RMIT UNIVERSITY

Natural Hazards and Disaster Resilience Research Capability

Disaster Research Network

RMIT University

What's next...

RMIT has a long record of innovation and partnership in natural hazards and disaster resilience research, including deep research expertise in areas as diverse as disaster risk reduction, green infrastructure and nature-based solutions, satellite mapping of bushfires, evacuation modelling and behaviour, design for resilient recovery, fire resistant fabrics and buildings, the role of creativity and the arts in recovery, and mental health and community resilience through crisis and trauma.

RMIT is also able to mobilise its research expertise through the formation of interdisciplinary research teams that can work in partnership with industries and agencies to help tackle society's complex disaster resilience problems. This document gives a high-level picture of RMIT's disaster resilience research capabilities, summarised under three interlocking themes:

- *Resilient Infrastructures and Environments* is about understanding, designing, and maintaining natural and human-made environments that support resilience, from disaster risk reduction to the planning and design of critical infrastructure. The theme also encompasses the digital and cyber-physical systems that support timely and relevant information about hazards and disaster risk to inform better decisions for stakeholders across all areas of government and society.
- *Resilient Communities and Governance* focuses on understanding the factors that contribute to individual, family, and community resilience, reduce disaster risk, and empower communities to better withstand extreme and unexpected events; and ensure decision makers are prepared and equipped with the tools, data, and mechanisms to design and implement policies and take decisions in support of resilience.
- *Whole-of-Society Resilience* acknowledges that a combination of different methodologies, technologies, approaches, and ways of knowing must come together for sustainable and just community resilience. This theme encompasses integrated, transdisciplinary, and impact-focused programs of strategic disaster resilience research that aim to bring about step changes needed in meeting tomorrow's challenges.

Resilient Infrastructures and Environments

Our capacity for societal resilience is underpinned by the resilience of our natural, built, and fabricated infrastructure and environments at every scale. RMIT's research capabilities in this area include:

- Earth observation and environmental monitoring at the global, national, and regional scales, for applications such as hazard mapping, climate monitoring, severe weather prediction, bushfire reconstruction and modelling, and detection of active bushfires.
- Landscape design and planning, flood mitigation and risk management, damage modelling of built assets, and predictive early warning to reduce disaster risks and forecast impacts.
- Construction design and adaptation at regional, urban, and individual building scales, for applications such as critical transportation infrastructure resilience, in building combustion and fire modelling, and smart coatings and fire-retardant materials for fire-proof homes.
- Resilient natural and manufactured infrastructure, from green infrastructure and nature-based solutions to material and clothing design, for applications such as high performance, fire protective materials and garments.

Information streams from digital and cyber-physical systems also enable us to make best use of more resilient environments, and provide the ability to make the best possible decisions, before, during, and following extreme events. RMIT's extensive research capabilities in this digital and cyber-physical area include:

- Next-generation sensing and sensor fusion, generating and disseminating up-to-date, reliable, and high-integrity information, such as precise positioning of people and infrastructure; using signals of opportunity to support emergency response; and coordinating autonomous sensor platforms and sensor swarms.
- Modelling, analytics and intelligence to support situational awareness, emergency preparedness and recovery, and predictive early warning, such as optimisation and planning for logistics and transport resilience; agent-based modelling and evacuation simulation; and artificial intelligence for human behaviour recognition and humans-as-sensors.
- Vulnerability and risk assessment across society, such as logistics and supply chain resilience, business continuity and resilience, lifelines and critical infrastructure, especially in multi-hazard risks and vulnerabilities.
- Human factors, human cognition and emergency decision making, such as wildfire and evacuation decision making in humans; digital twins; and the design of effective emergency decision support interfaces.

