Royal Academy of Engineering

The Distinguished International Associates Programme

Awardee profiles

INTRODUCTION

The Distinguished International Associates Programme is a grant scheme for excellent international engineers working across all sectors, who are at the cutting edge of engineering research or innovation, and have existing collaborations or connections to the UK which they would like to intensify.

The programme aims to develop a broad international community or network of excellent diverse engineers across countries and disciplines, with research and innovation links to the UK, to work alongside the Academy to enhance progress towards achieving its goals for an inclusive economy and sustainable society.

The programme aims to:

- **Support and strengthen** existing collaborations and engagement between awardees and their peers in the UK engineering community
- **Empower** Associates who can further broaden and demonstrate meaningful links with the UK and the Academy to promote their activities where they align with the Academy's objectives
- **Build a peer support network** of "International Associates" to facilitate international cooperation and to stimulate the engineering communities in participants' home countries
- **Facilitate opportunities** for alumni to create and strengthen their own research, innovation, or policy links to the UK engineering community

Awardees will be offered a grant to amplify the impact of their collaboration with the UK in an area which aligns with the Academy's strategic priority themes. The award enables awardees to develop or strengthen their research, innovation, and policy links to the UK and to improve and deepen links between the UK and their country of residence, through visits, workshops, communication and public engagement activities.

The pilot round of the DIA programme awarded nine Associates from across Jordan, South Africa, Thailand and India. Each awardee is showcased here, with details of their background, DIA-project, and wider work. Please share them with your wider networks, and find out more about the programme by visiting **www.raeng.org.uk/dia**.

Professor Rania Aburamadan

Assistant Professor in the Architectural Engineering School, Applied Science University, Jordan

PROFILE
Distinguished International Associate

Thematic area: Architecture engineering

Project title: Initiative Sanitation and hygiene Networking in Jordan (ISNJ)

Strategic goals: To respond effectively to sanitation and hygiene challenges in Jordan, bringing together all stakeholders to collaborate and improve the lives of vulnerable people in poverty pockets across the country.

Background: I graduated with First Class Honours in architecture engineering from Applied Science University in Amman in 1998, before obtaining a master's in architecture engineering and completing my PhD in sustainable development at the University of Salford in 2017. I joined Amman Arab University in 2019 as an assistant professor in the Architectural Engineering School, while working on a range of civil and structural engineering projects in my role as a qualified engineer.

Previous Academy involvement: I worked with the Academy in the 2018/19 Industry–Academia Partnership Programme, focusing on IT and conservation of traditional architecture and heritage. Separately, I helped develop a new portal for city information modelling, optimising systems integration in industry and sustainable urban regeneration. Other Academy schemes I have been involved in are Transporting Systems through Partnerships, DIA Round 2, and two Engineering X funds.

About my project

Objectives: There is a serious need for improvement in the sanitation and hygiene system for vulnerable people in several regions of Jordan – specifically, poverty pockets (areas where at least 25% of the population are classified as poor) in Jeras, Irbid and Karak. COVID-19 has amplified the need to provide adequate and safe sanitation, to prevent spreading the virus and provide safety between residents. I have seen first-hand people living in unsafe, inadequate and crowded settlements with no water or sanitation. These experiences encouraged me to think about conducting research to improve the living conditions of people in poverty.

Jordan's population is expected to double by 2050, and the country already faces extremely scarce water resources with severe sanitation issues. I propose to develop an interdisciplinary platform for experts, academics, researchers, and policymakers, focusing on the value of networking. Participants can share disruptive technologies such as waterless toilets and 3D printing to articulate modern solutions to the existing challenges of sustainable sanitation.

On the UK side... I am in the process of collaborating with academics in the UK at institutions including UCL, finding experts in this area. Since the beginning of the project, I have built a network with more than 50 experts from different regions, including half a dozen virtual workshop speakers from the UK. I am still looking to find industrial bodies in the UK working in sanitation systems and rainwater harvesting.

Project output: I have divided this project into four packages:

- **Establishing ISNJ** – introducing ISNJ to all stakeholders, professionals and policymakers.

- **Collaboration and partnership** – workshops on policy, technical and environmental issues.
- **Dissemination** – a webinar, scientific articles, non-technical executive summary, and so on.
- **Proposal development** – collating findings for sustainable, innovative Jordanian sanitation.

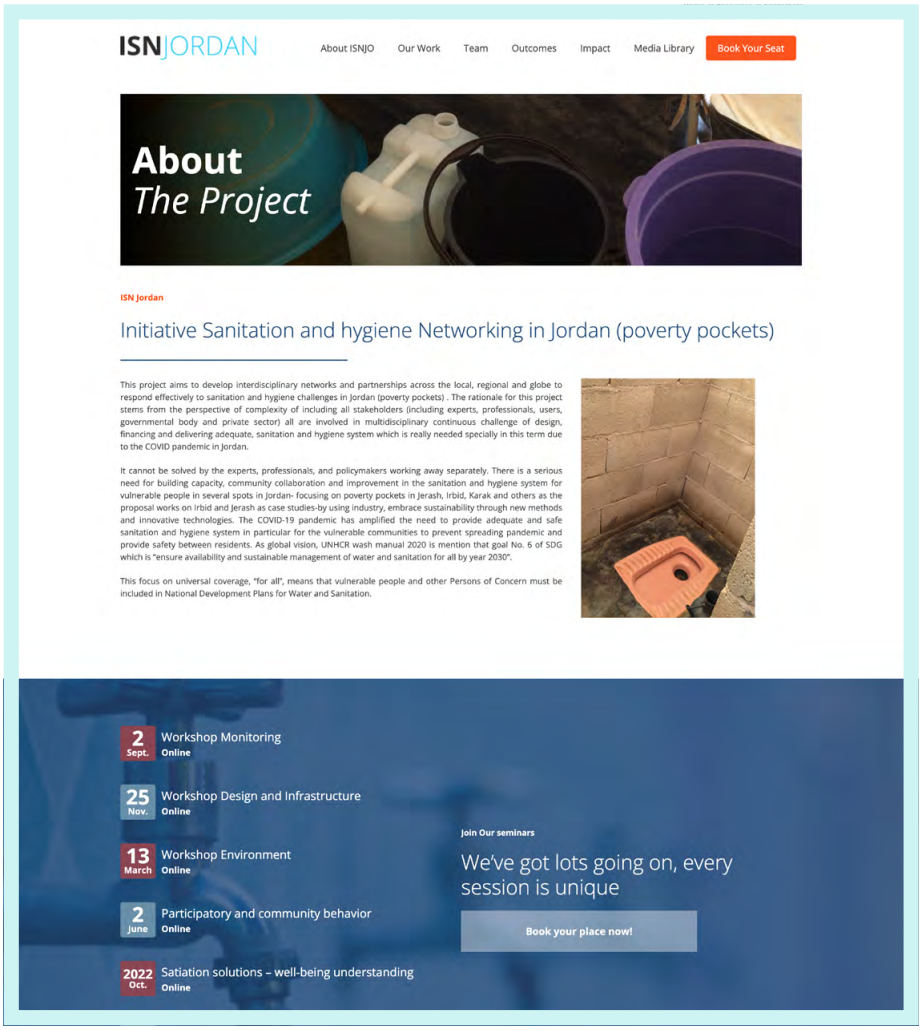
I am partway through hosting five workshops, featuring a variety of guest speakers and covering issues like sanitation system infrastructure and finance. This reflects the collaborations and partnerships I have developed as a direct result of the ISNJ – around 20 in total, from NGOs, academics and humanitarian organisations.

