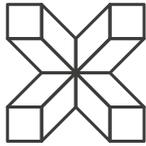




UCL



Annual Report
The Engineering Exchange
2017–18



The
Engineering
Exchange



Contact Us

The Engineering Exchange is always looking for new collaborators. If you are interested in our work or have an idea for a project, please feel free to contact us:

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Introduction

Since launching in March 2014, the Engineering Exchange (EngEx) at UCL has pursued an ambitious programme of projects and events in collaboration with community groups, academics, researchers and practitioners. In 2016, the EngEx expanded from operating solely within the UCL Faculty of Engineering, to also include UCL's Bartlett Faculty of the Built Environment.

In the past year, the EngEx has increased its research activity in three key areas (green infrastructure, air quality and big data, and waste and the circular economy); developed new CPD offerings; strengthened its partnerships with community organisations and held a showcase event, as part of its aim to establish UCL as a world-leading centre for community engaged engineering research, teaching and entrepreneurship.

The EngEx believes that community engagement is a two-way process, with communities benefiting from access to leading-edge research outcomes, and researchers and students benefiting from community knowledge and problem identification. This forms the foundation of all work undertaken by the EngEx. This report outlines our aims, projects, training and budget over the past year, as well as our plans moving forward.

Aims

EngEx activities are focused in three key areas:

Research: aligning engineering research with community needs. The EngEx supports researchers in developing community-based research projects and in working with communities to turn a specific need for technical knowledge into an appropriate research question and project. The EngEx supports researchers to incorporate upstream public engagement in their projects to better address the need for responsible, responsive research and innovation.

Skills: providing communities with access to engineering skills and knowledge. The EngEx provides a brokering service to match specific community needs for technical expertise with staff and students in UCL's faculties of engineering and the built environment. For instance, communities may have needs for environmental monitoring, mapping or support in developing local sustainability plans.

Learning: integrating community knowledge and needs into engineering curricula and continuing professional development (CPD). The EngEx works with academic staff across departments and faculties to identify opportunities to embed community based projects into the curriculum. Our CPD training courses support development of skills and capabilities in community engagement for practicing engineers and engineering researchers, and built environment specialists.

'It was really inspiring to see how the community commissioning model is working and I am thinking about how we can develop that through the research committee here.'

CPD attendee

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Projects



Projects

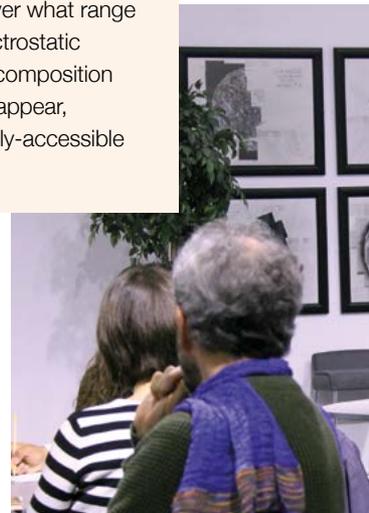
The Engineering Exchange develops, delivers and supports projects in partnership with local community groups. Partner networks, including Just Space and the London Sustainability Exchange (LSx), help by notifying their members of opportunities, and community groups can approach the EngEx with ideas, questions or problems.

When a project is initiated, either through queries from the community or through ideas generated during EngEx events and activities, the EngEx 'match-makes' community groups with the relevant expertise, skills and interest from its register of engineers and built environment specialists. Outputs, timelines and potential follow-on work is then agreed between the project participants. Although there are no restrictions on the length of time, subject or activity resulting from the projects, they must address a specific, technical problem faced by a London community and be delivered in partnership between UCL and members of community groups located or operating in London. They must also fit within the schedules and time availability of both the engineers and the community groups.

