Round 1 (2007): *Ingenious* Final project summaries

SARAH BEACOCK, Energy Institute
Energy Engineering
The Energy Institute, with support from CREATE, organised a series of workshops for teachers and industry professionals that worked with school children. Ten workshops were held around the UK to raise the profile of energy and engineering with teachers and give them more information on careers to pass onto their students. These workshops were then followed up by web and printed teachers resources and careers materials.

The workshops were delivered by Cliff Porter, a freelance education specialist with 20 years experience in the sector. During the workshops teachers were given information that tied in with the national curriculum making it easy for them to develop the content for use in lessons. They were encouraged to discuss how materials could meet curriculum targets such as collecting and interpreting data to make informed decisions about real life situations or understanding the impacts of energy use and issues such as global warming and climate change. Delegates were also given time during the workshops to plan an activity to use in the classroom designed to incorporate the needs of their specific students. The emphasis throughout the workshop was on engaging students, exciting their enthusiasm for the issues and interpreting the information for them in memorable and interesting ways.

The workshop also tackled the lack of careers knowledge in both teachers and young people. Delegates were given information on the wide range of jobs available in the sector in both the STEM fields and other roles such as marketing and communications. The opportunities for both able and less able students were explored.

Each workshop featured one or two guest speakers from the energy sector providing a case study of their role and career path and giving their advice for young people interested in a job in energy. All workshops featured an interactive session where delegates were able to question the speakers on their work and career choices.

Following the workshops the trainer's presentation has been recorded and is being put online. A careers booklet on energy engineering is also being developed to be distributed to schools and careers libraries. This will be used as part of the ongoing work of the EI to promote careers in energy and engineering to school children through its members.

JACK BRADLEY, University of Bradford
Saving the Planet - Eco Design Roadshow

The "Saving the Planet Eco-design Roadshow" dealt with issues around engineering, the environment, and alternative technologies. It aimed to provide clear demonstrations of how engineering has in the past affected the environment, causing climate change, and how engineering is a possible solution to that very same problem. Hands-on workshops on renewable energy production, recycling and climate change were conducted in schools around Yorkshire and the Humber, hosted both at the schools, and at the University of Bradford. 4 open air demonstrations of renewable technology and local, engineering-based solutions to global environmental problems were conducted in towns around Yorkshire, The University of Bradford's School of Engineering, Design and Technology teamed up with the Alternative Technology Centre in Hebden Bridge to provide both academic and practical knowledge of renewable technologies for the demonstration events

ALICE BROOK, Engineers without Borders

A year of awareness: Unlocking the passion of the Engineers without Borders

In the summer of 2007 Engineers Without Borders UK held a photography competition in order to find images showing young people employing their practical engineering skills on the behalf of communities in developing countries. The majority of the photos entered in the competition showed EWBUK volunteers working for community based organisations with typical images showing volunteers working on engineering projects to deliver clean water, improved sanitation and electricity to rural communities. 20 images were shortlisted to be displayed in a series of public exhibitions around the UK which were organised by EWBUK's Student Societies. In addition the societies arranged a variety of other events to accompany the exhibitions.

15 exhibitions had been held by May 08, but with the support of the Royal Academy, the series was extended to allow each society to organise a second exhibition improving on what they had done before. Feedback and learning from the initial exhibitions allowed EWBUK to improve and refine the organisation of these events and a bespoke training course was commissioned in order to better to inspire and support to the 20 or so volunteers involved in organising them at the local level. At the time of writing none of the second round of exhibitions have been held but it is expected that all the remaining exhibitions will be completed by Jan 09.

In our opinion, the most significant finding was that whilst our members (mainly engineers) recognise that there can be a lot of value in better public engagement often they had trouble understanding how it would relate directly to them and therefore why it was necessary. Our most effective way of breaking down this barrier was by helping them to better relate their own aims and objectives to specifically targeted audiences with purposeful objectives in mind.

