Royal Academy of Engineering

Symposium report

Frontiers of Development

The urban opportunity for building a resilient future

23-26 July 2019 | Putrajaya, Malaysia

HERIOT WATT UNIVERSITY

GCRF Global Challenges Research Fund

Royal Academy of Engineering

Introduction to Frontiers of Development

The Frontiers of Development programme brings together 60 of the best early- and mid-career researchers and practitioners from engineering, medical, social and natural science backgrounds from across industry, NGOs and academia in multidisciplinary workshops.

These highly interactive and curated symposia look at international development themes through an interdisciplinary lens, encouraging collaboration and knowledge transfer between a range of participants.

Competitively allocated seed funding is available to strengthen the collaborations developed at the symposia.

The Royal Academy of Engineering is a delivery partner of the UK government's Global Challenges Research Fund (GCRF), that supports cutting-edge research to address the challenges faced by developing countries. The GCRF funds the Joint Resilient Futures Initiative that consists of a group of programmes run across the four national academies. The Frontiers of Development programme is one such programme, run by the Royal Academy of Engineering with support from the Royal Society, the Academy of Medical Sciences and the British Academy.

THE ROYAL SOCIETY

The Academy of Medical Sciences

The British Academy

Contents

Challenges in building a resilient future

The fourth Frontiers of Development symposium took place between 23 and 26 July 2019 at Heriot-Watt University's Malaysia campus in Putrajaya. This was the first event in the Building resilience series. Sixty-three delegates from different disciplines and countries came together to discuss the wide range of challenges in building a resilient future in an urban context globally.

Urbanisation is a growing trend. The promise of jobs and prosperity, among other factors, pulls people to cities. Half of the global population already lives in cities, and it is predicted that by 2050, it will have risen to 64% of people across low and middle-income countries and 86% of people in high-income countries[1]. Much of this growth will occur in Africa and Asia. Currently, the Asian cities of Osaka, Karachi, Jakarta, Mumbai, Shanghai, Manila, Seoul and Beijing are each already home to over 20 million people, while Delhi and Tokyo are approaching 40 million people. Cities such as Tehran, Istanbul and Cairo are, or soon will be, home to over 10 million people each[2].

In these cities, many of the most pressing problems facing the world today come together: poverty, environmental degradation, poor air and water quality, insufficient water availability, waste-disposal and high energy consumption, all of which are exacerbated by the increasing population density. Urbanisation therefore creates enormous social, economic and environmental changes. Practitioners working in this field have a responsibility to society to address these challenges and create a sustainable future for urban living.

To achieve this, resources must be used more efficiently, equitable access to land and accommodation must be provided alongside adaptations for climate change and increased efforts must be made to protect biodiversity and natural ecosystems. Any planning of future interventions must take these aspects into consideration.

To explore these challenges, the following sub-themes were chosen:

1. Preparing for and responding to urban environmental hazards.
2. Planning for a sustainable urban future.
3. Building resilient urban communities.

1 https://population.un.org/wup/publications/files/wup2014-highlights.pdf
2 Ibid.

The event was co-chaired by Professor Garry Pender FREng FRSE, and Professor Caroline Knowles.

This report summarises learnings and insights from the discussions and activities that took place at the symposium.

The symposium was organised in partnership with Heriot-Watt University, a public research university based in Edinburgh, with campuses in Dubai and Malaysia. The Academy would like to thank everyone who made the symposium possible and a resounding success, especially the event chairs, the Global Challenges Research Fund, and the British Academy, the Academy of Medical Sciences and the Royal Society.

63 delegates from different disciplines and countries came together to discuss the wide range of challenges in building a resilient future in an urban context globally

Garry is Deputy Principal for Research and Innovation at Heriot-Watt University, with responsibility for implementing the university's research and innovation strategy, including in its Dubai and Malaysia campuses. His background is in civil engineering and his personal research interests lie in flood management and sediment transport. He is a Fellow of the Institution of Civil Engineers, the Chartered Institution of Water and Environmental Management, the Royal Society of Edinburgh and the Royal Academy of Engineering.

Professor Garry Pender FREng FRSE

Caroline is Professor of Sociology at Goldsmiths, University of London, Director of the British Academy's Cities and Infrastructure programme and a Fellow of the Academy of Social Sciences. An urban sociologist, Caroline is the author of many books and papers on cities, ethnicity, race, and the circulations of people (as migrants) and of objects composing contemporary globalisation.

