Emerging Risk Group

Annual Report
2022-23 Academic Year

ERG

EMERGING RISK GROUP

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.

Prof Finbarr Murphy
Executive Dean KBS
Co-founder ERG

Kemmy Business School
University of Limerick

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 Europe and ESRC) and nationally (e.g. SFI and EPA) and invigorate our commitment to Horizon Europe and other funding opportunities both nationally and internationally.
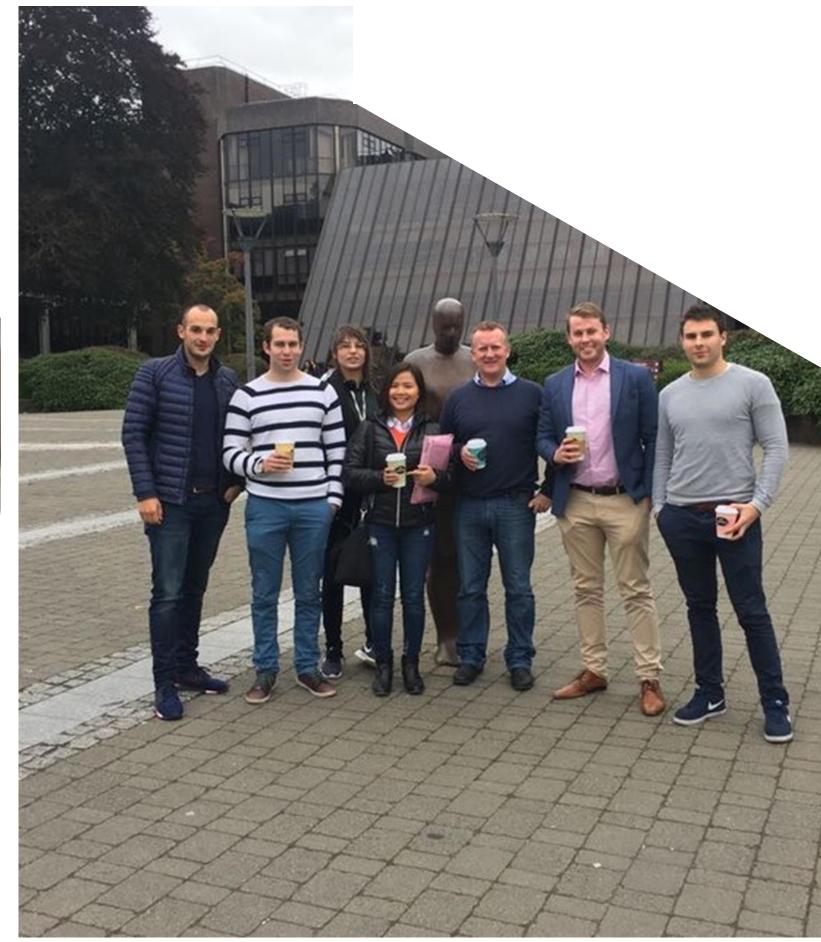
One measure of the success of the group is the number of funded projects and the extensive European network created in the process. Since inception, the ERG has been involved in projects funded by over €52 Million, with €5.7MM to UL and €1.6MM directly to the ERG. Without exaggeration, this has had a profound impact on the Kemmy Business School by shifting the research funding culture and prompting other, extant, funding successes.

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 past academic year is reflective of the group's core goals to lead positive change in the risk community and beyond.
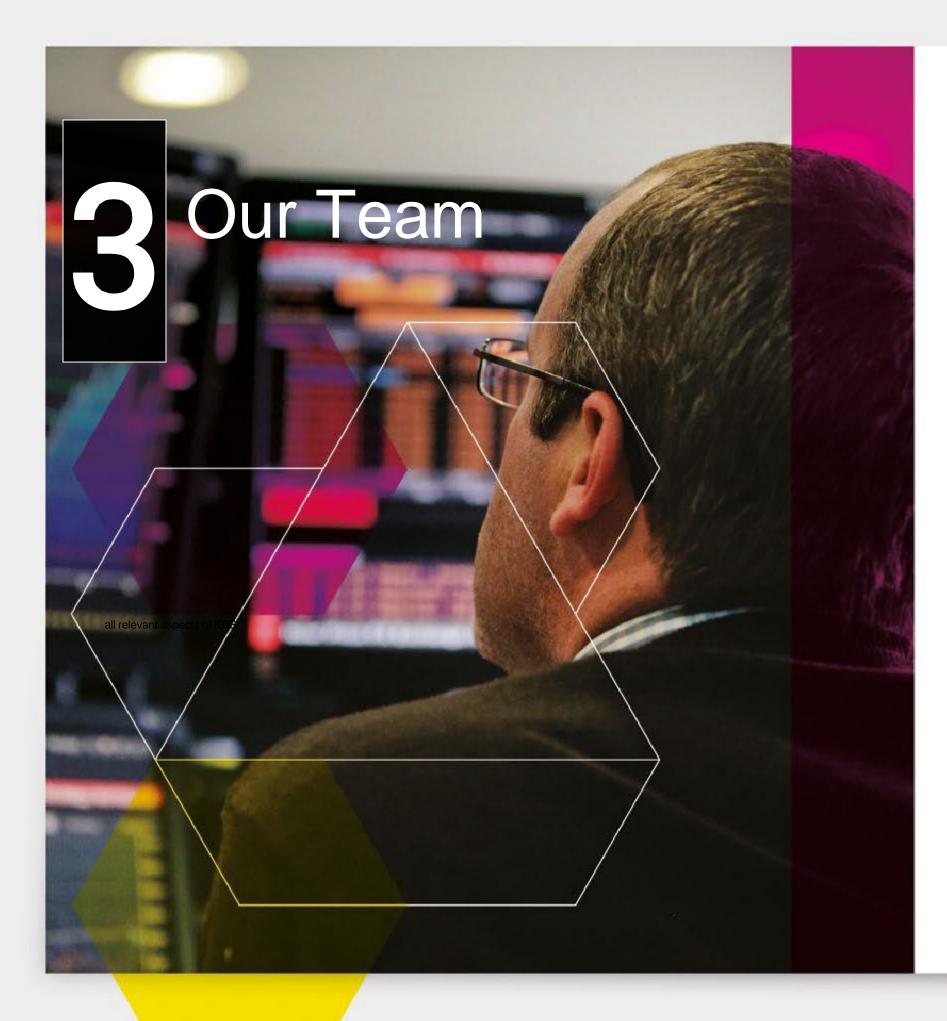
2 Emerging Risk Group: A Brief History

