e-Research Community Engagement Findings

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Chapter 1

Training, Education and Outreach

1.1 Understanding Distributed Systems

1.1.1 Understanding of Distributed Computing Principles[1]

Researchers are often not aware of the potential of distributed systems or of the issues involved in developing and using them. This means that they find it difficult to make sense of the e-Infrastructure services or to related them to their own work and come up with possible ways of using them. While training material exists that provides instructions for the use of advanced ICT systems, there is a lack of material that teaches the underlying principles of e-Research and helps researchers to engage creatively and critically with these technologies.

> *"...grid computing ... is an under utilised resource. I think there probably are barriers to people understanding how they could use it, what they could do with it, and seeing it as a true alternative to maybe poorly managed desktop processing or using under resourced local computers but I'd imagine that there's a, there's a lack of understanding of the technical context" (information services professional)*

> *"They probably wouldn't understand the impact it would have the way access it and what they would do with it. But they'd probably believe that because they can do what they're doing now that it's okay. But it'd be similar to somebody who sits and writes out fifteen letters in Word to fifteen people that are all the same and types them all out. But the person next to them puts the names and addresses into an excel spreadsheet and merges a letter from word. You both get the same result but the one has done it in about a tenth of the time but the other person doesn't think there's anything wrong with what they've done. They've used their own skills they've done the job it works but if you're not aware of the alternatives." (information systems professional)*

> *"We provide training material but it's more based on the technical use of products rather then the researchers requirements for the product, and as many people know if you throw a data set at some package like SPSS it will give you an awful lot of information whether it's what you wanted and whether you know what you do with it is another matter. (information systems professional)*

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[1]This content is available online at <http://cnx.org/content/m20940/1.4/>.

1.1.1.1 Enablers

- Embedding of education and training on distributed systems would enable young researchers to start developing the knowledge and skills required to effectively utilise e-Infrastructures.
- A textbook introduction to distributed systems for researchers would enable the teaching of distributed computing principles and e-Research skills. Funded by the UK's JISC, an effort is currently underway to produce a core introductory text under the title Research in a Connected World[2].

1.1.2 Understanding of Distributed Systems by IT Services[3]

IT service staff often lack understanding of distributed systems that would be necessary to effectively facilitate the uptake of e-Infrastructure services by researchers.

Example 1.1

"maybe [there is] a lack of understanding from the technicians that there is actually a requirement and again the idea that you know I could run a piece of analysis that takes three days. If it was on the grid it would take ten minutes [...]. Who can [...] tell a researcher actually you can do it better and I don't think many University IT departments even would appreciate how we do that. Even dealing with the business computing systems when we write a piece of code it's difficult to predict how long you think it will take. So if you don't understand the nature of high performance and what it will give you then it's difficult for you to promote it or be aware of its benefits." (information service professional)

1.1.2.1 Enablers

- Education and training courses for IT service staff would enable them to better facilitate the uptake of e-Infrastructure services by researchers.

1.2 Understanding the Potential of e-Research

1.3 Domain-Specific Material and Events

1.3.1 Training Aimed at Domain Experts[4]

Training offered is rarely tailored to the needs of researchers working in particular areas but is rather generic and technology-centric. This has the effect that training courses become less attractive for researchers and of making the learning outcomes less relevant for their day-to-day work.

"perhaps there's a general need for more training that's aimed at the domain experts rather than e-Science experts." (researcher)

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[2] *Research in a Connected World* <http://cnx.org/content/col10677/latest/>
[3] This content is available online at <http://cnx.org/content/m20941/1.3/>.
[4] This content is available online at <http://cnx.org/content/m24628/1.1/>.

1.3.1.1 Enablers

- Discipline-specific training programmes with content tailored to the specific needs of researchers can help to ensure that training is of interest and the outcomes practically applicable.
- Hands-on support sessions can be used to add relevance to a generic training course that teaches the basics, while the subsequent support sessions add context and help researchers to apply what they have learned to their own research problems. The combination of these two styles can help overcome the problem that creating tailored training material for every conceivable research area would be too expensive and would cause problems with keeping material up to date.

1.4 Quality of Training Material

1.5 Early Engagement and Outreach

1.5.1 Awareness of Services[5]

Researchers are often not aware of services available locally, regionally or nationally. In general, there seems to be a lack of systematic introduction to the services and the training available, which results in a lack of awareness as well as a lack of understanding of how services and methods can facilitate research and what different options exist. Some respondents from information services have suggested that there is an emphasis on basic desktop computing support caused by the wide uptake of desktop computing and that this may have led to a lack of emphasis on applications and advanced research tools.

> "maybe now [information services] need to get back and think about helping people with what it is they want to use computers for."

Researchers are often working with systems they know without becoming aware of the existence of other systems or recognising alternatives.

> What I tend to do is go straight to the web of science and you never really know what is going on to the rest of the site and I don't know what other things are available" (researcher)

Even when they take an interest in what services might be available, there are not necessarily easy ways for doing this as services are provided by different institutions, making it difficult to find out about their existence and their relevance.

