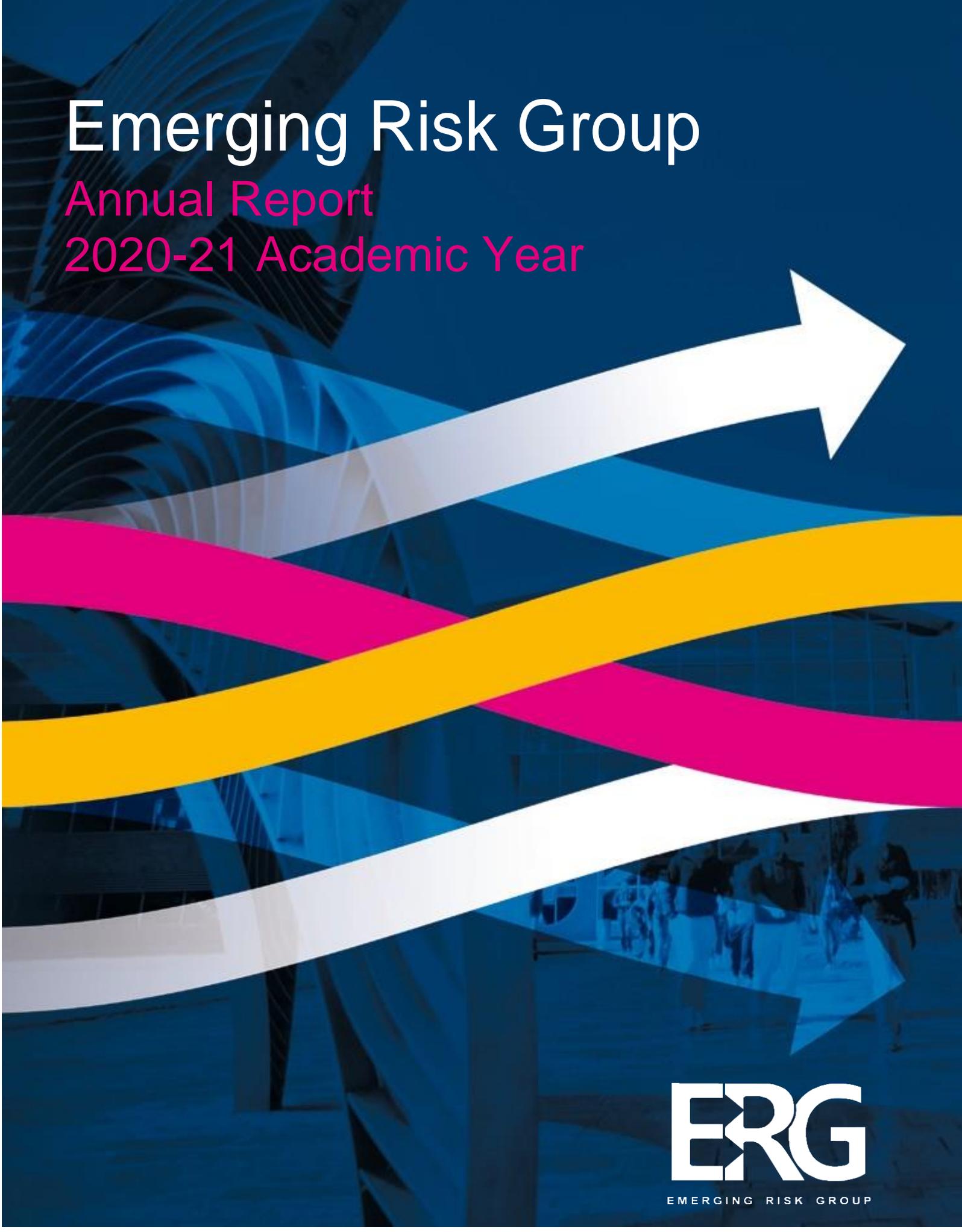


# Emerging Risk Group

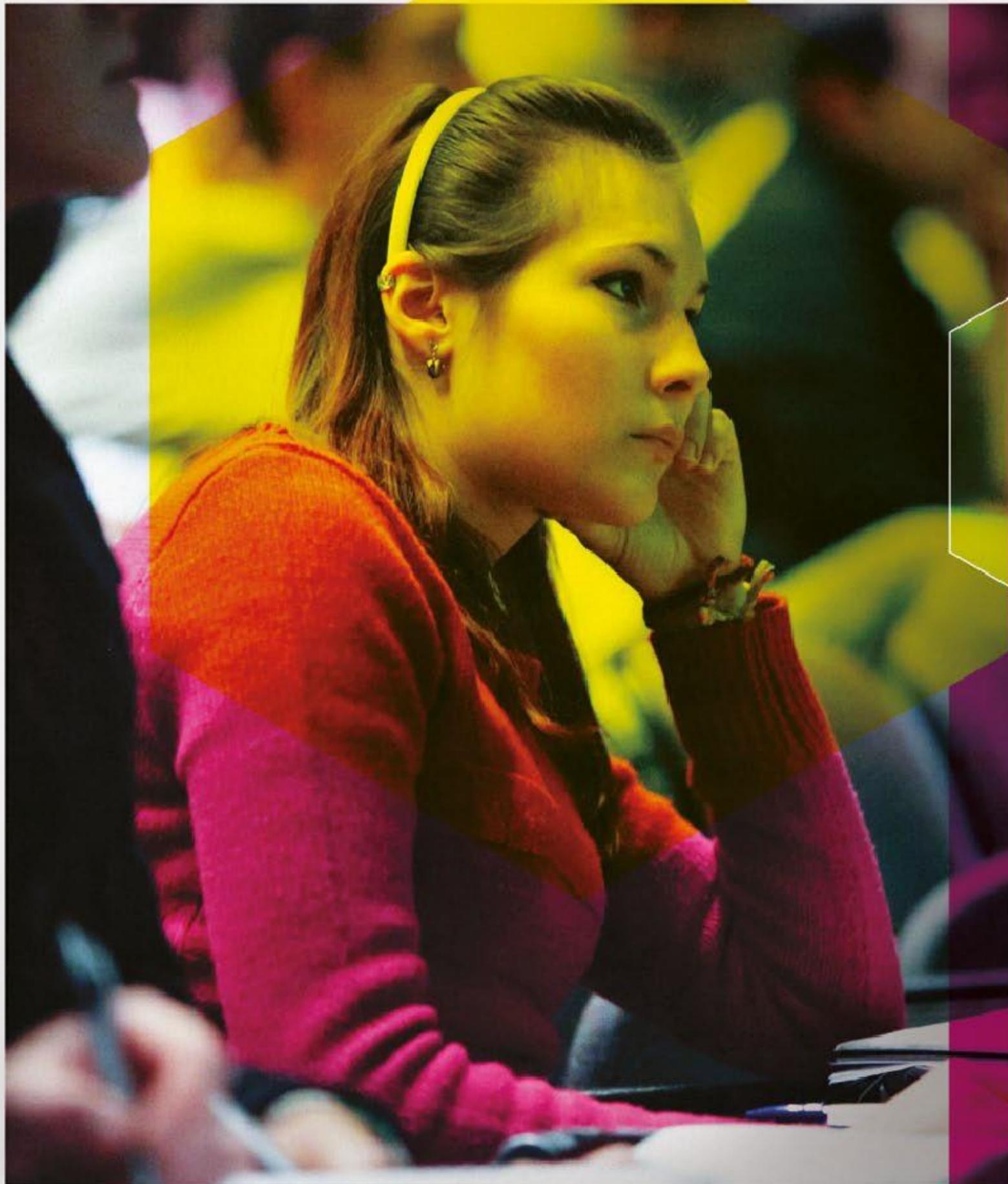
Annual Report

2020-21 Academic Year



**ERG**

EMERGING RISK GROUP



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# 1 MESSAGE FROM THE DEAN

Originally formed in 2007, the Emerging Risk Group has grown into an exemplar multi-disciplinary research team built upon a strong, collaborative scholastic mentorship programme.

During these turbulent times, I would like to focus on innovation and commercialising technologies and research, teaching and practice and advocating change – though not just change for change sake. What we have gone through over the last eighteen months has been change foisted upon us. This is a change we have embraced and responded to.

Consistent with our founding ethos at the Kemmy Business School, we value industry-relevant, pedagogically-informed and impactful research activity. Embedding our research culture across departments, themes and clusters is important in attracting exceptional faculty and will serve to inculcate an interdisciplinary approach that leads to innovation and a positive impact on our wide range of stakeholders. These activities will build on our funding successes both internationally (e.g. Horizon 2020 and ESRC) and nationally (e.g. SFI and EPA) and invigorate our commitment to Horizon Europe and other funding opportunities both nationally and internationally.]

The ERG is comprised of an international team of researchers devoted to advancing the state-of-the-art in areas as diverse as actuarial science, machine learning, ethics, risk management, nanotechnology, smart mobility and cybersecurity. The success of the team during the uncertain AY20-21 period is reflective of the group's core goals to lead positive change in the risk community and beyond.



Prof Finbarr Murphy  
Executive Dean KBS  
Senior Member ERG

**Kemmy Business School**  
University of Limerick





