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# **eUptake Deliverable D2.1.2**

## **Training Sustainability Report**

### **Review of e-Infrastructure Training and Education in the UK**

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## 1. Purpose of Document

The objective of this report is to summarise the UK's provision of training and education related to e-Infrastructure; Deliverable D2.1.3 presents gaps in provision based on information gathered here. The report is written for the JISC Project, Enabling Uptake of e-Infrastructure Services, but it will also to be made publicly accessible. This is a final draft summarising what is known about training provision.

The sustainability report was begun in August 2007; a survey of providers was initiated and information gathered by this means has contributed to the report – the survey form can be accessed at <http://homepages.nesc.ac.uk/~mjm/eUptake/JISCeUptakeSurvey.doc> and had been included in this report as Appendix 1.

## 2. Introduction

The nature of research and collaboration has changed over the past twenty years, so that now new research methods and technologies generate vast data sets that need to be shared. e-Infrastructure enables this kind of research because it assists in simulation, analysis, better management and sharing of large data sets across disciplinary, organisational and geographical boundaries. The objective of the e-Uptake project is to encourage the adoption and use of e-Infrastructure services, including those provided by JISC, because they facilitate the work of researchers. This report contributes to that objective by collating information about the provision of training and education, firstly so that it can be advertised to potential participants, and secondly in order to recognise gaps in provision (detailed in Deliverable D2.1.3).

In this report providers are categorised as follows:

- By goal
  - Training – creating skilled users of the technology
  - Education – teaching in academic courses
- Service providers – enabling use of the services they provide
- Component providers – who create components that services might deploy (for example, selected OMII-UK components are being deployed by the NGS), or that user communities might deploy.
- By community – providers with specific disciplinary scope
- By geographical scope – for example NWGrid courses are unsurprisingly delivered in the North-West.

This categorisation is described in the section below. Following sections highlight aspects of training and education in e-Infrastructure that are distinctive. The final sections tabulate the known providers and the report concludes with discussion of sustainability in relation to training and education provision. As previously noted, the 2007 Survey for Providers is included in Appendix 1, and is followed by a glossary defining relevant terms in Appendix 2.

### 2.1 Providers

The set of classifications we provide here is not orthogonal – for example, training teams are active within several of the services and component creators below.

However, the classifications do help to give structure to the pattern of provision. The providers listed are those who are active in training and education – this is not a full set of those who run services, or create software of use to others. Providers identified here include training teams, academic institutions, national e-Infrastructure services, component creators and research communities.

### **2.1.1 Training teams**

A common model for training in e-Infrastructure, for example, in the grid training offered by the TOE-NeSC team, is as follows:

- Outreach establishes interest in a research community
- Introductory training enables exploration of e-Infrastructure components to begin pilot use of services.
- Individual consultancy can also be required in addition to training.
- The community is then increasingly self-sufficient in training, building its own competencies in e-Science, with support from training teams.

This model is significant in setting objectives for training; the goal is not to build communities dependent on training teams, but to support growing independence and appropriate uptake as user communities grow in size and number.

### **2.1.2 Academic institutions/universities**

A growing number of universities are including grid computing in their academic teaching. The challenges of accomplishing this were one driver of the EU FP6 ICEAGE Project (International Collaboration to Extend and Advance Grid Education).<sup>1</sup> With support from ICEAGE, the e-IRG Education and Training Task Force (ETTF) has collected information on the state of grid and e-Science education in the EU, providing these details in the ETTF Report which serves as a good reference for educators and trainers on existing undergraduate and postgraduate courses.<sup>2</sup> The Open Grid Forum Education and Training Community Group (ET-CG) has also conducted work in this area and resulting documents present an international perspective, which includes the UK experience.<sup>3</sup> ICEAGE also organised a Curricula Development Workshop, held in Brussels in February 2008, to work towards developing curricula for both undergraduate and Masters e-Science-related courses<sup>4</sup>, as curricula development has been highlighted as presently deficient by both OGF and e-IRG reports. Sections to follow on academic teaching will draw from these various reports to provide a comprehensive picture of e-Infrastructure education in the UK.

A number of university campuses in the UK provide infrastructure for e-Science via campus grids and some have training programmes in place to assist users. These will also be detailed in a subsequent section of this report.

### **2.1.3 e-Infrastructure services**

National e-Infrastructure services include JANET, the National Grid Service, Access Grid Support Centre and the JISC Data Centres. These seek to provide sustainable resources upon which researchers can rely, and which include operational and training effort.

Grids also exist at regional scales: there is local training provision for some of these, e.g., White Rose Grid and NWGrid.

#### **2.1.4 Component creators**

This category of providers includes those releasing middleware, VLEs, VREs or toolkits of various types. In the UK context, OMII-UK is a prominent component creator.

Often training in such components is given by others or by user communities themselves. Globus Toolkit is taught by the NGS team because the NGS has deployed it – or by user communities themselves. High-level tools such as Ganga are taught by GridPP within its courses for particle physicists.

#### **2.1.5 Research communities**

The UK e-Science Programme, with additional JISC funding, involves all UK Research Councils in e-Science and has established e-Science centres dedicated to different domains served by the councils, including e-social science, arts and humanities and environmental science; most are engaged in training initiatives.

Specific research communities are also routinely engaged in training. The particle physicists routinely train in the software built upon the gLite middleware and EGEE infrastructure; that software supports processing related to the Large Hadron Collider experiments in CERN.

Networks and initiatives in bioinformatics are also becoming increasingly active in training their communities.

### **3. Challenges Specific to e-Infrastructure Training and Education**

Two aspects of distributed computing education and training that differ from basic IT teaching are scale and collaboration. These are both central to distributed systems. Scale and collaboration in teaching environments are well-known issues when moving from prototypes to production, but some central aspects of the effects of both become readily apparent only in real-life situations. For example, in terms of scale, the implications of providing global operational support for a 24/7 service might not be apparent at local scales. Similarly, few students can easily grasp the implications of cross-organizational collaboration without being made specifically aware of them. These specific issues are combined with the rapidly evolving technological landscape in this field. However, many educators in computing and related fields of engineering clearly share this issue.

A further combined effect of scale and collaboration that might not be readily apparent is that few departments—or even universities—contain the complete gamut of expertise required to support the emerging production infrastructures. Additionally, many teaching environments aren't sufficiently supportive of the inherent interdisciplinary nature of teaching e-Science (the research activities across disciplines that use the underlying e-Infrastructures). Therefore, the teaching environment must support not only collaborative efforts in creating and running such infrastructures but also collaborative approaches to teaching.

So we can identify several key challenges specific to e-Infrastructure education and training:

- **For service providers:**
  - to maintain stability of service for researchers, while also benefiting from production-quality new components.
- **For trainers/educators:**
  - to maintain current diverse training material, with an infrastructure that permits training on pre-release as well as production services
  - to be channels for the communication of best practice between user communities meeting similar patterns of requirements
- **For researchers:**
  - to find orientation in this fast changing landscape.  
to address their need to acquire e-Infrastructure knowledge in order to gain the benefits of its use.

The investment in creating training material is justified where there is a sufficient level of stability; a component is clearly of persistent value, for example. That investment is often collaborative effort between the sources of the technology or service and the training teams.

### **3.1 What are the specific requirements**

Several straightforward and obvious requirements for greater uptake of e-Science in the UK through training will be introduced here. These include support for educators, t-Infrastructure, material repositories and courses with e-learning options.