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 KPI

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-lsva.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. Current active projects include Anti-Fin-Ter (EC-funded), PROACTsme (Interreg europe) and BAV Spoke (SFI-finded).
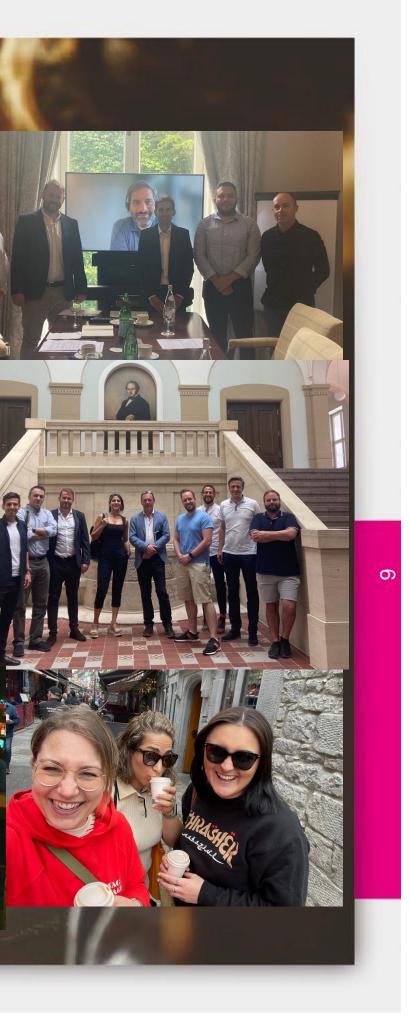
Our Team Today

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
2) Prof. Finbarr Murphy
3) Dr. Darren Shannon
4) Dr. Martin Cunneen
5) Dr. Irini Furxhi
6) Dr. Barry Sheehan
7) Dr. Cian Ryan
8) Dr. Arash Kia
9) Dr. Fabian Pütz
10) Dr. Tim Jannusch
11) Dr. Wei Xu
12) Dr. Mahsa Mirzaei

13) Ms. Juliane Ressel
14) Mr. Florian David-Spickermann
15) Dr. Leandro Masello
16) Mr. Frank Cremer
17) Mr. Kevin McDonnell
18) Mr. Niall O'Donnell
19) Mr. Sean Gaines
20) Ms. Emer Owens
21) Ms. Aisling Owen
22) Mr. Phillip Sampson
23) Mr. Eamon Leonard

4 Academic Output AY2022-23

A ⬡ Peer-reviewed Journal Articles

O'Donnell, N., Shannon, D. and Sheehan, B., 2023. A vaccine for volatility? An empirical analysis of global stock markets and the impact of the COVID-19 vaccine. *The Journal of Economic Asymmetries*, *28*, p.e00331.

Sheehan, B., Mullins, M., Shannon, D. and McCullagh, O., 2023. On the benefits of insurance and disaster risk management integration for improved climate-related natural catastrophe resilience. *Environment Systems and Decisions*, pp.1-10.

Kia, A.N., Murphy, F., Sheehan, B. and Shannon, D., 2023. A cyber risk prediction model using common vulnerabilities and exposures. *Expert Systems with Applications*, p.121599.

McDonnell, K., Murphy, F., Sheehan, B., Masello, L. and Castignani, G., 2023. Deep learning in insurance: Accuracy and model interpretability using TabNet. *Expert Systems with Applications*, p.119543.

Masello, L., Castignani, G., Sheehan, B., Guillen, M. and Murphy, F., 2023. Using contextual data to predict risky driving events: A novel methodology from explainable artificial intelligence. *Accident Analysis & Prevention*, *184*, p.106997.