## 2 Emerging Risk Group: A Brief History

The Emerging Risk Group (ERG) was developed by founding members Dr. Martin Mullins and Dr. Finbarr Murphy in 2007, to develop a new context of academic research that was informed by private and public knowledge requirements.

The first focus of the group concerned risk metrication in the context of insurance attentive to a changing private and public emerging risk environment and market. Since that time the group has collaborated with SUN and grown in strength to offer a dynamic and unique research model.

One of the key strengths of the ERG is in its ability to respond to an ever-changing dynamic and fluid array of emerging risk fueled by a new paradigm of emerging technologies. To respond to this new phenomenon of emerging technological risk the group has built a collaboration of members that collectively present one of the most unique risk focused knowledge basis and research paradigms on offer today.

ERG has built upon its key areas of insurance, nanotechnologies, cybersecurity and smart mobility to be a part of the new European funded Horizon 2020 consortia concerning the development of Vision Inspired Driving Assistance Systems (Vi-DAS).

# 3 Our Team

all relevant aspects of K&S

## Summary

The Emerging Risk Group (ERG) at the University of Limerick has a long-established expertise in insurance and risk management and has a continued success within large research consortia including a number of EU H2020 and FP7 research projects. The group and its members are active participants in international research partnerships and regulatory bodies influencing societal change, such as EIOPA, ERTICO, and CCAM.

Although our primary goal as a team is to emphasise the broader impact that emerging technologies will have on social structures, we thrive off creating innovative solutions to fledgeling issues. We accomplish our commitments by regularly collaborating with established industry leaders, publishing in respected academic journals and participating in conferences.

