Autonomous vehicles: mortality and insurance implications

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In 1908 Henry Ford profoundly changed the automotive industry by developing and manufacturing automobiles at scale. The Ford Model T is generally considered to have been the first affordable car, subsequently ushering in the era of mass-market transportation and leading to widespread societal changes around the world.

110 years later, in 2018, the recent advances in computing power and artificial intelligence have made the previously science-fiction idea of living among unmanned vehicles, capable of navigating their landscapes without human input, a reality. A number of companies are already testing their vehicles in various locations and, since 2009, Google-owned Waymo has already driven more than five million (real road) miles, using self-driving technology (Waymo, 2018). Clearly, in a similar fashion to Ford's global impact, autonomous vehicles are also set to change society, by significantly altering the way in which we travel.

The areas of potential impact are wide and far-reaching and could include:

- reduced car ownership
- radically different car design geared more towards comfort and luxury
- more older drivers, fewer taxi/bus/truck/delivery drivers
- lighter burden on hospital and emergency services from fewer road accident injuries
- significant improvements to rush-hour traffic.

However, perhaps the most significant and important implications, at least to the actuarial profession, are expected to be reduced mortality and morbidity from traffic-related accidents and an overhaul of personal auto-insurance risks.

Mortality and morbidity implications

Previous research has indicated that more than 90% of road accidents today are a result of human error. For example, the National Motor Vehicle Crash Causation Survey conducted between 2005 and 2007 attributed critical crash causation as follows:

Figure 1: Vehicle Crash Attribution

Crash Attributed to:	Percentage
Drivers	94%
Vehicles	2%
Environment	2%
Unknown critical reasons	2%
Total	100%

Source: National Motor Vehicle Crash Causation Survey (USA), 2005-2007 (cited in Singh, 2018)

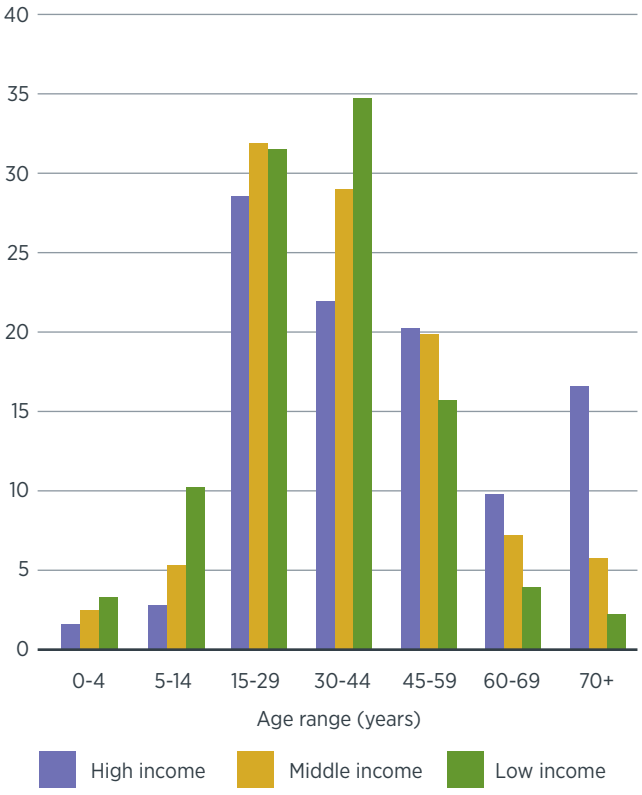
As we try to forecast and imagine the future driverless world implications, we should firstly note that nearly 1.3 million people die globally in road crashes each year and an additional 20 to 50 million people worldwide are injured or disabled (Association for Safe International Road Travel, 2013). Indeed, road traffic injuries are currently estimated to be the ninth leading cause of death across all age groups globally and the leading cause of death among people aged 15-29 years (World Health Organisation, 2015). Given the potential for driverless cars to reduce accidents caused by human error, clearly the mortality and morbidity implications from autonomous vehicles are profound.

It is of particular interest to consider where these mortality effects are likely to have most impact. Unsurprisingly, traffic-related deaths are not uniform across geographic location, socio-economic status, gender and age groups.

The World Health Organisation (WHO) highlights some of these disparities, as follows:

- **Income:** The global average number of deaths per 100,000 population is 17.4. However, the breakdown between low-income, middle-income and high-income is 24.1, 18.4 and 9.2 respectively (WHO, 2015).
- **Location:** The African region has the highest fatality rates (26.6 per 100,000 population) and Europe has the lowest (9.3 per 100,000 population) (WHO, 2015).
- **Age:** 60% of road traffic deaths are among 15-44 year olds (WHO, 2013).
- **Gender:** 77% of all road traffic deaths are men (WHO, 2013).

