UNIVERSITY OF LIMERICK
OLLSCOIL LUIMNIGH

SUSTAINABLE DEVELOPMENT G🌐ALS

8 DECENT WORK AND ECONOMIC GROWTH
9 INDUSTRY, INNOVATION AND INFRASTRUCTURE
11 SUSTAINABLE CITIES AND COMMUNITIES

Case study supports the following UN Sustainable Development Goals

Understanding the Risk in Developing Autonomous Vehicles

Details of staff conducting the underpinning research (names, job titles Dr Finbarr Murphy, Head of Accounting and Finance, Dr Martin Mullins, Senior Lecturer in Risk Management, Kemmy Business School, University of Limerick and members of Lero, the Irish Software Research Centre.

Summary of the impact:

Autonomous vehicles (AVs) challenge technology and design in many ways. Their deployment on our roads raises interesting legal, liability, and ethical questions. Dr Finbarr Murphy and Dr Martin Mullins, Kemmy Business School, University of Limerick and Lero the Irish Software Research Centre, have undertaken research in risk and liability that addresses these challenges.

Their research impacts industry competitiveness and expanded industry networks with numerous public and private partners through three EU funded projects[1]. Their work informs policy through the authors involvement in the European Commission expert group on future liability law (2019) which provides guidelines for testing autonomous vehicles. A year-long collaboration resulted in a public report[2]. Following on from this, Dr. Murphy was invited to present his findings and be questioned by the European Parliament Legal Committee (JURI). Ultimately, this will result in EU legislation on civil liability for AI which will be directly influenced by the Emerging Risk Group's (ERG) research.

Their research also contributes to the development of a novel teaching module, Risk, ethics, governance and artificial intelligence (AI), which is part of an MSc in

Dr Finbarr Murphy, Head of Accounting and Finance

Dr Martin Mullins, Senior Lecturer in Risk Management, Kemmy Business School, University of Limerick and members of Lero, the Irish Software Research Centre.

🟢🟢 The research has led to new underwriting processes. A campus spin-out company, Transgero, has been established to commercialise the work.

1. Cloud-LSVA, VI-DAS and Adapt Fin-Tech Spoke
2. Staudenmayer, D., Murphy, F. et al (2019) Liability for Artificial Intelligence and other emerging technologies. DG-Justice and Consumers, EU Commission. DOI: 10.2838/25362

Artificial Intelligence and other graduate programmes. The research has led to new underwriting processes. A campus spin-out company, Transgero, has been established to commercialise the work. Mullins and Murphy are developing ethical protocols to ensure fairness in the face of the applied ethical challenges posed by artificial intelligence.

Countries where the impact occurred: EU and specifically the countries listed below. UK, Germany, Israel, China, Chile, Greece, USA, Luxembourg.

Beneficiaries: Autonomous vehicles R&D industry, national and international policymakers, the insurance industry, general public, automotive and insurance consumers, students. Some specific examples include;

Details of the impact

The Emerging Risk Group is a multi-disciplinary team of researchers at the Kemmy Business School, University of Limerick who are tackling the challenges of the legislation and deployment of autonomous vehicles (AVs) for transportation and society. This research impacts the development of AVs and their underlying artificial intelligences. Moreover, this work impacts industry competitiveness, addresses skills shortages, and widens the industrial

network.

To expand the networks and partnerships in this ever-evolving field, the group have established Vision Inspired Driver Assistance System (VI-DAS), a research consortium dedicated to improving driver's reactions and safety on the road, through sophisticated driver assistance technologies. By observing drivers, calculating their perceptions and behaviour, and predicting their next actions, VI-DAS' technology aims to improve driver safety. The consortium is made up of research partners, such as Honda, Tom Tom, and IBM as well academic partners including Dublin City University and Karlsruhe Institute of Technology.

VI-DAS has also presented to the EU commission several times between 2016 and 2019 thus impacting the larger discussion at a European level around research and legislative priorities. In particular, University of Limerick researchers in VI-DAS have made recommendations on the management of legal and liability implications of level 3 automation. In particular, the research has focused on the issue of shared control between the driver and the vehicle. Furthermore, VI-DAS involves a consortium of research partners, mentioned above, all of which are at the forefront of the roll-out of ADAS technologies.

Skills shortages in artificial intelligence

are being addressed through the establishment of the Masters in Artificial Intelligence (online programme) at the University of Limerick. As part of the online programme, the Emerging Risk group are delivering a module Risk, ethics, governance and artificial intelligence (Source 2). The programme is industry led and developed with the support of companies working in AI in Ireland. Moreover a new programme hosted in the Kemmy Business School, M.Sc. Machine Learning in Finance (start date September 2020) is in large part a product of ERG research engagements. This programme has been adopted by Springboard, an education programme aimed at labour reactivation funded by the Irish government.