Mirzaei, M., Furxhi, I., Murphy, F. and Mullins, M., 2023. Employing Supervised Algorithms for the Prediction of Nanomaterial's Antioxidant Efficiency. *International Journal of Molecular Sciences*, *24*(3), p.2792.

Furxhi, I., Kalapus, M., Costa, A. and Puzyn, T., 2023. Artificial augmented dataset for the enhancement of nano-QSARs models. A methodology based on topological projections. *Nanotoxicology*, pp.1-16.

Peer-reviewed Journal Articles (cont'd)

Owens, E., Sheehan, B., Mullins, M., Cunneen, M., Ressel, J., Castignani, G. (2022) "Explainable Artificial Intelligence (XAI) in Insurance", *Risks*, 10 (12) 230.

Masello, L., Sheehan, B., Castignani, G., Shannon, D., & Murphy, F. (2023). On the impact of advanced driver assistance systems on driving distraction and risky behaviour: An empirical analysis of irish commercial drivers. *Accident Analysis & Prevention, 183*, 106969.

Mullins, M., Himly, M., Llopis, I.R., Furxhi, I., Hofer, S., Hofstätter, N., Wick, P., Romeo, D., Küehnel, D., Siivola, K. and Catalán, J., 2023. (Re) Conceptualizing decision-making tools in a risk governance framework for emerging technologies—the case of nanomaterials. *Environment Systems and Decisions*, 43(1), pp.3-15.

Furxhi, I., Costa, A., Vázquez-Campos, S., Fito-López, C., Hristozov, D., Ramos, J.A.T., Resch, S., Cioffi, M., Friedrichs, S., Rocca, C. and Valsami-Jones, E., 2023. Status, implications and challenges of European safe and sustainable by design paradigms applicable to nanomaterials and advanced materials. *RSC Sustainability*, 1(2), pp.234-250.

Chen A., Chen Y., Murphy, F., Tsui, W., Xu, X. (2023). How does the insurer's mobile internet sales strategy perform? *Journal of Risk and Insurance, 90(2): 487-519.*

Kose, O., Béal, D., Motellier, S., Pelissier, N., Collin-Faure, V., Blosi, M., Bengalli, R., Costa, A., Furxhi, I., Mantecca, P. and Carriere, M., 2023. Physicochemical Transformations of Silver Nanoparticles in the Oro-Gastrointestinal Tract Mildly Affect Their Toxicity to Intestinal Cells In Vitro: An AOP-Oriented Testing Approach. *Toxics*, 11(3), p.199.

Dumit, V.I., Ammar, A., Bakker, M.I., Bañares, M.A., Bossa, C., Costa, A., Cowie, H., Drobne, D., Exner, T.E., Furxhi, I., Farcal, L. and Friedrichs, S., 2023. From principles to reality. FAIR implementation in the nanosafety community. *Nano Today*, 51, p.101923.

Belosi, F., Koivisto, A.J., Furxhi, I., de Ipiña, J.L., Nicosia, A., Ravegnani, F., Ortelli, S., Zanoni, I. and Costa, A., 2023. Critical aspects in occupational exposure assessment with different aerosol metrics in an industrial spray coating process. *NanoImpact*, 30, p.100459.

Wang, J., Li, H., Xu, W. W., & Tsui, W. (2022). Envisioning a credit society: social credit systems and the institutionalization of moral standards in China. *Media, Culture and Society, 45(3): 451-470.*

B

Conferences, Presentations, Awards, Press

Shannon, D. (2023): 10 Years of Green Bonds: Information Leaks and Equity Market Reactions, World Finance Conference, August 2023

Shannon, D. (2023): 10 Years of Green Bonds: Information Leaks and Equity Market Reactions, 2nd Conference on International Finance; Sustainable and Climate Finance and Growth June 2023

Shannon, D. (2023): 10 Years of Green Bonds: Information Leaks and Equity Market Reactions, Irish Academy of Finance, May 2023

Cremer, F. (2023): Coverages and gaps of Cyber Insurance: An Analysis of the Suitability of German Cyber Policies, KBS Research Seminar Series 2023, 14.03.2023

Cremer, F. Sheehan, B., Mullins, M., Fortmann, M (2023): The German cyber insurance landscape: A mixed methods study, Annual Conference of the German Association for Insurance Science, 2023, 23.03.2023

Furxhi, I. (2023) Data-driven quantitative intrinsic hazard criteria for nanoproduct development in a safe-by-design paradigm: a case study of silver nanoforms. Nanosafe2023 conference, Grenoble France, June 2023

Furxhi, I. (2023) Title: A data steward's experience in a safe-by-design nanotechnology project: data management and data-driven quantitative hazard criteria from Bayesian Networks. SciDataCon 2023 conference, Salzburg, October 2023.

Wei, T. (2023): Risk screening in digital insurance distribution: evidence and explanations. KBS Research Seminar Series April 2023.

Conferences, Presentations, Awards, Press (cont'd)

Furxhi, I. (2023) A data steward's experience in a safe-by-design nanotechnology project: data management and data-driven quantitative hazard criteria from Bayesian Networks. Nanoinnovation, Rome, September 2023.