We have just completed three EU Horizon 2020 research projects with a combined fund of €20 million, with more projects on the horizon. These included two EU H2020 research projects related to semi-autonomous vehicles: VI-DAS (<http://vi-das.eu/>) and Cloud-LSVA (<http://cloud-lsua.eu/>). Technical objectives predominately drive these consortia and our role is one of assessing the legal, ethical, and actuarial impacts of ADAS technology. In addition, we were tasked with assessing the risk of nanotechnology applications within the PROTECT (<http://protect-h2020.eu/>) EU H2020 project.

## Our Team Today

Our team members are based across Europe and cover a wide array of research areas, including machine learning, actuarial, insurance strategy, legal and ethical considerations of emerging technologies. The Group's network includes close affiliations with national research funding bodies (LERO, CONFIRM, Dublin City Council, the Road Safety Authority), and international research partnerships such as IBM, Honda, Valeo, XL Catlin, Motion-S, Lloyd's of London and many more.

### Emerging Risk Group Team:

- |                         |                                   |
|-------------------------|-----------------------------------|
| 1) Prof. Martin Mullins | 11) Mr. Wei Xu                    |
| 2) Prof. Finbarr Murphy | 12) Ms. Mahsa Mirzaei             |
| 3) Dr. Darren Shannon   | 13) Ms. Juliane Ressel            |
| 4) Dr. Martin Cunneen   | 14) Mr. Florian David-Spickermann |
| 5) Dr. Irimi Furxhi     | 15) Mr. Leandro Masello           |
| 6) Dr. Barry Sheehan    | 16) Mr. Frank Cremer              |
| 7) Dr. Cian Ryan        | 17) Mr. Kevin McDonnell           |
| 8) Dr. Arash Kia        | 18) Mr. Niall O'Donnell           |
| 9) Dr. Fabian Pütz      | 19) Mr. Sean Gaines               |
| 10) Mr. Tim Jannusch    | 20) Ms. Emer Owens                |



# 4 Academic Output AY2020-21

1

## Peer-reviewed Journal Articles

Shannon, D., Fountas, G. (2021) Extending the Heston Model to Forecast Motor Vehicle Collision Rates ,*Accident Analysis & Prevention*, 159, p.106250. DOI: <https://doi.org/10.1016/j.aap.2021.106250>

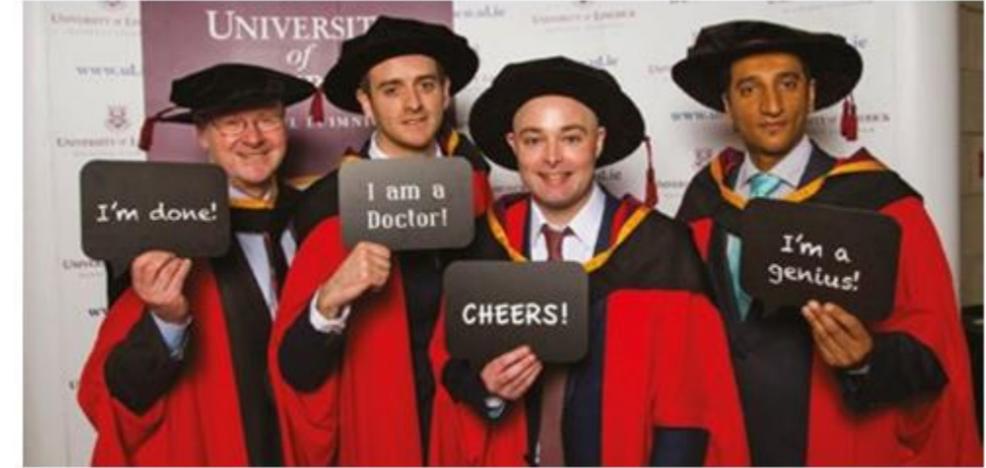
Shannon, D., Jannusch, T., David-Spickermann, F., Mullins, M., Cunneen, M., Murphy, F. (2021) Connected and Autonomous Vehicle Injury Loss Events: Potential Risk and Actuarial Considerations for Primary Insurers, March 2021, *Risk Management and Insurance Review*. DOI: <https://doi.org/10.1111/rmir.12168>

Jannusch, T., David-Spickermann, F., Shannon, D., Murphy, F., Völler, M., Mullins, M. (2021) Cars and Distraction: How to Address the Limits of Driver Monitoring Systems and Improve Safety Benefits using Evidence from German Young Drivers, *Technology in Society* <https://doi.org/10.1016/j.techsoc.2021.101628>

Jannusch, T., Shannon, D., Völler, M., Murphy, F., Mullins, M. (2021) Smartphone Use While Driving: An Investigation of Young Novice Driver (YND) Behaviour ,*Transportation Research Part F: Traffic Psychology and Behaviour*, 77, pp.209-220. DOI: <https://doi.org/10.1016/j.trf.2020.12.013>

O'Donnell, N., Shannon, D., Sheehan, B., 2021. Immune or at-risk? Stock markets and the significance of the COVID-19 pandemic, *Journal of Behavioral and Experimental Finance*. ,June 2021, p.100477. IF: 1.37. Q1 Finance. DOI: [10.1016/j.jbef.2021.100477](https://doi.org/10.1016/j.jbef.2021.100477)