> "I guess the big barrier is actually just finding out about what's available" (researcher)

> "I think the uptake of certain services like [...] the British library offer secure electronic delivery of documents which I think a number of researchers either haven't used, or weren't aware of, despite our best efforts to publicise this" (information systems professional)

> I mean in our organisation generally people don't know who JISC are and what they do [...] I know that some of the roadshows that have been happening have been addressing that" (researcher)

The fragmentation of researchers into small groups can add to the problem of awareness, especially when groups work in isolation. This is a problem that can be found quite regularly in some discipline areas.

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[5]This content is available online at <http://cnx.org/content/m20963/1.8/>.

> *"I'd imagine there might be an issue with awareness of what is available both locally and nationally and possibly regionally. I'd imagine that people because they work in small departments and in small groups which won't appear a particular [institution] trait would tend to work with what they know, and may not be aware of just communications or larger issues. You may find two research centres pretty close to each other with a completely different solution to the same problem and unaware of it." (information services professional)*

Support and outreach activities varied significantly between different kinds of institutions and between different disciplines. Awareness of services provided within an institution is systematically reported to be higher than that of equivalent services provided elsewhere even if those have a national remit.

Researchers appear to find out about e-Infrastructure services through events such as the UK e-Science All Hands Meeting, through colleagues or workshops. We might conclude that the network of social relations of people already involved in using e-Infrastructure services is a key enabler of uptake.

1.5.1.1 Enablers

Researchers become aware of the existence of e-Infrastructure services mainly through personal contacts and through the examples of others using them in their work. As a consequence, the following interventions can help to address the problem of awareness:

- Respondents have called for service providers to visit institutions, making use of staff development events. Roadshows such as the series of events funded by the UK's JISC[6] , booths at research conferences as well as other dissemination activities can help to raise awareness. However, they are relatively expensive interventions that do not scale well.
- Embedding of information about e-Infrastructure services in instituional resources such as information services websites and catalogues.
- Embedding of education on distributed systems and e-Infrastructure services in research education allows awareness to be raised amongst coming generations of researchers.

    > *"some of the OMII people have been helping us run the little short courses, so two three days courses on e Science or Life Sciences and these are actual workflows for Life Science and Medicine and that sort of stuff, and they're incredibly useful just to some people like PhD students and post-docs." (researcher)*

    Clearly, such routine arrangements would be of immense value in other areas but they rely on having a critical mass both on the demand and the supply side. Another opportunity that has perhaps not been exploited to a large enough extent is to link e-Research with existing ICT training programmes and with doctoral training centres.
- Case studies, roadmaps, examplars and success stories, e.g., in the form of briefing papers, short articles or video clips can help to raise awareness not only of the existence of services but also of the ways in which they can be combined and used.

    > *I think what would be useful particularly would be [...] information about developments in the sector or information on let's say case studies or exemplars where something has been identified as being a good practice possibly like the, the JISC intranet service where they have these sort of case studies and exemplars of how you go about introducing this to your institution. There's something where people can actually have an easy access point something that's quite readable but allows them to dig further.*

    > *Well I think the ideal would be to produce some kind of whether it's a roadmap or a guideline. But some kind of simple short document or resource on the web that just explains the context of the resources that are available. I do think the idea of you know exemplars, worked examples would be very helpful. But they'd have to be seen as being relevant for people to have an interest in them.*

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[6] http://roadshows.jiscinvolve.org/

Another important enabler is 'boundary spanning', where researchers move between their own discipline and another one, which may expose them to technologies and new ways of doing things:

"before I was at [my current institution], I was at an engineering department at [other institution] and so I was kind of aware of a lot of these things that we are talking about – Access Grid, e-Science."

The respondent recounted how they kept in touch with the e-Science programme from its early days even when switching institution and discipline area, for example through attending conferences. They used their experiences to come up with ways of applying e-Infrastructures in new contexts:

"[even] before the funding programme for e-Science had gone out I was aware of that, that it was happening and I thought 'oh, that is something we should look at for Arts and Humanities', so when the opportunity came for us to do something using e-Science technologies, I kind of hassled the research computing people [at my institution] to tell me about it."

1.5.2 Linking Initial Interest and Specific Training[7]

The initial interest generated through outreach activities needs to be converted into enrollment into specific training activities seamlessly, otherwise there is the danger that not only will the benefit of outreach be lost but also that people might be disenfranchised. An continuation of engagement is important even if researchers show initiative to acquire the necessary skills themselves.

you don't say to somebody we've got this wonderful technology, would you like to learn how to use it and then they say, 'yeah, great' and then nothing really happens after that if you know what I mean because the first port of call is obviously the documentation try and work a few things yourselves. If it gets complicated people get put off very quickly." (researcher)

People can be resourceful in getting the support they need once they have made a decision to engage and are becoming more self-reliant over time.

"I use Access Grid quite a lot, I have got training to my local node... I kind of hassled them until they taught me how to use it" (researcher)

Some may even actively contribute to the development of e-Infrastructure services and tools through reporting bugs and stating requirements. However, being able to engage in such a meaningful way depends on the availability of support mechanisms that are well advertised and dependable.

1.5.2.1 Enablers

- 'At elbow' support is an important enabler of uptake, especially in the early phases where there is a danger that researchers might give up on technologies as they see the costs of adoptions while the benefits might not yet be visible.