I am also working with almost two dozen civil engineers, sanitation and water experts, architects, and urban planners, collectively spreading knowledge of the importance of hygiene and water management.

I am also promoting my findings through a dedicated website, alongside YouTube, Facebook and Twitter accounts.

Anticipated outcomes and impact: The overarching project goal is to reflect the challenges currently faced and provide solutions or suggestions. This will drive – and be driven by – collaboration and partnerships between sanitation stakeholders, professionals and policymakers around the world. Removing data silos and supporting a multidisciplinary environment will engender technology transfer and capacity development between Jordanian academics, industry sectors and other countries.

On the ground, ISNJ will showcase sustainable and technology-driven water and sanitation solutions to households in poverty pockets, at the lowest practicable cost. It will be used as the basis for a larger international collaboration project, constructing a prototype of Jordanian innovative sustainable sanitation for testing and optimisation with potential for global outreach.



In the long term, I hope the ISNJ's impact extends to the establishment of a charity focused on less fortunate communities, with a participatory approach to improving their living conditions.

Final thoughts on the Distinguished International Associates programme: DIA is a huge opportunity to achieve my ambitions by applying my knowledge and leadership skills. It will allow me to capitalise on my knowledge to help less fortunate communities, and this project might become a foundation stone for a future charity or start-up.

Professor Arup Lal Chakraborty

Professor, Electrical Engineering, Indian Institute of Technology Gandhinagar (IITGN), Gujarat, India

PROFILE
Distinguished International Associate

Thematic area: Photonic sensors

Project title: Uncrewed aerial vehicle (UAV)-based laser spectroscopic monitoring of greenhouse gas emissions in urban and rural India

Strategic goals: To develop a compact and lightweight laser-based trace-gas-sensing system to measure ambient carbon dioxide, translating laboratory research to local industrial bases and providing reliable emissions measurements.

Background: Having already achieved a First Class Bachelor of Technology degree in electronics and communications, and a Graduation Certificate of Merit from the Department of Atomic Energy in India, I obtained my PhD in 2010 from the University of Strathclyde's Department of Electronic and Electrical Engineering. Since then, I have focused my research on tunable diode laser spectroscopy for precision gas parameter measurement, as well as fibre-optic physical and biomedical sensing.

I am nationally recognised as one of the few Indian researchers with expertise in engineering applications of tunable diode laser-based precision spectroscopy, and I have a flourishing Photonic Sensor Lab at IITGN with state-of-the-art research facilities.

Previous Academy involvement: This is the third time I have been awarded funding by the Royal Academy of Engineering and my growth as a researcher has received a significant boost as a result. I was the Indian lead in a previous Industry–Academia Partnership Programme (IAPP) project titled 'Development of a fibre-optic sensor network to monitor hazardous gas leaks in industrial plants', in partnership with a professor at City, University of London.

About my project

Objectives: Air pollution is a leading cause of severe and chronic health issues, and industrial emissions are dominated by carbon dioxide, carbon monoxide and oxides of nitrogen. The problem is especially acute in the state of Gujarat where I am based, which is home to a thriving chemical and pharmaceutical industry. Vast agricultural activity is also a major contributor to emissions, with unregulated use of fertilisers on crops contributing to the emission of ammonia and nitrous oxide, which is 300 times worse as a greenhouse gas than carbon dioxide.

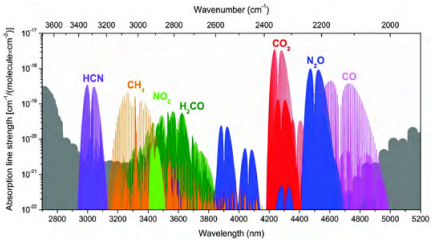
There is an urgent need to adopt advanced technologies for the reliable measurement of emissions, which must be precise, robust and easy to deploy. I propose developing and using UAVs for ambient air quality measurement, combined with laser spectroscopic systems using tunable diodes and embedded electronics. We envision partnering with Indian industries that could take up the technology for widespread use.

On the UK side... Building on an existing relationship with City, University of London, I am drawing on colleagues with complementary skills and facilities. My own background is highly international and interdisciplinary, which enables me to carry out impactful collaborative research with greater impact than would be possible by working solely with colleagues at my home university.

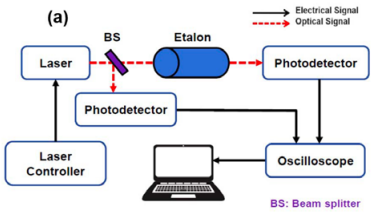
Project output: The first step involved designing a lightweight electronic system to drive the tunable laser. Future activities will include procuring a suitable UAV and mounting the laser-detector

UAV-based laser spectroscopic monitoring of greenhouse gas emissions in urban and rural India

1. A gas absorbs infrared light of wavelength specific to the molecule

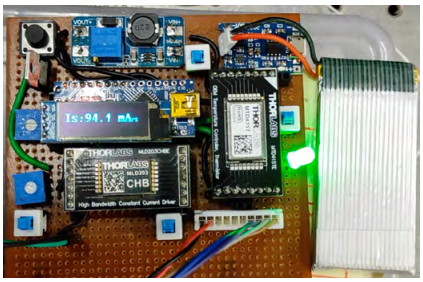


2. Use a tunable diode laser and a photodetector to make a sensor system

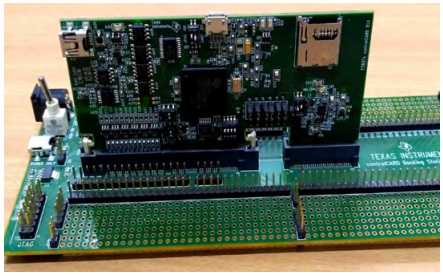


3. Mount the system on a drone for airborne measurement

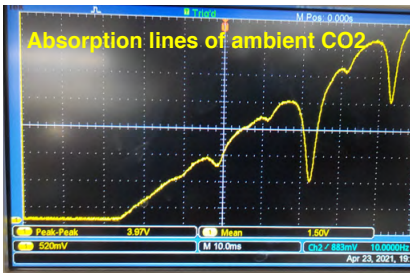
4. Design custom electronics to control the laser



5. Design custom electronics for data acquisition and signal processing



6. Make vertically resolved airborne measurements of trace gases



pair on it before testing for total flight time per battery charge. We will develop a Python-based post-processing algorithm for trace gas measurement and create a Raspberry Pi system for data acquisition and wireless data logging, again using Python.