Furxhi, I. (2023) Data-driven quantitative intrinsic hazard criteria for nanoproduct development in a safe-by-design paradigm: a case study of silver nanoforms. 3R Meeting in Rome, Italy, September 2023.

Wei, T. (2023) Risk screening in digital insurance distribution: evidence and explanations. Irish Academy of Finance, May 2023.

O'Donnell, N. (May 2023) 'The Impact of Monetary Policy Interventions on Banking Sector Stocks: An Empirical Investigation of the COVID-19 Crisis', Irish Academy of Finance, May 2023.

Ressel, J. (2023). Promoting a Trustworthy Adoption of Artificial Intelligence in the European Insurance Industry. insureNXT, Cologne, Germany, April 2023.

Innovators Award 2023 Received

Ressel, J. (2023). Is ChatGPT trustworthy? Exploring the notion of trustworthiness in conversational agents. KBS Spring Series, University of Limerick, May 2023.

O'Donnell, N. "From Vaccines to Volatility: Financial Market Drivers as COVID-19 Evolved", CSEAR Virtual Conference (2021)

Sheehan, B. & Martin, M.: Contributed to RIAI Design for Manufacture and Assembly. Design for Manufacture and Assembly (DfMA) Report. October 2022.

Funding Success

Sheehan, B., and Mullins, M. (2023) PROACTsme. Funding Authority: Interreg Europe. Co-funded by the European Union, UL Budget: €138,362, Total Budget: €1,515,448

Furxhi, I. (2022) Marie Skłodowska-Curie Postdoctoral Fellowships 2022

Shannon, D., Sheehan, B., and Masello, L (2022) ClaimRisk Project: Reducing Driver Risk using Technology-based Interventions. Enterprise Ireland Innovation Voucher. UL Budget: €5,000

Sheehan, B., and Mullins, M. (2022) NATCAT2.0 EI CS. Funding Authority: Enterprise Ireland Horizon Europe Coordinator Support. UL Budget: €12,445

Book Chapters and Conference Proceedings

Cremer, F. Sheehan, B., Mullins, M., Fortmann, M (2023): Cyber insurance - An insight into the exclusions of the German cyber market (Translated title) Conference proceedings of the 19th German IT Security Congress.

Cremer, F., and Materne, S. (2023): Coverage of cyber accumulation risks (Translated title). Book Chapter, "Risk and Insurance" - Institute for Insurance Studies TH Köln. Springer.

Jannusch, T., Ressel, J., Völler, M. (2023) Framing a safety narrative for young drivers in modern motor insurance (Translated title). Book Chapter, "Risk and Insurance" - Institute for Insurance Studies TH Köln. Springer.

A vaccine for volatility? An empirical analysis of global stock markets and the impact of the COVID-19 vaccine

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

Abstract:
The oscillation of COVID-19 growth has had a sustaining impact on financial markets. This study investigates the asymmetric impact of COVID-19 growth and recovery on financial markets. Examining ten epicenters of the virus from 01/01/2021 to 31/12/2021, we utilize a stepwise regression methodology and a diverse set of control variables. Controlling for volatility, credit risk, liquidity risk, monetary policy, gold, and oil, our findings indicate a significant impact of COVID-19 on equity indices. Vaccination growth correlates with positive price movements in the USA, UK, China, Japan, France, and Spain. Simultaneously, negative price trends align with virus growth in the USA, UK, China, Japan, Spain, and World models. A nexus of causality between COVID-19, global oil markets, and equity prices is identified, while credit and liquidity risks emerged as significant risk factors in China. Our results highlight the pertinence of swift vaccine developments, lockdown interventions, and central bank responses, providing valuable insights to governments, regulators, and all financial market stakeholders.

Citation: O'Donnell, N., Shannon, D. and Sheehan, B., 2023. A vaccine for volatility? An empirical analysis of global stock markets and the impact of the COVID-19 vaccine. The Journal of Economic Asymmetries, 28, p.e00331.

On the benefits of insurance and disaster risk management integration for improved climate-related natural catastrophe resilience

Sheehan, B., Mullins, M., Shannon, D. and McCullagh, O.

Abstract:
Insurance serves modern society and commerce by pooling risk to reduce the economic impact of disasters. Concurrently, Disaster Risk Management (DRM) scientists, responders and policymakers are co-developing proactive resilience and mitigation strategies with European citizens against accelerating climate-related natural catastrophes. The increasing frequency and severity of natural catastrophes exacerbates the insurance coverage gap by incurring even greater losses for (re)insurers, leading to higher premiums in exchange for cover or the withdrawal of services entirely. This paper presents a conceptual framework for cross-sectoral collaboration between the insurance and DRM communities towards open, transparent and optimised disaster risk management for all EU citizens and businesses. Furthermore, this research identifies key enabling technologies (satellite, drone, artificial intelligence, blockchain) and novel risk transfer mechanisms with the potential to accelerate societal resilience to climate disasters through effective risk management. The study emphasises the critical role of the insurance industry in effective DRM and highlights where insurers could take a more active role across the temporal plane of a natural disaster by engaging in ex-ante interventions to protect those vulnerable to climate change-related risk.