  "Really, hand holding is the way to get people onto these things to a large extent because every problem's different [...] and that's what you need to do, you can't just write a web page or even a tutorial that would cover everything." (information systems professional)

- Continuation of engagement requires the routine availability of training arrangements in a way that is accessible for people.

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[7]This content is available online at <http://cnx.org/content/m24045/1.1/>.

Chapter 2

User-Designer Relations and Requirements

2.1 Understanding Research Practice

2.2 Understanding Available Options

2.2.1 Exploring Possible Uses of Technologies[1]

Potential users of e-Infrastructures often lack the time and resources to explore their possible uses. One respondent commented:

> *"I can see that there are things there which we probably could be able to use in the future but first we'd have to work out how [...] if we had the time to actually be able to get far enough into the technology to be able to actually utilise it properly."* (researcher)

2.2.1.1 Enablers

- Exemplars and use cases, developed not as demonstrations of technical feasibility but as ways to explore possible uses and socio-technical configurations can help to further uptake by communicating a vision or triggering competitiveness:

  > *having stuff where you can show that people have done really new science using those tools [...] it seems to be working quite well in terms of getting engagement and we're seeing that other communities just like these things - like the systems biology communities are beginning to be very keen to play and join in."* (researcher)

- Clearly, it is important for the community to formulate clearly where e-Infrastructure usage has made a significant difference to researchers and to disseminate these success stories widely to inspire more researchers to start engaging
- It is important that the early exploration of technological options is supported and conducted as a conversation between researchers, service providers and intermediaries

2.3 Hybrid Knowledge

2.4 Social Organisation

2.4.1 Managing User-Designer Relations[2]

Managing the relationship between users and designers or service providers can be a challenging task for a number of reasons. The current divisions of labour in ICT development and service provision mean that there is often a gap between the social context in which people work on developing technologies and providing services and the contexts in which these get appropriated and used. The work involved in bridging this gap is increasingly recognised as crucial and ways are being devised for practically tackling the issues involved.

Unfortunately, much work in e-Science is driven by technological visions and is not sufficiently grounded in the real-world, day-to-day requirements of researchers, as illustrated by this quote:

> *My sense is that [the] e-science project in general has been a little bit too focused on building infrastructure and middleware [...] I fear it's been designed and implemented in a vacuum, so the problem I have with a quite bit of e-science projects is that they are built for general problems and maybe they can solve a class of problems but when we really want to use them you end up finding that they are not good enough"* (researcher)

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[1]This content is available online at <http://cnx.org/content/m24636/1.1/>.
[2]This content is available online at <http://cnx.org/content/m20971/1.4/>.

The same respondent pointed to a general problem in software engineering that is particularly vexing in e-Science, the problem of deciding what specific functions to support and how generic to make a piece of software:

"what I fear is that the e-science software so far has been too focused on building general infrastructure and maybe they [would be] better off solving, fewer, smaller [...] problems but at least solving them properly. I think they should at least be a lot more proactive with the specific, with a couple of groups, instead of trying to make all scientists happy maybe try and make the hardcore users happy, and maybe work much closer with them, so instead of trying to be a facility for everyone, try and solve some of the more difficult problems first and that will provide them with some very interesting solutions, rather than try to write something so general that everybody should be able to use it but in the end no one will use it." (researcher)

The choice, of course, who to work closely with and how to scale up to developing software that finds wider application is difficult to make in the abstract and can only be made in the light of experiences gained with specific users and their day-to-day work.

There are, as yet, no guidelines for the development of e-Science software that are based on sound software engineering practice but take into consideration the specific nature of e-Science. While many projects contain elements of closer user-designer relations, the practice followed can very widely.A range of methods get used at, are employed different times in the design lifecycle and with varying degrees of participation by researchers. Very often, participation is limited to distinct phases of the overall project lifecycle or takes the form of formal participation in project review boards etc. where the impact is likely to be limited.

2.4.1.1 Enablers

- A number of programmes such as the JISC VRE programme or the ENGAGE initiative recognise the importance of real end-user involvement and mandate it as a condition for awards.
- A number of mechanisms can be used to provide an environment in which an ongoing dialogue between technology providers, service providers and users can be fostered. These can involve technical elements but often the organisational arrangements and human effort are most crucial.

  "I mean you know we have a sort of common set of ways of interacting with them you know there's obviously their wikis and things that they can post questions on we have a help desk that they can phone up or email questions to or visit if they happen to be here and that's quite responsive but on top of that we have regular user group meetings to, where we'll take the temperature of what people want, we'll put proposals out for debate, we have weekly mailing lists where we'll send round a newsletter to say this is what's happening you know, what are your views and lastly we will because of this consortium based approach that the groups are in we have a regular programme of going out and visiting the leaders of each of the consortia sort of on an annual basis so someone will go and visit the various PI's discuss the problems that they're having, spend a day, two days with them." (service provider)

- It is important to recognise that the relationship between service providers and researchers is not necessarily a one-way road. It would be wrong to think that researchers are passive recipients and users of technological innovations and expertise provided to them. Rather, they can actively take part in shaping service provision. As one social scientist put it:

  "there is sometimes the case that I have downloaded a file and then found out perhaps an error within the data file or lack of priority on a particular variable or a variable missing within the data file that's referred to in the documentation and occasionally I have reported that sort of example to the help desk, and they've usually been, well in fact pretty much every time they've been able to get back and come up with the solution quite rapidly so I find them a very helpful service in that respect."