#### **3.1.1 Support for educators**

Training and education in e-Science will fail without proper support from adequately skilled educators. The e-Infrastructure Reflection Group (e-IRG) Education and Training Task Force (ETTF) identified a current lack of trained individuals able to teach e-Science skills:

“There is currently a skills and knowledge shortage in the e-Infrastructure industry (including grid computing) which has led to *a definite crisis* resulting in distributed system failures. We need more individuals educated in e-Infrastructure technology in order to address the crisis. We also need an increase in the skilled workforce to fully exploit the opportunities brought by e-Infrastructure and e-Science.”<sup>5</sup>

So, in order to address system failures *and* increase uptake of e-Science across communities, well-trained educators must be in place to pass on their knowledge of e-Infrastructure. These educators then need continued support so that they can update their knowledge and be able to teach adequately. Such support can come in the form of refresher training courses, t-Infrastructure facilities and education and training materials repositories.

#### **3.1.2 t-Infrastructure**

Educators rely on training infrastructure, or t-Infrastructure, when they teach

e-Science. t-Infrastructure enables education and training because it provides services which allow easy access to training material and supports the hands-on practice of skills acquired. This infrastructure is crucial to the functioning of e-Science courses. The Open Grid Forum (OGF) Education and Training Community Group (ET-CG) catalogued experiences with t-Infrastructure systems across several training projects, including the Grid INFN Laboratory of Dissemination Activities (GILDA)<sup>6</sup>, and produced a list of recommendations for t-Infrastructure to facilitate education and training<sup>7</sup>:

- **Convenient provision of authentication and authorisation**
  - automatic provision via web interface to users
  - batch provision to educators for courses and training events
  - provision of certificates via prerequisite self-paced exercises (cf. summer schools)
  
- **Provision of directly accessible training material**
  - trainer maintained wiki pages on GILDA
  - trainer materials strictly related to and tested on the t-Infrastructure (limiting the problem of adapting a generic procedure to a specific context)
  - ICEAGE and EGEE digital libraries
  
- **Use of virtual machines**
  - support systems administration training
  - provision of reconfigured middleware as a downloadable, installable context for users to experience
  
- **Use of web portals to ameliorate interface complexity**
  - GENIUS and P-GRADE examples can provide guides to best practice
  - providing access at any time to training platforms such as GILDA

### **3.1.3 Material repositories**

Material repositories provide another vital support for education and training. Barriers of entry for e-Science educators are lowered if teachers have access to repositories because they can share educational content, rather than creating their own, thus increasing the number of quality resources available to them so that they may teach effectively. Repositories, such as those created for EGEE and ICEAGE and by ReDReSS, can also offer students access to a wide range of relevant study material. They serve as successful examples showing the importance of repositories to education and training in e-Infrastructures.

### **EGEE and ICEAGE digital libraries**

The EGEE and ICEAGE Digital Libraries house a wide-range of educational materials for e-Science, particularly relating to distributed computing, and can be accessed by external organisations.<sup>8</sup> Educators can take advantage of the digital libraries in order to identify sources to reference for their courses. These libraries also provide learning materials that students can access at any time for self-paced flexible

study. The materials occur in various media, for example as texts, video and sound recordings, and include articles, assessments, books, courses, exercises, events, images, modules, presentations, podcasts, theses and tutorials. Users can add and edit content in the digital libraries. The libraries use the Dublin Core Schema, so that searches can be made using bibliographic data ; searching is made easy via metadata and full-text options. The EGEE Digital Library designers are in the process of creating training courses online by sequencing content into particular learning flows, but at the moment students can refer to the International Winter School on Grid Computing (IWSGC) 2008 materials and other courses available in both digital libraries. The IWSGC'08 will be discussed in more detail in the following section.

## **ReDRess**

Resource Discovery for Researchers in e-Social Science has created the Learning Space Catalogue, a repository of education and training material.<sup>9</sup> Similar to the EGEE and ICEAGE libraries, these materials are available in various formats, but are specifically relevant for and geared towards social scientists. Categories for training and educational material housed in the repository include:

- Introductory material and support
- Motivation and background
- Examples of e-Science projects
- UK e-Science programme
- Agenda setting
- Collaboration
- Social shaping
- Data management
- Semantics, knowledge and information management
- Databases
- Visualisation
- Software development
- Portals and related technology
- HPC
- Security and confidentiality
- Grid and web services
- Network technology
- Social science with the grid

### **3.1.4 eLearning**

eLearning is yet another enabler for e-Science education and training. It democratises learning, opening up opportunities to students who may not be able to afford travel to a particular university or summer school to study or the fees for fulltime on-site courses. The option of a flexible course that can fit around an existing schedule will also attract prospective students who already work fulltime, so time and cost are factors in decisions to choose eLearning. The ICEAGE Winter School on Grid Computing (IWSGC), held in February 2008, proved the importance of eLearning to e-Science.<sup>10</sup> The Winter School followed on from the successful Summer School (ISSGC) series, but its online format gave a wider range of students the opportunity to experience the unique features of the summer school without the costs of travel, accommodation and the attendance time involved. To fulfil educational requirements

for the Winter School, organisers re-purposed summer school materials and included resources such as the ICEAGE Digital Library and summer school tested t-Infrastructure such as GILDA. The goals of IWSGC'08 were to provide participants with the necessary theoretical background for practical use of the grid, enable participants to use Condor, Globus, gLite and OGSA-DAI, direct participants towards available GRID services and encourage collaboration among participants. The Winter School achieved these goals and successfully attracted students who found time and financial costs associated with the summer school prohibitive. Organisers of IWSGC'08 plan to continue with yearly winter schools in future.

### **3.2 Audiences for training**

It is worth noting that each training team is a consumer as well as a provider of training – the effect is to bootstrap competence, so that those who create a technology deliver some training to trainers, enabling sustainability of training a large number of people. As noted above, user communities become self-sustaining; those running services have a skilled workforce and those creating components are alert to the broader context, and to diverse relevant technologies and standards.

## **4. Training and Education Providers**

The following sections detail training offered by the providers identified previously, which include training teams, academic institutions and campus grids, national e-Infrastructure services, regional grid initiatives, component creators and research communities.

### **4.1 Training teams**

The NeSC Edinburgh e-Science Training Team (TOE), established in 2004, creates and delivers training courses to encourage development, uptake and proficient use of e-Science technologies and infrastructure across industry and public service as well as in many fields of research.<sup>11</sup> It leads training activities for EGEE and the NGS and organises training events throughout the UK. The following UK training events have been held in 2008:

- e-Science and the Grid for Bio/Health Informaticians, Manchester, 14-18 January
- Grid Tutorial for Physicists, London, 28 January
- International Winter School on Grid Computing (online), 6 February- 12 March
- Standards for Interoperable Grids: Experience from NextGRID and OMII-Europe, Edinburgh, 17 March
- 2<sup>nd</sup> UK Computational Steering School, Manchester, 18-19 March
- Using OGSA-DAI to Grid enable data for the Arts, Humanities and Social Sciences, Part 1, Edinburgh 18-20 March
- Using OGSA-DAI to Grid enable data for the Arts, Humanities and Social Sciences, Part 2 web-based, 25 March-20 April
- Using OGSA-DAI to Grid enable data for the Arts, Humanities and Social Sciences, Part 3 consultancy, Edinburgh 23-25 April
- SimDAT: Grid-based workflow technology, London, 12 May