Citation: Sheehan, B., Mullins, M., Shannon, D. and McCullagh, O., 2023. On the benefits of insurance and disaster risk management integration for improved climate-related natural catastrophe resilience. Environment Systems and Decisions, pp.1-10.

A cyber risk prediction model using common vulnerabilities and exposures

Kia, A.N., Murphy, F., Sheehan, B. and Shannon, D.

Abstract:
The cyber risk from malicious external attackers is a significant socio-economic problem. Cyber risk prediction is particularly difficult, given the constantly changing attack vectors. This study presents a model that automatically predicts cyber risks. The model is only based on common vulnerabilities and exposures (CVE) data and supervised prediction algorithms. This approach eliminates expert opinion bias in cyber risk prediction. Our supervised data-driven model, *CyRiPred*, CVE data into cyber risk groups by mapping the textual description field of the database into relevant Wikipedia article titles. Then *CyRiPred* aggregates the occurrence and severity of extracted topics for the desired time unit and produces a time series fed to supervised regressors for prediction. The risks are calculated using predicted occurrence and impact. Finally, the cyber risks are ranked by their score, and the top ten risks are presented. The proposed model is evaluated, and the results are discussed.

Citation: Kia, A.N., Murphy, F., Sheehan, B. and Shannon, D., 2023. A cyber risk prediction model using common vulnerabilities and exposures. Expert Systems with Applications, p.121599.

Deep learning in insurance: Accuracy and model interpretability using TabNet

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

Abstract:
Generalized Linear Models (GLMs) and XGBoost are widely used in insurance risk pricing and claims prediction, with GLMs dominant in the insurance industry. The increasing prevalence of connected car data usage in insurance requires highly accurate and interpretable models. Deep learning (DL) models have outperformed traditional Machine Learning (ML) models in multiple domains; despite this, they are underutilized in insurance risk pricing. This study introduces an alternative DL architecture, TabNet, suitable for insurance telematics datasets and claim prediction. This approach compares the TabNet DL model against XGBoost and Logistic Regression on the task of claim prediction on a synthetic telematics dataset. TabNet outperformed these models, providing highly interpretable results and capturing the sparsity of the claims data with high accuracy. However, TabNet requires considerable running time and effort in hyperparameter tuning to achieve these results. Despite these limitations, TabNet provides better pricing models for interpretable models in insurance when compared to XGBoost and Logistic Regression models.

Citation: McDonnell, K., Murphy, F., Sheehan, B., Masello, L. and Castignani, G., 2023. Deep learning in insurance: Accuracy and model interpretability using TabNet. Expert Systems with Applications, p.119543.

Using contextual data to predict risky driving events: A novel methodology from explainable artificial intelligence

Masello, L., Castignani, G., Sheehan, B., Guillen, M. and Murphy, F.

Abstract:
Usage-based insurance has allowed insurers to dynamically tailor insurance premiums by understanding when and how safe policyholders drive. However, telematics information can also be used to understand the driving contexts experienced by the driver within each trip (e.g., road types, weather, traffic). Since different combinations of these conditions affect exposure to accidents, this understanding introduces predictive opportunities in driving risk assessment. This paper investigates the relationships between driving context combinations and risk using a naturalistic driving dataset of 77,859 km. In particular, XGBoost and Random Forests are used to determine the predictive significance of driving contexts for near-misses, speeding and distraction events. Moreover, the most important contextual factors in predicting these risky events are identified and ranked through Shapley Additive Explanations. The results show that the driving context has significant power in predicting driving risk. Speed limit, weather temperature, wind speed, traffic conditions and road slope appear in the top ten most relevant features for most risky events. Analysing contextual feature variations and their influence on risky events showed that low-speed limits increase the predicted frequency of speeding and phone unlocking events, whereas high-speed limits decrease harsh accelerations. Low temperatures decrease the expected frequency of harsh manoeuvres, and precipitations increase harsh acceleration, harsh braking, and distraction events. Furthermore, road slope, intersections and pavement quality are the most critical factors among road layout attributes. The methodology presented in this study aims to support road safety stakeholders and insurers by providing insights to study the contextual risk factors that influence road accident frequency and driving risk.

Citation: Masello, L., Castignani, G., Sheehan, B., Guillen, M. and Murphy, F., 2023. Using contextual data to predict risky driving events: A novel methodology from explainable artificial intelligence. Accident Analysis & Prevention, 184, p.106997.