A working prototype is ready and has been tested in various parts of Ahmedabad and Gandhinagar. The system is being upgraded for many more measurement campaigns. Discussions are ongoing with a leading Indian company, which is keen to develop the laser-based sensing technology.

An online workshop titled 'Photonics for Health, Atmosphere, Safety, and Education' was held in January 2022, delivered in a hybrid format with invited talks by experts on optical sensors and optical imaging. The event saw significant participation from undergraduate and postgraduate students at IITGN, the University of Calcutta and the University of Strathclyde.

Anticipated outcomes and impact: Any advanced technologies for reliably measuring emissions must be precise, robust and easy to deploy. They will be mounted on UAVs for vertically resolved measurements that are currently not carried out because there are no such UAV-mounted systems. Once the technology has been developed and tested, planned demonstrations of UAV-mountable robust greenhouse gas measurement systems would inspire confidence among local industries to take up the technology for widespread indigenous production.

Final thoughts on the Distinguished International Associates programme: I thank the Academy for this excellent opportunity. The DIA programme has allowed me to strengthen my links with my current collaborators and to develop new relationships. I feel more connected to other parts of the world through this project, which will have a trickle-down effect on the quality of teaching and the development of graduate students working on this project.

Nico Fischer

Associate Professor at the Catalysis Institute and DSI-NRF Centre of Excellence in Catalysis, University of Cape Town, South Africa

PROFILE
Distinguished International Associate

Thematic area: Heterogeneous catalysis

Project title: NECatS – Novel Empowered Catalyst Supports

Strategic goals: To collaboratively further the development of a novel oxidic support material, to store renewable energy in chemical molecules.

Background: Since the beginning of my academic career, UK researchers and collaborators have played a significant role in my work. In 2015, I had the honour of being awarded a Newton Advanced Fellowship by the Royal Society for a collaborative project with the Cardiff Catalysis Institute. I helped organise the first-ever Faraday Discussion event in Africa in 2017, and I am the secretary of the Catalysis Society of South Africa, having previously been media officer and chairperson.

My chemical engineering studies were undertaken at the Karlsruhe Institute of Technology in Germany, and my PhD was completed at the University of Cape Town, where I now work.

Previous Academy involvement: In 2018, I secured Industry–Academia Partnership funding to run free training workshops for African emerging faculty researchers, on the analysis of experimental data collected at synchrotron and neutron facilities.

About my project

Objectives: South Africa is recognised as a country with outstanding potential for renewable energy generation, but its is widely underused. Wind and photovoltaic farms are slowly making inroads, but regions of high renewable energy production capacity lack infrastructure for energy distribution. There is a need to develop storage media.

The family of Power-to-X (PtX) processes in combination with green hydrogen generation is generally regarded as the main pathway to store renewable energy in chemical molecules such as ammonia, methanol or hydrocarbons. The processes at the heart of PtX often require a redesign of the catalyst. The NECatS project proposes to further the development and understanding of a new class of material that can be employed as catalyst supports, providing physical separation of the active phases while providing electronic-promoting functionality through impregnation or deposition of alkali/transition metals in an oxidised form on the catalyst.

Specific objectives include the conclusive analysis of synchrotron X-ray absorption data on the speciation of the potassium promoter, as well as the development of a density functional theory-based model. The choice of catalyst systems will be guided by the results of the experiments testing the introduction of the novel support materials.

On the UK side... The expertise of my partners has been invaluable, with four collaborators in the UK including Simon Kondrat, a lecturer at the University of Loughborough. The opportunity to strengthen the informal collaboration with the University of Loughborough was the main driver behind applying for the DIA programme. We are currently planning a visit by our UK partners to South Africa, probably in May 2022.

Project output: We will develop further understanding of the working principles of new catalyst support materials. This will be achieved through a combination of kinetic measurements, theoretical modelling, and advanced laboratory and synchrotron-based characterisation techniques.

A special focus will be on the characterisation of the catalytic materials under realistic working conditions.

The project will not only provide key information on a novel material but also strengthen the collaboration between the South African and UK teams, providing exposure and learning opportunities for young researchers' cutting-edge techniques.

Anticipated outcomes and impact: The project has really accelerated over the last months, and I believe there are many research questions directly related to our current work. The project team's focus recently has been concluding data analysis of the X-ray absorption spectroscopy experiments, allowing us to draft a manuscript for submission in a high-impact peer-reviewed journal.

The NECatS design concept has been submitted as a patent application to the UK Intellectual Property Office, and I plan to engage media outlets upon the successful publication of the prepared manuscript. Subsequent work is expected to yield two to three journal articles, with publication dates in 2022 and early 2023.

Catalyst manufacturing companies that will be approached include BASF, Shell, Haldor Topsoe, Sasol, and PetroSA, plus Johnson Matthey in the UK.

Final thoughts on the Distinguished International Associates programme: The DIA programme has allowed me to strengthen collaborations and present work at national and future international conferences. Paired with a UK network, we have been able to generate crucial material characterisation data more quickly, including an in-depth evaluation hardly possible for the South African team alone.

Professor Tim Gibbon

Director of the Centre for Broadband Communication at Nelson Mandela University (NMU), Gqeberha, South Africa

PROFILE
Distinguished International Associate

Thematic area: Engineering education and telecommunications research

Project title: Nurturing excellence, opportunity and equity through digital education for engineering and science

Strategic goals: To create and nurture a platform for first-year engineering students, where they can receive real-time help and access a library of video on demand (VoD) lessons.

Background: After achieving a PhD in physics at NMU in 2006, I studied a post-doctorate qualification at the Technical University of Denmark in Copenhagen. I have won several awards over the last 20 years including a bronze medal from the South African Association for the Advancement of Science, and the 2020 NMU Researcher of the Year award. I lecture around 350 first-year engineering students every year, as well as mentoring over half a dozen MSc and PhD students, and I particularly enjoy developing online learning platforms for physics and engineering students.

Previous Academy involvement: I was the overseas investigator in an Industry–Academia Partnership Programme (IAPP) grant, which was recently successfully completed with City, University of London, and I intend to build on the positive outcomes from this project in future.