Resilient Communities and Governance

Resilient communities act together in support of each other to reduce disaster risks and mitigate their impacts and to build back better, safer and stronger after a disaster. RMIT's research capabilities in this area include:

- Personal and family resilience in the context of climate change, emergencies, and disasters, such as the role of digital and social media in loss, recovery, and building resilience; knowledge management and digital work in emergencies; and the impacts of disasters on emergency responders, paramedics, journalists.
- Diverse communities and resilience, understanding both the important contributions and vulnerabilities of marginalised groups in resilient communities, such as gender and emergency safety and decision making; traditional knowledge and indigenous community resilience; social work practice in response to heat vulnerability; and the role and agency of children in emergencies and community resilience.
- Creative practice and design in building resilience, such as the role of arts and creativity in recovery; understanding the impacts of disaster on communities through narrative and lived experience; and co-design of disaster response and mitigation strategies.
- Community education, such as participatory and co-designed community education programs; bushfire education in primary and secondary schools; and community-emergency agency liaison and coordination.

Resilient communities thrive when empowered by governance, policy frameworks, and community-government relations that support and enable effective, planned, and safe actions by communities, locally, nationally, and internationally. RMIT's research capabilities in this area include:

- Evidence-based policy development, such as managing risk and uncertainty in a policy context; development, monitoring, and evaluation of new policy options; and government-community relationships in emergency and disaster management.
- Climate resilience governance and policy, including urban-rural interconnections; water and agrifood policy; multi-agency coordination and collaboration; design and governance of integrated adaptation and mitigation infrastructure; and communication for climate change and disaster risk reduction.
- International development in the global geopolitical and climate context, such as informal settlements and land tenure in emergencies; understanding the economic impacts of disasters in impoverished communities; cross-border coordination and capabilities; and humanitarian responses to disasters and "polycrises".

Whole-of-society resilience

The combined perspectives of Resilient Infrastructures, Environments, Communities, and Governance are important. However, natural hazards and disaster researchers at RMIT also adopt an integrated approach to research that takes a strategic, whole-of-society view of resilience. We bring together interdisciplinary and transdisciplinary teams with the mix of skills and expertise needed to engage in impact-focused research at scale and across all response stages and timescales. RMIT's research capabilities at this nexus include:

- Systems thinking: Systems thinking supports a holistic approach to disaster resilience research, recognising the cascading effects and feedback loops that typify disasters. Integrated and interdisciplinary research teams able to connect knowledge domains are better suited to respond not only to the immediate impacts of natural hazards, but also the underlying environmental and societal vulnerabilities that amplify disasters.
- Strategic and tactical research: Strategic research addresses the overarching frameworks and long-term visions that underpin resilient societies, where tactical research aims to realise more immediate, actionable tools, technologies, and innovations. Both strategic and tactical research are indispensable, but it is the interplay of these approaches is required in the pursuit of long-term disaster resilience.
- Curricula and workforce development: Embedding disaster resilience and recovery in teaching and workforce development is a foundation of a more responsive and adaptable society. Connecting our deep research expertise into taught curricula enables upskilling today's experts with new capabilities as well as educating the next generation of professionals in the field.
- Indigenous knowledge and First People: Indigenous knowledge systems are an essential facet of effective disaster management strategies in Australia, rooted in deep connections to local ecosystems and longstanding cultural practices. Meaningful and long-term engagement with Indigenous communities and Indigenous researchers can underpins culturally relevant solutions to contemporary disaster resilience challenges.
- New methodological frameworks: A changing climate and evolving uncertainties demand agility and creativity in innovation. Embracing new and transdisciplinary research methodologies helps to uncover hidden patterns, simulate complex scenarios, anticipate emerging risks, and advance our understanding of the intricate interplay of social, ecological, and infrastructural of disaster resilience.

Example Projects

Cost-effective mitigation strategy for flood prone buildings: https://www.bnhcrc.com.au/research/floodpronebuildings

Early Warning System for Drought Implemented in PNG by CREWS https://public.wmo.int/en/media/news/early-warning-system-drought-implemented-png-crews

Enhancing resilience of critical road infrastructure: https://www.bnhcrc.com.au/research/roadinfrastructure

Enhancing the Australian Gridded Climate Dataset rainfall analysis using satellite data https://www.nature.com/articles/s41598-022-25255-6

Enhancing urban resilience to climate change impacts and natural disasters: Honiara https://cur.org.au/project/enhancing-urban-resilience-to-climate-change-impacts-and-natural-disasters-honiara/

