

Round 6 (2012): Ingenious Final project summaries

MATT BAGLEY, Camouflaged Learning

Engineering the Landscape; How wind power has changed our lives

Engineering the Landscape explored the impact of engineering on the Norfolk Broads and Coast as manifest through the harnessing of wind power.

Tracing the uses of wind power throughout the centuries, from small medieval windmills through to giant offshore wind farms, the project engaged informal adult learners with engineers to trace the history, technology, purposes and impact of wind power over time.

The project also looked at the economic and social impact of windmills and wind turbines as well as their place within the cultural landscape. In bringing engineers together with adult learners and partners from a range of cultural and heritage organizations, the project created a touring photographic exhibition, open and accessible to the general public at a range of venues, exploring the participants encounters with the engineered landscape of the Norfolk Broads and Coast.

To illustrate the outputs of the project, a link to a folder containing the project images, video and an example engineer presentation can be found at the end of this document.

Engineers involved with the project were sourced from many local and national companies such as Wind Elements Engineering, EON, Amec, Perenco, Opito, Fendercare, Gardline, GY Wind, General Dynamics, University of East Anglia, BT, British Gas, Baker Hughes, ENSCO, NHS Trust and Lotus Cars and also a small number who act as consultants/sub contractors.

DR KERRY BAKER, West Yorkshire STEM - University of Bradford

West Yorkshire Engineers Engage!

West Yorkshire Engineers Engage took place over 15 months and involved over 60 engineers from industry and academia developing skills and activities that demonstrate the breadth and diversity of engineering subjects, jobs and the people that work in it. Over a number of workshops engineers were supported in developing an understanding of public engagement – how public engagement activities work, what to be aware of, working with people of all ages and backgrounds for example. The engineers taking part represented both industry and academia,

representing a variety of ages and backgrounds. The engineers developed their own activities (either individually or in small groups) which were then used as the basis for a public engagement event in March 2013 as part of the Leeds Festival of Science, held at the University of Leeds. The project also allowed for a great deal of individual needs to be addressed in terms of their development, including individual support during the development of activities, company based training sessions to fit in with the company timetable and the overall organisation of the public engagement event in March. In terms of its outputs, a number of engineering based activities have been developed around individuals' engineering areas, roles and interests as well as the delivery of a successful event in Leeds. Outcomes include the increased knowledge and skills of engineers in West Yorkshire regarding the communication and promotion of their industry to people of all ages as well as easy to use resources that help at the beginning of the development process for activity and demonstration design. The resource is also useful in terms of helping engineers to think about everything they do and have done to be and become an engineer and help them talk about and promote themselves. The key learning outcomes of this project include the factors to consider when organising a public event, the different types of learning styles amongst people and also the need for individualised support in a number of cases to ensure that all those engineers that want to be involved in such a project can do so. This individualised learning also posed a number of issues with regards to timing and progress that had to be accounted for. However, the evaluation from the participating engineers denotes not only an enjoyment of the training but also an increased confidence in public engagement and effectively promoting themselves and their industry. The comments received from the public during the event in March also highlighted the success of the project in that they found the day exciting, fun, informative, engaging, interesting and enjoyable and were surprised by the diversity of engineering subjects and areas.

SHARON BISHOP, Cheltenham Festivals

FameLab Engineering

Upon watching the FameLab International final at the Cheltenham Science Festival in June 2013 Nobel Prize winners Peter Higgs and James Watson commented that this was "the most fun they had had in years". One of those competing at the International FameLab final was 2013 UK finalist Leon Vanstone, an engineering PhD student at Imperial College London. His winning presentation at the UK Final, held at the Bloomsbury Theatre in London in April 2013, explained "[*the single greatest engineering feat ever accomplished*](#)" namely the device used to put the Mars Rover on Mars.

FameLab is a STEM communications competition open to anyone over the age of 21 and in 2012-2013 competition year an *Ingenious* grant from the Royal Academy of Engineering enabled FameLab organisers to solidly integrate engineering within the proven FameLab format. Previously there was a preconception that FameLab was dominated by scientists who received more support and encouragement to talk about their research

and engage with the world at large than engineers. FameLab engineering addressed these problems and raised awareness of the importance of public engagement around engineering. In order to do so the *Ingenious* grant facilitated dedicated support and training for engineers interested in pursuing public engagement and competing in FameLab.

Engineering specific heats were held in two locations, the Royal Academy of Engineering in London and Thinktank in Birmingham. **Leon Vanstone** went on to win the London heat (with his presentation on [insect flight](#)) **Josie Mmojieje** won at the heats in Birmingham also went on to present at the UK final and talked about [pyrolysis, biochar and its applications to our energy infrastructure](#).

In total 47 contestants with an engineering background, working both in industry and academia took part. Thousands of people watched the competition live and online. In 2013-2014 FameLab will again take place across the world and with our improved networks and means of engaging engineers, we hope the numbers of engineers competing in FameLab will continue to grow!

