Abstract
The Nuclear Island project established partnerships between Industry Stakeholders and Higher & Further Education providers, to develop an outline agreement on the critical future workforce needs identified in Next Generation: Skills for New Build Nuclear (2010).

Building on established good working practice identified in Engineering Graduates for Industry (2010), a partnership led by Cogent Sector Skills Council and Imperial College London, in association with Constructionarium Ltd, Engineering Construction Industry Training Board (ECITB) and Construction Skills, facilitated three employer and education provider events at The Royal Academy of Engineering which focussed on addressing the specific requirements to determine, develop and establish a simulated problem-based learning experience for undergraduate civil engineering students for nuclear new build based on the proven “Constructionarium” initiative.

Employer involvement was coordinated through Cogent, the Sector Skills Council for nuclear industries, in partnership with Constructionarium Ltd, the National Skills Academy Nuclear, the ECITB and Construction Skills.

The outcomes from these events provide a framework for the additional curricular material, industry behaviours and delivery methods necessary to meet the requirements of industry. Student numbers and costs of provision to all parties were also determined, with an emphasis on developing a sustainable and transferable activity.

The programme encouraged sector engagement in HE activities, and will help to deliver world-class employable graduates in strategic UK sectors from June 2011.

Keywords: Employer engagement, HE curriculum, nuclear industries, workforce upskilling
exposure of students, lecturers and employers to nuclear new build environments that currently do not exist in the UK (*Engineering Graduates for Industry (2010)*).

The Nuclear Island programme sought to deliver a sector based solution to the skills needs identified for nuclear new build in *Next Generation: Skills for New Build Nuclear (2010)*, whilst utilising an established best practice approach to Civil Engineering programmes across the HE sector in England and Wales (*Engineering Graduates for Industry (2010)*). Through the transfer of best practice to this new and upcoming sector, open discussion was facilitated between industry and academia, to determine solutions which can provide future graduates the skills and experience required for nuclear new build.

Bringing together Higher Education with FE colleges, stakeholders and employers aimed to reduce risk to all parties by coordinating a sector based activity, addressing learning, development, delivery and sustainability of this and future programmes.

**Rationale**

The Nuclear Island project was established to deliver primary research and engagement with employers and education providers to turn the Nuclear Island concept into a delivery mechanism. It also sought to embed good working practice across learning and employer engagement within HE and FE, and was supported directly by sector skills organisations and employers from the STEM sector. Additionally, ideal curriculum, learning outcomes, delivery methods and industry awareness needed to be determined to increase graduate expertise and skills through the exposure to nuclear new build environments that currently do not exist in the UK.

The programme aimed to address and embed curriculum based on international experiences of nuclear new build, identified in *Nuclear Lessons Learned (2011)*.

Sector based approaches to new areas of growth are of key priority to the UK Government, and collaborative approaches to sector based programme development enable an evidence-based approach to the collection and sharing of information, lessons learned from implementation and delivery of employer informed curriculum, and the rationale for wider delivery and dissemination through the HE sector. Sector based approaches also enable a national approach to pan-STEM curriculum delivery, and support the academic and employers through packages of learning.

Through Nuclear Island, employer’s attention was focussed on the skills needs of the future, and their input to the programme was essential in ensuring that the curriculum, nuclear behaviours, and ownership of the developments were secured. Employer fora were also used to discuss the strategic and financial issues relating to the delivery of the learning model, ensuring employer engagement and championing of the programme. The wider opportunities to engage with university and further education staff, their students, to improve the learning experience were also discussed.

The programme encourages coordinated UK wide employer engagement in HEI activity, aiding delivery of world-class employable graduates in strategic UK sectors. This also provides an opportunity to identify and support packages aimed at developing cross-STEM CPD for employers and lecturers to aid delivery, increase employer engagement, and provide information, advice and guidance for their participation in sector based projects.

Employers recognise that progression into Higher Education could be established through this programme, and request that universities work with Further Education colleges more widely, bringing undergraduates and postgraduates together with apprentices and employers, enabling careers information and guidance to be developed cohesively. In addition, employers existing outreach mechanisms can also be widened through this programme, linking schools, colleges and HE together to support a sector approach to engagement around careers information.