Projects are considered successfully completed when the objectives are met and stakeholders have held a final meeting to offer feedback and close out. This is also an opportunity to determine whether there is scope to continue with further work on the project. The following projects have either been completed this year, or are still in progress:

WATER DOPING FOR SMART POLLUTION REDUCTION

Air pollution is a serious and growing problem in London. In 2017, Alan Cooper, a citizen concerned about health impacts on his family and neighbourhood, approached the Engineering Exchange to discuss an idea to reduce airborne nanoparticles. One type of pollutant which is very harmful for human lungs is caused by the combustion process in diesel-powered engines. One way to reduce production of these pollutants is to improve combustion efficiency. Hydrogen and other gases can work as combustion accelerants, and water has been found to positively affect diesel combustion efficiency, leading to a rise in 'water doping' technologies in which water, mist and/or steam are added to diesel fuels. While some of these technologies are available commercially, a project was proposed to develop a low-cost, freely available and easily replicable design for a water doping product that could reduce particulates when fixed to diesel engines. To facilitate this, Dr Paul Hellier of the UCL Faculty of Engineering's Department of Mechanical Engineering supervised MSc student Seifeldin Mohamed Said Mattar to explore the effects of water mist and steam inhalation on a water doping system for combustion engines, assessing the reactor product gases in a standalone test rig that is able to vary temperature, pressure and flow and to use this to create simulants for engine testing. This research comprised the first stage in a larger project to determine over what range of temperature, flowrate, and electrostatic charge conditions effects on the composition of the gas from the device outlet appear, leading to a more robust, publically-accessible technology design.



SAVING LIVES WITH SMARTER SIGNALS

The speed and volume of motor traffic on urban roads can act as a barrier to those travelling on foot. The main tool used to mitigate this severance in London is the signalised pedestrian crossing. However, these crossings often operate in a manner that does not recognise the expectations and needs of the people using them, leading to pedestrian danger and stress. The development of ‘smart’ urban traffic control systems that actively respond to sensor input provides the technical opportunity for pedestrian behaviour to be taken into account. In 2016, Mike Grahn of London Living Streets, a charity campaigning for pedestrian-friendly streets, won seed funding during the EngEx community research forum on Healthy Ageing and Wellbeing. With support from Dr Tom Cohen of Transport@UCL, London Living Streets launched a project to better understand how pedestrians use crossing signals and to test the hypothesis that the current design does not take user behaviour into account. Since then, the project has developed links with Transport for London (TfL) to collaborate on a substantive piece of work. TfL is undertaking a comprehensive review of their 6,000+ signal-controlled pedestrian crossings with the aim to optimise the control algorithms to reduce wait times for users. Living Streets are measuring pedestrian experience and behaviour at selected sites before and after the signal timings have been adjusted. The results will be used to monitor and improve the operation of signalised crossings and will be made available for use by other transport authorities. With academics from Transport@UCL, the project aims to introduce a new generation of smart crossings that respond to user needs.



SCIENCE IN THE COMMUNITY

The Nuffield Foundation sponsors research placements to provide opportunities for students continuing on to higher or further education in STEM to undertake supported research projects. In 2017, the EngEx received a grant from the Natural Environment Research Council (NERC) to engage with communities to look at the current state of green infrastructure in London and how it impacts citizens (read more about the EngEx work on green infrastructure). During a community research forum on this theme, participants expressed an interest in developing community green spaces, and understanding more about available funding sources to facilitate this. As part of Nuffield Foundation student research placements on the theme ‘Science in the Community’, EngEx co-director Dr Carla Washbourne supervised two A-level students to spend four weeks undertaking research projects relating to funding urban green spaces, and understanding urban soils and their suitability for food growing. The idea for the projects emerged out of last year’s community research forum on green infrastructure, where participants expressed an interest in finding ways to reduce barriers and encourage the use of vacant urban spaces for community growing activities. The research projects involved collecting data and developing case studies, and after producing reports, the students presented their findings to UCL staff and academics.





POWER TO THE CITIZEN!