ROWAN BROWN, National Mining Museum Scotland **Engineering Scotland's Energy Future**

The Ingenious Grant enabled National Mining Museum Scotland to build on an existing programme of activity to contextualise the subject of coal mining and re-interpret it within the wider sphere of energy provision past, present and future. The project permitted the acquisition of a collection of important artefacts that tell the story of the birth of Scotland's renewable energy industry. The principle acquisition was the Wave and Tidal Group Portacabin which, over a thirty year period, spawned three commercially successful companies: Edinburgh Designs, Artemis Intelligent Power and Pelamis and represented the birth of an industry which has contributed c.£200M to the Scottish economy. The acquisition of the Cabin opened a valuable dialogue with key stakeholders from the green energy sector and enabled the Museum Team to work with high profile Engineers and Active Learning Specialists to determine a model for conducting public engagement activities in the Cabin targeted at a schools audience.

The project objectives dictated that the Cabin had to be redesigned as a very flexible space, suitable for housing interpretative material and interactives but also flexible enough to support group activity and active learning. A key element of the project was to provide resources which suited the new Scottish curriculum. The space, the interactions with engineers and the supporting schools materials were built around the creativity inherent in engineering and the four capacities of the Curriculum for Excellence: to enable each child or young person to be a successful learner, a confident individual, a responsible citizen and an effective contributor.

There were two distinct groups of Engineers participating in the project; the Engineers who had worked in the Cabin and Engineering students who

were keen to get involved in public engagement activity. The project team included representatives from both groups as well as education and museum experts. The Team undertook a day of science communication training before refining the design brief and scope of the educational materials. The Engineers provided the content and sourced the objects for the exhibition and assisted with the design of interactives. The Engineers also helped to direct and approve the guidance notes and Energy Transfer DVD which formed the Teachers' Pack.

This project created a new and unique space at the National Mining Museum Scotland dedicated to engaging primary school children with innovative engineering solutions for Scotland's energy future.

ED CARTER, Flowmill Project Ltd

~Flow engineering engagement programme

~Flow had over 40,000 visitors, with the majority rating their experience 10/10. The engineering engagement programme used ~Flow as inspiration to celebrate the fascinating technological research behind the project, exploring the relationship between art, energy, design and industry.

The outcomes included:

Increased public access from 4 to 5 days per week (25% increase)

A priority in terms of our public engagement programme was to increase public access to a tangible, hands-on, art + engineering project. By increasing opening hours, we were able to increase access by 25% (from 4 to 5 days), and by adding extra signage and interpretation print, could provide more detail about the role engineers played in the project.

4 new pieces of short writing: Julie Ward, Wes White, Guy Mankowski, Steven Ronnie

Engineering relies on precision and detail, as does good writing. We embarked upon a series of film and writing commissions, delivered with the Newcastle Centre for the Literary Arts, which focused on the engineering aspects of ~Flow. Four new pieces of short fiction were created by Julie Ward, Wes White, Guy Mankowski and Steve Ronnie. These pieces were published online, on both ~Flow and NCLA's websites, and in a small publication which was distributed to partners, stakeholders and attendees of the closing event.

1 new film: Mat Fleming

We offered an opportunity to film-makers to make a new work about ~Flow, working with Buro Happold, that particularly focused on the role of engineering in the historical development of the Newcastle and Gateshead Quayside. This regional context offered an excellent backdrop for the commission, a symbiotic relationship between the River Tyne and local industry, each having a huge impact on the other at different times in recent history.

This commission attracted some strong proposals and we selected artist and film-maker Mat Fleming to create the new film. Mat's film highlighted the elegance with which engineering works in sympathy with invisible forms of energy with a focus on moving water and ~Flow itself. Shot on 16mm film, the new work featured Andrew Walker of Buro Happold, along with visitors to ~Flow, talking about the project and its setting. The film was shown at Baltic Centre for Contemporary Art for a month, is available on Vimeo, and was also screened at ~Flow's closing event for partners and stakeholders.

4 public talks:

Our talks programme, which was delivered in partnership with the Institute of Civil Engineers, the University of Newcastle, the Miners Institute, and the Discovery Museum consisted of:

- i. How to mix traditional craft and digital innovation to create a Tyne-powered sound sculpture: talks from Andrew Walker (Buro Happold), Nicholas Kirk (Nicholas Kirk Architects), Simon Blackmore (Owl Project), Ed Carter (modular) and David Willcox (2V Microsystems).
- ii. From The Drawing Board To The Tyne: Andrew Walker of Buro Happold shares the detailed story of ~Flow's development and delivery
- iii. Water As A Resource And As A Risk: Anna Bruni from Buro Happold presented a journey along the water cycle, giving an overview on how as a society and as engineers we are interacting with it, impacting upon it and exploiting it.
- iv. Additionally, to wrap the programme up, Andrew Walker and Nicky Kirk spoke at the RAEng Ingenious Session in London.

BILL CONNOR, Sentinus Engineering Solutions

Sentinus, funded by the Royal Academy of Engineering, developed and delivered a programme focusing on the development of undergraduate/postgraduate and practicing engineers while delivering quality educational outcomes for schools and pupils. The programme set out to use student and practicing engineering as a means to provide great opportunities for pupils to discover the excitement of engineering.