About my project

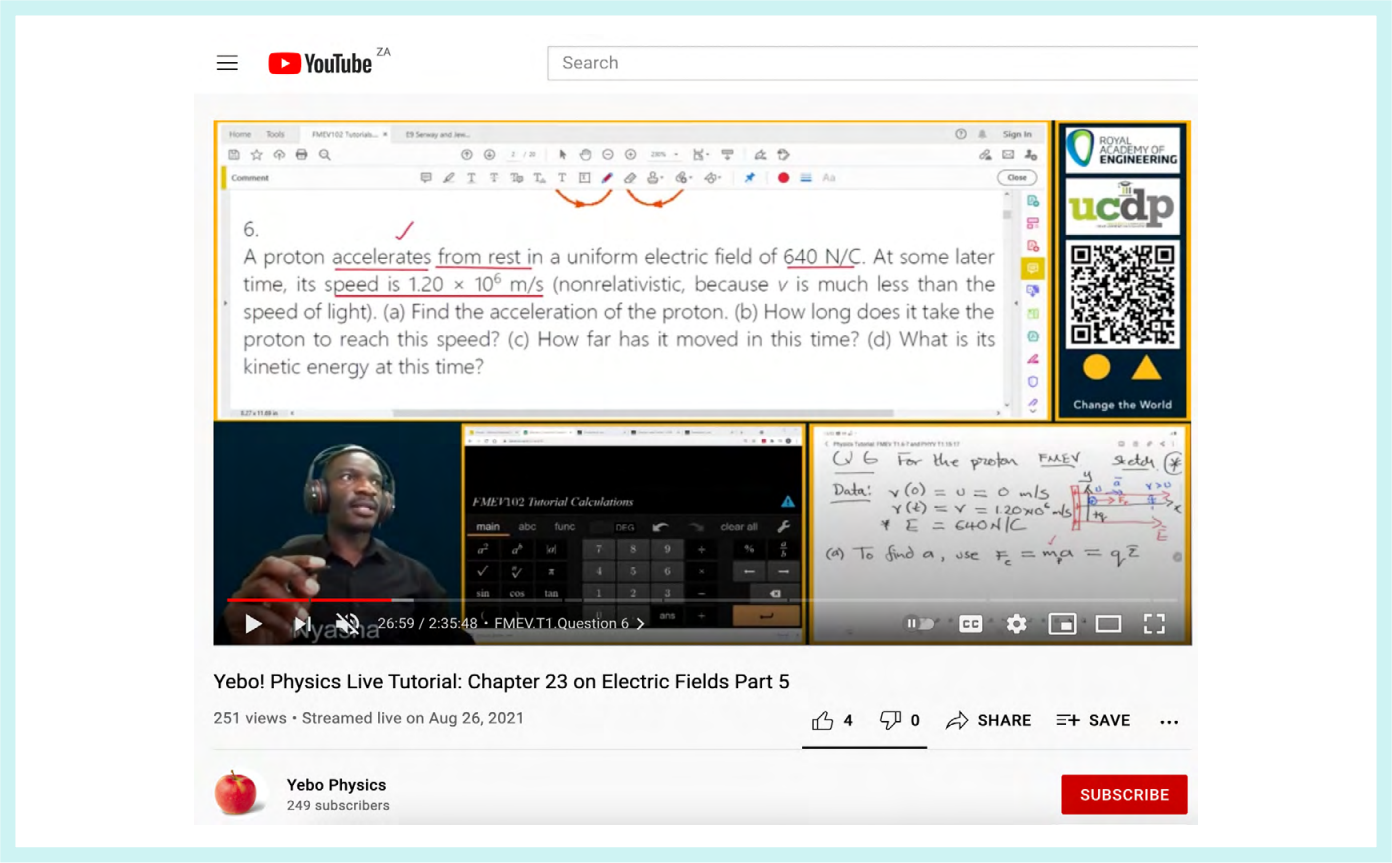
Objectives: The main objective is to improve the quality of education for undergraduate students. This will be done using a digital platform called Yebo Physics – the word 'yebo' is colloquial South African for a strongly affirmative 'yes'. On this YouTube-hosted platform, senior master's and PhD students are mentored and trained to create educational content for (and offer real-time assistance in support of) undergraduates.

The Yebo project aims to resolve the diverse challenges faced by engineering and STEM students in developing countries in the post-COVID-19 digital landscape, mitigating the effects among the underserved.

It will provide graduates of the South African school system (many of whom have extremely poor mathematical and problem-solving skills) with intense one-on-one guidance to sharpen their abilities. This is especially important in remote villages where students can't attend campus or meet in groups for learning; the problem is amplified in engineering and STEM classes, where one-on-one support may not be possible.

An additional benefit of this project is providing master's and PhD students with experience in digital technologies that are now in demand among employers, such as the ability to livestream.

On the UK side... Alongside the support from the DIA programme, additional funding for tutor remuneration has been leveraged from the Academy's University Partnership Development Programme. I will build on recently completed work done under the recent Royal Academy of Engineering IAPP grant, amplifying this connection to the UK and adding value to the work of UK colleagues.



Digital education techniques developed in South Africa can be implemented in the UK (and indeed globally), and I will be hosting industry-focused workshops in both the UK and South Africa.

Project output: Yebo incorporates the latest livestreaming and vlogging trends, such as HD cameras and greenscreen superimposition. The primary aim is to create quality on-demand assistance for engineering students, while the secondary aim is to develop a pool of tutors adept at creating digital learning using modern technology.

Livestreams are broadcast for four hours every weekday, with students encouraged to Zoom call in with questions. Other content will be timestamped VoD footage, which can be referenced as required.

Tutors are trained on how to livestream, edit, handle technical questions from younger students, and manage this YouTube channel. I will be holding workshops in both Port Elizabeth and London with academics and professionals to expand on the potential offered by digital education.

Anticipated outcomes and impact: The Yebo online platform has already been created, and we recently held our inaugural local workshop. We have recruited four tutors, and almost 500 hours of engineering and physics educational content has already been created and archived in VoD format. We have several hundred subscribers, and this will increase significantly as the project is promoted more widely.

My own background is highly international, and I believe this project will also make teaching and training more international in emphasis and scope, particularly relating to digital innovation. Ongoing mutual cooperation in education with colleagues at City, University of London, will support the joint publishing of new research work. Through the support of the Royal Academy of Engineering, this project is genuinely changing lives.

Final thoughts on the Distinguished International Associates programme: The vision and global impact of the Royal Academy of Engineering is inspirational, and I first applied because I wanted to be a part of this.

Beyond the benefits of being part of the community, and funding for research and equipment, I am extremely proud to be a DIA. It adds tremendous validation to my research, teaching and engagement activities.