In the area of public policy formation, Drs Finbarr Murphy and Martin Mullins, are part of the European policymaking ecosystem. Dr Murphy, sits on the European Commission's Expert Group on liability and new technologies (DG-JUST). In 2019, Dr Mullins has been selected to participate in the European Insurance and Occupational Pensions Authority (EIOPA) Expert Group on Digital Ethics. EIOPA is an EU financial regulatory institution and has become concerned with digital ethics (i.e. ethics about technology). A key focus of this group was the protocols required for insuring Advanced Driver-Assistance Systems (ADAS) enabled vehicles.

A central concern of both industry and regulators are the set of ethical issues regarding what an AV is programmed to do in situations where human drivers can only react instinctively. If an AV is involved in an accident, the liability regime is very different. The decisions an AV developer makes are potentially open to ethical examination. This is particularly the case in unavoidable traffic accidents (UTAs) where the AV's on-board computer might need to make morally consequential decisions. For example, the driving algorithm may need to decide between privileging the safety of a biker without a helmet over a biker with a helmet.

Another area of impactful research is on the management of data. To help

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improve AV driving, data must be gathered on driver behaviour. VI-DAS-inspired technology uses sophisticated cameras and software to gather and process data on driver behaviour in real-time. The research group investigates how this data should be used and makes recommendations on how to manage such data, based on both ethical and legal issues. The impact of these recommendations is far-reaching; underpinning the research is imperative to protect privacy, regulate surveillance regimes, and ensure that vulnerable groups are not denied access to privately owned road transport. Findings on the data governance regimes will feed into EIOPA's deliberations on digital ethics for European insurers which is due to report in late 2020. The research is informing the practice of developing AI and AV. There are important problems with the migration of the driving function from the human driver to the machine, which many developers neglect or ignore because they have no easy engineering solutions and few legal precedents. This research impacts that discussion by recommending an interdisciplinary approach to this work, drawing on insights from the fields of ethics, computational science, and public policy. In response to industry need, it also impacts training and academic programme development resulting in a new programme, new modules, and graduates of AI research entering the workforce. Researchers from the Emerging Risk Group in conjunction with Lero will work with staff from Jaguar LandRover based in Shannon, Ireland on developing good practice around risk transfer in advanced ADAS vehicles. The statement of works is now agreed for this project.

The research has also led to new underwriting processes. This has been achieved through close collaboration between Emerging Risk Group researchers and insurance practitioners. The insurance risk consultant AXA XL states that, "Automated driving will entail a paradigm shift in terms of how risks implicit in our transport systems are managed … this line of business will be seriously disrupted over the coming decade. The research carried out in this area by the Emerging

Risk Group has helped AXA XL prepare for this future … Our work together has gone beyond underwriting methodologies and has included collaboration on necessary governance regimes around the data gathered from assisted driving technologies, (Source 3). From the perspective of our key partner, Vicomtech Research Foundation, "the Limerick team has been effective partners especially in terms of scientific outputs which are an important metric of success within the European Commission. The main attraction of the ERG group for us at Vicomtech is their very strong connections to the insurance industry across Europe." This engagement with Vicomtech has resulted in Dr Martin Mullins being appointed Visiting Professor for the period September 2020 to June 2020.

The Emerging Risk Group has formed a campus spin-out company Transgero, that has been established to commercialise the work (Source 4). Transgero is currently a partner in three H2020 consortia in the field of emerging risk. It also works with the global insurance company AXA-XL in developing bespoke risk transfer solutions around AVs. The UL spin out creates machine learning tools that allow insurers to access the risk posed by emerging technologies, including semi-automated vehicles. The tools utilise hybrid qualitative and quantitative models to capture incomplete or even missing data into a software model that estimates risk with confidence intervals.

Sources to corroborate the impact

1. Policy Document, Connected and automated mobility in Europe https://ec.europa.eu/digital-single-market/en/connected-and-automated-mobility-europe
2. University of Limerick, Programme outline MSc in Artificial Intelligence, [Online] Available at https://ece.ul.ie/lm719-master-of-artificial-intelligence/ [accessed 05.02.20]
3. AXA XL, testimonial, company.
4. Spin-out company established Transgero.eu
5. Agreement between Vicomtech and UL on Research Collaboration.

Underpinning research

The 21st century vision of the future posits the idea of automated and connected cars. However, it is not yet clear when there will be complete automation. For the next decade, the responsibility of driving will be shared by humans and machines (Ref 8). This makes questions of risk (what can happen), ethics (what should and shouldn't happen), and liability (who is responsible for what happens) much more complex. Society needs to confront this new set of risks and ethical questions from autonomous vehicles. For the first time, risk includes the ability of socially embedded forms of AI designed to make complex decisions: decisions that will engender tangible life and death consequences.

AI decision-making is inherently different to human decision-making processes. There are questions about how AI weighs decisions, how we are to mediate these decisions, and what such decisions mean in relation to others (Ref 3). Society, policy, and end-users need to fully understand the differences. There is a long tradition of utilitarian ethics in the West, whereby complex calculations are used to determine courses of action (Sen 1979) . In life and death situations on the road, will we allow the cars of the future to make such decisions?