## 4.2 *Academic institutions*

Various academic institutions offer MSc courses in e-Science, Distributed Computing or Computing Science (with grid and e-Science elements)<sup>12</sup>:

- Aston University, Birmingham – MSc in Distributed and Networked Computing
- Brunel University, West London – MSc in Distributed Computing Systems Engineering
- Cranfield University – MSc in Grid Computing and e-Engineering
- De Montfort University (Leicester) – MA/MSc in Creative Technologies and MSc in Distributed Systems Integration
- Imperial College, London – MSc in Computing Science
- University of Aberdeen – MSc/PgDip in e-Commerce Technology
- University of Edinburgh – MSc in e-Science
- University of Greenwich – MSc in Distributed Computing Systems
- University of Manchester – MSc in Advanced Computing Science
- University of Liverpool – e-Science courses in programming (online) including Fortran 90 and High Performance Fortran
- University of Westminster – MSc in Cluster and Grid Computing

## 4.3 *Campus grids*

Examples of campus initiatives that have provided training include<sup>13</sup>:

- Cambridge
- Cardiff University
- Oxford
- Plymouth
- University of Reading (David Spence)

Other UK universities with campus grids (but no training) include<sup>14</sup>:

- Birmingham University (Midlands e-Science Centre)
- University College London

Smaller computing clusters exist at the following universities that may soon develop into campus grids:

- King's College London
- University of Bristol
- University of Edinburgh, ECDF (Edinburgh Compute and Data Facility)<sup>15</sup> – short introductory training courses are offered by ECDF in Sun Grid Engine and MPI (Message-Passing Programming using MPI). The webpage also provides links to NeSC training events.

The small clusters allow researchers access to increased compute power and storage capabilities to speed their research.

Although there are workshops for the campus grid providers, there is not yet any structured sharing of training material across these grids, for example, related to the use of Condor.

## **4.4 e-Infrastructure services – national infrastructures and training**

### **4.4.1 JANET**

Janet uses the global internet to connect UK education and research organisations to each other, to their European peers through the Geánt network and to the wider internet in order to meet their research needs via a ubiquitous networking infrastructure.<sup>16</sup> Janet facilitates activities such as video streaming and linking large data storage and HPC services. Janet offers a range of training courses for users:

- Introductory courses: Introduction to JANET, Introduction to DNS
- Technical courses: Basic networking, Basic router configuration, IP fundamentals
- JANET services courses: Introduction to the UK federation, Implementing Shibboleth at your organization
- Wireless courses: Wireless LAN fundamentals
- Videoconferencing courses: Introduction to videoconferencing, Technical support of videoconferencing.
- Security courses: Managing IT security, Using logfiles for security, Information security policies, Firewalls, planning and implementation
- Courses under development: Introduction to virtualization, Multicast fundamentals, IPv6 fundamentals, Basic wireless LAN analysis

### **4.4.2 NGS**

The National Grid Service provides UK researchers with a means to access computational and data based resources for research purposes, regardless of location. It uses an integrating, common grid infrastructure. This allows researchers to “collect, process, preserve and publish digital information, navigate through available and quality resources and link into international efforts.”<sup>17</sup> Services available through the NGS include an applications repository, applications hosting environment (UCL), P-GRADE and GEMICA (University of Westminster, which also runs a grid consultancy service for new projects).

NGS partners in training in specific services – these services are significant in that they build upon the basic middleware deployed by the NGS, and facilitate the use of the NGS by diverse communities. Courses offered by NGS fall into five categories: induction courses, application developer courses, grid data services, training the trainer courses and technology update courses. Within NGS 2, 29 events were held in 9 locations, attended by 305 participants and consisting of 1,754 participant days. The NGS plans to launch a UK summer school in 2009. A full list of training events can be found on the NGS training webpage at <http://www.nesc.ac.uk/training/events/index.cfm>.

### **4.4.3 Data centres**

- EDINA  
EDINA is a national academic data centre located at University of Edinburgh. Its goal is to “enhance the productivity of research, learning and teaching across universities, research institutes and colleges in the UK by providing

online services, support and by carrying out R&D projects.’’<sup>18</sup> EDINA offers a range of services and training material for each service:

- **Agcensus:** quick reference guide, getting started guide, service help, training guide, service demonstration
- **CAB Abstracts:** quick reference guide, getting started guide, service demonstration, Z39.50 target information
- **The Depot:** no training material, as the process for depositing seems quite straightforward
- **Digimap:** quick reference guides for carto, digimap, geology digimap, historic digimap and marine digimap, service demonstration, as well as courses (not listed on website) and training materials for digimap site representatives (ordnance survey collection training material, geology digimap training materials, historic digimap training materials)
- **Education Image Gallery:** quick reference and getting started guides, EIG training guide, introduction to EIG, service demonstration
- **Film and Sound Online:** quick reference guide, getting started guide, FSO training guide, introduction, service demonstration, and training through the British Universities Film and Video Council (BUFVC) – (upcoming)
  - Encoding digital video for streaming and network delivery, introductory and advanced levels
  - Moving image and sound for learning and teaching sources, search strategies, appraisal and use
  - Shooting with high-definition video
  - Copyright clearance for print, broadcast and multimedia production
- **Index to *The Times* 1790-1980:** quick reference guide and getting started guide
- **Inspec:** user notes and quick reference cards
- **Jorum:**
  - For the Jorum User –
    - User guides: A quick step reference, a step by step guide
    - Demonstration videos: finding resources in Jorum, contributing resources, introduction to the Jorum workflow
    - Site representatives’ resources: overview presentation, introduction factsheet, user training guide, Jorum functionality overview, Jorum leaflet
  - For the Jorum Contributor –
    - Contributing for beginners guidelines
    - User guides: contributing resources, contributing-quick reference guide, contributing-step by step guide, system guide for cataloguers, cataloguers handbook, application profile
    - Demonstration videos: creating and contributing a content package to Jorum, contributing resources to Jorum, finding resources in Jorum
- **Land, Life and Leisure (index):** quick reference guide, newsletter with navigation guide, training guide, leaflet, screencam service demonstration
- **SALSER:** getting started guide

- **Statistical Accounts of Scotland:** quick reference guide
- **SUNCAT:** quick reference guide, getting started guide, end user guide, service demonstration
- **UKBORDERS:** quick reference guide, service demonstration
- **MIMAS**  
Mimas is a national data centre for the UK higher and further education and research communities, providing access to key data and information resources for teaching, learning and research across disciplines.<sup>19</sup>

Training Material (listed on webpage) includes:

- Current courses: Introduction to Mimas bibliographic services (including Archives HUB, Copac, ISI, Zetoc), Crossfire, Introduction to the ESDS international databanks, New interface training (ISI web of knowledge service for UK education), Combining census aggregate statistics with digital boundary data for mapping and spatial analysis
- Separate training material provided on: Archives HUB, Copac, ISI web of knowledge service, Zetoc (and Landmap, satellite data?)
- **AHDS**  
The Arts and Humanities Data Service is a national data service which collects, preserves and promotes the electronic resources which result from research and teaching in arts and humanities.<sup>20</sup> It provides training materials for creating resources or for depositing:
  - Creating resources: guides to good practice in archaeology, history, performing arts, literature, language and linguistics and the visual arts (creating digital resources, etc)
  - Depositing: step-by-step instructions (on website)
  - Digitisation workshops

AHDS produces ICT guides for the arts and humanities which offer training through methods and tools indexes and case studies. These materials have been collected from online community chats (etc), quick guides and courses.