The Engineering Exchange, in partnership with Dr Claire McAndrew of The Bartlett's UCL Institute for Digital Innovation in the Built Environment, and with additional support from Jordan Rowe at the UCL Urban Laboratory, received funding from the UCL Grand Challenge of Transformative Technology to explore issues relating to citizen engagement in the smart cities agenda and the ways it impacts urban development. The idea followed on from an community research forum hosted by the EngEx in 2016, on the theme 'Smart, Sustainable London'. Work funded by the grant in 2017 included a panel event, open to the public, and an In2Science student placement, both of which pointed to the need to shift the smart city paradigm from market-led to community-led models that communicate, connect, investigate and mobilise in open source ways. This year, Dr McAndrew has developed a 'manifesto', titled 'Power to the Citizen!', from key discussion points emerging from the panel event. These findings have been adapted into a print and digital poster and flyer, which will be presented to the public during the Bloomsbury Festival in October 2018, and which are available online to stimulate further conversation and critique about the smart cities agenda.

MONITORING AIR QUALITY TO PROTECT A COMMUNITY

Recent and planned construction affecting Somers Town, a residential area north of Euston Road and bounded by St Pancras and Euston stations, has raised concerns among residents about negative impacts on their community. Various factors including heavy road traffic, diesel trains, ageing buildings, and planning leading to street canyons and pollution hotspots means much of the area already has illegal levels of nitrogen dioxide and high levels of health-harming pollutants. Residents fear that major planned infrastructure and construction projects will increase air quality problems. The Somers Town Neighbourhood Forum (STNF) are therefore working on a neighbourhood plan with an urgent interest in how to improve air quality in the area. Funded by UCL's Knowledge Exchange and Innovation Funding, the EngEx and STNF ran a co-design process with STNF members to develop a list of planning recommendations that reduce the harmful impacts of the upcoming construction and prioritize the spending of the Community Infrastructure Levy, a planning charge paid by developers to local authorities. A report will address the two most urgent points: evaluating current monitoring of air quality in Somers Town and future needs compared to best practice; and reviewing the air quality forecasts in the Air Quality Assessments for recent developments, compared to current air quality. STNF will use the outcomes of the debate to inform their neighbourhood plan and to identify actions that will have the greatest positive impacts for their community.