Dr Ali Mohammed Ali Hayajneh

Assistant Professor in Communication and Networking for Internet of Things (IoT), Robotics and Autonomous Systems at Hashemite University, Jordan

PROFILE
Distinguished International Associate

Thematic area: Wireless communications and artificial intelligence (AI)

Project title: Ultra-low-cost, machine-learning-enabled IoT Devices on the edge (MLEIoT)

Strategic goals: This project is working towards showcasing the capabilities of sensor node controllers in AgriTech, by enabling enhanced farming and water management practices in Jordan.

Background: After obtaining a BSc in electrical engineering and an MSc in wireless communications at Jordan University of Science and Technology, I studied a PhD in electronics and electrical engineering at the University of Leeds, with a thesis on drone-assisted wireless communications.

I returned to Jordan and spent several years working as a lecturer, teacher and trainer, before retruning to the University of Leeds in 2015 to focus on digital communications.

Previous Academy involvement: I collaborated with Dr Des McLernon at the University of Leeds on a Royal Academy of Engineering-sponsored project entitled 'Drone-assisted micro-irrigation for dry lands in Jordan based on IoT sensor networks'. The experience I had with the Academy was great, and I hope to continue working with them to develop more opportunities.

About my project

Objectives: In a country with scarce water resources, smart solutions to water management are vital, especially in the agriculture sector. Jordan is investing heavily in agriculture development and innovation, with many AgriTech startups and accelerators. However, reducing the cost of domestic solutions is proving problematic among poorer farmers.

This project aims to use edge machine-learning (ML) algorithms to address the issue of water and energy forecasting across the national water grid. The main objective is to build a good base for using ML algorithms in low-performance-edge IoT devices. This will reduce the congestion of the communication network and the capital expenditure costs of IoT infrastructure. I also hope to build collaborative links between local companies and UK researchers.

A main objective is to open new collaboration links with researchers in the UK and the local industry, and we are doing so. Visits for collaborative work are planned for next summer at the University of Leeds, where I will meet students and scholars from the universities of Leeds, Glasgow, York, and Huddersfield.

On the UK side... I'm co-supervising two PhD students at the University of Leeds, meeting them personally and giving them new ideas. In York and Glasgow, I will meet the research groups for two professors (Professor Alister Burr in the Department of Electronic Engineering at the University of York, and Muhammad Ali Imran, Professor of Communication Systems at the University of Glasgow) to discuss how we can collaborate in problem-solving.

Project output: By the time the project is completed, I will have designed the project website and populated it with all the appropriate data. I will do a collaborative extended literature study

to define all the aspects that will allow enabling ML on the edge of IoT devices, contacting Jordanian startups to identify the problems they have. This will lead to a draft review paper and make an online seminar for students and colleagues to densify their understanding, while I will choose students to run experiments as their graduation projects.

There will be conference and journal papers, plus a website showing the long-term results of the cooperation between the Universities of York, Leeds, Glasgow, and the Hashemite University. Iaceer and Smart Eye will be my industry startup partners. I'll hold free workshops that gather expertise from both industry and academia, building mutual research channels with all partners. Key project results (source codes, PCB schematics and data) will be open for developers and researchers on GitHub, subject to intellectual property rights.

Anticipated outcomes and impact: In terms of AgriTech, the project will make the use of ML-enabled edge IoT sensors more affordable, increasing the adoption of data-driven farming. It will improve and increase the research capacity of startups, spotlighting the benefits of using ML-enabled edge devices.

This project will create an application-oriented society of researchers, focusing on AgriTech applications.

Crucially, it will benefit smaller and poorer farmers throughout Jordan – and potentially elsewhere in the world – by making the benefits of smart water management more accessible across their land.

Final thoughts on the Distinguished International Associates programme: The links that we created and the opportunities that we opened are long lasting. The project has opened opportunities for me to expand my network with academics and engineers from international and local universities and industries. The sub-projects, workshops and products that relate to the project gave me some visibility and helped me to be selected as the director of the innovation and entrepreneurial projects centre at Hashemite University.

Bhupesh Kumar Lad

Professor, Department of Mechanical Engineering, Indian Institute of Technology Indore (IIT Indore), India

PROFILE
Distinguished International Associate

Thematic area: Smart manufacturing

Project title: Strengthening collaboration in the area of smart manufacturing (Industry 4.0)

Strategic goals: To build a sustainable global network of researchers and practising engineers to contribute to the inclusive economy through the advancement of Industry 4.0.

Background: My Bachelor of Engineering and PhD were both in the field of mechanical engineering, while my master's focused on industrial engineering and management. I was an assistant professor of mechanical engineering for six years, before becoming an associate professor in the same discipline in 2017 and a professor in 2021. Working with a variety of industries through my Industry Academia Consortium for Smart Manufacturing has provided me with first-hand knowledge of the challenges that small and medium-sized enterprises (SMEs) face when adopting and implementing new digitalisation solutions.

Previous Academy involvement: I was a keynote speaker for an introductory course on cyber physical production systems (CPS), run through the DIA programme in 2021. I am also a current and previous award holder through IAPP in the fields of digitisation and advanced manufacturing respectively.

About my project

Objectives: The manufacturing sector is witnessing a global paradigm shift known as Industry 4.0, or the fourth industrial revolution. This centres on technologies pertaining to digitisation, data analytics, artificial intelligence/machine learning, and the Internet of Things. My activities aim to overcome SMEs' barriers to adopting smart manufacturing by creating awareness of such technologies and imparting necessary skills to enhance smart manufacturing capabilities. Advanced economies are already reaping the benefits of implementing these technologies in terms of increased competitiveness, sustainability and reliability, but this is not the case in other nations.

Activities proposed under this programme will directly benefit industries as they address their need to enhance knowledge and skills in smart manufacturing. The overall objective is to strengthen the collaboration network – designing an industry-driven course on smart manufacturing and conducting two skill-enhancement programmes for practising engineers and engineering students.

On the UK side... This project aims to widen the ongoing India–UK research collaboration network for smart manufacturing. I started collaborating with the Institute for Manufacturing at the University of Cambridge in 2016, as part of the Royal Academy of Engineering Higher Education Partnership, and this collaborative project was shortlisted for the 2017 Newton Prize. I am still collaborating with staff at Cambridge, designing and conducting basic smart manufacturing course training, and my ongoing collaboration with my UK academic partners further encouraged me to apply for this programme.

Project output: A least three Indian and three global academic members, and at least four industry partners, will be included in an ongoing consortium. This will require interactions with industry and academic members, designing and conducting an industry-driven course for around 100 participants. A skills development

programme aimed at around 40 practising engineers and students will have nine speakers involved. There will be hands-on training using virtual reality technology, and an extension of the network by interacting with more academic and industrial members.

Many of the activities mentioned in my DIA programme are aligned with the initiatives of a project under the Indian Government's National Mission in Interdisciplinary Cyber Physical Systems. I'm sure this programme will offer me more opportunity to highlight the outcomes of the DIA at much larger scale.