#### 4.4.4 DCC

The Digital Curation Centre supports UK institutions in storing, managing and preserving digital data.<sup>21</sup> The centre assists in the management and appraisal of data.

It has held several training events:

- Phase 1 (JD): awareness raising events (March 2004-February 2007)
- Phase 2 (JD): tutorials on self-auditing digital repositories using DRAMBROA, practical tutorials on other DCC tools such as the life-cycle model, DCC Diffuse and Representation Information Registry, DCC Summer School, JISC Workshop in London (June 2008) to identify and map range of tools and resources (including training).

- Workshops and Tutorials (webpage): DCC Digital Curation Workshop 101 (October 2008, Edinburgh)
- Information Days: one half days to inform HE/FE institutions and e-Science community about latest digital curation issues, etc.
- Conferences: 4<sup>th</sup> International Digital Curation Conference (December 2008, Edinburgh)

#### 4.4.5 AGSC

The Access Grid Support Centre is a service to support collaboration using videoconferencing and remote visualisation.<sup>22</sup> AGSC uses audio and video tools so that people in different places around the world can set up virtual meetings (of any size). The service includes:

- Training to support use of Access Grid includes the following tutorials: ports for firewalls information, introductory movies (Introduction to the Access Grid and AGSC), guide to secure meetings using InSORS software. Along with the Access Grid Toolkit, user guides are also provided:
  - Quick Start Guide – AGtk3.0.2 – 3.1 OSX
  - Quick Start Guide – AGtk3.0.2 – 3.1 Windows
  - AG3 Venue Client User Manual
  - Venue Management Manual
  - <sup>23</sup>Venue Client Manual
- Six-monthly workshops, with presentations and online demonstrations, provide this information along with how to make the best use of the Access Grid Support Centre and its services. Training events are all geared towards introducing specific technology and infrastructure to a range of communities (not specific communities) and explaining the different software and options that users need to consider. The training shows the capabilities of Access Grid and helps users manage their nodes. Node testing sessions are used for training and giving advice to users.

#### 4.4.6 NCeSS

The National Centre for e-Social Science has been funded by ESRC to determine how UK e-Science Programme infrastructure (the grid) and tools can be used by social science researchers to enable their research.<sup>24</sup> Nodes provide *ad hoc* training on the outputs of work by NCeSS in e-Social Science; these “showcases” explain how node outputs can benefit everyone working in e-Social Science. But NCeSS does not yet offer formal, accredited training. The Centre does, however, have online case studies and tutorials (captivate videos and web based tutorials) which provide an introduction to the grid for non computer scientists. IMS content packages are being developed for deployment within a virtual learning environment. Any training events offered introduce specific technologies and infrastructure to a range of communities (rather than for specific communities).

#### 4.4.7 NIEeS

The goal of the National Institute for Environmental e-Science is to encourage and enable the use of e-Science technologies in environmental research. It shows the

benefits of e-Science to environmental scientists through its organised events, services, discussions and developed tools, for example.<sup>25</sup>

The NIEeS provides training through sponsored events and services available through their website. Examples of past training events include:

- Integrating Fortran and XML (January 2008)
- GENIE Workshop (2007)
- Google Earth and Geobrowsing Tools in Environmental Science Workshop (2007)
- Scalable Vector Graphics (SVG) Tutorial and Workshop (2006)
- DL\_Poly Training Workshop (2006)

Along with events, these services are available via the NIEeS website:

- Test services – researchers in environmental sciences can explore e-Science tools to determine how relevant they might be for their research. Access is provided on a trial basis to the following tools:
  - Storage Resource Broker
  - Access Grid (using NIEeS Access Grid Services)
  - Grid Computing (using the NIEeS cluster, using Condor at NIEeS, using Globus 4.0.1, using GridSam)
- NIEeS GridInfo website – this website is a depository of information on e-Science and refers to NIEeS services. It provides an introduction to e-Science and general information about tools that can be used in research.

#### **4.4.8 AHeSSC**

The Arts and Humanities e-Science Support Centre promotes e-Science in arts and humanities and interacts and networks with e-Science, e-Social Science, computing and information sciences communities.<sup>26</sup> The AHeSSC website offers links to various training resources and materials:

- ICEAGE digital library – a repository of valuable e-Science education and training materials
- Knowledge Base – a collection of information on tools, projects and methods in e-Science
- Summer schools listing – the information on this ICEAGE page is out of date.
- Training events – training activities for 2007/08 include:
  - Induction: introduction to e-Science terms and concepts, activities, what e-Science can do for you (aimed at post-graduates)
  - Access Grid for the arts and humanities, including ontologies and semantics
  - Collaborative text editing and annotation, including introduction to terminology and teaching and learning
- AHDS Performing Arts e-Science-themed Summer School – the summer school focuses on digital representations of performance, considering how performing arts can benefit from e-Science technologies and how these technologies can shape access and use of performing arts collections that have been digitised.

- A list of online resources to do with e-Science and grid computing, including links to Grid e-Learning, Grid Café and Grid Testbed for all.
- A link to the local e-Science Centre in Lancaster
- IBM resources (somewhat outdated?)
- Links to ICEAGE courses (but some of these links, the first two, do not work—needs updating)
- A list of links to NeSC Training events (2008) including:
  - e-Science and the Grid for Bio/Health Informaticians (14 January)
  - International Winter School on Grid Computing (6 February)
  - Standards for Interoperable Grids: Experiences from NextGRID and OMII-Europe (17 March)
  - Using OGSA-DAI to Grid-enable data for the Arts, Humanities and Social Sciences (23 April)
- Workshops and demonstrators reports that provide case studies of e-Science applied to arts and humanities (good examples to include in outreach):
  - User requirements: e-Science scoping study, user requirements in humanities, access grid in collaborative arts and humanities research
  - Collaboration in Performance: e-Dance, e-Science for the arts infrastructure, Performativity, place, space, Associated motion capture user categories
  - Virtual workbench: virtual workspace for the study on ancient documents, virtual vellum
  - Data deluge: e-Curator- 3D colour scans for remote object identification and assessment, Researching e-Science analysis of census holding, GIS e-Science- Developing a roadmap

#### **4.4.9 ReDReSS**

Resource Discovery for Researchers in e-Social Science aims to raise awareness of and accelerate development of new computing and data infrastructures to support collaborations in many areas of Social Science.<sup>27</sup> It achieves this through the following means:

- The Learning Space Catalogue, a repository of training and educational material previously introduced in this report under specific requirements section, material repositories. The catalogue consists of a collection of e-Science training and educational resources in various formats (such as video, pdf, etc.) and is aimed at social scientists. It provides social science researchers with an introduction to new technologies that they can apply to their research.
- Online Presentations: ReDReSS also provides users with multimedia videos of filmed e-Science events. These include, for instance:
  - Collaborative Computing Project (July 2008), Manchester
  - ESRC Research Methods Festival (June/July 2008), Oxford
  - 4<sup>th</sup> International Conference on e-Social Science (June 2008), Manchester
  - Surveying 2.0 – Digital Technologies, Market Intelligence and Social Media (March 2008), Manchester
  - Digital Geography in a Web 2.0 World (February 2008), London

- NCeSS Showcase (January 2008), Manchester
- Tutorials and online help: these are provided via a multimedia interface tutorial and an external link to Sakai help (University of Indiana).