Actively encouraging input from service users and dealing with requests and suggestions in a professional manner can help to engage researchers as contributors to the service, giving them responsiveness

to their needs and improving service provision for other users. Similarly, such engagement can also give rise to formulations of requirements that can be difficult to capture using other routes.

- A close involvement of researchers in the development of e-Science software and services can be achieved through combining technical work with (on-site) support, working with researchers on their immediate problems. Providing 'at elbow support' can provide useful input to systems development. An extreme form of such practices is the 'embedding' of developers into teams of researchers, a practice often found in areas where research problems drive the development of technological solutions and where researchers themselves have sufficient funds to employ technical staff. Some e-Science projects have found it useful to 'embed' their developers into research teams for extended periods to foster a close engagement and collaboration with researchers.

2.5 Understanding Infrastructure

2.6 Priorities

2.7 Conflicting Research Agendas and Commitments

2.8 Reward Structures

2.9 Software Engineering Practice

Chapter 3

Collaboration

Chapter 4

Policy and Funding

4.1 Research Assessment

4.2 Data Curation and Sharing

4.3 Models of Innovation

4.4 Measuring Impact

4.5 Priorities

4.6 Political Influences

4.7 Justifying Costs of Resources or Adoption of Services[1]

Justifying the cost of investing in advanced ICTs can be difficult as the effects are often long-term and indirect. The cost may relate to the provision of resources but also to the costs of adopting services, which can be significant even when the resource is free at the point of use.

Example 4.1

High performance computing is expensive, and I think it's difficult to justify from a research point of view why a large amount of money is needed maybe to perform calculations in one day rather than five. It may not seem very significant but it's the cumulative effect. (information systems professional)

4.8 Delays in Gaining Access to Services[2]

Delays in gaining access to resources can cause cause a significant start-up time before an research idea can be translated into practical action. This is the case especially where access to resources is dependent on a peer review process, especially if this is tied up with the funding process.

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[1]This content is available online at <http://cnx.org/content/m21217/1.2/>.
[2]This content is available online at <http://cnx.org/content/m20964/1.2/>.

Example 4.2

"I'm mostly interested in computational science and so this is the HPC end of the spectrum and I think access to the facilities is fairly straightforward actually, the problem comes down typically to the delay between having the idea and actually being able to carry out the idea because of the peer review process. [...] University facilities bought for example through SRIF, are available fairly readily, there are a few JISC clusters around that have the same sort of on demand approach but the facilities at the top end have quite a long delay in getting onto them. [...] I mean don't get me wrong [...] what I am not advocating is a situation which is freedom for all to use these because quite frankly I think there does have to be fairly rigorous selection and if you look at some of the latest projects in the US they are talking about a very, very rigorous selection. [...] I think the selection is good and right and necessary, it's just the time associated with it that's the problem [...] I think you could ask any researcher about going through the peer review process [...] this is a particularly a statement for EPSRC because they do things differently in the other research councils, which have no less selection although perhaps rather more targeted communities. I think certainly the feedback we get is a sense of frustration with the EPSRC process" (service provider)

4.8.1 Enablers

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Chapter 5

Organisation of Disciplines

5.1 Epistemic Traditions

5.2 Career Structures

5.3 Collaboration

5.4 Publication

5.5 Research Programmes

5.6 Multidisciplinarity

5.7 Silo-ed Communities

5.7.1 Relationship between e-Science and HPC[1]

There is only a limited overlap between communities involved in e-Science and in HPC, limiting the knowledge transfer and collaboration. Furthermore, the ways of accessing resources differs, where grid resources are becoming easier to access (both in terms of gaining access and in terms of usability), whereas the ways of accessing top-end HPC resources remains unchanged. There may be a vicious circle at work where it is currently not worthwhile for HPC service providers to grid-enable their resources because of a lack of immediate demand and, on the other side, a lack of accessibility of resources. At the same time, the highly regulated nature of top-end resources means that the number of users is going to be comparatively small, so the more scalable and easier to use mechanisms being developed in the e-Science community are not needed as urgently.

> **Example 5.1**
> "I think that the HPC and the e-Science Communities are pretty fractured at the moment with only a relatively small number, I mean a very small number of individuals actually crossing from one to the other or having a foot in both camps and that the HPC Communities are largely happy with the current access methods to the facilities and not really making much of a call for some of the tools and techniques for access that have been pioneered and developed in the e-Science Community. [...] So I think certainly on the computational side it really comes down very firmly

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[1]This content is available online at <http://cnx.org/content/m20968/1.3/>.

to the free for all type culture that exists in the e-Science side of things and the highly regulated, highly selective for the top end HPC" (service provider)

Example 5.2

I'm not entirely sure, I mean this is an issue that we have struggled with over the last few years because while there are one or two literally one or two users who have asked for common access methods in essentially things like the NGS software stack on [large HPC resources]. [...] it costs us as a Service Provider quite a lot of effort to put this up, to maintain it and uptake is very low so [...] we don't really want to put a lot of effort into something that's not being used by users.