Employing Supervised Algorithms for the Prediction of Nanomaterial's Antioxidant Efficiency

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

Abstract:
Reactive oxygen species (ROS) are compounds that readily transform into free radicals. Excessive exposure to ROS depletes antioxidant enzymes that protect cells, leading to oxidative stress and cellular damage. Nanomaterials (NMs) exhibit free radical scavenging efficiency representing a potential solution for oxidative stress-induced disorders. This study aims to demonstrate the application of machine learning (ML) algorithms for predicting the antioxidant efficiency of NMs. We manually compiled a comprehensive dataset based on a literature review of 62 in vitro studies. We extracted NMs' physico-chemical (P-chem) properties, the NMs' synthesis technique and various experimental conditions as input features to predict the antioxidant efficiency measured by a 2,2-diphenyl-1-picrylhydrazyl (DPPH) assay. Following data pre-processing, various regression models were trained and validated. The random forest model showed the highest predictive performance reaching an $R2 = 0.83$. The attribute importance analysis revealed that the NM's type, core-size and dosage are the most important attributes influencing the prediction. Our findings corroborate with those of the prior research landscape regarding the importance of P-chem characteristics. This study expands the application of ML in the nano-domain beyond safety-related outcomes by capturing the functional performance. Accordingly, this study has two objectives: (1) to develop a model to forecast the antioxidant efficiency of NMs to complement conventional in vitro assays and (2) to underline the lack of a comprehensive database and the scarcity of relevant data and/or data management practices in the nanotechnology field, especially with regards to functionality assessments.

Citation: Mirzaei, M., Furxhi, I., Murphy, F. and Mullins, M., 2023. Employing Supervised Algorithms for the Prediction of Nanomaterial's Antioxidant Efficiency. International Journal of Molecular Sciences, 24(3), p.2792.

Artificial augmented dataset for the enhancement of nano-QSARs models. A methodology based on topological projections

Furxhi, I., Kalapus, M., Costa, A. and Puzyn, T.

Abstract:
Nanoinformatics demands accurate predictive models to assess the potential hazards of nanomaterials (NMs). However, limited data availability and the diverse nature of NMs physicochemical properties and their interaction with biological media, hinder the development of robust nano-Quantitative Structure-Activity Relationship (QSAR) models. This article proposes an approach that combines artificially data generation techniques and topographical projections to address the challenges of insufficient dataset sizes and their limited representativeness of the chemical space. By leveraging the rich information embedded in the topographical features, this methodology enhances the representation of the chemical space, enabling a more an exploration of the structure-activity relationships. We demonstrate the efficacy of our approach through extensive experiments, employing various machine learning regression algorithms to validate the methodology. Finally, we compare two different resampling approaches based on different modeling scenarios. The results showcase a significant improved predictive performance of QSAR models demonstrating a promising strategy to overcome the limitations of small datasets in the field of nanoinformatics. The proposed approach offers noteworthy potential for advancing nanoinformatics research within the nanosafety domain by enabling the development of more accurate predictive models for assessing the potential hazards associated with NMs.

Explainable Artificial Intelligence (XAI) in Insurance

Owens, E., Sheehan, B., Mullins, M., Cunneen, M., Ressel, J., Castignani, G.

Abstract:
Explainable Artificial Intelligence (XAI) models allow for a more transparent and understandable relationship between humans and machines. The insurance industry represents a fundamental opportunity to demonstrate the potential of XAI, with the industry's vast stores of sensitive data on policyholders and centrality in societal progress and innovation. This paper analyses current Artificial Intelligence (AI) applications in insurance industry practices and insurance research to assess their degree of explainability. Using search terms representative of (X)AI applications in insurance, 419 original research articles were screened from IEEE Xplore, ACM Digital Library, Scopus, Web of Science and Business Source Complete and EconLit. The resulting 103 articles (between the years 2000–2021) representing the current state-of-the-art of XAI in insurance literature are analysed and classified, highlighting the prevalence of XAI methods at the various stages of the insurance value chain. The study finds that XAI methods are particularly prevalent in claims management, underwriting and actuarial pricing practices. Simplification methods, called knowledge distillation and rule extraction, are identified as the primary XAI technique used within the insurance value chain. This is important as the combination of large models to create a smaller, more manageable model with distinct association rules aids in building XAI models which are regularly understandable. XAI is an important evolution of AI to ensure trust, transparency and moral values are embedded within the system's ecosystem. The assessment of these XAI foci in the context of the insurance industry proves a worthwhile exploration into the unique advantages of XAI, highlighting to industry professionals, regulators and XAI developers where particular focus should be directed in the further development of XAI. This is the first study to analyse XAI's current applications within the insurance industry, while simultaneously contributing to the interdisciplinary understanding of applied XAI. Advancing the literature on adequate XAI definitions, the authors propose an adapted definition of XAI informed by the systematic review of XAI literature in insurance.

On the impact of advanced driver assistance systems on driving distraction and risky behaviour: An empirical analysis of irish commercial drivers

Masello, L., Sheehan, B., Castignani, G., Shannon, D., & Murphy, F.