Fuels 3D: https://www.bnhcrc.com.au/resources/poster/4917

Helping children find their role in disaster risk reduction: https://www.rmit.edu.au/news/all-news/2020/march/meet-women-improving-living-with-cities-nature

How GPS now helps us forecast rain more accurately https://www.rmit.edu.au/news/all-news/2019/oct/gps-weather-prediction

Preparing emergency services for operations in a climate-challenged world: https://www.bnhcrc.com.au/research/understanding-and-mitigating-hazards/8023

Talking Country: Sharing Indigenous stories of place through mobile media: https://cur.org.au/project/talking-country-sharing-indigenous-stories-of-place-through-mobile-media/

Tarnagulla Community Resilience Action Plan: https://cur.org.au/project/tarnagulla-community-resilience-action-plan/

Protecting our firefighters through human-centred engineering: https://www.rmit.edu.au/news/all-news/2020/sep/protecting-our-firefighters-through-human-centred-engineering

Resilient Information Systems for Emergency Response (RISER): https://riser.net.au/

Satellite-based disaster warning system: https://sccar.rmit.edu.au/the-network/case-studies/satellite-based-disaster-warning-system-for-australia/

Smart coating to fire-proof houses: https://www.rmit.edu.au/news/all-news/2020/oct/for-women-in-science

Example RMIT Researcher Profiles

RMIT University supports an interdisciplinary network of over 80 researchers actively working in areas connected with natural hazards and disaster resilience. Profiles of just a handful of such researchers, illustrating both the breadth and depth of interdisciplinary expertise, includes:

	**Professor Babak Abbasi** Babak's research focuses on industry-motivated quantitative modelling and decision making under uncertainty applied to health care delivery improvement, supply chain coordination, and emergency resilience. He has worked with several industry partners including Australian Red Cross Blood Life, The City of Melbourne, and Geoscience Australia, and The Florey Institute of Neuroscience and Mental Health. https://www.rmit.edu.au/contact/staff-contacts/academic-staff/a/abassi-babak
	**Professor Esther Charlesworth** Esther specialises in design strategies for reducing disaster risk and successful recovery and reconstruction. She has conducted development, peace-making and disaster related research in Australia, the Pacific, SE Asia, Japan, Lebanon, Israel, Cyprus, Bosnia, Germany, Ireland, Haiti, and USA. She is the Founding Director of Architects Without Frontiers for which she was awarded an Order of Australia in 2021. Prof. Charlesworth has been an ARC Future Fellow and is the author of numerous scholarly journal articles and book chapters as well as eight books. https://www.rmit.edu.au/contact/staff-contacts/academic-staff/c/charlesworth-professor-esther
	**Professor Prem Chhetri** Prem is Director of Global Supply Chain and Logistics (GSCL) Research Priority Area. Prem is a GIS analyst with a strong interest in spatially integrated emergency logistics, urban infrastructure, transport and logistics planning and management of geographic information. Prem has received several Australian Research Council and federal and state government grants to study quality of urban life, spatial labour markets, urban fire and emergency planning, logistics clusters, innovation and growth, and climate change and port logistics. https://sccar.rmit.edu.au/the-network/people/professor-prem-chhetri/
	**Professor Vanessa Cooper** Vanessa's research in information systems examines the impact of technology in complex contexts such as environmental sustainability, emergency management and the future of work. Vanessa has applied an analytical approach to connect information systems and knowledge management to a cross-disciplinary research program in emergency management. This body of work has resulted in a series of research publications for the Bushfire CRC, Emergency Management Victoria, and Country Fire Authority. https://www.rmit.edu.au/contact/staff-contacts/academic-staff/c/cooper-professor-vanessa