Engineering Solutions recruited eighteen undergraduate and two postgraduate engineering students from the local universities and further education institutes in Northern Ireland. The programme was extremely successful in recruiting students from a wide range of engineering disciplines including; Aerospace, Biomedical, Electrical and Electronic, Manufacturing, Mechanical, Software and Electronics and Technology and Design Engineering.

Student engineers were given training prior to engagement with schools in communication skills, working with young people and how to develop

project based activities which are designed to stimulate debate and promote innovative thinking on engineering issues.

The undergraduate/postgraduate engineers were linked, for 8–12 weeks, with ten post primary level schools in the Greater Belfast area.

During this time the young engineers engaged with pupils in an engineering project theme which was chosen by them and specifically related to their area of interest. The project themes were designed to encourage the pupils to examine key aspects of engineering, carry out research and propose innovative solutions to significant challenges of the future. The project themes were:

- Future Eco Cars;
- Driverless Cars of the Future;
- Future Technology with a Focus in Human Tasks;
- Future of Medical Devices;
- Future Design of Aircrafts;
- Future Technology using Smart Materials;
- Sustainable Solutions to Problems in the Developing World;
- Formula 1 Cars of the Future;
- Medical Devices in 100 Years.

Midway through the programme, a practicing engineer was invited to the school. Ten practicing engineers were recruited from local companies/institutes, including; Bombardier Aerospace, Fairhaven H&V Services, Michelin, Northern Ireland Technology Centre, Queen's University Belfast, RemapNI, Salamander Amphibious Vehicles and the University of Ulster. The practicing engineers visited the school to engage in dialogue and debate with both the engineering students and the pupils on the related project theme. During the visit the practicing engineer discussed their career history and why engineering was the career they aspired to.

The programme concluded with a Celebration Day where schools displayed their project work. With their link engineers pupils had the opportunity to present their work to a wider audience comprising teachers, Sentinus Ambassadors and invited guests.

Through the involvement of engineering students in the management and delivery of these projects, links have now been created between the next generation of engineers and their local schools which have inspired pupils to consider the impact of engineering on our lives and to consider engineering as career choice in the future.

STUART ELLINS, Young Engineers

Meet the Parents

The 'Meet the Parents' project has provided great opportunities for a number of engineers (STEM Ambassadors) from a diverse range of engineering companies to share their knowledge and experiences.

Companies represented included: Rolls Royce, the MOD, EDF, NPower, Network Rail, Knorr-Bremse, Siemens, Leicestershire Council, Wiltshire District Council.

We were very fortunate to have the involvement of several female engineers and a number of younger male Engineers who proved excellent role models and helped break down gender and age stereotypes. This, without doubt, had a great impact on those students and parents attending in widening their views and opinions on the diversity of roles within Engineering.

Each of the challenge sessions were based around the theme of 'Raising Water' - teams of students and parents work together to move a small amount of water vertically and horizontally using as little human input as possible and with only basic materials. Each challenge was adapted from the main version depending on the age of students participating. 'Raising Water' is a challenging but fun activity which tests the participants teamwork, communication, problem solving and creative skills and help them apply some basic physics principles in a practical engineering challenge setting.

For a number of schools this was their first experience of holding a STEM based event in / after school and almost none had ever run an event with parents before (other than the occasional Careers Fair). The overwhelming response from teachers was how valuable this experience had been with much positive feedback from students and parents.

Teachers are clearly keen to extend the concept and have expressed their wish to run similar events in the future. Many students (and parents) have been asking when the next event will be.

Example teacher comments received via email:

'Huge thanks for yesterday...the comments on twitter have been very entertaining.... lots of people asking when the next one will be (if you would be willing to come back!!)'

Jo Cox, Head of Science, Redmoor School

'Even now I am still getting positive feedback from students and parents about the evening. I have also gained four contacts – parents who are willing to come into the school and talk to students about science and engineering careers, Thank you'.

Martin Hampshire, Head of Science, Bournemouth School

DR BEN EVANS, College of Engineering, Swansea University

STEM schools-based public engagement based on the BLOODHOUND SSC

The following remarks summarise the successes/failures in meeting the original project objectives:

The estimated number of undergraduate ambassadors recruited to visit their former secondary school / college was less than anticipated. Out of a

potential pool of 630 first year undergraduates, 59 volunteered for the public engagement training and school visit (incentivised by a free poster). On reflection, the initial target of 200 students was somewhat ambitious. However, the estimated total number of school/college students engaged with through this aspect of the project was 940. The College of Engineering (Swansea University) has deemed that this activity has significant value to both the College and its students (particularly in terms of Personal & Professional Development). It is therefore going to become a standard part of first year undergraduate's personal and professional development programme of activities.