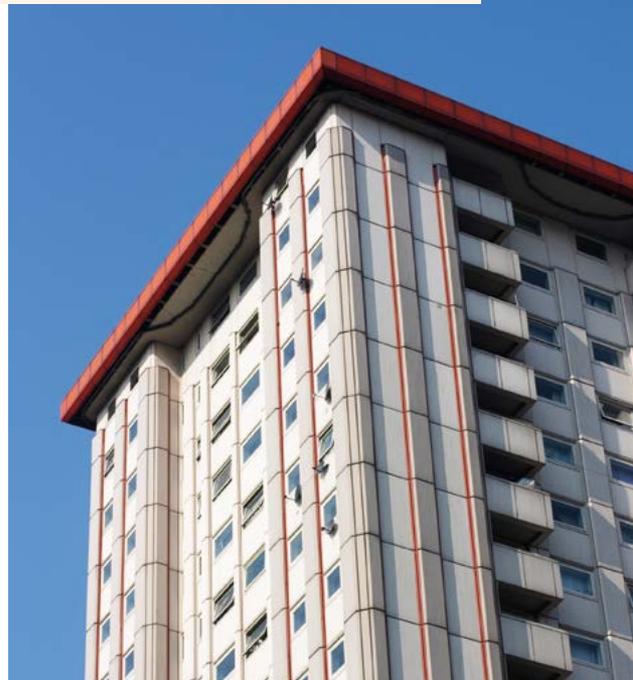
THAMES WASH MONITORING

Planning for the Thames Tideway Tunnel, a major sanitation infrastructure project which commenced in 2016, raised concerns amongst boating communities situated in the River Thames about potential impacts both on the community's living conditions and on the river's ecology. Agamemnon Otero, a member of the local canal boat community, approached the Engineering Exchange to discuss a monitoring programme to ensure disruption to the waterway was minimal and in line with Tideway's commitments. A series of discussions resulted in a student project in 2017 to design and test a wave height data collector to monitor water surface disruption resulting from increased river traffic during the tunnel's construction. It was intended that the apparatus could become part of a future citizen science project. As the design project developed, it became apparent that there were no consistent monitoring sites along the Thames estuary, and that there is very little open data on the state of the Thames. Further discussion with the Port of London Authority (PLA) indicated their interest in wave wash measurements, and their potential support for a more systematic future project that could provide data on wash. In collaboration with the river boat community, Thames Estuary Partnership (TEP), the PLA and other groups, a proposal was written for a springboard project – to use wash measurements as a catalyst for establishing a wider, open Thames monitoring system. In summer 2018, the project received funding from the EPSRC Knowledge Exchange and Innovation Fund to continue the project, with the aim of creating a sustainable set of 10 monitoring stations in the Thames Estuary which can be used by the wider scientific community working on water monitoring of any type. Project data will be openly available online as a public data set, with students and citizens encouraged to use and view it. UCL researchers, with support from the Engineering Exchange, will build the framework, manage the partnerships and run the wave monitoring.



THERMAL COMFORT

Residents of Ampthill Square in Somers Town, north of Euston Station, are impacted by construction and development in the area, especially the upcoming High Speed 2 (HS2) rail works. As part of their noise mitigation measures, HS2 contractors have proposed a plan to replace windows with double or triple glazing. This solution will require windows to be kept closed, and will rely on trickle ventilation to meet the thermal comfort needs of residents. This has raised concerns amongst residents, who approached the EngEx to discuss their fears that the proposed solution will not be sufficient to maintain adequate cooling and ventilation, particularly in the light of recent heatwaves which are likely to recur in the coming years. Dr Esfandiar Burman in The Bartlett's UCL Institute for Environmental Design and Engineering (IEDE) is assessing ventilation proposals from HS2's contractors to determine likely impacts on the health and wellbeing of residents resulting from various interventions. These comments will be used by residents to approach their discussions with HS2 representatives and their contractors with a more informed understanding of building dynamics and thermal comfort requirements.



The year in numbers



UCL staff involved in EngEx activities



UCL students involved in EngEx activities



Members of the public involved in EngEx activities



Project partner organisations



Projects completed



Projects on-going



Projects initiated



CPD courses run



CPD learners



Community forum participants



Community forum events



Presentations to external audiences

Engineering Exchange Showcase Event

In September 2018, the Engineering Exchange hosted an event titled 'Community Research Partnerships: Past, Present, Future'. The event had two aims: to showcase work undertaken in collaboration between UCL and London communities; and to catalyse new two-way research partnerships between these groups.

The event, held at BASE King's Cross, was free and open to the public. 75 people attended, including researchers, academics, students, professionals and Londoners interested in community-engaged research, engineering and/or the built environment.

The event included presentations on green infrastructure, air quality, and waste infrastructure, from EngEx Co-Directors and partners from **Community by Design, Just Space**, and the **Somers Town Neighbourhood Forum**. The audience was invited to participate in discussions on how these issues impact on their communities. Agamemnon Otero of **Repowering London** then delivered a lunchtime lecture about developing community energy programmes in Brixton and Hackney.



The afternoon session focussed on developing new research projects in collaboration between UCL researchers and academics, and London-based community groups. This was achieved during a two-hour 'speed dating' session, in which participants spent 5 minutes at each of 5 themed tables hosted by UCL specialists, brainstorming ideas for projects relating to air quality, big data, energy, green infrastructure or other topics. This was followed by more focussed discussion on the topics of greatest interest to the group. By the end of the session, 7 projects had been proposed, of which 6 are currently being taken forward with support from UCL academics and/or students.