Anticipated outcomes and impact: Development and implementation of Industry 4.0 requires expertise across disciplines like electronics, mechatronics and IT. Moreover, such a development requires involvement from both academia and industry, and my project aims to create a sustainable platform to support such development.

An industry-driven course can be offered routinely beyond the project duration, becoming a sustainable activity that provides a platform for basic knowledge dissemination in smart manufacturing. Similar activities may be started by various collaborators around the globe, helping the adoption rate of Industry 4.0. There will be global visibility for ongoing India–UK collaboration, making the consortium a global platform for researchers and practising engineers contributing towards the advancement of smart manufacturing in their respective countries.

Final thoughts on the Distinguished International Associates programme:
I was recently promoted to full professor at my institute, and I am sure the recognition received through the DIA programme must have played an important role in this career progression. This project will help me to identify key areas for designing and offering knowledge and skills-enhancement courses in this area.

Professor Dr Nipon Pisutpaisal

Professor, King Mongkut's University of Technology, North Bangkok, Thailand

PROFILE
Distinguished International Associate

Thematic area: Bioplastic production from palm oil

Project title: Sustainovative development of medium-chain polyhydroxyalkanoates (mcl-PHA) biodegradable plastics from palm oil

Strategic goals: The creation of a working prototype and process capable of delivering innovative medical-application products from palm oil, transferring this knowledge to stakeholders and the wider academic and engineering communities.

Background: I achieved an MSc and PhD in environmental engineering at Pennsylvania State University in the US, becoming an expert in bioremediation, industrial wastewater treatment technology and microbial fuel cell technology. I have been working as a lecturer and researcher at King Mongkut's University of Technology since 1997, and I have been a national consultant on various studies and research projects in Thailand. As an environmental engineer, I have driven industrial processes towards green practices, reducing environmental impact from the manufacturing process and recovering high-value chemicals from biomass and industrial waste.

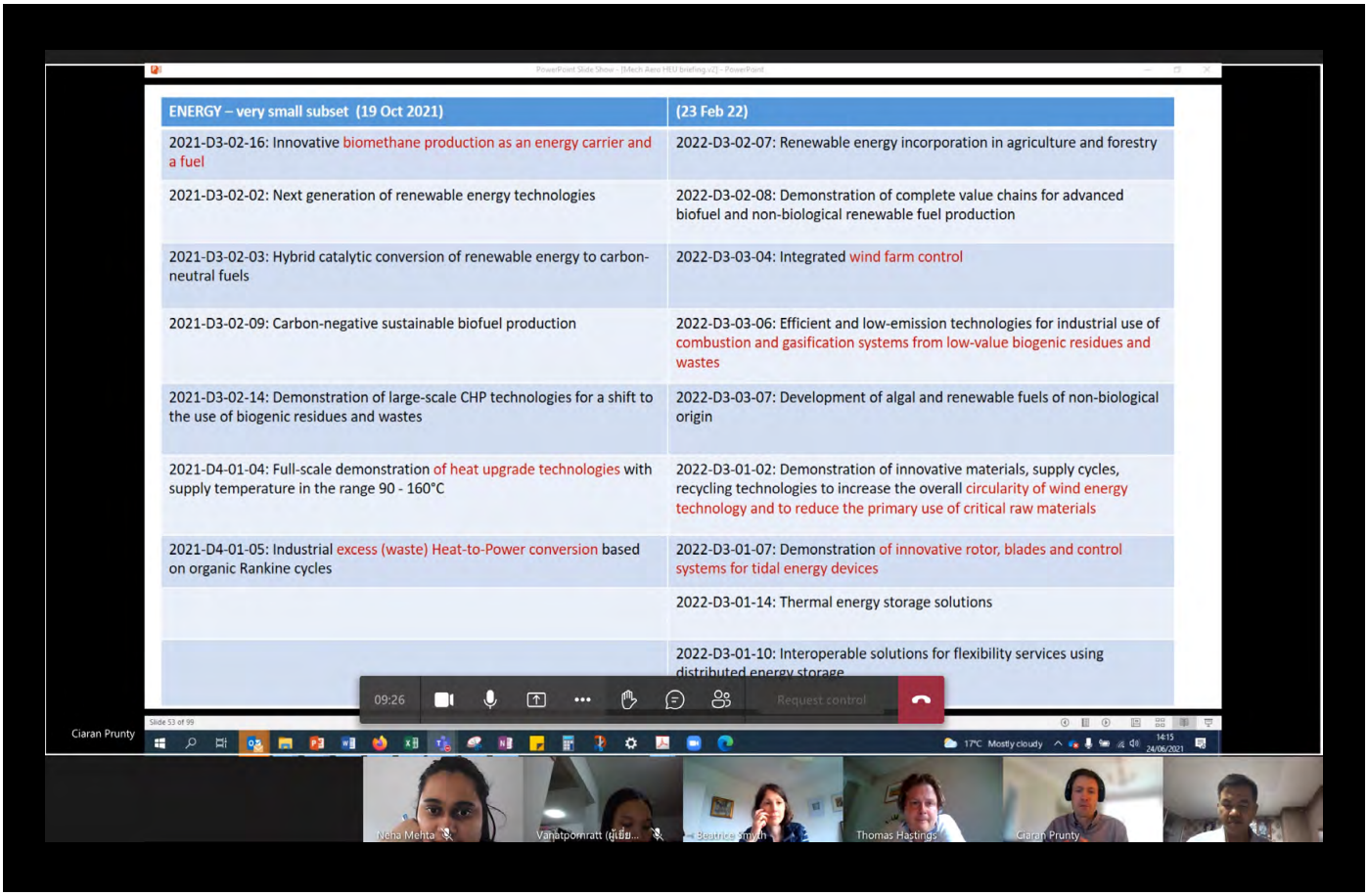
Previous Academy involvement: Since 2017, I have been collaborating with academics at Swansea University, Queen's University Belfast and Liverpool John Moores University on an Industry–Academia Partnership Programme (IAPP) scheme studying the production of mcl-PHA from palm oil. The DIA programme will build on the IAPP scheme's work.

About my project

Objectives: This project stems from discussions between academia and industry. The largest raw palm oil producer in eastern Thailand is looking for product diversification, to sell high-value innovative products in the world market. The palm oil industry is one of the main agro-industries in Thailand, and the company seeks to position themselves in alignment with Thailand 4.0 – a recent economic initiative intended to create sustainable business growth in industry sectors including agriculture, healthcare and pharmaceuticals.

Our project will be unique by incorporating bio-innovation as a major theme; mcl-PHA production from palm oil has yet to be commercialised. The ultimate goal is to develop and promote alternative technology for mcl-PHA production by focusing on the biochemical pathway of locally isolated bacteria that are highly efficient at converting palm oil to mcl-PHA. This is an attractive material for biomedical application because of its natural origin, biodegradability, biocompatibility and its ability to support cell growth and proliferation.