Case studies research is a valuable tool in teasing out such ethics, risk, and liability of AV. Many ethical problems coalesce around what the industry refers to as unavoidable traffic accidents (UTAs). Consider the dilemma of an AV deciding which motor cyclist to hit – the one with a helmet or the one without a helmet. The safest course of action is to hit the helmeted biker. However, this appears to punish the biker for being a responsible citizen. It also makes it riskier to wear helmets in such a programmed environment.

This research group investigates questions around insurance, and through Transgero provides bespoke solutions to industry. Emerging technologies pose singular problems for underwriters as, by definition, there is little or no data on which to create

4 https://nanorigo.eu/, https://riskgone.eu/home-riskgone-project/about-us/project-structure-partners/ and https://www.asina-project.eu/

5 See https://connectedautomateddriving.eu/wp-content/uploads/2017/09/2017-09_European-Commission-Expert-Group-Report-on-Connected-and-Automated-Driving.pdf

6 See Sen, A., 1979. Utilitarianism and welfarism. The journal of Philosophy, 76(9), pp.463-489.

standard actuarial models. AI actions raise tough questions about who is responsible, and who should absorb the risk. For example, where accidents involve AV, who is liable? Is an AV something that can be fined, hold an insurance premium, tried in court? If not – which is likely – then who can instead?

While AV decisions can be contextualised to specific meanings, significant challenges remain in terms of the technology of AV decision-making, the conceptualisation of AI decisions, and the extent to which various actors understand them. This is particularly acute in terms of analysing the benefits and risks of AI decisions. Due to the potential safety benefits, autonomous vehicles are often presented as significant risk mitigation technologies: they reduce the risk of driving in comparison to human drivers. However, AV are not humans and do not learn as humans do. The AV's driving intelligence will lack certain decisional capacities. They are unable to annotate and categorise the driving environment in terms of human values and moral understanding. For example, unlike other humans, AVs are not capable of empathising with humans or their behaviour based on being human themselves (because they are not).

There is a need to scrutinise how autonomous vehicle decisional capacity is conceptually framed and how this, in turn, impacts a wider grasp of the technology in terms of risks and benefits. This groups research interrogates the significant shortcomings in the current framing of the debate, both in terms of safety discussions and in consideration of AI as a moral actor and offers several ways forward.

References to the research

1. Ryan, C., Murphy F. and Mullins M. (2019). "Semiautonomous Vehicle Risk Analysis: A Telematics⬛Based Anomaly Detection Approach", Risk Analysis

2. Sheehan, B., Murphy, F., Mullins, M., and Ryan, C. (2019). "Connected and autonomous vehicles: A cyber-risk classification framework", Transportation Research Part A: Policy and Practice

3. Cunneen, M., Mullins, M., Murphy, F., and Gaines, S. (2019). "Artificial Driving Intelligence and Moral Agency: Examining the Decision Ontology of Unavoidable Road Traffic Accidents through the Prism of the Trolley Dilemma", Applied Artificial Intelligence, 1-27

4. Murphy, F., Pütz, F., Mullins, M., Rohlfs, T., Wrana, D., and Biermann, M. (2019) "The Impact of Autonomous Vehicle Technologies on Product Recall Risk", International Journal of Production Research. DOI: 10.1080/00207543.2019.1566651

5. Murphy, F. and Mullins, M. (2018). Editorial for the special issue – Liability and insurance for semi-autonomous vehicles. Transportation Research Part A: Policy and Practice. DOI: 10.1016/j.tra.2018.07.014

6. Pütz, F., Murphy, F., Mullins, M., Maier, K., Friel, R., and Rohlfs, T. (2018). "Reasonable, Adequate and Efficient Allocation of Liability Costs for Automated Vehicles: A Case Study of the German Liability and Insurance Framework", European Journal of Risk Regulation, 9(3), 548-563

7. Sheehan, B., Murphy, F., Ryan, C., Mullins, M., and Liu, H.Y. (2017). "Semi-autonomous vehicle motor insurance: A Bayesian Network risk transfer approach", Transportation Research Part C: Emerging Technologies, 82, 124-137

8. Bellet, T., Cunneen, M., Mullins, M., Murphy, F., Pütz, F., Spickermann, F., Braendle, C., and Baumann, M.F. (2019). "From semi to fully autonomous vehicles: New emerging risks and ethico-legal challenges for human-machine interactions", Transportation research part F: traffic psychology and behaviour, 63, 153-164

Grants and awards

Underpinning research linked to UN Sustainable Development Goals:
Goal 8 Decent Work and Economic Growth
Goal 3 Good Health and Well-being
Goal 9 Industry, Innovation, and Infrastructure
Goal 11 Sustainable Cities and Communities