Sheehan, B., Murphy, F., Kia, A., Kiely, R., 2021. A quantitative bow-tie cyber risk classification and assessment framework, *Journal of Risk Research*. , IF (2019): 1.931. Q1 Social Sciences, Q1 Engineering (misc.), DOI: [10.1080/13669877.2021.1900337](https://doi.org/10.1080/13669877.2021.1900337)



### Peer-reviewed Journal Articles (cont'd)

Jannusch, T., David-Spickermann, F., Shannon, D., Murphy, F., Cunneen, M., Furxhi, I., Mullins, M. (2021) "Vehicle automation, Surveillance and Privacy - Beyond the Panopticon. An exploration of 720-Degree Observation in Level 4 ADAS Systems.", *Technology in Society*, 66, DOI: 10.1016/j.techsoc.2021.101667

Cunneen, M. (2021) Could Autonomous Vehicles Become Accidental Autonomous Moral Machines? ,*Culturally Sustainable Social Robotics* ,DOI: 10.3233/FAIA200958

Jannusch, T., Shannon, D., Völler, M., Murphy, F., Mullins, M. (2021). Young Novice Drivers (YND) Smartphone Use: Understanding and managing the risk. 53rd annual meeting of the Universities' Transport Study Group (UTSG)

Furxhi, I., Arvanitis, A., Murphy, F., Costa, A. and Blosi, M., 2021. Data Shepherding in Nanotechnology. The Initiation. *Nanomaterials*, 11(6), p.1520. DOI: <https://doi.org/10.3390/nano11061520>

Furxhi, I., Koivisto, A.J., Murphy, F., Trabucco, S., Del Secco, B. and Arvanitis, A., 2021. Data Shepherding in Nanotechnology. The Exposure Field Campaign Template. *Nanomaterials*, 11(7), p.1818. DOI: <https://doi.org/10.3390/nano11071818>

Furxhi, I., Kia, A.N., Shannon, D., Jannusch, T., Murphy, F. and Sheehan, B., 2021. Associations between mobility patterns and COVID-19 deaths during the pandemic: A network structure and rank propagation modelling approach. *Array*, 11, p.100075. DOI: <https://doi.org/10.1016/j.array.2021.100075>

A.J Koivisto, A. Spinazzè, F. Verdonck, F. Borghi, J. Löndahl, I. K. Koponen, S. Verpaele, M. Jayjock, T.Hussein, J. L. de Ipiña, S. Arnold, I. Furxhi (2021) Assessment of exposure determinants and exposure levels by using stationary concentration measurements and a probabilistic Near-Field/Far-Field exposure model. ,*Open Research Europe*. *Open Research Europe* 1(72). DOI: 10.12688/openreseurope.13752.1

McDonnell, K., Murphy, F., Sheehan, B., Masello, L., Castignani, G. and Ryan, C., 2021. Regulatory and Technical Constraints: An Overview of the Technical Possibilities and Regulatory Limitations of Vehicle Telematic Data. *Sensors*, 21(10), p.3517. DOI: <https://doi.org/10.3390/s21103517>

Tsui, W., Murphy, F., Xu, Xian and Xing, W. (2021) Dynamic Communication and Perception of Cyber Risk: Evidence from Big Data in Media ,*Computers in Human Behavior* ,DOI: S0747563221001746

Mirzaei, M., Furxhi, I., Murphy, F. and Mullins, M., 2021. A Machine Learning Tool to Predict the Antibacterial Capacity of Nanoparticles. *Nanomaterials*, 11(7), p.1774. DOI: <https://doi.org/10.3390/nano11071774>



## 2

### Funding, Awards, Press, General

Irini Furxhi: Nanotox 2021 Conference Bursary Award

Barry Sheehan: The Irish Times, Silicon Republic and Irish Tech News referencing QBowTie Cyber research:

<https://www.irishtimes.com/business/technology/lero-researchers-develop-new-cyber-risk-tool-1.4593861>

Barry Sheehan: Interview on Live 95FM Referencing QBowTie Cyber research, 17<sup>th</sup> June 2021

Niall O'Donnell: Science Foundation Ireland referencing recent research into stock markets and COVID-19:

<https://www.sfi.ie/research-news/news/covid-19-stock-markets/>

Barry Sheehan & Darren Shannon: IMPACT - Enterprise Ireland Innovation Award enabling academic-industry collaboration.

Niall O'Donnell: Presentation given at the Irish Academy of Finance seminar –updated research on Covid-19 vaccine rollout and impact on financial markets

Tsui Wei: Presentation given at the Irish Academy of Finance seminar – working paper Mobile Internet, Search Cost and Insurance Inclusion

## Extending the Heston Model to Forecast Motor Vehicle Collision Rates

*Shannon, D., Fountas, G.*

### **Abstract:**

We present an alternative approach to the forecasting of motor vehicle collision rates. We adopt an oft-used tool in mathematical finance, the Heston Stochastic Volatility model, to forecast the short-term and long-term evolution of motor vehicle collision rates. We incorporate a number of extensions to the Heston model to make it fit for modelling motor vehicle collision rates. We incorporate the temporally-unstable and non-deterministic nature of collision rate fluctuations, and introduce a parameter to account for periods of accelerated safety. We also adjust estimates to account for the seasonality of collision patterns. Using these parameters, we perform a short-term forecast of collision rates and explore a number of plausible scenarios using long-term forecasts. The short-term forecast shows a close affinity with realised rates (over 95% accuracy), and outperforms forecasting models currently used in road safety research (Vasicek, SARIMA, SARIMA-GARCH). The long-term scenarios suggest that modest targets to reduce collision rates (1.83% annually) and targets to reduce the fluctuations of month-to-month collision rates (by half) could have significant benefits for road safety. The median forecast in this scenario suggests a 50% fall in collision rates, with 75% of simulations suggesting that an effective change in collision rates is observed before 2044. The main benefit the model provides is eschewing the necessity for setting unreasonable safety targets that are often missed. Instead, the model presents the effects that modest and achievable targets can have on road safety over the long run, while incorporating random variability. Examining the parameters that underlie expected collision rates will aid policymakers in determining the effectiveness of implemented policies.