On the UK side... The collaboration will lead to knowledge exchanges between local and UK partners, with Thai and UK universities benefiting from technical training programmes. Swansea University will develop new ideas and methodologies around the chemical processing and purification of high-value mcl-PHA products, which could be further used to explore other applications, while Queen's University Belfast is also assisting with research work. UK partners not only provide technical input directly into the project, but they can also provide training to young Thai researchers.



Project output: A key output will be the development of in-house expertise in the manufacturing processes and engineering applications for producing mcl-PHAs from palm oil. The pathway to achieving this goal will generate lasting connections between institutions across a range of sectors, which will be promoted and disseminated at regional and national level workshops and conferences.

The findings will be published in national and international journals plus a manuscript, and we will promote the international aspect of this collaboration to attract other Thai industries to engage in future opportunities. We will also set up social media accounts (Facebook, YouTube, Instagram, and LinkedIn), and launch a website to promote the project while providing knowledge to the public.

Anticipated outcomes and impact: Developing new technologies for mcl-PHA production will generate sufficient data to enable design engineers to translate the results into commercial realities and realise its full potential. The main commercial goal is to develop large-scale production, which could lead to new opportunities to licence the technology or offer consultancy services, based on our expert knowledge. It could also create a new sustainable agro-industrial manufacturing sector based around renewable biomass (such as palm oil).

Final thoughts on the Distinguished International Associates programme:
The DIA programme has provided funds, resources and opportunities to strengthen existing collaborations and initiate new ones. My work has certainly progressed in a positive way under the collaborations among the existing UK partners. Working side by side with both academia and industry partners means the existing network will grow stronger and expand further.

Dr K Devendranath Ramkumar

Professor, Department of Manufacturing Engineering at the School of Mechanical Engineering, Vellore Institute of Technology (VIT), Vellore, India

PROFILE
Distinguished International Associate

Thematic area: Additive manufacturing; welding; bio-corrosion of weld joints

Project title: Promoting a transdisciplinary research approach for diversified engineering applications using multi-functional materials and advanced processing technologies through industry and academic partnership.

Strategic goals: To solve some of the key problems in the manufacture of critical components used in both the aerospace and automotive industries.

Background: I became a Doctor of Philosophy in the area of weldment corrosion at VIT in July 2012, having achieved a First Class master's with distinction in CAD/CAM at the same institution in 2004. I was recognised as being in the top 2% of Indian scientists across all fields in a survey conducted by Stanford University, and I have had over 100 research articles published in journals of international repute. I am a life member of both the Indian Institute of Metals and the Indian Welding Society.

Previous Academy involvement: In collaboration with Cranfield University and Tata Advanced Systems, I received an Industry–Academia Partnership Programme (IAPP) grant from the Academy in 2019 for 'Enhancing research-based learning and teaching on advanced materials and manufacturing technologies for the aerospace sectors in India and UK'.

About my project

Objectives: The failure of industrial equipment, gas pipelines and military machinery due to microbiologically influenced corrosion (MIC) leads to billions of dollars in damage annually. MIC impedes the integrity of stainless steel alloys and is estimated to account for around 20% of all costs related to corrosion failures. The range of industries affected by MIC includes:

- onshore and offshore oil and gas
- marine and shipping
- nuclear power
- aviation
- sewage.

MIC studies on welded or additively manufactured structures have not been thoroughly explored in the aerospace, marine and nuclear sectors. My proposal extends an ongoing IAAP project on the use of advanced materials and manufacturing processes, developing multifunctional materials for aerospace, nuclear and marine applications.

The main objective is to develop wire plus laser additive manufacturing (WLAM) and wire plus arc additive manufacturing (WAAM) for producing critical components. These wire-based additive manufacturing technologies with the use of arc/laser sources will be adopted to develop components using stainless steels, titanium- and nickel-based alloys.

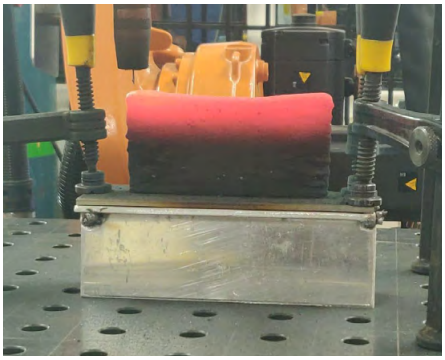
On the UK side... Between February 2021 and October 2022, joint student projects are being executed in collaboration with VIT, Cranfield University and Tata Advanced Materials Ltd. Post-MIC studies on developed components will be taught on Cranfield's postgraduate programme, followed by a joint UK–India industrial

brainstorming workshop to disseminate the knowledge developed. There will also be a three- or four-day industrially relevant training course.

Project output: Firstly, I intend to develop novel concepts of multifunctional materials through innovative manufacturing practices and application of the latest-generation alloys. Brainstorming sessions will be performed to identify potential multifunctional materials.

The product lifecycle of multifunctional components obtained from these manufacturing methods will be assessed by exposure in actual service environments, and the technical outcomes from the works undertaken will give us confidence to integrate research findings into existing teaching units at VIT and Cranfield.

From here, I will build world-leading industrial technology-driven academic curriculum and professional development courses. I will organise joint undergraduate and postgraduate training internships, research projects, short courses on additive manufacturing, workshops, and teaching module development between industry and academic partners based in both the UK and India.



Key competencies will be honed through the development of lab-scale intricate components using micro and macro characterisation of components fabricated through advanced manufacturing processes, alongside structural integrity assessments of prototypes. Also, the product lifecycle will be assessed by exposing these components in actual service environments.

Anticipated outcomes and impact: A two-day international workshop on Manufacturing of Advanced Structural Materials for Transport Systems was organised by VIT Vellore in collaboration with Cranfield University, with participants from industry and academia invited to take part.

We are also planning to conduct workshops and value-added programmes pertaining to the project activities. Other associates working in relevant fields will be invited to explore possible collaborative works, while a cross-functional team will be developed to demonstrate research among students who can then work on these real-time problems.

Final thoughts on the Distinguished International Associates programme: The undergraduate students are eager to start the project, as they love to contribute and work in transdisciplinary or interdisciplinary research works.

Abimbola Windapo

Professor of Construction Management at the Department of Construction Economics and Management, University of Cape Town, South Africa

PROFILE
Distinguished International Associate

Thematic area: Construction business and project management

Project title: Strategies for improving the awareness of local building materials (LBM) in housing construction

Strategic goals: To improve the use of local building materials in housing construction, reducing environmental impact by raising awareness of LBMs and tackling existing policy challenges around their use.