ROWAN BROWN, National Museums Scotland

National Museums Scotland: Building Bridges

The project had four main strands: the workshops which took place in the museum; the commission; the exhibition and the permanent exhibit in NMS. The bridge building workshops were a tremendous success. Each of the four conducted in Hawthorden Court in the Museum of Scotland drew in over one

hundred inter-disciplinary family groups and as the sessions were drop in, we were not always able to meet demand for them. Sessions lasted approximately four hours with students and staff offering advice and support on building approaches and distributing colour-coded guides. Evaluation highlighted audiences' enthusiasm for practical activities and despite varying degrees of interest and prior knowledge in the subject, everyone from aged three to seventy-three managed to build with K'Nex. The visitor feedback has been terrific with one parent writing "Do it every week, my daughter loved it" and another commenting "Have it every week, the kids are bored of colouring in." Remarkably 93% of the visitors who completed our survey stated that they would return to the museum for this type of event and 7% said that they would consider it. As a result, further K'Nex training has taken place for NMS staff and similar workshops are being programmed for the National War Museum.

The commission arrived on time and on budget. Digitally plotted from Telford's original drawings, it became the centrepiece for the exhibition and has prompted enquiries from other museum and archives services. The National Archives of Scotland has already commissioned a model of the Forth Rail Bridge from Gilberts.

Telford: Father of Modern Engineering ran from 2nd October till the 25th November 2007 at the Scottish National Portrait Gallery. The multi-disciplinary exhibition assessed Telford's exploits under the credentials of modern civil engineers as established by the Institute of Civil Engineers, of which Telford was the first president. It contained a mixture of portraits, engineering drawings, newly commissioned photography, models including Craigellachie Bridge, scientific instruments and geological samples and was attended by 7, 127 visitors. The positive feedback rating was in excess of 90%.

To complete the project, the Craigellachie model has now been installed in the Museum of Scotland accompanied by the first graphic panel dedicated solely to Thomas Telford. The exhibit works in tandem with an existing digital interactive focussiong on bridges and includes colour images of Craigellachie from the Royal Commission on the Ancient and Historical Monuments of Scotland's archive.

DR JONATHAN CORNEY, Heriot-Watt University

Imagineering Schools Roadshow

The Imagineering Schools Roadshow project has been an exciting pilot project that has managed to capture the enthusiasm of young engineering researchers and students to demonstrate both the link between science and engineering and the thrill of engineering experimentation.

The project provided professional training and support in science communication and creativity for engineering researchers to develop exciting engineering activities for schools outreach work. The researchers then trained a cohort of undergraduate students to deliver the activities at schools and youth groups.

The activities were aimed at pupils aged 10-14 in an effort to influence their subject choices in S2 to include science. A typical event took the form of an introductory session of "Guess who is an engineer", and then a round robin situation where the pupils were split into three groups and each group completed

three twenty minutes activities. One or two demonstrators would run each activity and the pupils would switch between the activities. This arrangement was highly successful for a number of reasons.

- The pupil to engineer ratio was kept at a level where the pupils could participate in experiments (and explosions!) with close supervision.
- The ratio also ensured a good relationship could develop between the engineers and the pupils.
- Inexperienced demonstrators could observe/support one colleague before leading the second (or third) activity with the class.
- The demonstrators were not overextended with having to do a complete full hour demonstration.

Because of the need to accommodate students with differing timetables schools visits were largely restricted to Wednesday afternoon. This was too restrictive for many secondary schools. Fortunately primary schools are more flexible. Another strategy to overcome scheduling difficulties was the targeting of youth groups (such as the Scouts and Woodcraft folk) which allowed evening events. In addition opportunities arose to deliver the activities to family audiences at two Science Festivals.

With time, the demonstrators became skilled enough to adapt the workshops to different age groups, but initially the difference between a 10 and 14 year olds significantly affected the success of the activities.

The project demonstrated that experiential learning is highly effective for developing communications skills, and showed that paying students is an effective means of involving those who might not have had the resources to volunteer. Payment also ensured a certain degree of professionalism, with committed team members.