This programme aims to be industry recognised and championed, enhancing learning outcomes not only for university students, but with the lecturers and employers alike – all parties will benefit from this consortium approach. Through this programme, the skills needs for nuclear new build are to be tackled and delivery eased by attraction of people into the industry, where the industry recognises the skills developed through interaction with the programme.
Through active partnership with the professional bodies already engaged in the National HE STEM Programme, accreditation of this undergraduate programme will be considered. In addition, other professional bodies, including the Nuclear Institute, were also asked to engage in the programme.

The Approach

The first phase of the Nuclear Island programme was to bring together industry and education providers in order to coordinate and deliver solutions that would meet the graduate skills needs for nuclear new build.

Through active partnership between Imperial College London, Cogent Sector Skills Council and Constructionarium Ltd, a programme of activity to approach this research phase was coordinated in order to establish the learning outcomes, delivery method and approach for the nuclear and civil engineering sectors to aid the future development of an undergraduate package that could be used and transferred to other universities engaged in the existing Constructionarium site.

Members of the project team each had a specific role:

- Imperial College London were responsible for engagement of undergraduates and interaction with other interested universities primarily through Constructionarium Ltd and the Royal Academy of Engineering;
- Cogent was responsible for engagement of the nuclear sector, including widespread employer and university engagement, and dissemination of activity through various Industry Advisory Councils and Steering Committees, and National Skills Academy Nuclear;
- In addition, Cogent was responsible for the coordination and engagement of other relevant Sector Skills Councils, including Construction Skills and ECITB, and their employer representatives.

Initial project team meetings were coordinated to bring together the project team members to discuss the main priorities for the programme, and to coordinate activity at each of the planned events.

Through the project team, three events were scheduled and organised for October 2010, November 2010 and March 2011 at The Royal Academy of Engineering, London. All events followed a pattern of introduction to the National HE STEM Programme, and the role of The Royal Academy of Engineering, followed by speakers from industry and education to set the scene, and to facilitate subsequent workshops. Specific topics were agreed upon for discussion through facilitated break-out sessions, in order to establish feedback and evidence to take the project forward.

The events were operated as Open Fora allowing all stakeholders to discuss freely the development of the Constructionarium project in the nuclear new build sector. Event invitees included:

- Employers from the nuclear and civil engineering sectors (and their supply chain) in order to achieve a coordinated approach and input to specific nuclear new build issues.
- HEIs currently engaged in the Constructionarium project, in addition to those providers offering nuclear specific and civil engineering courses.
- A number of FE colleges to encourage and establish links to the programme.

The first two of these events were separated in terms of invitees: the first event was specifically for employers and the second for education providers. This approach was taken as it enabled clear messages to be delivered to each audience, facilitated workshops to deliver clarity of argument to maximum effect, and the priority issues discussed without prejudice. The third event acted as a joint meeting where clear arguments and concerns could be addressed and discussed openly. The topics discussed through facilitated workshops included:

- Detailed curriculum content and delivery modes
• Costs to establish and operate the Nuclear Island
• Student numbers
• Sustainability options
• Opportunities for FE engagement
• Development of CPD for academic and industry employees

<table>
<thead>
<tr>
<th>Events Attendance</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Employers</td>
<td>Education Providers</td>
<td>Stakeholders</td>
</tr>
<tr>
<td>Aker Solutions</td>
<td>Aston University</td>
<td>Cogent Sector Skills Council</td>
</tr>
<tr>
<td>AMEC</td>
<td>Bridgewater College</td>
<td>Construction Skills</td>
</tr>
<tr>
<td>Areva</td>
<td>Coleg Menai</td>
<td>Constructionarium</td>
</tr>
<tr>
<td>Atkins</td>
<td>Dalton Nuclear Institute</td>
<td>Department for Energy and Climate Change (DECC)</td>
</tr>
<tr>
<td>Babcock International Group</td>
<td>Glyndŵr University</td>
<td>Engineering Construction Industry Training Board (ECITB)</td>
</tr>
<tr>
<td>Balfour Beatty VINCI</td>
<td>Imperial College London</td>
<td>National Construction College</td>
</tr>
<tr>
<td>Buro Happold</td>
<td>Kingston University</td>
<td>National HE STEM Programme</td>
</tr>
<tr>
<td>Civil Engineering Contractors Association</td>
<td>Llandrillo College</td>
<td>National Skills Academy Nuclear (NSAN)</td>
</tr>
<tr>
<td>CONSTRUCT</td>
<td>Sussex Coast College</td>
<td>New Engineering Foundation (NEF)</td>
</tr>
<tr>
<td>Doosan Power Systems</td>
<td>University of Birmingham</td>
<td>The Royal Academy of Engineering</td>
</tr>
<tr>
<td>EDF Energy</td>
<td>University of Central Lancashire</td>
<td></td>
</tr>
<tr>
<td>Expedition Engineering</td>
<td>University of Greenwich</td>
<td></td>
</tr>
<tr>
<td>Hoile Associates Ltd</td>
<td>University of Manchester</td>
<td>Students</td>
</tr>
<tr>
<td>Horizon Nuclear Power</td>
<td>University of Plymouth</td>
<td></td>
</tr>
<tr>
<td>John Doyle</td>
<td>University of Sheffield</td>
<td></td>
</tr>
<tr>
<td>Learning World</td>
<td>University of Westminster</td>
<td></td>
</tr>
<tr>
<td>Liang O'Rourke</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mace</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Morgan Sindall</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nucleus Training</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rolls Royce</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Skanska UK</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Think Up</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Through the facilitated workshops, evidence was gathered and reports written by the project team to establish the critical issues for the development of the future nuclear new build programme.