The schools shows and workshops delivered by the trained postgraduate presenters has been extremely successful with feedback from both students and teachers overwhelmingly positive (see following sections). A team of 6 (paid) postgraduates was recruited and trained (by 'Science Made Simple') in the first phase of the project. It quickly became clear that the rocket car workshop was in much greater demand than the simple 'show', greater emphasis was therefore placed on delivering this activity since, although the total numbers engaged through this would be lower, we deemed it to be a 'deeper' and more meaningful engagement with greater impact. Over the course of the project, 36 shows and 13 workshops have been delivered with an estimated cumulative audience of ~3900 students. This number, combined with the interactions by the undergraduate volunteers, means that the overall interactions with students is close to the 5,000 estimated in the initial project targets.

The development of an online community related to the project has been less successful. Despite developing a twitter feed and revamping of our Bloodhound webpages the post-event response from participants with this has been minimal. Perhaps, more effective ways of engaging students with social media activities needs to be explored. We are considering releasing the speeds of rocket cars via twitter and the website after the workshop in future delivery to encourage participants to engage.

Engaging students and schools with the wider Bloodhound project education programme and its resources has been successful. The Bloodhound Education Team have reported that many of the schools that we visited have since joined up as schools partners.

JO FOX, Spacefund

The Biggest Rocket Ever Built!

Spacefund is an innovative space-themed educational company based in Canterbury, Kent and the brain-child of partners Jo and Matt Fox. For the past 13 years they have been delivering high quality, fun, and educational STEM learning to Primary school audiences throughout the UK with the highly successful "Kids in Space" show. In 2013 Matt and Jo were ready to embark on a new venture, one that involved a partnership with the University of Kent, a giant rocket, time travel and most importantly, engineering!

The Biggest Rocket Ever Built is an exciting new project that aimed to train a group of young engineers to co-present a show that would educate and inspire a new generation of Primary School Children about engineering.

Using the inspirational story of the 1960's Apollo missions to the Moon and the building of the mighty Saturn V rocket as the backdrop, the Biggest Rocket Ever Built tells the story through the eyes of the thousands of engineers who worked tirelessly together to succeed at this great challenge.

From October 2012 through to May 2013 a group of 9 enthusiastic engineers from the Engineering and Digital Arts department at the University of Kent trained with Spacefund and assisted in the creation of the new show with the view to perform it in 20 local Primary schools. None of the engineers had any previous experience with presenting before the training took place, but were selected because of their enthusiasm for engineering and because they wanted to communicate this to children.

Throughout the project Spacefund were impressed with the engineers' dedication and determination to be involved, considering the difficulties they had juggling the project alongside their demanding full-time studies. To allow for more flexibility, Spacefund held shorter, but more frequent training sessions than had been originally planned. As the training progressed Spacefund observed a clear improvement in the engineers' confidence, presenting ability and communication skills. Training consisted of background information on Spacefund activities and the 'Space Race', confidence building activities, script reading and workshops with small groups of children. Although not all the engineers that took part in the training were able to present the final shows, 8 participating engineers signed up to become STEM ambassadors with the view to get involved in additional STEM activities.

The 20-school tour took place in June 2013 and was a tremendous success, enjoyed by the 4 presenting engineers (each presenting 5 shows and assisting in at least 2 other) and over 3000 primary school children, teachers and parents. (The remaining engineers who had received training were unable to actually present the shows due to work placements, course demands and changing courses.)

After each performance evaluations were conducted; with the teacher, the children, and the presenting engineer, all taking part in a separately tailored evaluation. The engineers also completed a more in-depth evaluation at the end of the project.

All of the 4 presenting engineers displayed great professionalism while working in the schools and performing in front of large audiences of up to 150 pupils. From the evaluations it was clear that they each felt that the project very much met their expectations; they found it interesting, and indicated they would like the opportunity to continue with the project and would recommend it to other engineers.

In each of the 20 schools visited both a teacher and a class evaluated the performance using the following criteria: "Very", "Quite", "A little", "Not at all".

The teachers' responses were very positive. Their overall satisfaction was a resounding 100% being "Very" satisfied with the show. 95% of the teachers found the show "Very" informative and enjoyable (with the remaining 5% finding it "Quite" informative and enjoyable)

The pupils responded very positively too. 85% "Very" much enjoyed the show with a further 10% enjoying it "quite" a lot.

SIMON GAGE, Edinburgh International Science Festival **InMotion and Make a Move**

InMotion is an interactive event which explores technology and engineering in relation to the science of human movement. It offers an extremely high quality, 'wow-factor' experience: this has been consistently reflected through feedback and evaluation.

InMotion was staged within the main exhibition space (the Grand Gallery) in Edinburgh's National Museum of Scotland, the most popular visitor attraction in Scotland. It had extremely high visitor numbers: over 30,000 people directly interacted with InMotion's activities during its time in situ, and over 100,000 people saw the exhibition. Being located in a central, high-profile location within NMS gave the exhibition a national reach and provided it with huge credibility.