It is not clear that there is a problem with access mechanisms for HPC resources for existing users as they tend to have the necessary expertise and as they tend to use a single machine at a time. However, there are users who need access to different types of resources for different purposes and need them to work in conjunction with each other to solve a large-scale overall problem. It is here that the issue of how HPC resources are accessed can become an issue.

5.7.1.1 Enablers

- Changes in funding policy could drive an alignment between the grid and HPC sectors. The US TeraGrid[2] might provide an example for this.

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[2]http://www.teragrid.org

Chapter 6

Individuals

Chapter 7

Organisational Issues

7.1 Rate of Change

7.2 Relationships

7.3 Financial

7.4 Provisions for Curation

7.5 Labour Market

7.6 Support

7.6.1 Information Services Support Provision[1]

Information services departments often do not provide support specifically for e-Research. Large research-oriented universities tend to have research computing departments, computing centres or e-Science departments that fill this role but even in these such groups can be relatively small and lacking institutional support, being dependent on the acquisition of research grants. Where support for research is not strongly supported by institutions in their general IT strategy, problems can arise for information services staff working to help researchers utilise e-Infrastructures:

> *"unfortunately, this general strategy seems to change very, very quickly. That might be because the strategy isn't well thought out or it doesn't cover the things we actually would need to do or it's missing foresight." (information systems staff)*

A member of another information services department raised the issue that departments like theirs are not necessarily equipped to provide hands-on support for research applications:

> *"within information services 20 or 30 years ago it was the case that people [...] had the skills [...]; information services I'd say has become more focused over the last few years on technical support, and I would say that application support has lost out."*

7.6.1.1 Enablers

- Central support for e-Research needs to be developed within many institutions, with institutional funding for at least a core team.

7.6.2 Consideration of IT at proposal stage[2]

Researchers often do not consider their computing needs when they write grant applications. As a result, grants often either lack budget headings for research computing or they contain capital expenditure items but lack funding for the necessary development and support activities. Often, researchers approach research computing departments or information services only once a grant has been awarded, missing the opportunity to consult with them earlier, when their input can be most valuable.

> *"The big problem we face is people write their proposals, run into problems, come to us, but in their proposal there was never anything mentioned about computing support or visualisation support" (information services staff)*

Respondents commented that there is a lack of awareness of the existence of many groups supporting e-Research that hinders the early facilitation needed. There can even be a lack of awareness within the wider information services departments of their existence and role:

> *"we should in theory be contacted via the University IT support. Unfortunately, at this time [...] we have still the problem that faculty IT support doesn't necessarily know about [us]" (information services staff)*

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[1]This content is available online at <http://cnx.org/content/m24634/1.1/>.
[2]This content is available online at <http://cnx.org/content/m24635/1.1/>.

7.6.2.1 Enablers

- There is evidence of very active and routine user engagement in some institutions that can help raise the awareness amongst researchers of e-Research support:

  "information services has [...] academic liaison directors whose task it is to speak to the users and their colleges. [There are] monthly stakeholder meetings, and [liaison staff] go out and meet with the research groups." (information services staff)

  Clearly, active user engagement by research computing services has the potential to overcome the lack of awareness discussed above.

7.7 Access to Services

7.8 Institutional Context and Culture[3]

Differences in institutional cultures and the context in which insitutions operate may may give rise to factors that inhibit the uptake of e-Infrastructure services.

Example 7.1

"You might find that there are cultural differences with different institutions. Institutions like [institution] have people from all over the world who have experience of many different approaches different ways of doing things. So you might find that there's a richer approach to using different approaches here than maybe a University that has more of a local market or a local research establishment. However [institution] may also be fragmented in the way it approaches things, in which case you might find one group doing something very good and another not aware. [...] So I think that there are probably cultural differences in universities." (information systems professional)

Chapter 8

Ethical and Legal Issues

8.1 Data Protection

8.1.1 Conditions for Access to and Use of Datasets[1]

A number of researchers commented on the legal and ethical issues in relation to conditions applied for the access and use data and on various ways in which these might inhibit the research process. In many fields, the sharing of data is subject to policies, which are designed to protect confidentiality and IPR (e.g., where commercial collaborators are involved). In some cases, these policies were seen as being too restrictive. In some cases raised by respondents, licensing policies are still in their formative stages, limiting the ability to share data. This posed a problem for medical researchers in particular: "W

> "have spent endless hours, essentially one person full time on a big collaborative project negotiating these issues [...] the fact that there is no national policy has cost us [...]" (researcher)

8.1.1.1 Enablers

One of the solutions suggested was to move the computation to the data:

> "you could use other people's data but not necessarily download it, its licence agreement kind of allowed it. And then you could run your model regardless [...] you could just get the results from the model and that sort of thing so there was a lot of discussions on how to deal with that as well." (researcher)