The final formal session of the day was a panel, hosted by Emeritus Professor of Education and Society Andrew Brown, and including Engineering Exchange Director Professor Sarah Bell. The panel focussed on the theme 'Community Inspired Research and Teaching'.

The day finished with an informal networking session over refreshments.



Education

IN2SCIENCE UK

For the second year, the EngEx welcomed two students as part of the In2Science UK programme, which aims to empower students from disadvantaged backgrounds to progress into STEM and research careers through work placements and careers guidance. Two year 11 students came to UCL for two weeks after participating in a highly competitive selection process, meeting with academics and partner organisations, touring laboratories, libraries and workspaces and undertaking research activities relating to air quality. At the end of the placement, the students produced reports on their research findings and wider experience at UCL.

One of the students' work is extracted here:

According to the Collins dictionary, 'air quality' can be referred to as the degree to which air is suitable or clean enough for humans, animals, or plants to remain healthy. Therefore, good air quality is air that is clean and does not contain pollutants such as smog, smoke and other particulates.

In the past two weeks, I have learnt that air quality can be measured using air quality sensors which have diffusion tubes that measure pollutants over a period of time. Pollutants include nitrogen dioxide coming from the exhaust fumes in cars, PM 2.5 which are tiny fine particulates in the air that reduce visibility and cause the air to appear foggy when present in large amounts. I now understand that diesel engines play a large part in the air pollution and actually account for 40% of the polluted air in London.

I believe it is very important for people to be educated about air quality because of the significant health impacts it can have on people such as stunted growth, as well as inflammation in the lungs which can aggravate conditions such as asthma and also increase the risk of dementia and stroke. This can be especially harmful to vulnerable

members of society such as the elderly, people with existing medical conditions and especially children who are quite often exposed to highly polluted air due to the increasing pollution outside their schools. Measuring air quality both in our homes and outside is very important because it provides the knowledge to people who are vulnerable and so can prevent further damage.

One of the main challenges of air quality in regards to local communities is being able to carry out monitoring of air quality in their local areas and then accessing and understanding the results. This is why collaboration with universities or community outreach programmes by institutions are quite important... The next challenge that I believe caters more to the government, is ways to actually reduce this pollution on a large scale. I have learnt about green infrastructure directly removing pollutants from the air by deposition and absorption on plant surfaces. Trees, green roof, open green spaces and green walls are examples of green infrastructure. The government can also set up more air quality monitoring stations or reopen the ones that have been closed.

Another way the government could help in the air quality crisis in London is to pay closer attention to the environmental impact predictions of construction. It should then be compared to the actual environmental impacts and so construction companies would be more cautious about their impacts on the environment which could then help decrease the amount of pollution released. However, maintaining good air quality still proves to be a big problem but some small behaviour changes can help reduce this problem, such as moving a bus stop to a slightly less polluted area or closing doors of shops to help keep the polluted air out, rather than customers breathing polluted air both inside and outside of shops.

By Temitope Kalejaiye

Continuing Professional Development

The EngEx has developed a number of continuing professional development (CPD) courses. The first of these is a one-day training called 'Working with Communities: Practical Skills for Engineers', which provides an introduction to useful skills and approaches for professionals and academics working with communities. The training offers case studies from community-based organisations, as well as skills sessions and opportunities to develop learners' own project ideas. Case studies can be selected from a range of options, based on the interests of the participants in each cohort. Following 3 successful deliveries of this training in 2015-16, last year the EngEx developed a tailored CPD focusing on green infrastructure, with funding from the Natural Environment Research Council (NERC). In addition to some of the practical skills sessions from the previous course, new case studies were included which looked at citizen science approaches to biodiversity and air pollution monitoring. The course was framed to address an environmental science audience.

This year, the EngEx delivered a new multi-day course, Skills and Strategies for Community Engagement, which enabled learners to gain both practical skills for engaging with communities, and strategies for developing a community engagement hub at their own institution. Participants came from UCL, Chile and Norway, and included PhD students and practitioners in engineering and the built environment.