All information regarding the project and the events was coordinated by Cogent SSC, who utilised a single web portal for free access to key project information, including event information, agenda, presentations and event reports.

In addition, Cogent SSC was responsible for the coordination of all publicity and invitations to the sector. The programme was well publicised through a dedicated Communications and Marketing Team, to the national and sector press, and to individuals known to the organisations involved in the project team. Through the networks established, a steady flow of information was maintained to
all interested parties through electronic media and press releases, ensuring continued engagement.

Assessment

Assessment and evaluation of the project were measured in terms of engagement of the project team with employers, stakeholders and other educational institutions. At each of the three events, informal feedback and support was requested to inform priorities and future direction. Feedback forms were used at the first two events to engage and monitor event organisation and additional feedback.

Measures of success included a count of Employers, Higher and Further Education Institutes, and other stakeholders engaging in the project and attending the events, commitment to the programme through continued engagement, and subsequent engagement in the follow-on programme.

Establishment of deliverables was also a marker for project assessment and evaluation, ensuring progression. These included clear presentation of development, delivery and operational costs for the programme, employer informed curriculum and learning outcomes, assessment of potential student numbers and options for sustainability, including CPD for academic and industry employees.

Throughout the project a number of reports were produced and disseminated detailing information relating to the above criteria for assessment. In addition, a dedicated website was used to maintain access to information.

Evaluation

Attraction and engagement of employers, Higher and Further Education Institutions were the critical success factors in this project. Through the careful organisation of events aimed at these target markets, considered delegate invitations and additional communications and marketing strategies, three events hosted at The Royal Academy of Engineering succeeded in attracting over 82 individual delegates to the programme. These delegates breakdown into a combination of 16 universities and further education colleges, 23 employers and 11 key stakeholders.

The number of delegates attending the events could have been increased if the project had not been restricted in terms of timescale and availability of dates at the location of events. However, this has not detracted from the additional engagement with employers and providers through other media, including email and website traffic, and through additional face to face meetings and teleconference calls with the project leads.

Wider engagement in the project directly with students was unexpected at this stage, but achieved. Two graduates from University of Westminster presented on their experience of the existing Constructionarium programme, with over 100 Imperial College second year undergraduate civil engineering students discussing the programme.

In terms of achieving project outcomes, the events facilitated successful interaction of education providers with industry and key stakeholders, enabling learning outcomes to be determined (see text box below), delivery methods to be challenged with solutions determined, costs of development and operation openly discussed and supported, engagement with the Further Education sector achieved, and the wider issues regarding the development of supporting materials for both industry and academic CPD.

The value proposition was well received by the civil engineering community. However, the potential to expand the existing Constructionarium concept beyond the civil engineering boundaries was challenged. Employers welcomed the programme, but wished for expansion of the curriculum into other areas of STEM, particularly mechanical and electrical engineering, and sought to engage discussions around key skills topics, including that of high integrity welding. Although this was welcomed by the academic community, a realisation of what employers could expect from a civil
engineering package was noted. Through these discussions, it was agreed that some issues were beyond the scope of the existing funded programme of activity, and that there needed to be a mechanism to take forward suggestions with employers and education providers in order to aid delivery of a cross-STEM model, addressing the community as a whole.