	**Dr Marco de Sisto** Marco's research interests concern the implementation of HR principles within the decision-making in unstable or extreme environments. Marco was also recognised by the Australian government as an international "Distinguished Talent" in the field of emergency management. Since 2015, Marco has worked with the emergency departments of several Victorian local councils such as Cardinia Shire and Mornington Peninsula to develop effective communities' resilience frameworks and better community engagement strategies. https://www.rmit.edu.au/contact/staff-contacts/academic-staff/d/de-sisto-dr-marco
	**Professor Simon Feeny** Simon is professor in RMIT's School of Economics, Finance and Marketing and group leader of the International Development and Trade Research Group. Simon has undertaken work for several organisations including the Australian Agency for International Development (AusAID), the United Nations University World Institute for Development Economics Research (UNU-WIDER), the ASEAN Secretariat, South Pacific Forum Secretariat, Oxfam Australia, World Vision Australia and the Make Poverty History Campaign. https://www.rmit.edu.au/contact/staff-contacts/academic-staff/f/feeny-professor-simon
	**Professor John Fien** John's research focuses on disaster risk management and on how systemic design can help protect communities vulnerable to flooding, bushfire, and cyclone damage and rebuild safely and stronger afterwards. He has led research projects for the ARC, CRCs, and Natural Hazards Research Australia and research, evaluation, and training projects for UNEP, UNHCR, UNICEF, UNESCO, the OECD, the World Bank, the Asian Development Bank, and the Environment Departments of several governments. Prof. Fien has published over 150 scholarly books and articles, and is among the most cited researchers in the world. https://www.rmit.edu.au/contact/staff-contacts/academic-staff/f/fien-professor-john
	**Dr Amy Griffin** Amy is a geographer with expertise in how people read maps and understand spatial information. Her research has spanned a range of hazards (bushfire, cyclones, floods) and a range of stages of emergency management (preparation, response, mitigation) to contribute new knowledge of how to understand and model risk, vulnerability, and resilience in Australia and South Asia. She has recent experience with a NHRA-funded project that is developing and testing map-driven communication that will assist householders to take appropriate protective actions in the event of bushfires. https://www.rmit.edu.au/contact/staff-contacts/academic-staff/g/griffin-dr-amy
	**Professor Usha Iyer-Raniga** Usha has contributed to national and international programmes on energy efficiency and sustainability in the built environment such as the Asia Pacific Economic Cooperation (APEC), Building and Construction Authority (Singapore). She is co-lead of the UN's Sustainable Buildings and Construction programme. Through this initiative, major sustainable construction activities have been funded in countries such as India, Kenya and Nicaragua. https://www.rmit.edu.au/contact/staff-contacts/academic-staff/i/iyer-raniga-professor-usha

	**Professor Simon Jones** Simon's research interests lie in the areas of remote sensing for natural resource mapping, wildfire, linking ground observations with remotely sensed imagery and data uncertainty. He has been a research leader in several large federally funded research initiatives, including the CRCSI Landfor project that is constructing land use histories from the Landsat archive using machine learning; TERN AUSCOVER; as well as BNHCRC projects that seek to detect wildfires using satellite imagery and produce tools for fuel load estimation. https://sites.rmit.edu.au/remotesensing/people/
	**Dr Erica Kuligowski** Erica's expertise is in response behaviour of people under imminent threat, emergency communications, and evacuation modelling. Erica worked for 18 years in the U.S. National Institute of Standards and Technology researching evacuation and sheltering behaviour and emergency communications in disasters. Erica's work has led to the development of new or improved building codes and community standards, decision-making tools for disaster response, and emergency alert/warning creation tools and templates. https://www.rmit.edu.au/contact/staff-contacts/academic-staff/k/kuligowski-dr-erica
	**Dr Lucy Lunevich** Lucy is the author of "Disaster and Emergency Planning for Preparedness, Response, and Recovery: Promoting Resilient Infrastructure and Community". This book addresses key elements of emergency planning, including regulatory requirements and how to recover from resulting emergencies and build on resilience of community and develop new standards for infrastructure. Dr Lunevich's research aims to fundamentally shift the emergency management concepts from a traditional focus on vulnerability to a focus on resilience. https://www.rmit.edu.au/contact/staff-contacts/academic-staff/l/lunevich-dr-lucy
	**Dr Tariq Maqsood** Tariq's research has focused on vulnerability and risk assessment of built environment from natural hazards. He has been a part of several national and international initiatives, such as the Bushfire and Natural Hazards CRC, the Climate Resilient Honiara, the Global Earthquake Model, the Greater Metro Manila Risk Assessment and the UNISDR Global Assessment Report. He has also conducted numerous post-disaster surveys in several countries to assess the impact of severe events and to identify typical building failure mechanisms. https://www.rmit.edu.au/contact/staff-contacts/academic-staff/m/maqsood-dr-tariq#
	**Professor Darryn McEvoy** Darryn's expertise covers climate risk assessment and adaptation, innovative adaptation practice (both institutions and technologies), institutional adaptive management (and adaptation as a process), vulnerability assessment, the building of local adaptive capacity, and the synergies and conflicts between the adaptation and mitigation agendas. Of particular interest is the translation of theory into practice and highlighting the implications for climate risk management and decision-making (including both public and private actors). https://www.rmit.edu.au/contact/staff-contacts/academic-staff/m/mcevoy-professor-darryn