**Citation:** Shannon, D., Fountas, G. (2021) Extending the Heston Model to Forecast Motor Vehicle Collision Rates, *Accident Analysis & Prevention*, 159, p.106250. DOI: <https://doi.org/10.1016/j.aap.2021.106250>

## Connected and Autonomous Vehicle Injury Loss Events: Potential Risk and Actuarial Considerations for Primary Insurers

*Shannon, D., Jannusch, T., David-Spickermann, F., Mullins, M., Cunneen, M., Murphy, F.*

### **Abstract:**

The introduction of connected and autonomous vehicles (CAVs) to the road transport ecosystem will change the manner of collisions. CAVs are expected to optimize the safety of road users and the wider environment, while alleviating traffic congestion and maximizing occupant comfort. The net result is a reduction in the frequency of motor vehicle collisions, and a reduction in the number of injuries currently seen as “preventable.” A changing risk ecosystem will introduce new challenges and opportunities for primary insurers. Prior studies have highlighted the economic benefit provided by reductions in the frequency of hazardous events. This economic benefit, however, will be offset by the economic detriment incurred by emerging risks and the increased scrutiny placed on existing risks. We posit four plausible scenarios detailing how an introduction of these technologies could result in a larger relative rate of injury claims currently characterized as tail-risk events. In such a scenario, the culmination of these losses will present as a second “hump” in actuarial loss models. We discuss how CAV risk factors and traffic dynamics may combine to make a second “hump” a plausible reality, and discuss a number of opportunities that may arise for primary insurers from a changing road environment.

**Citation:** Shannon, D., Jannusch, T., David-Spickermann, F., Mullins, M., Cunneen, M., Murphy, F. (2021) Connected and Autonomous Vehicle Injury Loss Events: Potential Risk and Actuarial Considerations for Primary Insurers, March 2021, *Risk Management and Insurance Review*. DOI: <https://doi.org/10.1111/rmir.12168>

## Cars and Distraction: How to Address the Limits of Driver Monitoring Systems and Improve Safety Benefits using Evidence from German Young Drivers, Technology in Society

*Jannusch, T., David-Spickermann, F., Shannon, D., Murphy, F., Völler, M., Mullins, M.*

### **Abstract:**

We are facing an increase in the emergence of distracting activities while driving. This is especially the case for young people who, more than other age groups, employ their cars as a place of personal fulfilment. This study proposes an interdisciplinary safe-by-design (SbD) heuristic to address this emerging risk. It harnesses a German version of the Behaviour of Young Novice Driver Scale (BYNDS) to gather representative information about young people's distracting activities. This information is then used to address to limitations of Driver Monitoring Systems (DMS) and posit safety measures in the context of young driver distraction. Our novel approach reveals three recommendations that should guide the employment of DMS in future generations of cars. We argue that the sole use of DMS Type 1 (i.e. vehicle motion data) is not sufficient to cope with the complex range of distracting activities that occur inside the car. We suggest designers and technologists employ DMS Type 2 (i.e. cameras and acoustic sensors) as this makes it possible to capture rich information about humans, objects and their interaction. In light of concerns about data privacy, policymakers must act to regulate the ethical use of data from the inside of the car and to find the necessary trade-off between data privacy and the unnecessary attrition of young human lives. This research provides a reasonable foundation for this discussion.

**Citation:** Jannusch, T., David-Spickermann, F., Shannon, D., Murphy, F., Völler, M., Mullins, M. (2021) Cars and Distraction: How to Address the Limits of Driver Monitoring Systems and Improve Safety Benefits using Evidence from German Young Drivers, Technology in Society. DOI: <https://doi.org/10.1016/j.techsoc.2021.101628>

## Smartphone Use While Driving: An Investigation of Young Novice Driver (YND) Behaviour

*Jannusch, T., Shannon, D., Völler, M., Murphy, F., Mullins, M.*

### **Abstract:**

Road traffic collisions are the leading cause of death for those between the ages of 15–29, according to the World Health Organisation. This study investigates one of the primary reasons for the high fatality rate amongst Young Novice Drivers (YNDs) – their use of smartphones while driving. We gathered responses from a representative sample of YNDs on their behaviour while driving using an updated version of the 'Behaviour of Young Novice Drivers Scale'. Survey responses totalled 700 YNDs situated throughout Germany. From these responses, we examined the prevalence of certain driving behaviours that are described as 'distracting' and compared these driving behaviours to the respondents' use of specific smartphone features. The responses report that music-related activities (e.g. changing music on a smartphone) are most common amongst YNDs. Speaking on the phone is seldom-reported, although more males than females indicated engagement in this behaviour. We further carried out a correlation analysis and correspondence analysis. On that basis we found that those who report speaking on a smartphone are significantly more likely to engage in driving behaviours with potentially fatal consequences, such as speeding and driving while impaired by prohibited substances (drugs, alcohol). We propose that the results could be used by policymakers for public information implications and to tailor financial penalties for those engaging in smartphone behaviours that are linked to harmful driving behaviours. In addition, our findings can also be used in a Usage-based Insurance (UBI) context to financially incentivise safer driving.