Professor Caroline Knowles

Preparing for and responding to urban environmental hazards

Session co-chairs

Bruce Malamud, Kings College London and Lindsay Beevers, Heriot-Watt University

1. Complicated and complex: How do we include multi-hazard risk in the urban Global South?

   Faith Taylor, University of Portsmouth

2. How does dynamic vulnerability influence urban resilience? Case study of Bandung City, Indonesia

   Saut Sagala, Resilience Development Initiative

3. Can we engineer resilience to hazards in urban areas? EU case studies

   Maria Pregnolato, University of Bristol

This session considered the challenge of how, when preparing for and responding to urban environmental hazards, models include not only 'all' single hazards that might influence a city, but also:

- The interactions of those hazards with themselves (multi-hazard cascades and coincident hazards).
- Impacts that both the single and multi-hazards might have on physical exposure and vulnerability of the urban area.
- How a city evolves over time with influences such as anthropogenic processes on the natural hazards.

With this context in mind the first speaker, Faith Taylor, introduced the spatio-temporal dimensions of multi-hazard risk. She discussed a global framework that was developed for multi-hazard assessment from Gill and Malamud (2014[3], 2016[4]). Using case studies from Nairobi, Kenya and Karonga, she gave examples of single hazards, hazard interactions and their impact. She then outlined some of the opportunities and challenges faced by the Urban Ark research and capacity building programme in developing multi-hazard risk assessments for towns and cities in the Global South. This led into the first activity of the session where participants worked together in pairs to present an urban area known to them, outlining the single hazards that might influence that urban area and the potential socio-economic impacts of those hazards.

Following this activity, Saut Sagala, the second speaker, presented a case study of Bandung Metropolitan Area in Indonesia. He reflected on how dynamic vulnerability – how an individual's or a community's level of vulnerability changes over time – can influence risk and resilience. He highlighted that vulnerability should be measured in dynamic, rather than stationary terms. For example, if a flood occurs in a post-earthquake slum, the vulnerability of that slum differs from the pre-earthquake setting and should therefore be measured in relation to its post-earthquake adaptive capacity.

The last presentation of the session was given by Maria Pregnolato and focused on how engineering methods can support impact assessment in the context of extreme flooding and transportation. Maria introduced damage curves that show the relationship between hazard intensity and damage. Through case studies from Newcastle and Florence she illustrated how these can vary in different circumstances. She went on to discuss the challenges of the risk-based approach that looks at the interaction between elements to understand the damage and consequences of events. As vulnerability and exposure levels are continually changing it can be difficult to establish the costs involved and Maria explained that a new type of matrix is required to account for such changes.

Participants were then asked to form groups of four, choose one of the urban areas identified in the first activity, and design a poster that considered natural hazards, dynamic vulnerability, anthropogenic processes and the related timelines. The examples considered included Tauranga in New Zealand, Dhaka in Bangladesh, Addis Ababa in Ethiopia and Santiago de los Caballeros in the Dominican Republic. Groups then presented their posters and compared and contrasted their differences and similarities.

In the plenary discussions that followed, a number of key points were made:

- It is important to **consider all relevant timescales** at the start of the planning process, whether that is minutes or decades after the hazard event has occurred, or both, because recovery is a process.
- When planning, **all potential consequences** of the hazards must be considered. For example, plans to combat flooding must also consider the impact of the flooding on the quality of water.
- The challenges caused by urban environmental hazards are interdisciplinary by nature, and therefore, stakeholders must **adopt an interdisciplinary approach** when dealing with them to make full use of the available resources/technology.
- The process of **urbanisation needs to be managed** so areas of land that are not conducive for healthy living conditions, e.g. flood plains, are avoided.
- **Clear communication** to the public is key when implementing interventions in response to urban environmental hazards; people need to understand the purpose of the intervention.

3 agupubs.onlinelibrary.wiley.com/doi/epdf/10.1002/2013RG000445

4 www.researchgate.net/profile/Joel_Gill/publication/308198887_Hazard_interactions_and_interaction_networks_cascades_within_multi-hazard_methodologies/links/58308bbe08ae138f1c05e9bf/Hazard-interactions-and-interaction-networks-cascades-within-multi-hazard-methodologies.pdf

Planning for a sustainable urban future

Session co-chairs

Claudia Loggia, University of KwaZulu Natal and Ya Ping Wang, University of Glasgow

1. What is the role of multi-scalar private entrepreneurs in low-income informal settlements in the Global South?

   Yasmin Ara, Lancaster University

2. What are the challenges of using data for transport planning in the Global South?

   Roberto Speicys Cardoso, Scipopulis

3. What is the role of urban blue and green infrastructures in planning for a sustainable future?

   Alex Lechner, University of Nottingham (Malaysia)

Effective urban planning and design are increasingly seen as some of the most important policy tools for the creation of socially inclusive, resilient, economically prosperous, and energy-efficient cities (UN Habitat 2015[5]). In the Global South, most of the urban expansion has not been formally planned and informal settlements are home to more than half of the urban population. Planning for a sustainable urban future therefore requires a new set of principles, tools and methods to understand and respond holistically to the pressing challenges of rapid and unplanned urbanisation, migration, climate change, poverty and inequality.