DR ALISTAIR GUNN, University of Manchester

Illuminate at Jodrell Bank

The 'Illuminate' project consisted of four events in 2007. The first, called 'First Light', celebrated the Lovell Telescope as a striking sculptural engineering object situated within a landscape. Renowned artists Jem Finer and Ansuman Biswas, along with Jodrell Bank astronomers and engineers, used the Lovell Telescope itself as a live musical instrument and physical focus. Choreographed to track a number of celestial objects, as it turned and tilted it relayed a live stream of radio data while microphones attached to its structure amplified the sounds of its motion. Pre-recorded musical sources formed the basis of an hour long semi-improvised composition, responding and interweaving with the sounds of the Telescope. The event attracted the maximum number of audience members (600). During the second event, called 'Space 50', the huge dish of the Telescope acted as a giant video screen displaying images of early space exploration, manned space-flight, the scientific output, technology and future of radio astronomy and the construction of the Lovell telescope itself, with particular emphasis on the engineering aspects of these achievements. These spectacular moving images were combined with music and a specially-commissioned light and laser show. This event was performed on two evenings and attracted a total audience of 2400. The final two events, 'Diwali' and 'Christmas' consisted primarily of images projected onto the Lovell telescope

from a national art competition whose themes were engineering. The events were both successful, attracting audiences of over 100 and competition entries totalling 219. All four events in the 'Illuminate' project attracted significant media interest

DR JANE MAGILL, University of Glasgow

Chips with Flair

Images of semiconductor devices often fit the old saying small is beautiful. However, these images of microscopic devices, which are often used at scientific conferences, are rarely seen outside the R&D environment where they are generated.

This project has taken these images to a wide audience, especially a non-scientific one, not just to look at but to gain an insight into the underlying technology.

We have used a combination of media with the aim of engaging different audiences: static art work, video, music and hand-on activities. We were able to do this by linking several different projects to get a whole larger than the sum of the parts. The main focus of Chips with Flair was the development of the artwork but we decided quite early in the project to produce both static art and also an accompanying video. It was important for our artist (Louise Camrass) to have an opportunity to immerse herself in the technology so that the interpretation could be an artistic rather than a purely engineering one. To that end Louise spent several days in both undergraduate and research "Clean room" laboratories at Glasgow University. The first step was in the undergraduate labs where Louise joined other students to make and test a semiconductor device with the support of technicians and postgraduate students. On subsequent visits Louise selected both still and video locations that best interpreted the technology and, over several visits, built a large bank on image data. From this the final images were selected in discussion with the project team. The artwork uses a style of annotated images borrowed from Leonardo da Vinci's notebook to interpret semiconductor images in 9 large hanging panels. The panels are attractive and can be viewed in quite a superficial way but also studied in much more depth to draw out more detailed information about the images, and the underlying technology. The short video (about 9 minutes) provides a different dimension and shows Engineers going about their daily research routine while talking to camera about what they do in a very informal way. This is an insight rarely seen and seemed to both surprise and capture the imagination of many visitors. Composition of the music was funded from an associated project, Chips with Relish (EPSRC) and is used to accompany both the art show and the *Chips for Everyone* hands on activities. The Chips with Flair music was composed in a workshop format where the engineers and artist worked with musicians from Paragon Kaleidophone Ensemble to develop a suite of music reflecting the both the underlying principles and the fabrication of semiconductor devices.

We have delivered 5 events at 2 venues during 2008;

1. In the University of Glasgow Education Faculty, Art Gallery
    - Exhibition opening and 2 week show. The opening for invited guests from very diverse organisations (teachers and local education authorities, engineering and science companies and organisations,

local and national government, public engagement organisations) featured a live performance of the Chips with Flair suite and was supported by postgraduate explainers appropriately dressed in clean room suits!
- Launch of the STEM education centre by the University principal and Heather Reid from BBC Scotland.
- NSEW family event day with hands-on activities (Make a silicon chip badge; Silicon chips and mobile phones)

2. In the Hunterian Museum, Glasgow
   - Exhibition during the Glasgow Science Festival Summer Schools

Exhibition during the Glasgow Science Festival/West End Festival family days

DR CHRISTOPHER MEGONE, University of Leeds

Professional ethics training for professional engineers

There is widespread recognition of the importance of ethical awareness within the engineering profession. This is reflected by developments such as the publication of a Statement of Ethical Principles by the Royal Academy of Engineering and the Engineering Council UK in October 2005. Since this time there has been a growing demand for ethics to be taught explicitly within university engineering programmes both at undergraduate and postgraduate level and many Higher Education institutions have begun to integrate the teaching of ethics into their courses. Furthermore, the UK Spec of the Engineering Council UK, published in 2004, makes explicit reference to ethics related competencies which Engineers should be able to demonstrate in order to gain chartered status. The importance of ethical practice is therefore also shown by the codes of practice, or equivalent documentation, of the Engineering professional bodies. However, despite the rising profile of ethics within engineering, the interest and focus on engineering ethics to date has predominantly been on equipping students with the relevant skills, with little support or training in engineering ethics being available to engineers working in industry.