InMotion comprised of seven key interactive exhibits, which included:-

- Speckled Computing – creating human movement through prosthetics, controlling an avatar and exploring the research behind robotics and prosthetics
- Speed of Light – exploring ways of generating electricity through human movement
- How High, How Far, How Fast – testing how high participants could jump, how far they could throw, how fast they could run
- Anatomy – examining how muscles and bones work and exploring technology which measures oxygen in muscles
- Dance Communication – voting for favourite avatars and rating dancing styles; watching and comparing films of other visitors' avatars and exploring the experiment's findings and other relevant research
- Biomechanics – testing the difference that technology makes and exploring real world biomechanics research
- Testing power strength and endurance – a range of activities pushing participants to their limits

We worked in close partnership with the following engineers to develop these events, who we identified after extensive research into sports technology and engineering which established where examples of innovative, cutting-edge work could be found:

- DK Arvind and team: Director of the Centre for Speckled Computing (University of Edinburgh)
- Sethu Vejayakumar and team: Director of the Institute of Perception, Action and Behaviour (IPAB) in the School of Informatics (University of Edinburgh)
- Dr Peter Lovatt and team: Head of the Dance Psychology Lab (University of Hertfordshire),
- Susan Brown and team: Lecturer in Sports and Exercise Science at Edinburgh Napier University
- Chris Cooper and team: Professor and Head of Sports Science Research, University of Essex
- Otto Bock: medical technology company who produce high-end sports prosthetics
- Touch Bionics: company who produce prosthetic technologies

We also programmed a series of talks and discussions which brought together researchers, engineers, physical performers and athletes to explore the medical, economic and social impact of recent advancements in this field. The talks included: "Dancing Brain"; "What Makes a Winner?" and "How Far, How Fast, How High?"

EISF also developed an engineering workshop for children – "Make a Move" which was hosted in the National Museum during the Science Festival and has subsequently toured Scotland in 2013 as part of our national schools education programme, Generation Science. We reached 82 schools in 2012 and 94 schools in 2013, delivering a science and engineering workshop to 2,820 children this year.

Make a Move, as part of Generation Science, has also worked with ≥ 100 professional teaching staff over the period, improving their capacity to develop and deliver science and engineering education as part of the formal curriculum. This is via the creation of an education resource pack which was sent to all teachers who booked Make a Move.

SUE HORDIJENKO, British Science Association **Strictly Engineering**

Strictly Engineering challenged 30 engineers from academia and industry to develop an eye-catching poster about their work. The posters were used to attract the attention of visitors of the British Science Festival and create opportunities for informal chats about a diverse range of engineering topics.

The engineers were mentored by professional graphic designers and public engagement specialists through a one day workshop designed to develop their verbal and visual communication skills. Prior to finalising their posters they received feedback from graphic designers and science communicators.

For three days the engineers chatted about their work with festival-goers. The public voted for their favourite, as well as a panel of 20 judges who

included science communicators, researchers and industry representatives.

The winner and two runners up were announced at the x-change, the British Science Festival highlights show.

The engineers valued what they learned from the project and stated that that will support them in their public engagement and professional life.

Overall, I felt that I gained significant knowledge in methods to convey my research activities to the general public, and the best methods to generate interest in my work. I developed skills in communication and expanded my view of public update ding of science.

Strictly Engineering participant

A catalogue of all posters is available online, with a reference stating that high resolution versions of the posters are available on request. We have already had requests by third parties to use the posters for educational purposes.

We produced a poster design practical guide in collaboration with a graphic designer, based on the workshops and the engineers' feedback. The guide is now available online to support those who want to delve into how to use posters to engage with lay audiences.

DR DAVID JAMES, Sheffield Hallam University

Sports Lab 2012 – A public discourse in sports engineering

This project supported a team of 13 sports engineers to deliver two programmes of activity linked to an exhibition at the V&A Museum of Childhood.

A question box, writing kiosk and supporting graphics was installed at the Sports Lab exhibition. Inspired by their visit to Sports Lab, visitors were encouraged to ask a sports engineer a question on a postcard and post it into the box. Over the duration of the exhibition the box received 464 question cards. Museums staff collated the postcards daily, filtered out the nonsensical scribbles, and sent the rest on to the team of engineers. The engineers then wrote blog posts in response to these questions (31 in total) after undertaking training, mentoring and editing. During the period of the five month exhibition period these blog posts were viewed by 52,580 unique visitors. The process provided a fantastic opportunity for the engineers to develop their online communication skills, and the blog posts generated considerable dialog on a host of technological and ethical issues.

When the exhibition closed at the end of the Paralympics, the project team coordinated a series of five events where the team of engineers could engage directly with the public. These events took the form of a panel discussion/presentation and focused on the topics and issues raised in the exhibition question box. Many of the engineers who wrote the blog

posts also took part in one of the live events. The events were delivered in partnership with organisations that had existing public programmes, and the engineers were trained, mentored and supported by the project lead. None of the events attracted large audiences, but they did provide a safe and supportive environment for the engineers to discuss their work and the issues it raises directly with the public.