Abstract:

Advanced driver assistance systems (ADAS) present promising benefits in mitigating road collisions. However, these benefits are limited when risky drivers continue engaging in distraction events. While there is evidence that real-time warnings help improve driving behaviour, the sustained benefits of warning-based ADAS on reducing driving distraction in light commercial vehicle (LCV) drivers remain unclear. This research determines the effect of receiving instant distraction warnings over two years using a naturalistic driving dataset comprising around one million trips from 373 LCV drivers in the Republic of Ireland. Furthermore, the study applies Association Rule Mining (ARM) to find the contextual variables (e.g., speed limit, road type, traffic conditions) that increase the likelihood of distraction events. The results show that warning-based ADAS providing real-time warnings helps reduce distraction events triggering driver inattention, forward collision, and lane departure warnings. Over half of the studied fleet reduced these warnings by at least 50% – lane departure after two months and driver inattention and forward collision after six months. It is found that both passive and active monitoring systems, coupled with coaching and rewards, significantly reduce aggressive driving behaviours tied to harsh acceleration (by 76%) and harsh braking (by 65%). The results of ARM show that the driving context introduces explanatory information for road safety programs. Low-speed urban roads and the summer season increase the likelihood of driver inattention and forward collision warnings. In contrast, high-speed rural roads increase the likelihood of lane departure warnings. These research findings support road safety stakeholders in developing risk assessments based on warning-based ADAS, targeted campaigns to reduce driving distraction, and driving coaching programs.

(Re)Conceptualizing decision-making tools in a risk governance framework for emerging technologies—the case of nanomaterials

Mullins, M., Himly, M., Llopis, I.R., Furxhi, I., Hofer, S., Hofstätter, N., Wick, P., Romeo, D., Küehnel, D., Siivola, K. and Catalán, J.

Abstract:

The utility of decision-making tools for the risk governance of nanotechnology is at the core of this paper. Those working in nanotechnology risk management have been prolific in creating such tools, many derived from European FP7 and H2020-funded projects. What is less clear is how such tools might assist the overarching ambition of creating a fair system of risk governance. In this paper, we reflect upon the role that tools might and should play in any system of risk governance. With many tools designed for the risk governance of this emerging technology falling into disuse, this paper provides an overview of extant tools and addresses their potential shortcomings. We also posit the need for a data readiness tool. With the EUs NMP13 family of research consortia about to report to the Commission on ways forward in terms of risk governance of this domain, this is a timely intervention on an important element of any risk governance system.

Status, implications and challenges of European safe and sustainable by design paradigms applicable to nanomaterials and advanced materials

Furxhi, I., Costa, A., Vázquez-Campos, S., Fito-López, C., Hristozov, D., Ramos, J.A.T., Resch, S., Cioffi, M., Friedrichs, S., Rocca, C. and Valsami-Jones, E.

Abstract:
Current European (EU) policies, such as the Green Deal, envisage safe and sustainable by design (SSbD) practices for the management of chemicals, which cogently entail nanomaterials (NMs) and advanced materials (AdMa). These practices, applied at the earliest stages of innovation and throughout the life-cycle of chemicals, materials and products, could prevent and/or minimise their environmental, health and safety (EHS) and sustainability impacts. This requires a shift from the established risk control paradigms towards prevention-based approaches at the design stage that accelerate the development of safer and more sustainable chemicals, materials, products and processes, while promoting a transition towards a circular economy and a more sustainable future. The EU commission has funded several Horizon 2020 projects applying the concepts of SSbD to nanotechnologies, biotechnologies and advanced materials. This article is inspired from the answers and opinions shared during a stakeholders meeting arranged throughout the workshop entitled 'Safe and Sustainable by Design Paradigms applied to NMs and AdMa', held in Venice, Italy, in September 2022. The goal of the workshop was to identify differences and overlaps between the SSbD approaches and to provide common messages on the progress towards the implementation of concrete SSbD concepts, and to reveal challenges faced in their realistic and straightforward execution. In this article, we provide insights into the intersecting industrial domains, the technical and organisational challenges to the practical implementation of the SSbD, and future financial directions in supporting and maintaining the digital products currently under development within the H2020 projects, in order to ultimately enable their uptake by industry and regulators.

How does the insurer's mobile internet sales strategy perform?

Chen A., Chen Y., Murphy, F., Tsui, W., Xu, X.

Abstract:
While the impact of an Internet-based sales strategy on sales performance has been well studied, there is little academic research that examines the impact of a mobile application (MA) sales strategy on the sales performance of insurers. Using a unique data set for term life insurance policies from a Chinese life insurer, we study the impact of implementing this strategy on insurance purchases. We find a significant growth in the insurance purchase quantity and somewhat lower growth in premiums received from new policies. This paper determines that this is due to improved channel accessibility and the cost reduction of the MA channel. Although sales of traditional distribution channels are cannibalized in the short term by the MA distribution strategy, this substitution effect does not persist in the long run. In addition, we find that this strategy reduces impulsive purchases.

Physicochemical Transformations of Silver Nanoparticles in the Orogastrointestinal Tract Mildly Affect Their Toxicity to Intestinal Cells In Vitro: An AOP-Oriented Testing Approach

Kose, O., Béal, D., Motellier, S., Pelissier, N., Collin-Faure, V., Blosi, M., Bengalli, R., Costa, A., Furxhi, I., Mantecca, P. and Carriere, M.