8.2 Software Licensing

8.3 Protection of Research Subjects

8.4 Intellectual Property Rights

Chapter 9

Project Management

Chapter 10

Presentation / Public Engagement

10.1 Success Stories

10.2 Use Cases

10.3 Paths to Adoption

Chapter 11

Crossing Boundaries

Chapter 12

Infrastructures

12.1 Middleware Maturity

12.2 Heterogeniety

12.3 Capacity

12.4 Support

12.5 Operating Environment

12.6 Role of Computing Services

12.7 Security Restrictions

12.7.1 Procedure for Acquiring and Managing Certificates[1]

A number of researchers commented negatively on the procedure for acquiring a UK e-Science certificate. The process of acquiring a certificate and managing it is quite fundamentally different from the normal ways in which researchers gain access to resources within their institutions as well as in other contexts. The overall process gives rise to a number of inhibitors at different stages but our interviews indicate that the first step of acquiring a certificate is the main hurdle that many researchers do not pass.

We found evidence that practices for issuing certificates differed from one registration authority to another, with institutions adding to the complexity of the process:

> "we will only issue certificates to members of the university [...] we will only issue certificates to people who we have some reason to believe might possibly have some good reason to have a certificate [...] if an undergraduate comes along and says I want an e-Science certificate, our first question would be 'why?' [...] we need authorisation from your director of studies for that" (information systems staff).

Ironically, the effort involved in obtaining a certificate leads to a security problem:

> "you create an incentive for the users to behave badly and we've seen this, we've come across users sharing certificates and stuff like that." (information systems staff)

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[1]This content is available online at <http://cnx.org/content/m24689/1.2/>.

12.7.1.1 Enablers

- The NGS is now using the model of a 'roaming RA' to simplify the process of issuing certificates by singing up groups of researchers at the same time and in their normal work environment.

12.7.2 Authentication Mechanisms[2]

Researchers complained about the need of using different passwords for different services. Clearly, some unified form of authentication is required. Athens is a partial answer to the problem but the sign-up process and the need to remember and periodically renew passwords make it less than ideal.

The move towards Shibboleth-based authentication will address many of these issues and efforts are underway to integrate Shibboleth and the UK Access Management Federation with traditional certificate-based security mechanisms. Other models such as community gateways were mentioned but there are significant issues with authorisation and accounting where the resource provider does not know the identity of the requesting user.

While Shibboleth and the UK Access Management Federation offer a potential solution for many authentication scenarios, they are not without their problems. Respondents from information services raise issues about scalability:

> "at the moment, there is this huge XML file that has to be passed round which is here's everybody that the UK Access Federation knows about" (information services staff)

The respondent also commented that there should be drop-in plug-ins for commonly deployed systems:

> "[for example, for] IIS, for Apache and for Tomcat. So that it's a simple drop in install for an ignorant webmaster, oh I run Apache, right, what do I do to get Shibboleth, well it should be double click on this." (information services staff)

12.7.3 Authorisation[3]

Authorisation provides the definitions of what resources a researcher can actually access once they are authenticated (i.e. their identity is established).

In a grid environment, the possession of a certificate does not normally equate to gaining access to a protected resource. The division between authentication and authorisation is unusual from a user's point of view as it differs from the familiar model of gaining access to a system by obtaining a password for it. While in the long run mechanisms such as certificates or single sign-on systems provide benefits, they often require an initial effort that is not immediately rewarded by gaining access to a resource.

Several issues were mentioned concerning the need for registration in order to access services, the lack of standardised rules and systems to access services and the lack of group access to services for teaching purposes:

> "I know there has been a barrier for me and also for a lot of users which is the requirement that you register before you can download anything from the [service] and [...] a lot of people just give up before they download stuff." (researcher)

12.7.4 Trust in Distributed Systems[4]

The flipside of practical issues with authentication and authorisation is the lack of trust in the security of distributed computing systems that is often observed:

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[2]This content is available online at <http://cnx.org/content/m24690/1.1/>.
[3]This content is available online at <http://cnx.org/content/m24708/1.1/>.
[4]This content is available online at <http://cnx.org/content/m24720/1.1/>.

> *"other projects (not necessarily medical ones, but also engineering ones) where the organisations involved saw the Grid as [a] great looking solution but didn't want their data to leave their network [...] it has happened before where companies involved didn't want to go beyond some toy examples, despite the project being able to solve a lot grid related problems."*

The lack of strong assurances about security and confidentiality in general e-Infrastructures for research means that research with sensitive data often has to be carried out in secure environments ('data enclaves'):

> *"if we want to link individual level data and link things like census data and council registries then we need to have names and addresses."*

To date there are no generic mechanisms and organisational arrangements that make work with sensitive data possible at a reasonable cost while complying with data protection legislation and relevant regulatory regimes.