With this introduction setting the context for the session, Yasmin Ara introduced her current PhD research, which focuses on the role that multi-scalar private entrepreneurs play in low-income informal settlements in the Global South. As the urban population continues to increase, so has the proliferation of low-income informal settlements, characterised by unauthorised construction, unregulated infrastructure and service provisioning, and untailored everyday governance. Within these settings, various factors have given rise to the number of privately managed informal settlements in cities. These factors include the diminishing availability of public land, inefficiencies in urban planning, increasing rural-urban migration and slow delivery of serviced land. This often disadvantages tenants as landlords tend to be exploitative profit-makers, rendering tenants invisible and powerless. As the settlements are not official, it is hard to follow regulations. Even for settlements in which the government is involved, regulations, such as the height of the buildings, are often not followed. Yasmin showed examples from empirical studies in four settlements in Dhaka and New Delhi that form the basis of her research.

Roberto Speicys Cardoso introduced Scipopulis, his company that builds data processing software platforms to leverage the existing data that cities collect about transport. The main goal is to improve urban mobility and specifically the challenges of traffic congestion.

Using São Paulo as an example, Scipopulis has taken various data sources into account including weather, GPS, ticketing, and accidents, to produce a series of contextual information-based dashboards that can help stakeholders make transport-related decisions. For example, passengers can view a summary of flow and speed on main streets to help decide which route is best, while bus companies can use the same data to understand the financial performance of a particular bus route. Scipopulis has analysed the bus networks of six different cities in Brazil and built a tool that helps identify how routes within these networks can be changed to reduce pollution. Roberto outlined three key issues to consider when dealing with data:

- How do you collect the data?
- What is the quality of the data? Does it represent the phenomenon in question properly?
- How do you keep the data fresh?

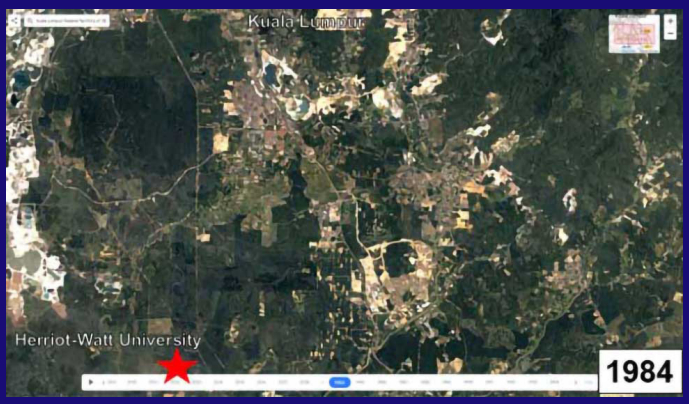
> Effective urban planning and design are increasingly seen as some of the most important policy tools for the creation of socially inclusive, resilient, economically prosperous, and energy-efficient cities[5]

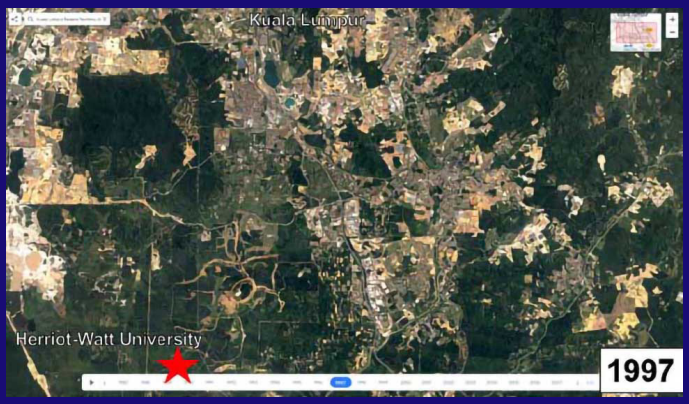
While they successfully overcome the first issue, data quality and freshness remain problematic.