#### **4.5 Regional grid initiatives**

Training is a part of the services provided by these regional grids:

- North West Grid –  
The NW-GRID service represents a collaboration among Daresbury Lab, the University of Lancaster, Liverpool and Manchester, which together manage a computational grid connecting high performance computing systems via a high speed fibre network.<sup>28</sup> This network allows the use of grid middleware technologies by computer science and engineering applications.
- White Rose Grid (WRG) –  
This initiative connects e-Science researchers in the Yorkshire region by building on IT infrastructure (the grid) to create a collaborative space for e-Research.<sup>29</sup> WRG has offered the following events for outreach and training: e-Science challenges and perspectives (27/3/08), Introduction to e-Infrastructure: enabling the research of the future (28/3/06), WRG Workshop (14/4/05). It also provides users with training leaflets which include (from September 2007):
  - About White Rose Grid
  - Access Grid
  - Broaden
  - CARMEN
  - COLAB: CROWN-C
  - EASA
  - FAQs
  - HTC: Parallel file serving
  - Modeling and simulation for e-Social Science
  - Network Enabled Capability: system integration for the military
  - Simulating Cardiac Arrest
  - UK NGS Node at University of Leeds
  - White Rose Grid at Leeds
  - Virtual Vellum
  - York Projects Using White Rose Grid
- UK e-Science Centres offer regional, as well as UK-wide, training opportunities<sup>30</sup>:
  - The e-Science NW Centre provides education and training by making lecture notes from the University of Manchester Grid and e-Science course available online, in PDF format.
  - Lancaster University is in the process of developing short courses in e-Science.
  - The Midlands e-Science Centre provides an Access Grid Survival Guide for users of Access Grid
  - The Welsh e-Science Centre offers tailored training courses such as: autonomic computing, Fortran 90 workshop, grid programming using

Globus and Java, high throughput computing WS with MPI, introduction to immersive visualisation, Jini technology in building a service-oriented grid system, mobile access to grid infrastructure and service oriented computing.

#### **4.6 Component creators**

OMII-UK provides training<sup>31</sup>:

- Southampton, Manchester (Taverna), and Edinburgh (OGSA-DAI) deliver courses in the OMII-UK releases.
- Where components are adopted by service providers (NGS), there is additional effort in teaching these.

The OMII-Europe project, which ran from May 2006 to May 2008, created standards-based middleware components to permit interoperability across grids.<sup>32</sup> The training effort was led by TOE, with courses in the UK and elsewhere.

Reference has already been made above to some components used with the NGS : P-GRADE, etc.

*The realms of authorisation and authentication are poised for needing additional effort, with the emerging Shibboleth and potential convergences with Grids*

*Support for VLE and VREs is less clear.*

#### **4.7 Research community support**

Training in e-Science for specific communities is provided by the research councils<sup>33</sup> and affiliated centres and institutes:

- Arts and Humanities Research Council (AHRC) – funds AHeSSC and AHDS (detailed above)
- Biotechnology and Biological Sciences Research Council (BBSRC) – The BBSRC lists a number of training events it has funded that have been or are being held in 2008:
  - Bioinformatics and e-Science Programme II – provides training in bioinformatics to relevant user communities to address their needs. (contact Michael Ball for further information, michael.ball@bbbsrc.ac.uk)
  - Proteomics and e-Science Training Projects for 2008 – Practical Proteomics (University of York), a short course held once a year for three years (until 12/2008), and Training Course for Proteomics Data Management (University of Manchester), to be delivered once a year for three years (until 5/2008), but then it will continue via Access Grid and distance learning options.
  - Bioinformatics for High Throughput Proteomics Short Courses – Cranfield University has offered these courses during 2008 (end date, 8/2008).
  - Short Courses in Practical High Throughput Bioinformatics – intensive one week training courses (Imperial College, London) offered (end date of 6/2008).

- Engineering and Physical Sciences Research Council (EPSRC) – The EPSRC has partnered with the Medical Research Council to launch the e-Science Development fund, which has the goal of providing training in e-Science. It has also funded the development of networks to provide communities with opportunities to learn more about e-Science. These networks include:
  - National e-Science Centre Information Network
  - UK e-Science Engineering Task Force Network (David Wallom)
  - Adding Value to Data: Digital Repositories in Research Infrastructures (Tobias Blanke)
  - All Hands Meeting Network
- Economic and Social Research Council (ESRC) – funds NCeSS (details above)
- Medical Research Council (MRC) – primary organiser of the All Hands Meeting which presents case studies to researchers, and has partnered with EPSRC on the e-Science Development Fund
- Natural Environment Research Council (NERC) – provides funding for the NIEES (as detailed above)
- Science and Technology Facilities Council (STFC) – provides funding for GridPP and AstroGrid. GridPP runs training courses for physicists engaged with high-energy experiments. AstroGrid
- E-Science Institute<sup>34</sup>:
  - The Institute develops specific themes and holds related events such as workshops and some training courses. The following events will be held in 2008:
    - EdiKt2 Seminar and ECDF Anniversary Celebration (18 September 2008), researchers discussing the use of computing in their work.
    - HECToR User Group 2008 (23 September 2008), talks from users and service providers as well as an open forum for exchanging ideas and discussing issues.
    - Network Inference in Genetic Studies: the GeneSys Inaugural Meeting (1-3 October 2008), promoting integration of genetics, bioinformatics and mathematics.
    - DCC Digital Curation 101 (6-10 October, 2008), introducing digital curation methods and planning for new projects involving curation.
    - Living Texts: interdisciplinary approaches and methodological commonalities in biology and textual analysis (16-17 October), a workshop highlighting the most innovative research in biology and textual analysis which will begin to define a cooperative research agenda for these disciplines.
    - MVM Research Symposium (29 October 2008), presentation of projects within the School of Medicine and Veterinary Medicine as well as an opportunity to network.
  - eSI also provides webcasts of their public lectures, which cover a range of topics including Trust and Security in Voting Systems, Principles of Provenance, Geography in Motion, Dynamizing Spatial Semantics and e-Science and Digital Scholarship.
- VizNET is described as “a collaboration between a number of visualization centres in the UK that has been established to share knowledge, communicate

best practice between application domains, provide training and support to researchers in visualization.”<sup>35</sup>

Training Material (listed on webpage) include:

- Tutorials: Powerwall display design and implementation, Access Grid 3 install tutorial
- Links to external training materials:  
[The Advisory Group on Computer Graphics \(AGOCG\)](#) –  
IRIS Explorer Self-Teaching Module  
UNIRAS Training Materials  
Review of Visualization in the Social Sciences

Plus Reports and Papers (for background knowledge, higher level):

**Technical reports**

Review of visualization systems

Case studies of visualization tools in the social sciences

Survey of visualization tools in the social sciences

**Workshop reports**

Supporting the teaching of computer graphics, visualization, multi-media and virtual environments

Graphics, visualization and the social sciences

Advanced visualization and virtual reality in the social sciences

**Briefing papers**

A review of the interactive data language (IDL)

Graphics and visualization newsletter

And support via the following institutions:

[University of Manchester research computing services](#) – (provide link)  
[Supercomputing, visualization and e-Science Group \(SVE\)](#) – (link)

- CompuSteer is a computational steering network which promotes collaborations among application and computer scientists to solve grid computing problems. CompuSteer collaborated with vizNET to offer training in computational steering in December 2007, through the 1<sup>st</sup> UK Computational Steering School; other training has been organised by Reality Grid and gViz.<sup>36</sup>
- There are bioinformatics support networks, which have organised training events:
  - Bioinformatics Support Service, Imperial college<sup>37</sup>  
Training provided includes:
    - Introduction to High Throughput Computing
    - Job scheduling with Sun Grid Engine
    - Collaborative tools
    - Globus, GridSAM
    - XML for bioinformatics
    - Distributed Annotation System (DAS)
    - Web Services for bioinformatics

- Cluster design

These courses are open to all suitably qualified candidates for fees, but are free for BBSRC-funded researchers/students/technicians, and aimed at bioinformaticians.