In response, the Inter-Disciplinary Ethics Applied Centre for Excellence in Teaching and Learning (IDEA CETL) identified the need to develop training provision for professional engineers to equip them with the skills to identify, analyse and respond effectively to ethical issues as they arise in the course of their work. In particular, to enable them to properly engage with and apply the Royal Academy of Engineering's Statement of Ethical Principles and the codes of conduct governing their own part of the profession. The project involved bringing engineers and ethicists together to design, market and deliver an introductory course in professional ethics for professional engineers.

KATRINA NILSSON, Science Museum

Engineering Senses

5 Senses was a series of five original public engagement events exploring the theme of 'engineering the senses' (*Sound, Sight, Touch, Smell* and *Taste*), that took place at the Science Museum's Dana Centre during autumn 2007.

Aimed at an audience with no specialist knowledge of engineering, *5 Senses* offered a unique chance for the public to interact with the latest engineering

innovations and the experts behind them. These experts were also consulted throughout the series development, and included a wide range of engineers, as well as scientists, artists and nutritionists. The Dana Centre's experienced team developed interactive event formats to facilitate open dialogue between the audience and participating experts about engineering's impact upon the human senses.

The series was accompanied by an acoustic installation, *'Ah…the sea'*, developed by a collaborative partnership of sound engineers and acclaimed artists Braunarts. Open to the public at the Dana Centre throughout the first week of *5 Senses*, this installation acted as a high profile, thought-provoking launch of the series. For full descriptions of the events and installation, including video montages and podcasts of the series, please visit: http://www.danacentre.org.uk/events/programmes/14.

5 Senses was widely promoted through a press preview of *'Ah… the sea'*, the targeting of relevant press and media contacts and dedicated marketing materials including a leaflet, e-flier and *Time Out* advert. We were keen to attract and accommodate people with visual impairments for the *Sound* and *Sight* events, and worked closely with the Royal National Institute of Blind People (RNIB) and The University of York to develop appropriate marketing tools and special event resources. We hope to build upon these relationships in future series and the tools and staff knowledge developed will remain indefinitely available for future Dana Centre series.

An online presence was also developed to extend the reach of the project, with webcasts and (for the first time ever at the Dana Centre) podcasts, featuring highlights of each event.

We were delighted with the outcomes of the project, which was independently evaluated. The series attracted 232 audience members, over half of whom had no science or engineering background, and involved c.40 engineers. The vast majority of participants expressed that they enjoyed the events, learnt new information, interacted with interesting and new technologies and appreciated being able to talk with the engineers and presenters. For their part, the engineers involved all stated that they found the events enjoyable and interesting and many considered their participation to be worthwhile, useful and relevant.

The evaluation also revealed learning points which we will be taking on board. These include the way we recruit and work with participating experts, and the importance of managing the role of each expert throughout the event to optimise opportunities for open dialogue.

We look forward to building upon the outcomes of the series evaluation in the development of future events and other engineering-related projects.

GEOFF PARSONS, By Design Group
Sport, Ethics and Engineering of the Olympic Games

The Sport, Ethics and Engineering (SEE) of the Olympic Games presentation provided a medium through which to communicate engineering's contribution to the Olympic Games and the Olympic athlete, whilst also highlighting some of the ethical challenges that it also poses.

The presentation (1 hour long) was developed by a group of engineers from the Loughborough Sports Technology Institute working with two Olympians and a small group of the By Design staff. Designed to be flexible in terms of delivery location, the presentation can be transported in a single vehicle and was delivered in a variety of venues ranging from school halls through to major theatres. The group worked together in trialing the presentation, modifying and refining it, and in sharing their combined knowledge and learning, in terms of presentation and communication skills.

The presentation, delivered in combination, by an engineer and an Olympian, who, in discussion, explore a range of engineering and sporting issues, has thus far been presented 15 times at 11 venues to an audience of 2530 people.

The presentation incorporates a range of engineering and sporting props and video clips, and creates a strong initial impact with a created music and video introductory sequence.