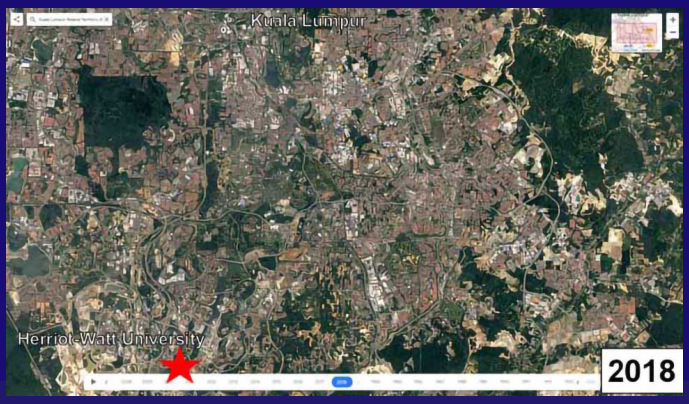
The final presentation was given by Alex Lechner who spoke about the importance of nature-based solutions – a relatively new term that refers to the protection of ecosystem services and their application to sustainable city planning – when considering how to plan for a sustainable urban future. This is particularly relevant in the Global South where urban blue and green infrastructures have typically not been prioritised. Alex highlighted the benefits that green and blue infrastructures provide, including the critical habitat for biodiversity and important ecosystem services for urban populations such as water regulation, flood mitigation, climate change adaptation and amenity.

5 sustainabledevelopment.un.org/content/documents/1726Habitat%20Global%20Activties%202015.pdf

As part of his presentation, Alex showed satellite images of the area surrounding Heriot-Watt University's Malaysia campus between 1984 and 2018. This illustrated how dramatically the picture has changed and the lack of priority given to green spaces in Kuala Lumpur and the surrounding region.







Following the presentations, participants split into groups to think about how urban planning can respond to environmental, demographic, economic and social-spatial challenges in the urban context.

Some of the key points and recommendations they shared included:

- **There is a need for better social integration in urban planning**. Cities need better plans for citizens across different classes and income levels to share spaces to reduce social tensions. This could be supported by attractive public transport networks and reducing the use of cars in the first instance, and planning for mixed neighbourhoods in the longer term.
- **Urban planning should be interdisciplinary.** Different perspectives across disciplines are needed to make sustainable urban plans for the future.

- Inclusion needs to become a priority. Meaningful participation of all groups, especially the most vulnerable and excluded such as the urban poor and people with special needs, needs to be ensured in any planning processes.
- More research is needed to understand how best to engage citizens in urban planning. How can we ensure transient groups such as migrants and refugees are included? How can we best address the spatial and physical needs of various citizen groups? Could big data and citizen engagement data be used to inform the process?
- Increase awareness of social and economic rights. What is the best way to communicate this? Land rights are a big political issue and it's crucial that they are solved to achieve collaborative planning. A process to move informal areas towards more semi-formal areas could be a route.
- It is difficult to plan a city's economy as investments are fluid. Capitalism does not allow for flexibility and can raise insecurity.

Building resilient urban communities

Session co-chairs

Diane Archer, Stockholm Environment Institute and Nishara Fernando, University of Colombo

Speakers

Eric Chu, University of Birmingham

Bansari Prajapati, Mahila Housing Sewa Trust

Huraera Jabeen, BRAC University

The focus of the final session was on the barriers to resilience that the most marginalised urban population groups face. Nishara Fernando introduced the session, highlighting that few systems are designed with resilience in mind and disasters will affect the people within a community in different ways depending on their local needs. A bottom-up approach is seen as the most appropriate and feasible method to build local and national resilience.

The session took the format of a panel discussion. Key points that were raised included:

- Resilience is not enough; it can be a barrier to more transformative forms of development.
- Some of the stresses or shocks that are being considered are abstract to the communities who may be affected by them because their priorities are more immediate, for example feeding their families.
- To see change there is a need for dialogue between communities and technology stakeholders where communities are given a choice, rather than have decisions made by others inflicted upon them. It is crucial to get feedback from communities on the technology design.
- There is a need for intermediary organisations to break the barriers between inventors and their science, and the communities who are using the new technologies.
- Statistics show that the proportion of women living in urban areas is increasing, and that women are increasingly in head-of-household positions. There is the potential for this to exacerbate gendered challenges, especially in countries where assumptions about gender and gendered roles are very strong. However, if these changes are framed and supported in appropriate ways they can be harnessed as an advantage.