The project achieved three key outcomes/impacts that are described below;

1. The process of answering questions posed by visitors to Sports Lab drove considerable traffic to the blog and increased its reach and profile. The online audience were able to see how engineers approach a problem, and generally became more enlightened about a host of engineering principles.
2. The audience at the public events had direct contact with practicing engineers and were provoked to consider the impact of engineering on society. This experience will have undoubtedly challenged some of those outdated preconceptions of who engineers are, and what they do.
3. The team of engineers who took part in the project felt both skilled and empowered to agree to deliver similar public engagement activities in the future.

BEN JOHNSON, Graphic Science Ltd

Everyone's Energy

The project set out to develop a series of workshops for members of the public looking at energy generation options for the future. The workshops were to be facilitated by specially trained engineers from the energy sector and supported by a simple to use bespoke electronic carbon calculator. However we struggled to recruit engineers to take part, and in the end found the project was not viable.

We found that engineers in academia do not seem to be at all interested in this kind of engagement. Although this was dispiriting for us, we found that it was in common with other colleagues' experience. It seems that the model of public engagement that works for natural scientists does not work for engineers. We have a number of observations about factors that may contribute to this:

1. Engineers like to structure their thinking in terms of working towards a solution to a pre-defined problem. The problem is often set by external agencies. Discussing the context in which the problem was set and its wider implications is generally outside their professional experience and way of thinking (although they might have a personal interest).
2. Where engineers were interested in discussions for Everyone's Energy, it tended to be for the purpose of drawing people towards what they viewed as the "right" solution (reducing energy consumption) rather than a broader conversation.

3. Indications from other research we have undertaken suggest that, unlike natural scientists, engineers are much less likely to get involved in communication for sheer love of their subject. Once again, their communications tend to be directed towards finding solutions to identified problems (e.g. student recruitment, user engagement/testing).

DR JANE MAGILL, University of Glasgow

Torqueing Turbines

Torqueing Turbines has created a public performance delivered through dance, music and drama but led by engineering concepts in renewable energy generation and specifically wind turbines. The performance was developed collaboratively by a team of engineers and performance artists and delivered in a major public venue in Glasgow during March 2013. In parallel with the performances there were a series of participatory engagement events for school pupils age 11-14 supported by teachers from both science and arts subjects. Pupils from 5 Glasgow schools attended in-school workshops to prepare for a taster of the main performance in which they actively participated.

KATRINA NILSSON, Science Museum

Engineering London 2012: exploring Olympic engineering through exhibits and events

PROJECT SUMMARY

The Engineering London 2012 project had 28 engineers take part in the project, which consisted of: 1 topic zone exhibit, a Talkaoke and six Antenna Live events, three of these took place at Lates events. A press launch event took place in the Antenna gallery to coincide with the installation of the topic zone.

OUTPUTS

Training

Four engineers attended a writing workshop, 24 received presentation training and four engineers from King's College London took part in four Talkaoke facilitation training sessions.

Topic Zones

Four engineers from the Pervasive Sensing group at Imperial College London benefited from the writing and exhibit development training and in conjunction with the Science Museum developed an exhibit in one of our temporary museum displays or Topic Zones. The exhibit was based on the groups work on bio-sensors for use in sports training. They created an exhibit that featured some of their work and asked visitors about their attitudes towards engineering in athletic sports – whether they thought it offered an unfair advantage or not. The exhibit proved popular and gained a lot of attention at the press launch event for the “Summer of Sport”

Lates and Talkaoke

The Talkaoke ran at the August Lates for the entire evening with a regular exchange of visitors at the table discussing the broad topic of the Olympic and Paralympic Games, such as drugs in sport. Three separate antenna live style events ran at the July Lates.

Antenna Live Events

Three live events took place in the Antenna gallery and each ran for three days, allowing for higher visitor numbers to try out the technology from the groups involved. The events were run by research groups from Imperial College London, Loughborough and Kingston Universities.

These groups brought different objects and demonstrations to engage visitors with. The Pervasive Sensing group from The Staffordshire group produce new materials to engineer advanced athletic shoes. The Kingston team demonstrated the value of salsa dancing as a legitimate form of exercise by using a range of devices that measure activity and respiration. Loughborough researchers brought a high-speed camera and other devices to show people in detail how they run and jump! These events demonstrate something new, exciting and interactive and get engineers to converse with visitors about the technology, about the way they work and about themselves.

OUTCOMES, IMPACT AND LEARNING

The evaluation by an external evaluator indicates that engineers found the training useful and relevant and that the engagement experiences were rewarding. Engineers felt their confidence in engaging the public grow.

The audience found the experiences enjoyable and the evidence from the external evaluation indicates that audience members' interest and knowledge in engineering increased.

Some engineers also had the opportunity for them to appear in videos of the events. The videos can be found on the Science Museum's Youtube channel:

http://www.youtube.com/playlist?list=PLwx8_TBZ6z_nAuIq1_Vxc_gOSTqrht6px.

SCOT OWEN, Techniquet Glyndŵr

Bridging the Gap

Techniquet Glyndŵr engaged with schools and engineers from across the Cheshire, South Wirral and North East Wales areas and linked the schools with engineers to work together to design and model a bridge to traverse the Mersey.