## 5. Coordination and Cooperation

Ad-hoc cooperation among providers of training, service operators and component creators is common-place. For example, training teams developing new modules find willing support from those deploying or creating the relevant middleware; the NGS team contributes its material and effort to support NWGrid events; material is reused in new circumstances so that OMII-UK material on OGSA-DAI and GridSAM has been re-used in the NGS and OMII-Europe events.

To facilitate this exchange of material, and to support web-based learning, repositories of training material are held by TOE-NeSC and ReDReSS.<sup>38</sup>

The benefits of this kind of cooperation have been duly recognised, as has the need for cooperation that extends into new realms, such as the provision of training infrastructure. This recognition of the importance of collaborative and cooperative effort resulted in a workshop at the e-Science Institute in October 2004 which provided a networking forum for UK trainers and educators in e-Science. The network has been developed further at subsequent All Hands Meetings, in Birds of a Feather sessions and then at a further workshop in January 2007 hosted by NIEeS ([http://wiki.nesc.ac.uk/read/ahm\\_bof\\_training](http://wiki.nesc.ac.uk/read/ahm_bof_training)). Among consequences, an agenda of issues has begun to be explored, including IPR and Digital Libraries, t-Infrastructure provision, cooperation in events; the network has established good relationships within its members evident in diverse other contacts; several cooperative events ensued, including a series of one day introductions to e-Infrastructure, sometimes termed the “roadshow events.”

The animation of this network has been on a “best-efforts” basis to date; developing this is one of the objectives within the e-Uptake project.

The Workshop for UK e-Science Educators took place at the e-Science Institute in Edinburgh on 10 December, 2007.<sup>39</sup> The workshop focused on education and defined its primary goal as the promotion of cooperation and the sharing of experiences among educators in order to stimulate engagement and exchange through an educators’ network within the UK. It was funded by a National e-Science Centre grant and is intended to become an annual event.

## 6. EU & World Wide Initiatives that Impact UK Training and Education

### 6.1 EGEE

Enabling Grids for E-sciencE (EGEE) describes itself as “the largest multi-disciplinary grid infrastructure in the world, which brings together more than 120 organisations to produce a reliable and scalable computing resource available to the European and global research community. At present, it consists of 260 sites in nearly 50 countries and more than 79,000 CPU cores available to some 9,000 users 24 hours

a day, 7 days a week.”<sup>40</sup> As noted earlier in this report, the Training, Outreach and Education team at NeSC has led training efforts for EGEE. EGEE supports European training events that serve as forums for collaboration and sharing of know-how within the EU and internationally. Upcoming events in 2008 include:

- 6<sup>th</sup> International GridKa School, Forschungszentrum Karlsruhe, Germany, 8-12 September
- Access Germany and International Grid Resources using gLite Induction Course, Greifswald, Germany, 10 September
- Access Germany and International Grid Resources using gLite Induction Course, Greifswald, Germany, 11 September
- EGEE EU-IndiaGrid Training School, Trieste, Italy, 15-18 September
- gLite Core Services, Annecy le Vieux, France, 18-19 September
- Introduction to gLite RESPECT tools at EGEE08 Conference, Istanbul, Turkey, 20-21 September
- Swiss Grid School, Geneva, Switzerland, 21-22 October

Along with these events, the EGEE Training webpage provides links to the EGEE Digital Library (previously described), GILDA and user information pages. Use of GILDA for training can be requested and trainers can also request to add their training events to the EGEE schedule.

## **6.2 ICEAGE**

The EU FP6 ICEAGE Project built on EGEE but focused primarily on promoting the advancement and uptake of education and training in e-Science and distributed computing across the EU.<sup>41</sup> ICEAGE organised and supported the International Summer Schools in Grid Computing (ISSGC) series, created the online International Winter School on Grid Computing (IWSGC) in 2008, developed a repository of education and training materials, housed in the ICEAGE Digital Library, and supported the development of policy through OGF ET-CG and e-IRG documents that have had influence on the direction of education and training in the UK, and beyond. These events and documents will be discussed in further detail below.

## **6.3 OGF ET-CG**

The Open Grid Forum Education and Training Community Group (ET-CG) has provided an arena for international collaboration on e-Science education and training issues.<sup>42</sup> Collaboration resulted in the production of informational documents on t-Infrastructure provision, digital repositories, professional grid certification, curricula development and high-level policies to support the advancement of education and training.

As introduced previously in this report, the OGF t-Infrastructure document proposed valuable recommendations that can be referenced by UK educators and trainers, and institutions; *all* OGF documents produced by the ET-CG concluded with suggestions for future practice and provision that prove useful for the further development of education and training in the UK. UK representatives contributed to and benefited from the OGF ET-CG sessions, supporting conclusions reached in this forum and using recommendations to guide their practices. The e-Uptake Project has supported

ET-CG work and intends to use the forum in future for collaborative discussion on important e-Infrastructure issues.

## 6.4 e-IRG ETTF

The e-Infrastructure Reflection Group (e-IRG) Education and Training Task Force (ETTF) was established in order to further education and training efforts in the European context.<sup>43</sup> The ETTF’s primary goal has been to obtain consensus on and determine means for collaboration in development and delivery of education and training, to improve provision and use of e-Infrastructure in Europe. To achieve its goal, the ETTF has organised meetings at e-IRG Workshops, supported the Curricula Development Workshop held in Brussels in February 2008 (also supported by OGF and ICEAGE) and produced a comprehensive report on e-Science education and training; this report was developed through the collaborative efforts of ETTF members and individuals external to the group, such as OGF ET-CG members and ICEAGE Project participants. The ETTF Report highlighted a number of general challenges that educators in e-Science currently face:

- Poorly developed curricula and textbooks to support that curricula
- Lack of students motivated and prepared for e-Science and e-Infrastructure courses
- Fluidity of the technological landscape
- Lack of general expertise
- Disparate educational policies across universities and countries which create security and access problems
- Lack of shared t-Infrastructure
- Lack of a solid IPR framework

The task force explored these problems in depth and suggested ways to confront them. The ETTF Report was adopted by the e-IRG Delegates at the e-IRG Delegates Meeting in Lugano (June 2008) and now stands as an influential reference for educators and trainers throughout Europe.

## 6.5 Summer schools

The International Summer Schools in Grid Computing (ISSGC) series, supported by the ICEAGE Project, is in its sixth year.<sup>44</sup> These schools bring together leading experts and practitioners in the Grid computing field with selected international students for two weeks of intensive study. The selection procedure gives special consideration to students who describe how they will use their experience at the summer school to disseminate expertise locally and within their field of study. Table 1 shows how many students from various geopolitical regions attended ISSGC 07, held in Sweden. It shows the figures for the entire registration process. The “started” column lists students who began the process, “submit” provides numbers of students who submitted a registration form with referee letters, “offer” shows the number of offers made to students to attend and “attended” lists the number of students who actually came to the summer school.