Resilience alone is not enough. A resilient city is not an end but a process, and sustainable development is the goal

- There are insufficient arenas for decision-makers to tackle difficult questions such as, 'Who could lose out by action being taken to combat climate change?' and 'Who will lose their home, or lose their farmland?'
- Communities should be empowered in the planning process – it is important to include community members from all areas in the dialogue and think through resilience in a controlled setting.
- Local government funding is not enough to achieve resilience, nor will international funding agencies have enough to fill the gap. Private funders and business investment are also required.
- Nature-based solutions can be powerful so need to be given more consideration.
- Using networks, both within and across cities internationally, is key in learning what works and what not to do.

The speakers then shared both successful and unsuccessful examples of policy initiatives that aimed to transformative outcomes:

- In Bangladesh, gender is addressed at a policy level and is referenced in every document. However, it is unclear how gender aspects are addressed in practice. The government is motivated to create change though and by making it a requirement to include women and members of marginalised communities on committees, city officials' attitudes have started to shift and there is more acknowledgement of vulnerable communities.
- The Indian Institute of Health's action plan on how houses cope with heat stresses involved discussions at city level and hospital level, but not at slum level, despite the slums already having measures for heat stress such as white paint. This solution is inexpensive and can be easily organised locally.

Participants then joined the discussion and shared their views. Simon Gusah, Chief Resilience Officer in Lagos, highlighted that a poor city can be resilient but its resilience doesn't mean that there are no further issues. Resilience alone is not enough. A resilient city is not an end but a process, and sustainable development is the goal. Linked to this point, it was highlighted that all hazards are different and individual communities respond to hazards differently. Participants discussed the idea that communities within cities are not homogenous and there are power struggles that need to be overcome within a community as part of the strive to be resilient, such as gender and religion.

Following the discussion participants were split into groups in which they were assigned an identity as a different urban stakeholder with a set of priorities. These ranged from public health official to an international funding agency. Using this identity to frame their thinking, delegates were asked to develop an urban resilience strategy focused on an informal settlement of approximately 100 households on the banks of a river with an informal agreement to remain on site from the private landowner. This framework enabled participants to think practically about questions such as:

- What outcome(s) is the stakeholder working towards?
- Which actors need to be engaged with and how?
- What financing will be required and what are potential sources?

The delegates reflected on some of their key learnings:

- From the perspective of the private landowner (a factory owner), the priority is to take care of their employees. The willingness to work with the local government and community is only there if there is extra capacity to do so – it cannot be a burden to the running of the factory.
- Public health officials felt that more information was needed before any actions to improve health and wellbeing indicators could be determined, especially population and water quality data.
- It is crucial to engage different partners to improve conditions such as the community, private landowners, and the local government. It is difficult for organisations acting as an intermediary to bridge that gap.
- There was an overwhelming sense of having to act fast, which made it difficult to prioritise actions. Participants decided to start by mapping out key stakeholders, agreeing the project objectives as well as understanding the infrastructure needed and discouraging settlement in the area.

Paul Wilkinson

London School of Hygiene and Tropical Medicine

Paul Wilkinson is Professor of Environmental Epidemiology at the London School of Hygiene and Tropical Medicine (LSHTM). He is one of the leads on the Complex Urban Systems for Sustainability and Health (CUSSH) programme, a four-year Wellcome Trust-funded project that aims to deliver key global research on the systems that connect urban development and health using six cities (London, Beijing, Ningbo, Nairobi, Kisumu and Rennes) around the world as case studies. Cities remain the main driver for action and have significant potential to have impact.

In his keynote Paul discussed how the CUSSH programme research aims to understand how actions to achieve important goals for healthy sustainable development can be accelerated through research that includes participatory methods and multidisciplinary inputs.

Healthy and sustainable urban development is a goal for cities throughout the world. Achieving it entails balancing responsibilities for planetary health, especially regarding climate change, with those for protection against local environmental risks. Although there is hopeful rhetoric of change, there is no evidence that CO_2 emissions are slowing down. Action to achieve the transition to a low-carbon economy has the potential for appreciable benefits to public health through reduction in exposures.

Matthew Oakley

Mott MacDonald

Matthew Oakley is Technical Director at Mott MacDonald, a UK-based engineering and development consultancy with offices around the world, including Malaysia. He has a background in civil engineering and has been working in Malaysia since 1995.

Matthew spoke to the group about a number of projects that Mott MacDonald have been involved in, particularly those related to climate resilience in infrastructure, both in Malaysia and the wider region. This included an explanation of the Stormwater Management And Road Tunnel (SMART) in Kuala Lumpur. This 9.5 kilometre tunnel diverts floodwaters away from the confluence of Kuala Lumpur's two major rivers while its central three kilometre section doubles up as a two-deck motorway. In extreme floods – which historically have had devastating consequences in Malaysia - the road decks are flooded to increase stormwater capacity. In its normal, everyday function, the tunnel is a toll road, so it pays for itself.