Background: I have over 30 years of experience in practice, teaching and research. I am a professional construction project manager and mentor, registered with the South African Council for the Project and Construction Management Professions, and I'm also registered with the Council of Registered Builders of Nigeria.

Previous Academy involvement: I have worked on three projects with the Royal Academy of Engineering, on topics ranging from emergency sheltering for African citizens to long-term sustainable housing provision.

About my project

Objectives: I believe that the science of materials, infrastructure and construction businesses can change access to basic infrastructure and job opportunities across Africa. I've previously established that although LBMs are available, challenges to their adoption include:

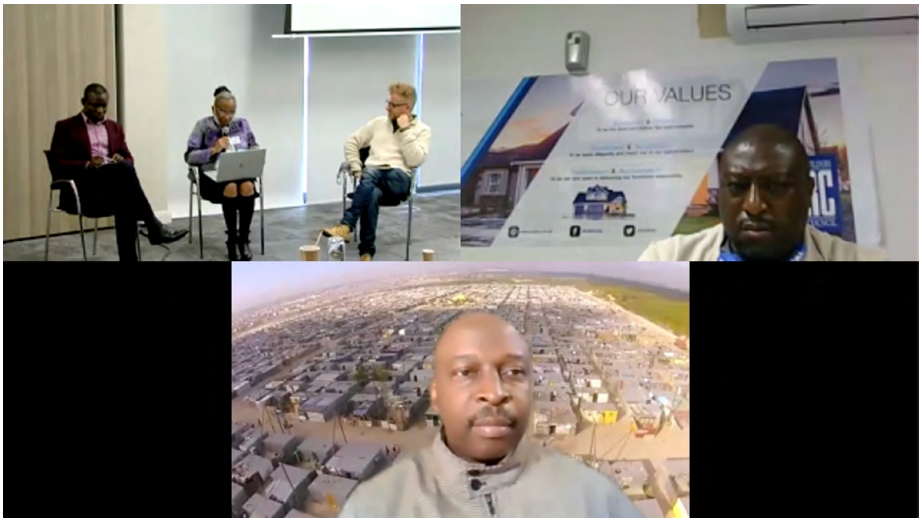
- a lack of promotion and understanding
- a lack of subsidies and tax reductions
- lengthy planning and approval processes
- governmental and stakeholder policy challenges around complex certification
- a lack of importance attached to LBMs across the construction industry.

I wish to tackle this by improving the awareness and uptake of LBMs in housing construction, documenting their availability while developing technical reports and teaching materials outlining methods of construction. I want to publicise the use of selected LBMs, in particular sandbag building materials, furthering their use based on their environmental impact.

The project's main objective is to ensure the efficient delivery of more affordable, sustainable and adequate housing in accordance with UN Sustainable Development Goals 9 (Industry Innovation and Infrastructure) and 11 (Sustainable Cities and Communities). My activities will help provide a sustainable and affordable way of obtaining a balanced, fair, accessible, and better quality of life.

On the UK side... I have spent the last four years working closely with Dr Francesco Pomponi, the Associate Professor of Sustainability Research at Edinburgh Napier University. He is demonstrating cutting-edge tools and techniques used to analyse the environmental impact of LBMs, networking with UK academics and contracting practitioners.

Project output: I will produce reference materials on LBMs, improving the awareness of stakeholders and contractors.



Alongside this will be teaching materials and technical reports, which construction stakeholders can use to update their knowledge on LBMs. Preparing educational materials aligns with the Academy's priority themes of developing and shaping future engineering skills, which encompass sustainability and lifelong learning.

To date, I have already completed a sandbag building material technology textbook, providing information on standard methods of construction and physical properties.

I am currently planning a training workshop on LBM technology in South Africa, focusing on sandbags. A previous LBM workshop attracted over 50 attendees and concluded that the sandbag has more potential than any other building material: it's cheap and environmentally friendly, and can provide adequate housing in South Africa. Yet it has not found its way into the domestic construction market.

Anticipated outcomes and impact: The overall outcome is to develop strategies for improving the awareness of LBMs in sustainable housing development, furthering their use based on their environmental impact. An international partner in my programme has already expressed interest in constructing a prototype of the sandbag building technology in Cape Town.

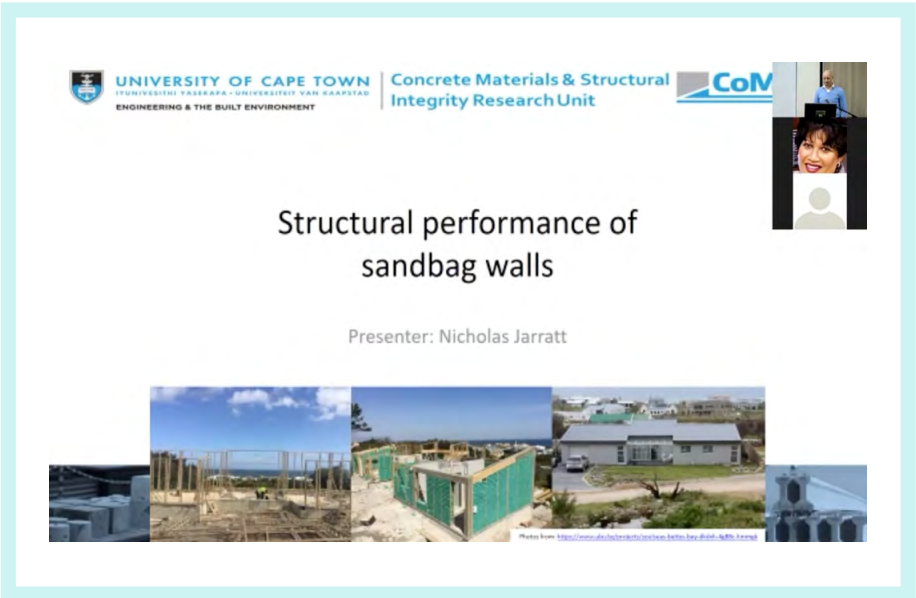
To support the findings of my research, I am developing a website where information about LBMs will be publicly accessible. I am preparing teaching materials and technical reports on sandbag building materials and other similar LBM technologies, including PowerPoint presentation slides.

Crucially, the programme will put LBMs at the centre of sustainable housing discussions, tackling lengthy planning and approval processes for LBMs amid a current lack of regulation.

A database of building materials will improve the understanding of both public sector officials and the wider public of the use and availability of LBMs. Funders will also obtain knowledge on non-conventional building materials used in housing construction.

Final thoughts on the Distinguished International Associates programme: The DIA programme has given me the necessary platform to showcase my research, communicate and undertake public engagement activities.

It has helped validate my standing as a researcher and construction professional, and network activities undertaken through the DIA programme will produce reports and communiques that outline shared understanding and best practice on using LBMs in affordable and environmentally friendly housing construction.



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