.

The conceptual sketches outlined above are not meant as blue prints more or less ready for implementation, but rather are intended to trigger further thinking and debate, hopefully on the way to a seamless solution with clear liability, clear coverage, and minimization of litigation. After all, if the technology really results in a massive reduction of accidents, in fewer fatalities and severe injuries on road, and in numerous other advantages, it is utter worth making the legislative adjustments that are conducive to making the AV technology practice a reality.

Yet barriers to implementation and mass penetration remain. Initial costs will likely be unaffordable and licensing and testing standards in the developed countries are being advanced at various levels. Liability regime remains undefined, security concerns linger and absence of privacy standards, i.e. a default lack of privacy for personal travel may become the norm. Finally, with the advent of this new technology, many impacts, and interactions with other components of the transportation system, and implementation details remain uncertain. To address these concerns, research in these areas should be expanded, areas should be expanded and US and all EU should create nationally recognized licensing structures for AVs and determine appropriate standards for liability, security and data privacy.

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References

1. Fisher Adam. Inside Google's Quest To Popularize Self-Driving Cars. Popular Science. Retrieved, 2013.
2. John Markoff. Google Cars Drive Themselves, in Traffic. The New York Times. Retrieved, 2010.
3. Sebastian Thrun. What we're driving at. The Official Google Blog. Retrieved, 2010.
4. Alex Knapp. Nevada Passes Law Authorizing Driverless Cars. Forbes. Retrieved, 2011.
5. John Markoff. Google Lobbies Nevada to Allow Self-Driving Cars. The New York Times. Retrieved, 2011.
6. Mary Slosson. Google gets first self-driven car license in Nevada, Reuters. Retrieved, 2012.
7. Ana Valdes. Florida Embraces Self-Driving Cars Retrieved, 2012-2013.
8. John Oram. Governor Brown Signs California Driverless Car Law at Google HQ Retrieved, 2012-2013.
9. New Law Allows Driverless Cars On Michigan Roads. CBS Detroit. Retrieved, 2013-2014.
10. CDA Press. Aye robot: Cd'A City Council approves robot ordinance, 2014.
11. Liz Gannes. Google Introduces New Self-Driving Car at the Code Conference - Re/code''. Re/code.
12. Google's 'goofy' new self-driving car a sign of things to come. San Jose Mercury News. Retrieved, 2014.
13. KPMG report on AV, 2015.
14. Munich Re report on AV, 2015