The project has achieved the following outcomes, and will progress to the next phase of curriculum development and delivery through follow-on funding aimed at a national cross-STEM programme. This will share responsibility, risk and facilities, and establish industry champions who will take on an active role to encourage wider industry engagement and enhance student experience, inform curriculum development for learners, academics and other employers in a time where there is less reliance on public funding.
Nuclear Island: Learning Outcomes

The existing Constructionarium initiative includes a range of objectives for Civil Engineering undergraduates. These include:

- ‘Hands-on’ experience of scale civil engineering projects;
- General construction site experience;
- General health and safety awareness;
- Project Management awareness;
- Personnel management practice;
- Communication skills practice;
- Identification with engineering.

A Nuclear Island Constructionarium project aims to increase experience of civil engineering related to the nuclear industry. It is perceived that such a project should not be limited to civil engineering undergraduates but could become available throughout the skills pyramid of school and further education students, right through to post graduate students and possibly, for improving the skills of employees. Nuclear construction projects are subject to rigorous safety justification to provide assurance of long term safety of the facility, workforce and general public.

Whilst the above objectives are valid, the Nuclear Island Constructionarium must also be focussed on the acquisition of nuclear safety culture to ensure that the deficiencies identified in The Royal Academy of Engineering report ‘Nuclear Lessons Learned’ are not repeated. Provision of the necessary level of skilled personnel to enable the nuclear new build programme is also a consideration.

The particular Learning Outcomes for the Nuclear Island Constructionarium must include:

- Awareness of nuclear safety culture and nuclear safety practices;
- Awareness of the need for rigorous Quality Assurance processes and quality control measures;
- Awareness of nuclear industry career opportunities.

To enable these objectives to be met, the existing Constructionarium project brief should be amended to include the roles of:

- Quality Assurance Officer (QAO) – This should be a student member acting as the Contractor QA Officer to provide assurance with the project brief requirements;
- Site Operators Compliance Officer – A Staff Member acting as the Operators oversight of Nuclear Safety and QA requirements and compliance with Nuclear Site Licence Conditions. The Student’s QAO will report any deficiencies to the Compliance Officer who will provide feedback of the impact of the deficiency on the safety justification and any necessary rectification work or immediate or future inspection regimes.

Her Majesty’s Nuclear Inspector – A staff member acting as the Site Nuclear Inspector, conducting irregular inspections of the on-site activity and checking for general and nuclear health and safety issues.

Through the engagement of the Cogent SSC Industry and Communications and Marketing teams, with that of Constructionarium and The Royal Academy of Engineering, key stakeholders were successfully engaged and information flow maintained to secure progression of the project. This strategy was supported by the development of a dedicated web portal, regularly updated, to ensure access to information and event details. The availability of these teams enabled successful dissemination of activity to a wider range of interested organisations through press releases, publications and direct contact with industry and professional groups and steering committees. A
key success factor was discussion with Government agencies including the Department for Business, Innovation and Skills and the Department of Energy and Climate Change, where ministerial support has been expressed for the programme.

All expected outcomes for the programme have been met, with additional benefits gained from the engagement with students and Government bodies. The programme has also established clarity for the follow on curriculum development and delivery through a national pilot phase programme funded by the National HE STEM Programme and employers.

Discussion and Summary

The Nuclear Island project has established a network of Higher and Further Education providers, employers and stakeholders committed to the development, establishment and delivery of the Nuclear Island concept. During this initial research phase, the following outcomes have been achieved:

1. A broad consensus of the knowledge, skills and competencies for civil engineering practices in nuclear new build (stated as Learning Outcomes above);
2. An agreed overview of potential mechanisms for delivery based on the existing Constructionarium concept;
3. An overview of a paradigm to include the disciplines of nuclear physics, mechanical, electrical, and chemical engineering, supported by the required underpinning engineering and financial mathematics;
4. A core group of employers, university and further education colleges committed to the follow on funding programme to help develop and pilot a civil engineering programme from June 2011-June 2012;
5. Commitment from other employers and education providers has been secured in order to develop a wider STEM programme based on the Nuclear Island pilot programme.

Full details of these event outcomes can be found through the Nuclear Island website.

The project partnership has facilitated a sectorial approach to communication, interaction and delivery, more specifically:

- National and regional HE partners have been attracted to the programme, bringing their subject specialities and expertise to the fore to help produce a curriculum that can be delivered to students and lecturers across their STEM footprint, maximised local employer engagement, worked alongside Further Education Partners;
- Professional bodies, led by The Royal Academy of Engineering, have advised and embedded good working practice around curricula development and delivery;
- Employer engagement team, comprising Cogent, Constructionarium, Construction Skills and ECITB, has brought together national employer partnerships to aid design and delivery of Nuclear Island and the support packages for its future use;
- Other stakeholders, including the National Skills Academy Nuclear, the National Construction College, Trade Organisations and other professional bodies, will be utilised to inform and maximise engagement of employers with providers, and establish professional recognition of the scheme in the future.