Professor Alberto Posso

Alberto is Director of the Centre for International Development at RMIT University, Australia. As a poverty specialist, Alberto's work sheds light on how vulnerable households respond to shocks, including economic shocks, natural disasters, as well as household-level shocks. Alberto has authored sponsored research projects with leading partners, including FAO, UN ESCAP, the UN Global Compact, the Fred Hollows Foundation, Plan International, the APEC Secretariat, the Australian Government, and the Peruvian Government.
https://www.rmit.edu.au/contact/staff-contacts/academic-staff/p/posso-alberto

Professor Sujeeva Setunge

Sujeeva is a professor in Civil Engineering and leads the research portfolio of stem college at RMIT as Associate Deputy Vice Chancellor (ADVC) for research and Innovation. Her research interests focus on disaster resilience and sustainability of buildings and infrastructure and innovative and sustainable construction materials. The asset management system developed by her team entitled CAMS is currently being used by several organisations.
https://www.rmit.edu.au/contact/staff-contacts/academic-staff/s/setunge-sujeeva

Dr Shahrooz Shahparvari

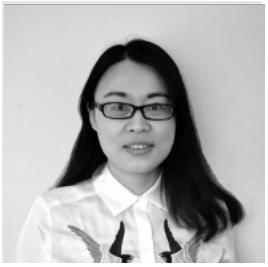
Shahrooz is a lecturer in Supply Chain and Logistics at RMIT University. He has published in the top tier transportation journals including OMEGA, Transportation research part A, part D, Part E and Australasian Journal of Information System, Computers & Operations Research, and various others. His research interests include stochastic modelling, mathematical modelling, decision support systems, and statistical analysis in the disaster environment.
https://www.rmit.edu.au/contact/staff-contacts/academic-staff/s/shahparvari-shahrooz

Associate Professor Nirajan Shiwakoti

Nirajan has significant research experiences in the field of human factors engineering, passengers'/pedestrians' crowd evacuation modelling, adoption and deployment of connected and autonomous vehicles, crowd dynamics modelling, supply chain, safety analysis and evaluation and emergency services planning.
https://www.rmit.edu.au/contact/staff-contacts/academic-staff/s/shiwakoti-associate-professor-nirajan

Dr Mittul Vahanvati

Mittul's research focuses on the long-term impacts of housing reconstruction projects, the theory and practice of socio-ecological systems resilience and community-led approaches. Her research sits at the intersection of human geography and built environment and design. Mittul is has worked with regional communities in Victoria (Australia) to co-produce their resilience action plan and on a UN-Habitat project for a "Climate Resilient Honiara" (Solomon Islands) developing nature-based solutions to informal settlements and urban spaces.
https://cur.org.au/people/mittul-vahanvati/



Associate Professor Rebecca Yang

Rebecca has developed a strong and passionate commitment to industry-focused and applied research. Her research resonates with RMIT's vision of transforming the built environment to create sustainable and resilient cities. Her primary research focus is on solar energy applications in buildings, and construction innovation, with applications to safe, healthy, and liveable cities.
https://www.rmit.edu.au/contact/staff-contacts/academic-staff/y/yang-rebecca