The aim of the project was to highlight the range of engineering careers and disciplines involved in the Mersey Gateway project. The task will allow year 10 students to make decisions about the materials used, design, and environmental concerns as if they were heading up the construction of the Mersey Gateway bridge project.

A science communication skills training session was held for the participating engineers in order to hone their public engagement skills. The project enabled the link engineers to highlight the diverse range of their work and career paths to the students.

The project was run as a competition with the final presentation taking place at Glyndŵr University as part of a STEM day that showcased the work of the students and link engineers. The winning team was from an all-girls school, Upton Hall FCJ, from the Wirral.

CHRISTOPHER PARKIN, Museum of the History of Science, University of Oxford

Objects of Invention

The project ***Objects of Invention*** was funded by a grant from the Royal Academy of Engineering under the *Ingenious Programme* for public engagement. It was a partnership project between the Museum of the History of Science, and the Department of Engineering Sciences at the University of Oxford.

The Museum of the History of Science houses a unique collection of scientific objects which include devices designed and engineered for everyday use. The Museum has a well-established education programme which engages schools and families.

The project aimed to provide training for up to 16 graduate engineers from the University's Department of Engineering Sciences in techniques of public engagement, and the opportunity to gain experience through the planning and delivery of events for secondary schools and families in which their own interests and research in modern engineering applications could be interpreted alongside objects from the Museum's collections. Initially a group of about 20 engineers were recruited and this number reduced to a core group of 16 who continued to take part in the events.

The training programme, delivered in partnership with the University Museums' Volunteers Service, consisted of four 2 hour sessions focussing on object handling, learning from objects, and working with different types of audience. Towards the end of the training programme, the engineers worked with education and collections staff to plan the events; a whole day for the general public which took place in March 2013 during National Science and Engineering Week, and three study day events for secondary school students, one in March and two in June.

The Family day provided a friendly opportunity for the engineers to find their feet. The event attracted a near record single day audience of over 2,000 people and was a huge success. Activities ranged from investigating gyroscopes to Stirling engines and mobile medical technology, and the programme was supplemented by exhibition tours and workshops which also involved other community volunteers. The feedback from visitors was very positive and highlighted the enjoyment of learning about current engineering applications in the historical context of the Museum.

The three schools' events attracted 150 students from 6 local secondary schools. These events included a circus of activities facilitated by the engineers alongside a 'design and build' workshop created by education staff and a workshop on the early history of radio technology. The feedback from the school students and teachers was also very positive indicating that the activities were informative and interactive, and the presence of the engineers had contributed significantly to the students' enjoyment.

In addition to the development of skills and knowledge of different audiences, the engineers reported a significant increase in levels of confidence in public engagement as a result of the training and taking part in the events. They also felt more inspired about their own work.

As well as the contribution to the Museum's programming, the project has created a template for future projects and made a significant impact on other staff and the organisation as a whole by bringing new knowledge into the Museum and challenging ways of working with objects from the Museum's collection.

DR SUBRAMANIAN RAMAMOORTHY, University of Edinburgh

Games Robots Play

This project was based on a set of public engagement events including, as the main event, the Royal Society Summer Science Exhibition. The other events included both engagement events, such as the Edinburgh International Science Festival, and robot competitions involving student participation, i.e., RoboCup. Our main vehicle for engagement was live robot demonstrations – which were structured in the form of interactive games. Example games included a penalty shootout between a human-controlled and autonomous robot, a game of rock-paper-scissors between a human (whose gestures were interpreted by computer vision) and robot (which was running a newly developed learning algorithm). These demonstrations not only allowed us to showcase the technology for the public to understand, but also taught us engineers about the difficulties involved in designing broadly reusable robot behaviours – which went on to become research contributions in their own right.

In addition to the PI and co-PI, the team consisted of student engineers, including Aris Valtzanos, Efsthios Vafeias, Stefano Albrecht, Majd Hawasly, Alesia Novik, Andrew Robinson who participated in most of our events. In addition, the RoboCup event and some of our 2013 events benefitted from the involvement of Alejandro Bordallo Mico, J Daniel Manjowitz and Nantas Nardelli. All of these engineers were students in the School of Informatics, including 1 UG student, 1 MSc student with all of the others being PhD students.

These events all summed up to a coherent and sustained engagement activity, which included direct engagement with a large public body (>10000 people in two different cities each), media (in various ways

ranging from newspaper articles reporting on our work to participation in panel discussions on BBC radio) and articles in both the popular and professional spheres. Through all this, we believe we managed to achieve our main objectives – to inform the general public about what robotics is and is not (Hollywood fears versus an assistive and useful reality), to train student engineers to convey this message to a broad audience and to experiment with new methodologies for using direct engagement with the public to shape our own research. This last point was a substantial and initially unexpected lesson learnt by the PIs. Through this project, especially the carefully planned Royal Society exhibits and the RoboCup team, we have managed to utilize our opportunity to engage with a diverse public body to generate hypotheses regarding interactively intelligent systems in the real world, and to test our solution algorithms – closing the loop by directly engaging the public in cutting edge research experiments (with their explicit consent, of course).