**Citation:** Jannusch, T., Shannon, D., Völler, M., Murphy, F., Mullins, M. (2021) Smartphone Use While Driving: An Investigation of Young Novice Driver (YND) Behaviour, Transportation Research Part F: Traffic Psychology and Behaviour, 77, pp.209-220. DOI: <https://doi.org/10.1016/j.trf.2020.12.013>

## Immune or at-risk? Stock markets and the significance of the COVID-19 pandemic

*O'Donnell, N., Shannon, D., Sheehan, B.*

### **Abstract:**

The closure of borders and traditional commerce due to the COVID-19 pandemic is expected to have a lasting financial impact. We determine whether the growth in COVID-19 affected index prices by examining equity markets in five regional epicentres, along with a 'global' index. We also investigate the impact of COVID-19 after controlling for investor sentiment, credit risk, liquidity risk, safe-haven asset demand and the price of oil. Despite controlling for these traditional market drivers, the daily totals of COVID-19 cases nevertheless explained index price changes in Spain, Italy, the United Kingdom and the United States. Similar results were not observed in China, the origin of the virus, nor in the 'global' index (MSCI World). Our results suggest that early interventions (China) and the spatiotemporal nature of pandemic epicentres (World) should be considered by governments, regulators and relevant stakeholders in the event of future COVID-19 'waves' or further extreme societal disruptions.

**Citation:** O'Donnell, N., Shannon, D., Sheehan, B., 2021. Immune or at-risk? Stock markets and the significance of the COVID-19 pandemic, *Journal of Behavioral and Experimental Finance*. , June 2021, p.100477. IF: 1.37. Q1 Finance. DOI: <https://doi.org/10.1016/j.jbef.2021.100477>

## A quantitative bow-tie cyber risk classification and assessment framework

*Sheehan, B., Murphy, F., Kia, A., Kiely, R*

### **Abstract:**

Cyber-attacks pose a growing threat to global commerce that is increasingly reliant on digital technology to conduct business. Traditional risk assessment and underwriting practices face serious shortcomings when encountered with cyber threats. Conventional assessment frameworks rate risk based on historical frequency and severity of losses incurred, this method is effective for known risks; however, due to the absence of historical data, prove ineffective for assessing cyber risk. This paper proposes a conceptual cyber risk classification and assessment framework, designed to demonstrate the significance of proactive and reactive barriers in reducing companies' exposure to cyber risk and quantify the risk. This method combines a bow-tie model with a risk matrix to produce a rating based on the likelihood of a cyber-threat occurring and the potential severity of the resulting consequences. The model can accommodate both historical data and expert opinion and previously known frameworks to score the Threats, Barriers and Escalators for the framework. The resultant framework is applied to a large city hospital in Europe. The results highlighted both cyber weaknesses and actions that should be taken to bolster cyber defences. The results provide a quick visual guide that is assessable to both experts and management. It also provides a practical framework that allows insurers to assess risks, visualise areas of concern and record the effectiveness of implementing control barriers.

**Citation:** Sheehan, B., Murphy, F., Kia, A., Kiely, R., 2021. A quantitative bow-tie cyber risk classification and assessment framework, *Journal of Risk Research*. , IF (2019): 1.931. Q1 Social Sciences, Q1 Engineering (misc.), DOI: <https://doi.org/10.1080/13669877.2021.1900337>

## Surveillance and privacy – Beyond the panopticon. An exploration of 720-degree observation in level 3 and 4 vehicle automation

*Jannusch, T., David-Spickermann, F., Shannon, D., Murphy, F., Cunneen, M., Furxhi, I., Mullins, M.*

### **Abstract:**

On the path to high-level vehicle automation, the degree of surveillance both inside and outside the car increases significantly. Consequently, ethical considerations are becoming central to questions around surveillance regimes and data privacy implicit in level 3 and 4 vehicle automation. In this paper, we focus on outputs from the EU Horizon 2020 project Vision Inspired Driver Assistance Systems (VI-DAS). In particular, we assess the VI-DAS 720-degree observation technology, critical to ensuring a safe Human Machine Interaction (HMI), from multiple theoretical perspectives to contribute to a better understanding of the phenomena of privacy. As a synonym for surveillance, we started our evaluation with Bentham's ideation of the panopticon. From there, it is a relatively short step to radical Foucauldian critiques that offered more dystopian technologies of power. However, both theorems demonstrate a limited understanding of the issue of data privacy in the context of safe transportation along the evolution of highly automated vehicles. Thus, to allow the debate to move beyond more binary discussions on privacy versus control/power and to a certain degree escape the shadow of the panopticon, we applied the Nissenbaum four theses framework of Contextual Integrity (CI). Her decision heuristic allowed us to introduce structure and a degree of precision in our thinking on the matter of privacy that represents a step forward to phenomena of privacy in a specific context. Our approach concludes that the VI-DAS 720-degree observation technology can respect the user's privacy through an appropriate flow of personal information. However, the flows of personal data must be strongly regulated to ensure that data is seen as a value in terms of a commodity to protect human life and not seen as an asset that needs to be turned into value in terms of capital or the facilitation of asymmetric power-relations.