'It helped me immensely with a number of issues relating to my PhD. Not least; the vast range of things we can do in terms of retrofitting, providing community resources such as food-growing, and working with communities to help them improve where they live.'

CPD attendee



TEACHING TEAM

The teaching team for each delivery depends on the interests of the cohort, and is comprised of UCL staff, engineers and representatives of community organisations. The Engineering Exchange works with UCL academics as well as external organisations to provide this training. In the past, EngEx CPD content has been delivered by representatives of the following organisations and departments:

- Community by Design
- Just Space
- Repowering London
- Somers Town Neighbourhood Forum
- Thames21
- UCL Biosciences
- UCL Engineering Exchange
- UCL Mapping for Change
- UCL Public Engagement Unit

Increasing our capacity

One of the key outcomes of this year's work was to focus more closely on supporting a smaller number of active partners to develop projects with scalable outputs. This year, our steering committee turned over to include new community partners, and to engage more deeply with colleagues in The Bartlett Faculty of the Built Environment.

We've also continued to work to raise our profile within UCL in order to increase our capacity to meet the demand for community-engaged research. To meet this aim, our three Co-Directors are developing their own community engagement, teaching & learning and internal outreach activities relating to their areas of academic specialism. The streams of activity, which build on our previous work, are as follows:

Dr Aiduan Borrion, Lecturer in the Department of Civil, Environmental and Geomatic Engineering (CEGE) and the Engineering Exchange's Education Coordinator, specialises in sustainable waste infrastructure. This year, she will partner with the Calthorpe Project, Repowering London, CommUNITY Barnet, and Just Space on a range of activities relating to anaerobic digesters, lifecycle assessment and community energy including student projects.

Dr Ed Manley, Associate Professor in the Centre for Advanced Spatial Analysis (CASA) in the Bartlett Faculty of the Built Environment, focuses on big data, including data visualisation, monitoring and modelling and how these can be used to understand processes of urban change. Over the coming year, he will develop closer links with the Turing Institute through their existing community engagement structures; create community briefing resources relating to open datasets, including challenges for communities in relation to spatial analysis and modelling; and explore agent-based modelling within community-based student projects.

Dr Carla Washbourne, Lecturer in the Department of Science, Technology, Engineering and Public Policy (STePP), looks at evidence relating to green infrastructure (GI) including sustainable drainage systems, and how it impacts on air pollution, housing, regeneration, health, wellbeing and environmental quality. Over the coming year, she will liaise with GI specialists both across and outside of UCL and develop platforms for relevant discussion and collaboration; coordinate and distribute outputs including a major report and related factsheets/policy briefings; and coordinate student projects.



Funding

Income 2017–18:

	EPSRC IAA	UCL Engineering (2017–18)	Membership Scheme
Director (0.4 FTE)		£21,000	
Communications Officer (0.6 FTE)		£31,000	
Co-Director	£3,200		
Community workshops	£2,300		
RA	£23,800		
CPD teaching team			£800
Keynote speaker			£200
Printing		£1,460	
Catering		£685	
Legal fees		£3,540	
TOTAL	£29,300	£57,685	£1,000

Publications

Bell, S. J. (2018). *Engineering with the Trouble: the Engineering Exchange at UCL*. Presented at: Engineering Social Justice and Peace Network.

Borrion, A., Matsushita, J., Austen, K., Johnson, C., & Bell, S. (2018). *Development of LCA calculator to support community infrastructure co-design*. International Journal of Life Cycle Assessment. doi:10.1007/s11367-018-1492-2.

Fairbrass, A. J., Jones, K., McIntosh, A. L. S., Yao, Z., Malki-Epshtein, L., & Bell, S. J. (2018). *Green Infrastructure for London: A Review of the Evidence*. London: The Engineering Exchange.

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