Figure 2 (opposite): Proportion of road traffic deaths by age range and country income status



Source: World Health Organization (2013)
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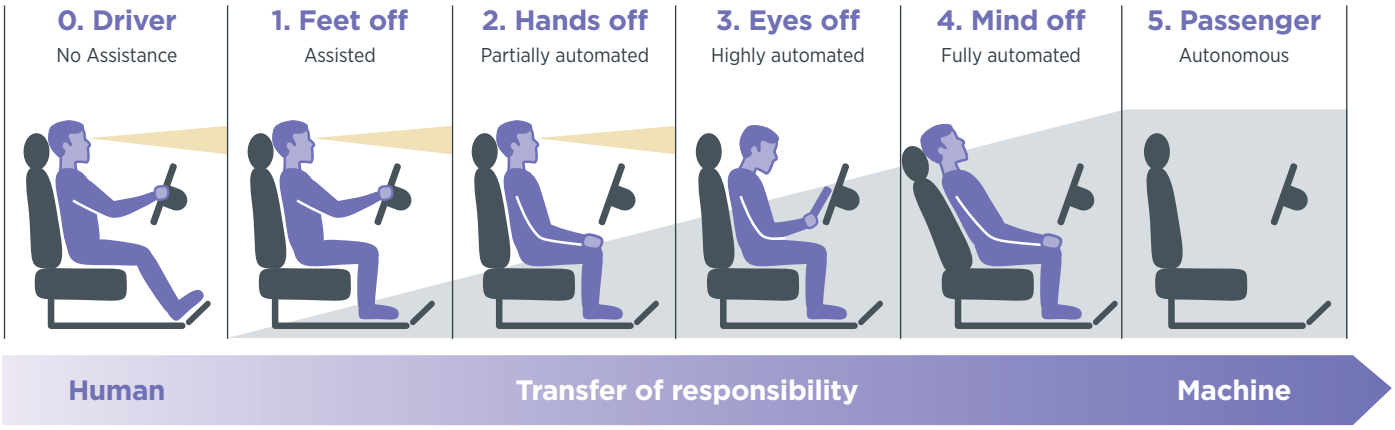
In terms of the potential for improvements in vehicle accident-related mortality and morbidity, this may depend on the degree to which drivers in society can and wish to transition from fully operating vehicles to vehicles that are completely automated. Despite recent advances, there are still many hurdles and obstacles to overcome, and like any innovation there will be a prolonged period of transitionary change before autonomous vehicles become mainstream. According to the Society of Automotive Engineers' (SAE) J3016 standard there are six different levels of automation from level 0 (no automation) to level 6 (full automation), as shown below.

Figure 3: The five stages of vehicle autonomy



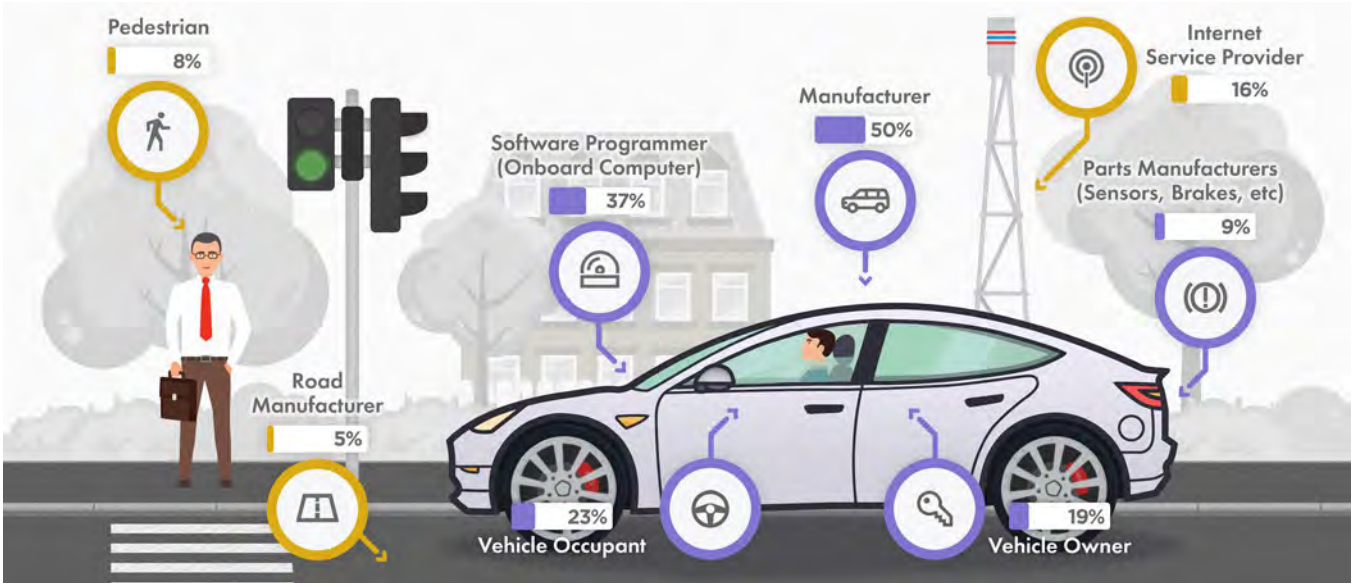
Source: Society of Automotive Engineers International, 2016