**Table 1. Participation by Geographic Location.**

	Attended	Offer	Submit	Started	Attended	Offer	Submit	Started
Residence by geopolitical region	Students				Percentage			

EU	34	38	50	67	55	47	50	48
Russia	1	1	1	2	2	1	1	1
Europe (other)	1	1	1	5	2	1	1	4
China	1	2	2	2	2	2	2	1
Asia (other)	5	12	17	26	8	15	17	19
USA	16	19	20	23	26	23	20	16
Central America	1	1	1	1	2	1	1	1
South America	1	1	2	2	2	1	2	1
Africa	2	6	6	12	3	7	6	9

The primary aim of the summer schools is to educate students so that they will pass their knowledge of grid computing and enthusiasm on to others. In each summer school, trainers present students with four to five of the leading technological implementations in the field as specific examples of the topics presented (for instance, specific solutions to the problems of security in a distributed environment). This exercise has required development of t-Infrastructure for multi-middleware integration. At the 2008 Summer School, which took place in July at Lake Balaton in Hungary, all of the technologies used at the Summer School were presented on a single infrastructure for the first time. In contrast to previous years, the technologies were also expanded to include UNICORE, gLite, Condor, Globus, OGSA-DAI and Microsoft HPC. The summer school programme has provided a model for the development of similar schools, in terms of teaching infrastructures, methods and content.

## 7. Conclusions – Sustainability

There is a crucial separation between training provided by long term funded services and training provided by services funded on a fixed-term (i.e., project or programme) basis. The provision of training by JISC Services can be expected to be maintained over the foreseeable future assuming the services are part of their core roadmap (e.g., EDINA, MIMAS). Equally, services funded on a project basis can only be expected to provide training or maintain repositories of materials over the period of that funding. While projects may have their funding renewed, gaps and uncertainties may result in the reduction of the effectiveness of provision due to the loss of experienced staff. Similarly, renewal may require revision of the original provision which may lead to a gap arising in that sector. Of course, training is not required where a service no longer continues to exist, either through a reduction of requirement or the introduction of a new approach.

The third clearly differentiated type of provision is through academic courses in universities. This type of provision is, in some ways, the ideal mechanism to provide training and education to the research community. However, this training/education is at the mercy of university priorities and may not take into account the needs of service providers or funders. Of course, university provision will reflect the market for courses among students and, consequently, the broader market conditions for the employment of graduates. But, while the persistence of individual courses may not be guaranteed, the withdrawal of a single training provider will not necessarily lead to the emergence of gaps if a wide enough range of providers exists.

We can conclude then that the sector requiring a more explicit sustainability strategy is the sector relating to project-based training provision. It clearly follows that for successful projects there should be an expectation that training moves into the university sector as demand is stimulated by researchers who wish to use the products of the project. However, in itself, this does not address the mechanisms for transfer of the knowledge and expertise that must form the basis of this migration. An important conduit for this transfer is the existence of the network of national, regional and domain specific e-Science Centres. These are themselves funded on a fixed-term basis and a time could certainly be envisaged when these centres may not exist in their current form. It is not currently clear how quickly the use of e-Science services will become entirely ubiquitous and consequently become so firmly embedded that all undergraduate research degrees would be expected to contain all of the information needed for researchers to access these services.

The analysis in this document suggests that training materials and events exist in the case of many services but not all. e-Science centres provide some of the effort required in bringing together outputs of the individual services in a coherent way in order to provide direct training to communities or materials which can be re-used and re-purposed for eventually being incorporated into higher education curricula.

In order to provide both dissemination and sustainability for these outputs from services, projects and centres, there is a need for repositories which are tailored to not only contain educational materials but are also well suited to making these easily available to all higher education institutions in the UK.

An infrastructure with the correct characteristics for supporting training across the UK is a clear requirement which has been put forward by various workshops for educators and trainers. This type of infrastructure is also needed to help stimulate the development of academic courses in the UK.

Finally, as evidenced in Deliverable D2.1.1, a clear need for basic texts (online or printed) which provide the underlying materials for trainers and educators to use in constructing courses and for use as supporting material on courses has been articulated by trainers and educators. Infrastructures described above and the development of content and resources such as texts for courses would provide the support necessary to ensure the sustainability of training in e-Science within the UK.

## **8. References**

References appear as endnotes after Appendix 2.

## Appendix 1: Survey Circulated in August 2007

### Survey of Providers of Training and Education in e-Infrastructure

Mike Mineter, 9 August 2007

#### What is this survey about?!

You are invited to answer a few questions to help JISC's "Enabling Uptake of e-Infrastructure Services" project to achieve two goals:

1. survey the provision of education and training related to e-infrastructure, not least so that gaps can more easily be identified.
2. create web-pages giving contacts for providers of training and education - there is no such single source of this information at present.

Please return this to Mike Mineter, [mjm@nesc.ac.uk](mailto:mjm@nesc.ac.uk) - by email and if possible by around 20th August.

This will allow an initial collation of responses to be discussed at the UK All Hands Meeting in September; further development will continue in the light of discussions at the AHM. (The AHM, <http://www.allhands.org.uk/> is the main UK forum for e-research.)

#### Glossary of terms:

- *Training* - communicates skills to encourage and support use of e-infrastructure
- *Education* - within academic courses, to build understanding of e-infrastructure.
- *e-infrastructure* - infrastructure that exploits the internet to enable research, curation and learning. It embraces networks, grids, collaborative environments, data services and associated initiatives, technologies and support organisations.

For more information about the project please see:  
<http://www.e-ResearchCommunity.org/e-Uptake>

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#### Training/Education Group's Details:

*Please note: the intention is to build a simple database of providers, this will be accessible via unprotected web pages. The e-Uptake project is establishing this as a service to those seeking training.*

**University/Institute:**

**Project/team name (if any):**

**Contact Name and Email address:**

**Web address:**

Can all the information provided here be entered in the "e-Uptake" contacts database and made public via web pages?

Please select:

Yes

Yes except where stated below

No, use my data for the survey only

---

**EDUCATION**

1. Please list any academic courses in which e-infrastructure modules are given:

2. Please outline the e-science/e-infrastructure content

3. Web address

---

**TRAINING**

1. Please list technologies and/or e-science methods in which you give training:

2. Please briefly indicate the scope of your training:

a) geographical extent:

b) disciplinary extent:

c) relevant infrastructures: (e.g. <My Regional Grid>, NGS)

d) specific projects:

e) Any concepts and principles on which you especially focus:  
(e.g. "how e-science helps researchers", "what is a grid?",)

f) Modes of delivery (use of web-based material, face-to-face courses)

3. Please give a link to your training web pages:

4. Please indicate...

a) Number of events run between 1-Aug-06 and 31-Jul-07:

b) Number of days training between 1-Aug-06 and 31-Jul-07:

c) Please estimate the percentages of your training events that are:

a. for specific communities:

b. introducing specific technology and infrastructure to a range of communities:

5. If you have training material that others can re-use, please give a link to this material:

(To help this re-use, please consider uploading it, or links to your material, into the "UK e-science" collection in <http://baillie.lib.ed.ac.uk>, the NeSC-TOE Digital library - and email [training-support@nesc.ac.uk](mailto:training-support@nesc.ac.uk) if you need help to do this.)