RICHARD POVALL, Mikron Theatre Company
Married to the job... Thomas Telford and Engineering
This project involved wroting, rehearsing and touring a play to non-theatre venues (village halls, museums, pubs and supporting workshops in Schools) to commemorate 250 years since the birth of Thomas Telford. The show addressed the issues surrounding the profession today and raised awareness of engineering to all our audience and participants. In recent years, Mikron's productions of All Steamed Up and Mrs Brunel reviewed the lives and achievements of Richard Trevithick and Isambard Kingdom Brunel, we have now concluded our trilogy of plays about the great engineers with an exploration through humour, music and a strong narrative of the life of Thomas Telford. Is there room for another of his kind, male or female, in the 21st century?

DAVID ROSS, Partners in Innovation/SETPOINT West Yorkshire
The Great Engineering Debate
The Solutions for the Planet – Great Engineering Debate programme brought together scientists/engineers/teachers/parents/school governors/ politicians and teams of young people on an inter-school competitive basis to explore, explain, develop and celebrate 'Solutions for the Planet' and to raise awareness of the significance of inventions, technologies, systems and products on our everyday lives, communities and wider economic systems.

The programme developed teacher training materials, and pupil teaching and learning resources and materials. It recruited, trained and supported 49 teachers, 40 parents, 152 scientist/engineers and 4 politicians as 'Engineering Champions' who in turn helped to support 265 pupils in a competitive, communication framework to develop and eventually present their 'Solutions for the Planet' in a multi media format. These Great Debates were hosted at 4

regional universities with a national event at the Palace of Westminster. Pupils presented to audiences of peers, teachers, parents, politicians, business, industry and academic experts, and were questioned and marked by a multi skilled panel of judges. Audience members also had an opportunity to quiz presenters.

Some aspects of the events were broadcast on local community radio, and attracted local and regional media interest in the form of newspaper and television coverage. The programme generated multi-media presentations, which are freely available to support teaching, learning and training

Metrics/Experiences/Impacts.

- The Great Engineering Debate engaged with 265 pupils / 49 teachers / 152 scientists / engineers / 4 politicians/ The 5 public events engaged with 385 people.
- Media coverage will influence a wider audience
- Generated 41 multi-media products.

NIGEL TOWNSEND, Y Touring

Engineering, Privacy and Surveillance: Theatre of Debate

Y Touring undertook to develop and commission a new play looking at the issues surrounding privacy and surveillance. To deliver this, Y Touring drew together a group of experts in the field of privacy and surveillance including: Professor Nigel Gilbert, Martyn Thomas, Colin Langham Fitt, Charlie Edwards, Ian Forbes and Gus Hosein. A workshop day was held, when presentations from all experts were given to young people, writers and other stakeholders. The issues were then discussed and explored.

Following the workshop day 4 writers submitted a synopsis for a new play exploring privacy and surveillance, and one writer (Laura FitzGerald) was commissioned to develop the synopsis to a full length audio drama. The group of experts formed an advisory group who assisted in the choice of which writer to commission.

The first and second draft of the play were also read and considered by the advisory group. They fed back their suggestions and revisions which were then taken into account for the next re-write. The play was then cast, and the actors spent 4 days rehearsing the play. 3 days were spent in the recording studio, and on Friday 25th April 2 rehearsed reading were given at Soho Theatre Studio.

Between May and the end of August the recording was edited, music was commissioned and added and a finished podcast was delivered. It was then considered and small revisions were made. Simultaneously education resources were researched and developed. At the beginning of September the website (www.theatreofdebate.com) was launched with the podcast and educational resources available for download. At the beginning of September the podcast was marketed to every secondary school in the country with targeted marketing going to schools with specialist engineering and science status. The podcast was also made available through the TES website.

The project outcomes included: an online podcast available for download as a resource, accompanying educational resources and online videos of the experts' presentations from the workshop day.

Through this project we have learnt what a good tool a podcast is to offer to schools across the country. It is flexible for them to use - it can be used by teachers or students, in or out of class, and it enables us to offer it as a free resource country wide. It is also a resource that, once created, can go on being accessible to schools.

INDIVIDUAL GRANTS

Gino Henry of RedR Cambridge and Stephen Jones of Engineers without Borders were awarded grants for communication training to help them deliver public engagement programmes.