Frontiers insights

In this final session of the symposium the group of experts split into three groups according to the sub-theme that was most closely aligned with their work or research, choosing from:

- Hazards.
- Planning.
- Communities.

Each group discussed areas that they felt needed more dialogue or hadn't been addressed. Following these discussions and feedback to the plenary, participants had the opportunity to pitch their seed-funding ideas in a session facilitated by the event chairs. The group discussions are summarised as follows.

1. Preparing for and responding to urban environmental hazards

The group split the focus of their discussion to look first at preparing for urban environmental hazards, and then responding to them. When considering how to prepare for urban environmental hazards they focussed on the challenges added by ageing populations. Older citizens typically have greater challenges in adapting to future urban environmental hazards, with characteristics such as memory loss adding to their vulnerability. The group also discussed ageing infrastructure and questioned how assets would survive and continue to perform. The importance of improving the shared understanding of data, hazards and risks across disciplines and sectors was highlighted.

In considering how to respond to urban environmental hazards, there is a need for a better connection between academia and implementation in policy. For example, undertaking a systematic review across projects may maximise learning in practice. There was also a suggestion for countries to be surveyed on their environmental hazard risk registers to see how they compare.

2. Planning for a sustainable urban future

Participants in this group took a big-picture approach when considering this sub-theme, and used a timeline to map their thoughts: the present, the mid-term, the long-term, and the more distant future. They highlighted the importance of identifying priorities at different stages, for example, in the mid-term working towards having more sustainable transport, and ensuring an increase in equity over time. There needs to be an emphasis on a flexible planning approach to dynamic situations, especially in the context of increasing urban populations, temperature rises and more frequent extreme weather events.

3. Building resilient urban communities

'Resilience to what?' was one of the questions posed by this group, with participants discussing how important it is to identify which areas need greater resilience building efforts through mapping out the different issues. They made the point that resilience is a process rather than an outcome. Discussions also centered around the importance of including marginalised voices in the planning process, ensuring flexibility of solutions, developing public awareness, sharing good practice and lessons learned between communities, and recognising co-benefits between resilience and other aims, such as the Sustainable Development Goal (SDGs). This area however requires continuous research and feedback.

How to write a successful grant application

In this session, the event and session chairs discussed what makes a grant application successful in their experience. Their points have been summarised as follows:

1.

Writing a good application is a skill that can be developed with practice. To help develop this skill it is a good idea to:

- Read successful proposals written by others, especially those submitted to the funder the applicant intends to apply to.
- Consider feedback received on unsuccessful project bids and reflect on what could be done differently the next time.
- Use clear simple language that can be understood across disciplines.

Strong networks can help an applicant stay up to date with the state-of-the-art innovations in their field

2.

Read, re-read and then read again any advice and guidance provided by the funder, and make sure that what is written fits the guidance. This will require applicants to write and re-write their proposal. It is also a good idea to speak directly to the funder to ensure that the proposal fits with the funder's interests. Many funders provide examples of well written 'justification of resources' and 'pathways to impact' for example.

3.

The starting point for most reviewers is to be critical of a proposal. This is normal as they are being asked to sanction the allocation a considerable sum of money. To overcome this, it is necessary for applicants to ensure that a proposal provides the reviewers with confidence that, if they support your proposal, it will be money well spent. To cover all bases, applicants may:

i. Include a short summary at the beginning. This should be written in clear language that avoids jargon.

ii. Consider the 'big picture' – what is the issue and why it is important, for example a big picture might be 'building a resilient urban future'. For international research, the UN Sustainable Development Goals can provide a useful context.

iii. Explain what research needs to be done to address this issue and how the proposal fits in with this. Applicants should be realistic and not overambitious, avoid overstating and be clear as to why the work is important. Expressing the importance in terms of clear objectives or research questions may also help.

iv. Explain how the proposed research builds on what has been done by others.

v. Discuss what expertise and track record there is that makes them the best person/team/partnership to do this research. If appropriate, examples of previous successful collaborations can be beneficial.

vi. Set out what each member brings to the team/partnership and why the collaborations are meaningful.

vii. Provide a detailed explanation of: a) the methods that will be deployed to address the objectives/answer the questions, b) what data is available and its quality, c) the programme for the work and d) the costing of the necessary resources.

viii. Be clear about what the funder will get in return for their investment in the project.

ix. Explain the impact of the work and how this will be achieved.