Additional benefits have originated from the close working relationship and direct engagement of the project team members to increase facilitation and discussion with Government, industry and students.

This programme has begun to address the immediate to long-term skills requirements of UK nuclear new build, develop curriculum based on international experiences of nuclear new build, and embedded the principles of employer engagement in HE curricula development identified through Engineering Graduates for Industry (2010).
External factors, including the events at Fukushima Nuclear Power Plant (subsequent to the earthquake and tsunami hitting Japan in March 2011) also affected the impact of the programme. Specifically:

- Interest in the future of UK nuclear new build was raised: students were engaged and began discussing the technical and societal effects of nuclear power operations in lectures at Imperial College London, providing a real life element to the safety and build specifications required;
- The events at Fukushima initiated the Government to commission the Weightman Report to determine the future of new nuclear build in the UK. This has postponed employer financial commitment to the programme until the report is published and Government agreement to continue with the proposed 16GWe nuclear new build programme.
- Engagement with the aspects of safety and build compliance have been highlighted as critical factors for nuclear new build: roles and responsibilities are currently under review, and future programme developments will incorporate recommendations once the Weightman Report is released.
- The events also raised awareness of this particular programme to senior Government Ministers, including the Minister for Higher Education, David Willetts.

**Further Development**

Based on the findings of the Nuclear Island project, further development of the pilot phase programme is currently being established. In this follow-on project funded by the National HE STEM Programme and employers, the "Building the Nuclear Island" team will develop a "Plug and Play Programme" that will be led through a consortium comprising Imperial College London, Constructionarium and Cogent Sector Skills Council, involving expertise from industry, professional bodies and Higher and Further Education Institutes across England and Wales.

This follow-on programme will pilot a nationally available curriculum package based on a nuclear core reactor design enhanced by employer input (both in-kind and financial) to ensure that students and education providers across England and Wales are supported in their learning. This pilot will also provide a route to developing a support package for academic staff, and clarify best practice delivery mechanisms for the sector.

Based on the findings of Nuclear Island project, the follow-on programme will determine the:

- Content (knowledge and competencies);
- Learning outcomes and delivery of employer informed scenario based learning;
- Assessment methodologies;
- Best practice development and delivery of employer led curricula;
- Best practice administrative mechanisms required for employer and HE engagement in the delivery of education and training;
- Flexible engagement of all partners, including mitigation of risk to those partners.

In addition, through a package aimed at bringing education providers together with this critical employment sector, clarity of message, financial support, further design and curriculum requirements can be discussed, ensuring sustainability is achieved. In return, the student experience will be enhanced through exposure and engagement with employers; graduates will be offered an experience to improve their practical and employability skills, and increase their awareness of the industry and the careers within it.

This programme will address the immediate to long-term skills requirements of UK nuclear new build develop curriculum based on international experiences of nuclear new build (identified in Nuclear Lessons Learned, 2011), and embed the principles of employer engagement in HE curricula development identified through Engineering Graduates for Industry, 2010.
References

Further Reading

- Nuclear Island Website: [www.cogent-ssc.com/Higher_level_skills/ni_index.php](http://www.cogent-ssc.com/Higher_level_skills/ni_index.php)
- Employer Event Summary: [www.cogent-ssc.com/Higher_level_skills/Publications/Employer_Workshop_Summaries.pdf](http://www.cogent-ssc.com/Higher_level_skills/Publications/Employer_Workshop_Summaries.pdf)
- Education Event Summary: [www.cogent-ssc.com/Higher_level_skills/Publications/HEFE_Workshop_Summary.pdf](http://www.cogent-ssc.com/Higher_level_skills/Publications/HEFE_Workshop_Summary.pdf)
- Joint Event Summary: [www.cogent-ssc.com/Higher_level_skills/Publications/March_Event_Minutes.pdf](http://www.cogent-ssc.com/Higher_level_skills/Publications/March_Event_Minutes.pdf)

This work is licensed under a Creative Commons Attribution-NoDerivs 3.0 Unported License

Publication Date: 04/01/2012