Insurance implications

Inevitably, the motor insurance world is going to change drastically as we move through the six levels of autonomy. As previously discussed, it's estimated that more than 90% of road accidents today are a result of human error. Hence, personal car insurance will be redefined as risk moves from vehicle users to vehicle manufacturers and software/hardware suppliers.

Attribution of liability will become a much more grey area as shown by AIG's survey (2017). Respondents were asked who would be 'most liable' in crash scenarios involving driverless cars (shown on the next page):

Figure 4: 'Risk shifting from driver to entities inside and outside the car'



Source: AIG (The Future of Mobility and Shifting Risk, 2017); reproduced with kind permission.

As the inevitable driverless world takes over, many traditional auto-related risks will no longer be as prevalent. Risks such as those caused by reckless or distracted driving, speeding, ignoring stop signs/red lights, unsafe lane changes, tailgating and road rage will be replaced by new, emerging risks such as malfunctioning software and cybersecurity.

The migration and ensuing calculation of risk will be particularly challenging during the 'chaotic middle' transition period where vehicle owners and the AI software share responsibility for the vehicle's operation and any resulting liability.

Clearly, we are entering a new era of transportation. Despite the many challenges ahead, it appears that significant changes will be increasingly felt across many different aspects of society, as autonomous vehicles make their way into our everyday lives.

References

AIG (2017). *The future of mobility and shifting risk*. (Innovation + Risk series; 8). December 2017. **https://www.aig.com/knowledge-and-insights/k-and-i-article-the-future-of-mobility-and-shifting-risk** [Accessed: 5 May 2018]

Association for Safe International Road Travel ([2013]). 'Annual global road crash statistics'; 'Annual United States road crash statistics'. **http://asirt.org/initiatives/informing-road-users/road-safety-facts/road-crash-statistics** [Accessed: 5 May 2018]

Society of Automotive Engineers (2014; 2016). *Taxonomy and definitions for terms relating to driving automation systems for on-road motor vehicles.* J3016_201609. **https://www.sae.org/standards/content/j3016_201609/** [Accessed: 5 May 2018]

Singh, S. (2018). Critical reasons for crashes investigated in the National Motor Vehicle Crash Causation Survey. (*Traffic Safety Facts: Crash; Stats.* Report No. DOT HS 812 506). March 2018. Washington, DC: National Highway Traffic Safety Administration **https://crashstats.nhtsa.dot.gov/Api/Public/ViewPublication/812506** [Accessed: 5 May 2018]

Waymo (2018). *Waymo safety report: On the road to fully self-driving*. **https://waymo.com/safety** [Accessed: 5 May 2018]

World Health Organization (2013). *Global status report on road safety 2013: supporting a decade of action.* **http://www.who.int/violence_injury_prevention/road_safety_status/2013/en/** [Accessed: 5 May 2018]

World Health Organization (2015). *Global status report on road safety 2015.* **http://www.who.int/violence_injury_prevention/road_safety_status/2015/en/** [Accessed: 5 May 2018]

Biography

Dr Mark Farrell is a Fellow of the Institute and Faculty of Actuaries (FIA) and Senior Lecturer at Queen's University Belfast. He is Programme Director of Actuarial Science and Risk Management at Queen's Management School. Prior to moving into academia in 2009, he worked as a pensions actuary and in actuarial recruitment in London, Toronto, Belfast and Dublin. He has a PhD in Finance and was a 2017 Fulbright Scholar. His research interests include Enterprise Risk Management and InsurTech as well as other actuarial science-related fields. He also blogs on related topics at **www.proactuary.com**.