4.

Developing a strong academic network is important. Strong networks can help an applicant stay up to date with the state-of-the-art innovations in their field. Getting this information via networking is faster than waiting for work to be published, as there is a significant time lag in the publication process.

Seed funding awards

Climate-resilient slums: a systems approach for inclusive climate impact assessment

- Melissa Bedinger, Heriot-Watt University
- Faith Taylor, King's College London
- Bansari Prajapati, Mahila Housing Sewa Trust (SEWA)
- Lindsay Beevers, Heriot-Watt University
- Bijal Brahmbhatt, SEWA
- Siraz Hirani, SEWA
- Annie Visser-Quinn, Heriot-Watt University

Mobilising women: navigating urban infrastructures and resilience in Dhaka, Bangladesh

- Nabeela Ahmed, University of Sheffield
- Yasmin Ara, BRAC University
- Huraera Jabeen, BRAC University

Nature-based solutions for urban disaster mitigation in middle-income countries

- Juan Miguel Kanai, University of Sheffield
- Alex Lechner, University of Nottingham (Malaysia campus)
- Saut Sagala, Resilience Development Initiative
- Lindsay Beevers, Heriot-Watt University
- Amol Chaphekar, StrataEnviro Pvt Ltd

Opportunities for improving preparedness and resilience to urban explosive violence

- Jack Denny, University of Southampton
- Sara Waring, University of Liverpool
- Achala Jayathilleke, Postgraduate Institute of Medicine, Colombo
- Amila Ratnayake, Military Hospital Narahenpita, Colombo
- James Batchelor, University of Southampton
- Rebecca Brown, University of Southampton
- Iain Overton, Action on Armed Violence (AOAV)
- Vajira H.W. Dissanayake, University of Colombo

Pathways to sustainability in post-industrial cities of the Global South

- Felix Ringel, Durham University
- Ashiq Ur Rahman, Khulna University
- Evance Mwathunga, University of Malawi
- Huraera Jabeen, BRAC University
- Nishara Fernando, University of Colombo
- Juan Miguel Kanai, University of Sheffield

Rapid identification and effective communication of waterborne hazards in emergencies

- David Werner, Newcastle University
- Osuolale Olayinka, Elizade University
- Muhammad Nauman Ahmad, University of Agriculture, Peshawar
- Sara Waring, University of Liverpool
- Shaaban Mgana, Ardhi University

The educational opportunity for building a resilient future

The project is being funded by Heriot-Watt University.

- Alan Forster, Heriot-Watt University
- Liz Brogden, Queensland University of Technology
- Leigh-Anne Hepburn, University of Sydney
- Desmond Bernie, icecream architecture
- Megan Boston, University of Waikato
- Jolanda De Villiers Morkel, Cape Peninsula University of Technology
- Taibat Lawanson, University of Lagos

Transforming lives through low-cost housing – case study of Uganda and Indonesia

- Sheida Afshan, University of Southampton
- Anne Rweyora, Smart Havens Africa
- David Sagita, University of 17 Agustus 1945 Surabaya
- Yun Ii Go, Heriot-Watt University (Malaysia campus)
- Stephanie Gauthier, University of Southampton
- Yuli Kusworo, ArkomJogya
- Wen Tong Chong, University of Malaya

Attendee list

Name	Organisation
Adam Prana	University of Canterbury, New Zealand and National Land Agency, Republic of Indonesia
Akino Midhany	Resilient Development Initiative
Alan Forster	Heriot-Watt University (UK)
Alex Makalliwa	Solar e-Cycles Kenya
Alex Lechner	University of Nottingham (Malaysia)
Aliyu Barau	Bayero University, Kano
Amol Chaphekar	StrataEnviro Pvt Ltd
Andrew Mahon	RedR
Anne K Rweyora	Smart Havens Africa
Armin Mustafa	University of Surrey
Bansari Prajapati	Mahila Housing SEWA Trust
Ben Chrisinger	University of Oxford
Biniam Ashagre	Anglia Ruskin University
Brian Sheil	University of Oxford
Bruce Malamud	King's College London
Caroline Knowles	Goldsmiths, University of London
Claudia Loggia	University of Kwazulu-Natal
David Rush	University of Edinburgh
David Sagita	University of 17 Agustus 1945 Surabaya
David Werner	Newcastle University
Desmond Bernie	ice cream architecture
Diane Archer	Stockholm Environment Institute (SEI)
Eric Chu	University of Birmingham
Evance Mwathunga	University of Malawi - Chancellor College
Evangelia Topriska	Heriot-Watt University (Dubai)
Faith Taylor	University of Portsmouth
Felix Ringel	Durham University
Garry Pender	Heriot-Watt University (UK)
Goodman Kazoora	Uganda Martyrs University
Huraera Jabeen	BRAC University
Izni Zahidi	Monash University Malaysia