12.7.4.1 Enablers

Practical arrangements can sometimes be made that allow some processing to be carried out outside these secure settings, e.g., through the use of artificial identifiers (or pseudonyms):

> *"have you heard of pseudo-anonymisation where you create an ID from a name and address, for example, and then those pseudo-anonymised IDs can be [...] kept in a very secretive file."*

12.8 Digital Divide

12.9 Dependability

12.10 Rate of Change

12.11 Ease of Access

12.11.1 Availability of Access Grid Nodes and Overheads in Arranging Meetings[5]

Running effective Access Grid Meetings requires access to properly maintained Access Grid nodes. The most effective way of using the Access Grid is through room-based nodes, especially when more than one person is joining the meeting from a site or when a larger number of participants are taking part overall. However, the best maintained room-based nodes are often also the most heavily used ones, limiting access to the Access Grid. In addition, running a successful meeting requires some expertise in managing a session but institutions often struggle to make support arrangements. As a consequence, even when nodes are available, usage can be limited by the lack of local support.

As a consequence, organising Access Grid sessions can be difficult as this involves securing access to a number of different nodes for participants in different locations. Arranging a meeting requires the coordination of these technical and organisational resources as well as the coordination of participants.

Example 12.1: Lack of availability

> *"I would love to be able to use AGN from my PC with a webcam the same as in the lab if possible. One of the big barriers to collaboration is organising meetings and the bigger the group the more difficult it gets to organise a meeting."* (researcher)

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[5]This content is available online at <http://cnx.org/content/m20185/1.6/>.

Example 12.2: Lack of local support

"they won't let us use the node if there's not someone on site trained to drive it was the bottom line, they weren't in the situation for quite some time to be able to provide someone to drive it, so it was a bit of a catch twenty two for us. I think the node here, there was an attempt to try and make it pay for itself or make it generate money, and people stopped using it and therefore the service was very sketchy but we were still quite reliant on it." (researcher)

Example 12.3: Effective access determined by lowest common denominator

"we also use Access Grid only with those that we know there is a very good Access Grid support, so it's wonderful for our collaboration with [other university] and with [other university], it works brilliantly for our collaboration with [other university], but all of those centres have very good support. [Other university] isn't using it anymore, they have dropped it, so we are not using it with [them] anymore." (researcher)

12.11.1.1 Enablers

- It is possible to install a small Access Grid node on an ordinary desktop computer with a camera, speakers and microphone. IOCOM[6] offer a desktop version of their Access Grid software and the Access Grid Toolkit[7] provides a free alternative.
- Researchers at the University of Manchester a building a Portlet Access Grid[8] , that allows Access Grid sessions to be initiated from a web browser.
- The Access Grid Booking System[9] provided by JANET in the UK provides a way to book Access Grid nodes and to schedule meetings. However, it does not cover all cases, e.g., rooms may need to be booked locally or may have other constraints imposed on them.

12.12 Scale

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[6]http://www.iocom.com
[7]http://www.accessgrid.org/
[8]http://www.rcs.manchester.ac.uk/research/PAG
[9]http://www.jvcs.ja.net/cgi-bin/grid/welcome.cgi

Chapter 13

Applications

Chapter 14

Standardisation and Alignment

14.1 Reverse Salients

14.2 Lock-In

14.3 Adoption

14.4 Compliance

14.5 Certification

14.6 Timeliness

14.7 Quality

14.8 Evolution

14.9 Identifying Generic Functionality[1]

Economies of scale can be realised where effort invested can be reused. While, arguably, the mechanics of software reuse are relatively well understood, identifying just what is and what is not generic and how generic components can be adapted to specific purposes, remains a challenging task.

> "the amount of work that you have to put in to getting something that works for [a service] for example I mean they have a very different access model to HPC and you know if you're going to have a sort of common look and feel to both to them I think you may struggle and you'd struggle to get something that was workable and met the needs of the different communities and they're very significant practical issues." (service provider)

> "what I fear is that the e-science software so far has been too focused on building general infrastructure and maybe they better off solving, fewer, smaller [...] problems but at least solving them properly [...] rather than try to write something so general that everybody should be able to use it but in the end no one will use it." (researcher)

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[1]This content is available online at <http://cnx.org/content/m21218/1.2/>.

Chapter 15

State of the Art

15.1 Algorithms

15.1.1 Parallelisation of Code[1]

Developing correct and efficient parallel code for research applications remains a challenging task that is being exacerbated by the increase in potential parallelism supported by modern computer architectures. The emergence of multi-core and multi-threaded CPUs means this has become an issue even in applications running on commodity hardware. The problem is even more pronounced in cluster and HPC systems.

> **Example 15.1**
>
> "we've sat on the back of Moore's Law for the last forty years and sort of expected [that] processors would get twice as fast every 18 months or so and that's simply stopping. The approach of going down the multi-core route means that if you're going to solve the computational problems of a decade's time you're not going to be able to do it on 100 or 1000 processors you're going to be looking at 10,000 or 100,000 processors and frankly if you look at the code-base they don't scale so the numerical tools for example that we have today need a thorough overhaul and that's an enormous task. You know if I look at [a large-scale HPC service] alone I mean we've got some 20 codes on [it] in general purpose use in the chemistry area alone so I think there's a real challenge there and it's not just for the UK but how to move the code base forward to have algorithms that really meet 21st Century needs." (service provider)

15.1.1.1 Enablers

Collaborations between HPC experts and researchers as well as key enablers such as mathematicians can help to develop new computational codes that scale better to modern architectures. Where possible, these should be factored into reusable libraries that can be taken up across a range of disciplines but it may well be that the best way to parallelise code is application specific.