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**ADDITIONAL INFORMATION**

- Please give up to 6 lines summarising what you'd like the world to know about your training/education activity:

**AND FINALLY:**

- Are you aware of any possible gaps in the training/education provision related to e-infrastructure?

- Are you aware of any particular problems that influence training/education in e-infrastructure? Are there any initiatives that could help to address these problems?

**THANK YOU!!!**

**Mike Mineter.**

## Appendix 2: Glossary

- **Education** – a long-term institutionalised process using conceptual models and resulting in development of conceptual understandings and reasoning abilities.
- **e-Infrastructure** – the term is used to denote the digital equipment, software, services, tools, portals, deployments, operational teams, support services and training that provide data, communication and computational services to researchers, innovators and decision-makers. An e-Infrastructure is usually multi-purpose and has to be a sustained dependable facility which can be used for the duration of the work being done.
- **e-Science** – the invention and application of computer-enabled methods to achieve new, better, faster or more efficient research, innovation, decision support or diagnosis in any discipline. It draws on advances in computing science, computation and digital communications.
- **TOE-NeSC**: Training Outreach Education team associated with the National e-Science Centre.
- **Training** – a short-term process to develop specific skills in a certain technical area.

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- <sup>1</sup> <http://www.iceage-eu.org>
  - <sup>2</sup> <http://e-irg.eu/>, to download the ETTF Report
  - <sup>3</sup> [http://www.ogf.org/gf/group\\_info/view.php?group=et-cg](http://www.ogf.org/gf/group_info/view.php?group=et-cg)
  - <sup>4</sup> Please see Appendix B of the ETTF Report
  - <sup>5</sup> e-IRG ETTF Report, p. 6
  - <sup>6</sup> GILDA web page: <https://gilda.ct.infn.it/>
  - <sup>7</sup> For full OGF document please see OGF wiki, “Experiences and Issues with t-Infrastructure” at <http://forge.gridforum.org/sf/wiki/do/viewPage/projects.et-cg/wiki/TInfrastructureExperiences>
  - <sup>8</sup> ICEAGE: [www.iceage-eu.org/library](http://www.iceage-eu.org/library) and EGEE: <http://egee.lib.ed.ac.uk>
  - <sup>9</sup> [http://redress.lancs.ac.uk/Learning\\_Space/](http://redress.lancs.ac.uk/Learning_Space/)
  - <sup>10</sup> <http://www.iceage-eu.org/iwsgc08/index.cfm>
  - <sup>11</sup> <http://www.nesc.ac.uk/training/>
  - <sup>12</sup> Aston University, <http://www.cs.aston.ac.uk/proginfo/mscinfo.php>, Brunel, <http://www.brunel.ac.uk/about/acad/sed/sedcourse/pg/ece/distributedcompsyseng>, Cranfield, <http://www.cranfield.ac.uk/soe/postgraduatestudy/gridcomputing/index.jsp>, De Montfort, <http://www.dmu.ac.uk/Subjects/Db/coursePage2.php?courseID=2639>, Imperial College, [http://www.doc.ic.ac.uk/teaching/postgraduate/computing\\_science/index.html](http://www.doc.ic.ac.uk/teaching/postgraduate/computing_science/index.html), Aberdeen, [http://www.abdn.ac.uk/prospectus/pgrad/study/taught.php?code=e\\_comm](http://www.abdn.ac.uk/prospectus/pgrad/study/taught.php?code=e_comm), Edinburgh, <http://www.inf.ed.ac.uk/postgraduate/msc.html>, Greenwich, <http://www.cms.gre.ac.uk/postgraduate/DCS.asp>, Manchester, <http://www.manchester.ac.uk/postgraduate/taughtdegrees/courses/bysubject/course/?code=02066&pg=2>, Liverpool, <http://www.liv.ac.uk/e-science/e-Science/courses.html>, Westminster, <http://www.wmin.ac.uk/cscs/page-1581>
  - <sup>13</sup> Cambridge, <http://www.escience.cam.ac.uk/projects/camgrid/>, Cardiff, <http://www.cf.ac.uk/insrv/it/network/grid.html>, Oxford, <http://e-science.ox.ac.uk/index.xml>, Plymouth, <http://www.plymouth.ac.uk/>, Reading, <http://www.resc.reading.ac.uk/resources.php>
  - <sup>14</sup> Birmingham, <http://www.mesc.bham.ac.uk/about/centre.htm>, University College London, <http://www.lesc.imperial.ac.uk/projects/coe.html>
  - <sup>15</sup> <http://www.ecdf.ed.ac.uk/>
  - <sup>16</sup> For training see <http://www.ukerna.ac.uk/services/training/index.html>
  - <sup>17</sup> NGS at <http://www.grid-support.ac.uk/content/view/183/137/>
  - <sup>18</sup> <http://edina.ed.ac.uk/about/index.html>
  - <sup>19</sup> <http://www.mimas.ac.uk/>
  - <sup>20</sup> <http://ahds.ac.uk/>
  - <sup>21</sup> <http://www.dcc.ac.uk/>
  - <sup>22</sup> <http://www.ja.net/services/video/agsc/AGSCHome/>
  - <sup>23</sup> <http://www.accessgrid.org/userguides>
  - <sup>24</sup> <http://www.ncess.ac.uk/>
  - <sup>25</sup> <http://www.niees.ac.uk/index.shtml>
  - <sup>26</sup> <http://www.ahessc.ac.uk/ahessc-home>
  - <sup>27</sup> <http://redress.lancs.ac.uk/>
  - <sup>28</sup> <http://www.nw-grid.ac.uk/>
  - <sup>29</sup> <http://www.wrgrid.org.uk/>
  - <sup>30</sup> NW Centre, <http://www.esnw.ac.uk/>, Lancaster University, <http://e-science.lancs.ac.uk/index.html>, Midlands, <http://www.mesc.bham.ac.uk/about/centre.htm>, Welsh e-Science Centre, <http://www.wesc.ac.uk/>
  - <sup>31</sup> <http://www.omii.ac.uk/>
  - <sup>32</sup> <http://training.omii-europe.org/>
  - <sup>33</sup> Please see Research Councils UK e-Science page at <http://www.rcuk.ac.uk/escience/default.htm>
  - <sup>34</sup> <http://www.nesc.ac.uk/esi/>
  - <sup>35</sup> Please see <http://www.viznet.ac.uk/>
  - <sup>36</sup> <http://compusteer.dcs.hull.ac.uk/pages/workshops>
  - <sup>37</sup> [http://www.bioinformatics.ic.ac.uk/bio\\_support.html](http://www.bioinformatics.ic.ac.uk/bio_support.html)
  - <sup>38</sup> <http://baillie.lib.ed.ac.uk> and <http://redress.lancs.ac.uk/>
  - <sup>39</sup> <http://www.nesc.ac.uk/esi/events/834/>
  - <sup>40</sup> <http://www.eu-egee.org/> and for a full list of training events, please see <http://www.egee.nesc.ac.uk/schedreg/index.cfm?startdate=2001-01-01&enddate=2020-01-01&resultsperpage=20&pageno=1>

<sup>41</sup> <http://www.iceage-eu.org>

<sup>42</sup> [http://www.ogf.org/gf/group\\_info/view.php?group=et-cg](http://www.ogf.org/gf/group_info/view.php?group=et-cg)

<sup>43</sup> <http://e-irg.eu/>

<sup>44</sup> <http://www.iceage-eu.org/issgc08/index.cfm>