PETER REID, The University of Edinburgh

Renewable energy in SCI-FUN, the Scottish Science and Technology Roadshow

SCI-FUN/FUSION have worked in collaboration with: researchers and graduate students from the School of Engineering at the University of Edinburgh; an experienced engineering engagement team (a retired professor from Edinburgh and a professional artist interested in social aspects of engineering); and Industry professionals – in particular members of FloWave TT; to produce and deliver a variety of public engagement materials discussing the technologies and social issues behind the development of marine renewable energy in Scotland.

There were four strands to the project:

- 1) *The production of engagement exhibits, around the central theme of renewable energy, to be taken to public events and schools in Scotland, and for engineers to use in the future.* A central touchscreen-driven console displays images, text, video and audio files, describing basic issues behind energy policy in Scotland. Other exhibits introduce users to the basic ideas behind electrical generation. These exhibits are designed to be updated in future, adding new interactive elements.
- 2) *Presentations for public audiences at different levels of understanding, on similar themes, incorporating video films generated by team members, including industry contributors.* An adult talk at EISF 2013 took the form of an extended panel session with academic, industrial and artistic presenters. Talks at 2012 and 2013 Orkney International Science Festivals (OISF) discussed the impact of renewable energy on coastal areas, and on the construction of a wavetank for research into wave/tidal generators. A talk aimed at S1/2 school pupils will be used in future visits to schools.
- 3) *Events at which exhibits were demonstrated to a public audience, by graduate engineers and SCI-FUN/FUSION staff.* The OISF 2013 Family Day, Edinburgh Doors Open Day at the BGS, and the Elements Science festival in Greenock: were opportunities for the

teams to engage with large numbers of interested adults and children.

- 4) The SCI-FUN Roadshow and engineers visited nine Scottish schools, taking exhibits (including the marine renewable console and others) to the entire S2 year-group, and S5/6 senior pupils.

Audiences have been extremely receptive to the information provided, and are keen to learn more. One major conclusion from the project (at all levels) is the need to understand the *context* in which renewable energy technologies are developed – in particular the constraints underpinning the production and consumption of energy in general. Much more work must be done to educate the public in the complexities of energy production, which will help them to properly appreciate the need for research into new methods of generation and storage.

In addition, there is an opportunity *now* to engage with the Scottish public on the career opportunities afforded by an engineering background; pupils are showing great interest in the subject area, and adult audiences are aware of the need for new sources of energy, and in the research and development needed (here in Scotland) to harness them.

Most encouragingly, SCI-FUN and FUSION have opened up a range of new connections with School of Engineering researchers and students, and will be actively involved in public engagement training, mentoring and collaboration (with University and industry partners), in the years ahead.

MEL WEATHERLEY, The Black Country Living Museum Newcomen Festival and Conference

The project consisted of a 2-day Festival and a 5-day conference celebrating the 300th anniversary of the Newcomen atmospheric steam engine - the world's first engine to successfully use the power of steam to produce mechanical work and which first operated just a mile away from the Black Country Living Museum in Dudley, West Midlands. The Museum possesses the only full size working replica of this feat of engineering which paved the way for the Industrial Revolution.

Scientists and engineers from local engineering companies, colleges and universities, and representatives from regional branches of national engineering institutions featured heavily in the Festival. They provided 'real world' applications of engineering, demonstrating its impact on the modern world, and how current engineering understanding germinated from this early steam technology. There was a strong focus on hands-on, experiential learning.

The Museum provided an atmospheric backdrop for the events, showcasing steam exhibits and hot metal working demonstrations to celebrate the Black Country's engineering heritage and industrial significance. This was a new venture for the Museum using the high profile Newcomen celebrations as a vehicle to offer a deeper level of engagement with its collections and heritage (a key learning objective). The project supported the development and delivery of a diverse and innovative programme of activities exploring the cross-curricular potential of the site,

and in turn, the Museum's mission to engage hearts and minds through the best use of its collections and to inspire the widest possible audience about the story of the Black Country. The project also related to two other learning objectives: to strengthen the Learning Programmes through collaborative partnership working and to improve impact, diversity and appeal.

Although the project was a sharp learning curve for all involved and posed challenges in the organisation and implementation, it was a great success and opened up many opportunities for the future. Outcomes included:

- Impact on the regional community, bringing increased recognition of those involved in engineering, product design and manufacture.
- Increased levels of appreciation and understanding amongst students of the engineering and manufacturing heritage of the Black Country region and its potential for their future employment.
- Introductions of teachers to local STEM Ambassadors to help develop their expertise in developing an innovative curriculum model shaped around the heritage, needs and aspirations of the region.
- Development of the public engagement and communication skills of local engineers through leading activities and presentations, empowering them to inspire and influence the local community and play a part in the motivation and recruitment of a skilled workforce for the future.

The Museum now has a tried and tested template for both formal and informal STEM focused events. It has also created strong sustainable partnerships that will continue to provide future public engagement activities.