63 participants

Based in
17 countries

Name	Organisation
Jack Denny	University of Southampton
James Schell	Global Alliance for Urban Crises/IMPACT Initiatives
Jan Gaviña	USHER Technology - Mapua University (PH)
Josephat Izunobi	University of Lagos
Leigh-Anne Hepburn	University of Sydney
Lindsay Beevers	Heriot-Watt University (UK)
Liz Brogden	Queensland University of Technology
Maria Pregnolato	University of Bristol
Maria Isabel Serrano Dina	Pontificia Universidad Católica Madre y Maestra
Matthew Oakley	Mott MacDonald
Md Ashiq Ur	Khulna University, Bangladesh
Megan Boston	University of Waikato
Melissa Bedinger	Heriot-Watt University (UK)
Miguel Kanai	University of Sheffield
Mohd Zahirasri	Universiti Putra Malaysia
Muhammad Nauman Ahmad	University of Agriculture, Peshawar
Nabeela Ahmed	University of Sheffield
Nishara Fernando	University of Colombo
Olayinka Osuolale	Elizade University
Paul Wilkinson	London School of Hygiene and Tropical Medicine
Qammer H. Abbasi	University of Glasgow
Roberto Speicys Cardoso	Scipopulis
Sara Waring	University of Liverpool
Saut Sagala	Resilience Development Initiative
Sheida Afshan	University of Southampton
Simon Gusah	Lagos State Resilience Office (LASRO)
Suleiman Halasah	i.GREENs
Wee Teo	Heriot-Watt University (Malaysia)
Ya Ping Wang	University of Glasgow
Yasmin Ara	Lancaster University
Yun Ii Go	Heriot-Watt University (Malaysia)
Zhiwen (Vincent) Luo	University of Reading

Event feedback

In the post-event survey, completed by 29 respondents, 100% of respondents said they would recommend attending a Frontiers of Development event. 90% rated the overall event 'excellent' and the remaining 10% rated it 'good'.

"A great opportunity to network with people from across disciplines that I wouldn't ordinarily have an opportunity to meet through other channels."

"It was perfect!"

"A great mix of disciplines, people and institutions and very, very well organised."

"This provided me with a lot of valuable experience."

"Participant countdown was my favourite part!"

Royal Academy of Engineering

The Royal Academy of Engineering is harnessing the power of engineering to build a sustainable society and an inclusive economy that works for everyone.

In collaboration with our Fellows and partners, we're growing talent and developing skills for the future, driving innovation and building global partnerships, and influencing policy and engaging the public.

Together we're working to tackle the greatest challenges of our age.

Our 2025 ambition

Talent & diversity

We'll grow talent by training, supporting, mentoring and funding the most talented and creative researchers, innovators and leaders from across the engineering profession – with an aim to help over 7,500 professionals to enhance their leadership skills.

We'll develop skills for the future by identifying the challenges of an ever-changing world and developing the skills and ideas we need to build a resilient and diverse engineering profession. We've set ourselves a target to work with over 500 engineering businesses and organisations to champion diversity and inclusion in the workplace.

Innovation

We'll drive innovation by investing in some of the UK's most creative and exciting engineering ideas and businesses. In partnership with industry, entrepreneurs and academia, we're on course to support the growth of more than 500 companies through our Enterprise Hub.

We'll build global partnerships that bring the world's best engineers from industry, entrepreneurship and academia together to address the greatest global challenges of our age. As a leading voice in engineering and technology, we're working to build networks and partnerships in over 40 countries, across six continents.

Policy & engagement

We'll influence policy through the National Engineering Policy Centre – providing independent and expert guidance to government, drawing on the expertise and creativity of over 450,000 engineers. In our 2020-25 strategy we've committed to working with over 1,000 policymakers in the UK and internationally to improve people's lives.

We'll engage the public by opening their eyes to the wonders of engineering and inspiring young people to become the next generation of engineers. Through campaigns like This is Engineering, we're changing perceptions of the profession and by 2025, we'll have helped a million young people – from every background in the UK – to explore a career in engineering.

For more information, including eligibility,
please visit **raeng.org.uk/frontiers** and follow **@RAEngGlobal**

Royal Academy of Engineering
Prince Philip House, 3 Carlton House Terrace, London SW1Y 5DG