**Citation:** Jannusch, T., David-Spickermann, F., Shannon, D., Murphy, F., Cunneen, M., Furxhi, I., Mullins, M. (2021) "Surveillance and Privacy - Beyond the Panopticon. An exploration of 720-Degree Observation in Level 4 ADAS Systems." ,Technology in Society, 66, DOI: <https://doi.org/10.1016/j.techsoc.2021.101667>

## Could Autonomous Vehicles Become Accidental Autonomous Moral Machines?

*Cunneen, M.*

### **Abstract:**

In this paper, I make two controversial claims. First, autonomous vehicles are de facto moral machines by building their decision architecture on necessary risk quantification and second, that in doing so they are inadequate moral machines. Moreover, this moral inadequacy presents significant risks to society. The paper engages with some of the key concepts in Autonomous Vehicle decisionality literature to reframe the problem of moral machine for Autonomous Vehicles. This is defended as a necessary step to access the meta questions that underlie Autonomous vehicles as machines making high value decisions regarding human welfare and life.

**Citation:** Cunneen, M. (2021) Could Autonomous Vehicles Become Accidental Autonomous Moral Machines? ,Culturally Sustainable Social Robotics ,DOI: [10.3233/FAIA200958](https://doi.org/10.3233/FAIA200958)

## Data Shepherding in Nanotechnology. The Initiation.

*Furxhi, I., Arvanitis, A., Murphy, F., Costa, A. and Blosi, M.*

### **Abstract:**

In this paper we describe the pragmatic approach of initiating, designing and implementing the Data Management Plan (DMP) and the data FAIRification process in the multidisciplinary Horizon 2020 nanotechnology project, Anticipating Safety Issues at the Design Stage of NANO Product Development (ASINA). We briefly describe the general DMP requirements, emphasizing that the initial steps in the direction towards data FAIRification must be conceptualized and visualized in a systematic way. We demonstrate the use of a generic questionnaire to capture primary data and metadata description from our consortium (data creators/experimentalists and data analysts/modelers). We then display the interactive process with external FAIR data initiatives (data curators/quality assessors), regarding guidance for data and metadata capturing and future integration into repositories. After the preliminary data capturing and FAIRification template is formed, the inner-communication process begins between the partners, which leads to developing case-specific templates. This paper assists future data creators, data analysts, stewards and shepherds engaged in the multi-faceted data shepherding process, in any project, by providing a roadmap, demonstrated in the case of ASINA.

**Citation:** Furxhi, I., Arvanitis, A., Murphy, F., Costa, A. and Blosi, M., 2021. Data Shepherding in Nanotechnology. The Initiation. *Nanomaterials*, 11(6), p.1520.

DOI: <https://doi.org/10.3390/nano11061520>

## Data Shepherding in Nanotechnology. The Exposure Field Campaign Template

*Furxhi, I., Koivisto, A.J., Murphy, F., Trabucco, S., Del Secco, B. and Arvanitis, A.,*

### **Abstract:**

In this paper, we demonstrate the realization process of a pragmatic approach on developing a template for capturing field monitoring data in nanomanufacturing processes. The template serves the fundamental principles which make data scientifically Findable, Accessible, Interoperable and Reusable (FAIR principles), as well as encouraging individuals to reuse it. In our case, the data shepherds' (the guider of data) template creation workflow consists of the following steps: (1) Identify relevant stakeholders, (2) Distribute questionnaires to capture a general description of the data to be generated, (3) Understand the needs and requirements of each stakeholder, (4) Interactive simple communication with the stakeholders for variables/descriptors selection, and (5) Design of the template and annotation of descriptors. We provide an annotated template for capturing exposure field campaign monitoring data, and increase their interoperability, while comparing it with existing templates. This paper enables the data creators of exposure field campaign data to store data in a FAIR way and helps the scientific community, such as data shepherds, by avoiding extensive steps for template creation and by utilizing the pragmatic structure and/or the template proposed herein, in the case of a nanotechnology project (Anticipating Safety Issues at the Design of Nano Product Development, ASINA).

**Citation:** Furxhi, I., Koivisto, A.J., Murphy, F., Trabucco, S., Del Secco, B. and Arvanitis, A., 2021. Data Shepherding in Nanotechnology. The Exposure Field Campaign Template. *Nanomaterials*, 11(7), p.1818. DOI:

<https://doi.org/10.3390/nano11071818>

## Associations between mobility patterns and COVID-19 deaths during the pandemic: A network structure and rank propagation modelling approach

*Furxhi, I., Kia, A.N., Shannon, D., Jannusch, T., Murphy, F. and Sheehan, B.*

### **Abstract:**

Background: From February 2020, both urban and rural Ireland witnessed the rapid proliferation of the COVID-19 disease throughout its counties. During this period, the national COVID-19 responses included stay-at-home directives issued by the state, subject to varying levels of enforcement.

Methods: In this paper, we present a new method to assess and rank the causes of Ireland COVID-19 deaths as it relates to mobility activities within each county provided by Google while taking into consideration the epidemiological confirmed positive cases reported per county. We used a network structure and rank propagation modelling approach using Personalised PageRank to reveal the importance of each mobility category linked to cases and deaths. Then a novel feature-selection method using relative prominent factors finds important features related to each county's death. Finally, we clustered the counties based on features selected with the network results using a customised network clustering algorithm for the research problem.