Abstract:
The widespread use of silver nanoparticles (Ag NPs) in food and consumer products suggests the relevance of human oral exposure to these nanomaterials (NMs) and raises the possibility of adverse effects in the gastrointestinal tract. The aim of this study was to investigate the toxicity of Ag NPs in a human intestinal cell line, either uncoated or coated with polyvinylpyrrolidone (Ag PVP) or hydroxyethylcellulose (Ag HEC) and digested in simulated gastrointestinal fluids. Physicochemical transformations of Ag NPs during the different stages of in vitro digestion were identified prior to toxicity assessment. The strategy for evaluating toxicity was constructed on the basis of adverse outcome pathways (AOPs) showing Ag NPs as stressors. It consisted of assessing Ag NP cytotoxicity, oxidative stress, genotoxicity, perturbation of the cell cycle and apoptosis. Ag NPs caused a concentration-dependent loss of cell viability and increased the intracellular level of reactive oxygen species as well as DNA damage and perturbation of the cell cycle. In vitro digestion of Ag NPs did not significantly modulate their toxicological impact, except for their genotoxicity. Taken together, these results indicate the potential toxicity of ingested Ag NPs, which varied depending on their coating but did not differ from that of non-digested NPs.

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From principles to reality. FAIR implementation in the nanosafety community

Dumit, V.I., Ammar, A., Bakker, M.I., Bañares, M.A., Bossa, C., Costa, A., Cowie, H., Drobne, D., Exner, T.E., Furxhi, I., Farcal, L. and Friedrichs, S

Abstract:
Developing safe and sustainable nanomaterials-based solutions to current global challenges including clean energy, sustainable food production and water security requires access to high quality data and appropriate analysis and modelling approaches. Achieving these challenges requires increased re-use of research data to accelerate progress and support development of new materials that are safe and sustainable for energy capture and storage, nano-agriculture and environmental remediation. The principles of Findability, Accessibility, Interoperability and Reusability (FAIR) provide a roadmap to enhanced data sharing and re-use, but require consensus within the nanosafety community on metadata, ontologies and persistent identifiers (among other things) and guidance to support implementation and achieve machine-readability. Here, we highlight the main focus of the AdvancedNano GO FAIR Implementation Network in supporting the nanosafety community with implementation of FAIR to maximize data-driven safe and sustainable application of nano- and advanced materials.

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Critical aspects in occupational exposure assessment with different aerosol metrics in an industrial spray coating process

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Abstract:
Engineered Nanomaterials (ENMs) have several uses in various industrial fields and are embedded in a myriad of consumer products. However, there is continued concern over the potential adverse health effects and environmental impacts of ENMs due to their unique physico-chemical characteristics. Currently, there are no specific international regulations for various ENMs. There are also no Occupational Exposure Limits (OEL) regulated by the European Union (EU) for nanomaterials in the form of nano-objects, their aggregates or agglomerates (NOAA). For ENMs the question of which metric to be used (i.e., mass, surface area, number concentrations) to determine the exposure is still not resolved. The aim of this work is to assess the worker exposure by inhalation in an industrial spray coating process by using all three metrics mentioned above. Two target ENMs (N-doped TiO_2, TiO2N and AgNPs capped with a quaternized hydroxyethyl-cellulose, AgHEC) generated for industrial-scale spraying processes were considered. Results showed that the averaged particle number concentration (10–100 nm) was below $2.7 \cdot 10^4$ cm^{-3} for both materials. The Lung Deposited Surface Area (LDSA) was in the range between 73 and 98 $\mu m^2 cm^{-3}$ and the particle mass concentration (obtained by means of ICP-EOS off-line analysis) resulted below 70 µg m^{-3} and 0.4 µg m^{-3} for TiO_2 and Ag, respectively. Although, the airborne particles concentration compared well with the NIOSH Recommended Exposure Level (REL) limits the contribution to the background, according to EN 17058 (Annex E) was significant (particularly in the particle number and PM1 mass concentrations). We successfully evaluated the worker exposure by means of the different airborne particles' metrics (number, surface and mass concentrations). We concluded that worker exposure assessment involving ENMs is a complex procedure with requires both real time and off-line measurements and a deep investigation of the background.

Envisioning a credit society: social credit systems and the institutionalization of moral standards in China

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Abstract:
China's Social Credit System (SCS) has been widely considered a centralized surveillance project, whereas recent research found multiple scoring systems co-existing in various fields at multiple administrative levels and in diverse forms. Despite the broadened view toward the complexity of SCS, these research projects continue to focus on SCS mainly as political and digital control mechanisms. Instead, this paper is interested in the social and cultural meanings of SCS constructed in the media, both at the national and local levels. Based on the analyses of news reports since the year 2003, when the term SCS was officially coined, this paper examines the historical narratives about SCS, including its rationales, stakeholders, and intended goals/tasks. It argues that the SCS construction has been a societal project anchored in a distinct moral orientation of financial credit. While credit systems are often used to classify consumers and financial subjects in Western contexts, the case of Chinese SCS shows that the moral dimension of financial credit scoring has enabled its spread into other non-financial domains. Also, the institutionalization of such moral standards is considered an effective approach to addressing various socio-economic and ethical issues that have long baffled economic development and social justice in China's reform era.