Findings: Our analysis reveals that the most important mobility trend categories that exhibit the strongest association to COVID-19 cases and deaths include retail and recreation and workplaces. This is the first time a network structure and rank propagation modelling approach has been used to link COVID-19 data to mobility patterns. The infection determinants landscape illustrated by the network results aligns soundly with county socio-economic and demographic features. The novel feature selection and clustering method presented clusters useful to policymakers, managers of the health sector, politicians and even sociologists. Finally, each county has a different impact on the national total.

**Citation:** Furxhi, I., Kia, A.N., Shannon, D., Jannusch, T., Murphy, F. and Sheehan, B., 2021. Associations between mobility patterns and COVID-19 deaths during the pandemic: A network structure and rank propagation modelling approach. *Array*, 11, p.100075. DOI: <https://doi.org/10.1016/j.array.2021.100075>

## Regulatory and Technical Constraints: An Overview of the Technical Possibilities and Regulatory Limitations of Vehicle Telematic Data

*McDonnell, K., Murphy, F., Sheehan, B., Masello, L., Castignani, G. and Ryan, C.*

### **Abstract:**

A telematics device is a vehicle instrument that comes preinstalled by the vehicle manufacturer or can be added later. The device records information about driving behavior, including speed, acceleration, and turning force. When connected to vehicle computers, the device can also provide additional information regarding the mechanical usage and condition of the vehicle. All of this information can be transmitted to a central database via mobile networks. The information provided has led to new services such as Usage Based Insurance (UBI). A range of consultants, industry commentators and academics have produced an abundance of projections on how telematics information will allow the introduction of services from personalized insurance, bespoke entertainment and advertise and vehicle energy optimization, particularly for Electric Vehicles (EVs). In this paper we examine these potential services against a backdrop of nascent regulatory limitations and against the technical capacity of the devices. Using a case study approach, we examine three applications that can use telematics information. We find that the expectations of service providers will be significantly tempered by regulatory and technical hurdles. In our discussion we detail these limitations and suggest a more realistic rollout of ancillary services.

**Citation:** McDonnell, K., Murphy, F., Sheehan, B., Masello, L., Castignani, G. and Ryan, C., 2021. Regulatory and Technical Constraints: An Overview of the Technical Possibilities and Regulatory Limitations of Vehicle Telematic Data. *Sensors*, 21(10), p.3517. DOI: <https://doi.org/10.3390/s21103517>

# Dynamic Communication and Perception of Cyber Risk: Evidence from Big Data in Media

*Tsui, W., Murphy, F., Xu, Xian and Xing, W.*

**Abstract:**

Cyber risk is consistently viewed as a threat to the proper function of commercial and societal activity. Regardless of whether this risk is real or perceived, understanding how societal communication and perception of it change over time has important implications for both regulatory authorities and insurers. This contribution analyzes Chinese media news over the years 2009–2018 to identify the dynamics of cyber risk sources and associated societal assessment. Taking the psychometric paradigm as its point of departure and applying combination of computational and statistical methods, we identify 34 sources of cyber risk. The actions of government turn out to have a significant impact on public attention to the different sources of cyber risk, an influence that has been neglected in past research. The dynamics of societal aversion against most cyber risk sources are found to present inverted-U shapes. Adaptation and learning effects are found to explain this dynamic. Another finding is that news sentiment has a strong correlation with cyber risk perception, an insight of importance for regulators and insurers.

**Citation:** Tsui, W., Murphy, F., Xu, Xian and Xing, W. (2021) Dynamic Communication and Perception of Cyber Risk: Evidence from Big Data in Media ,Computers in Human Behavior, DOI: <https://doi.org/10.1016/j.chb.2021.106851>

# A Machine Learning Tool to Predict the Antibacterial Capacity of Nanoparticles

*Mirzaei, M., Furxhi, I., Murphy, F. and Mullins, M.*

**Abstract:**

The emergence and rapid spread of multidrug-resistant bacteria strains are a public health concern. This emergence is caused by the overuse and misuse of antibiotics leading to the evolution of antibiotic-resistant strains. Nanoparticles (NPs) are objects with all three external dimensions in the nanoscale that varies from 1 to 100 nm. Research on NPs with enhanced antimicrobial activity as alternatives to antibiotics has grown due to the increased incidence of nosocomial and community acquired infections caused by pathogens. Machine learning (ML) tools have been used in the field of nanoinformatics with promising results. As a consequence of evident achievements on a wide range of predictive tasks, ML techniques are attracting significant interest across a variety of stakeholders. In this article, we present an ML tool that successfully predicts the antibacterial capacity of NPs while the model's validation demonstrates encouraging results ( $R^2 = 0.78$ ). The data were compiled after a literature review of 60 articles and consist of key physico-chemical (p-chem) properties and experimental conditions (exposure variables and bacterial clustering) from in vitro studies. Following data homogenization and pre-processing, we trained various regression algorithms and we validated them using diverse performance metrics. Finally, an important attribute evaluation, which ranks the attributes that are most important in predicting the outcome, was performed. The attribute importance revealed that NP core size, the exposure dose, and the species of bacterium are key variables in predicting the antibacterial effect of NPs. This tool assists various stakeholders and scientists in predicting the antibacterial effects of NPs based on their p-chem properties and diverse exposure settings. This concept also aids the safe-by-design paradigm by incorporating functionality tools.

**Citation:** Mirzaei, M., Furxhi, I., Murphy, F. and Mullins, M., 2021. A Machine Learning Tool to Predict the Antibacterial Capacity of Nanoparticles. *Nanomaterials*, 11(7), p.1774. DOI: <https://doi.org/10.3390/nano11071774>

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