> [We have a programme to] develop a set of numerical techniques targeted key application areas that will be designed to scale and then ways in which we can guide the compilers actually to get better performance out of these new codes [...]. More generally than that we're engaged in specific research projects looking at specific codes or specific sets of codes for key research areas to try to solve the scaling problem and develop, you know, new techniques and the challenge

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actually of course is that the new techniques that we have to develop are radically different in some cases from the ones that we've had for the past 20 years because of the need to not simply look at one narrow slice of a problem but you need to look at the problem in their own [right] so if you're designing an aircraft wing, in the past we've split it up in a way that you'd have one set of people or one set of codes looking at the structural integrity of the wing and another set of people and another set of codes looking at the airflow over the wing whereas actually you know that you want to combine them because different airflows could produce different strains on the wing and therefore different issues for structural integrity and so on and so forth so there is a lot more thrust towards inter-disciplinary working that we have to drag together and that just makes the computational task much harder." (service provider)

15.2 Managing Distributed Systems

15.3 Software Engineering

Chapter 16

Digital Resources

16.1 Discovery

16.1.1 Data Discovery[1]

In the idealised research process, the data collection phase marks the beginning of the data lifecycle. For many researchers, however, data collection is complemented or even substituted by the discovery phase where a search is conducted to see if relevant datasets already exist. For example, repositories such as the UK Data Archive, Mimas and EDINA provide a vast range of datasets to the social science research community. Respondents confirmed that these services are perceived as being very valuable but that they also feel the discovery process is not always effective or reliable. In a number of cases, it was the quality of metadata that was a key concern:

> "it is quite difficult to find all the data that exist [...] There is metadata there to be sure but you cannot query it in a way we want, that would facilitate the research, because it's a laborious part of the research which is not that exciting. So a better metadata and better ways of searching the metadata is what's needed there." (researcher)

16.2 Metadata

16.2.1 Metadata, Standards and Semantics[2]

Access to datasets is often hindered by a lack of agreement within research communities on data and metadata standards:

> "people do not use controlled vocabularies, and ontology, that also causes difficulties sharing data, because meanings of the terms used [...] are different from individual to individual or even the same individual on different trials, they may use the same word to mean different things. That was the biggest problem we identified." (researcher)

There are often problem associated with defining an appropriate scope and level of detail. These kinds of problems also often play out in discipline specific ways:

> "in terms of dealing with relatively complex data and relatively complex analytical techniques, at least complex to the perspective of social scientists, there is this basic tension between describing things clearly and from an introductory level and having enough space to go into the more details, detailed output." (researcher)

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[1] This content is available online at <http://cnx.org/content/m24711/1.1/>.
[2] This content is available online at <http://cnx.org/content/m24733/1.2/>.

16.2.1.1 Enablers

Disciplinary initiatives are required to for the development of common agreed vocabularies and ontologies. Developing these is often a long-term project that requires the establishment suitable structures spanning institutional boundaries and defined by common interests of researchers working in a particular research area.

> "[The] solution [...] was the development of common data element and the use of agreed controlled vocabularies. That is something that's done by some research communities, for instance, gene expression research community formed a society, the MGM society to agree what meta-data to collect [...] the US National Cancer Institute has developed a source that developing to be as comprehensible as possible in anything to do with cancer research [...] So I have been involved in forming an international society to deal with anti-body therapy again to try and develop data standards and models for use in describing research data can be shared effectively, which is a much more complex thing because there are multiple parameters [...] to deal with." (researcher)

16.3 Curation

16.3.1 Curation in Research[3]

Curation, i.e., the preservation, archiving and maintenance of digital resources for future use, is becoming an issue that researchers are increasingly expected to grapple with. For example, if new (or derived) datasets are to be discoverable, researchers must prepare them for deposit according to accepted standards. However, curation of existing data is not an activity that researchers would normally define as part of their role:

> "some researchers are a little concerned that putting either research papers or data in an institutional repository [...] they're worried that that will increase their workload [...] that will slow them down and take them away from actually [...] conducting research which is what they see their role as." (information services staff)

16.3.2 Repositories[4]

The funding of institutional and discipline specific repositories and associated curation efforts has been flagged as an issue by a number of respondents. Perceptions of what level of support is needed differ quite widely, with some researchers suggesting that what they need is bulk archival storage while others point to the complexity of their data and discipline specific ways of managing and using it. One respondent commented that a service provided

> "fairly rapid access back again but that comes at a cost premium so we didn't go for it." (researcher)

Another respondent pointed to discipline specific needs to have not just bulk data storage but a service that forms the heart of a community of users of data:

> "the main need we hear of that we should be able to help with is storing large quantities of data and curating it for humanities researchers, and it's obviously a new problem since the end of the data service was announced [...] it obviously provided a facility but it also built a community because the people sharing it would naturally get to know each other, be introduced to each other, which we can't really do, or only on a smaller scale." (information services staff)

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[3] This content is available online at <http://cnx.org/content/m24758/1.1/>.
[4] This content is available online at <http://cnx.org/content/m24765/1.1/>.

Another respondent commented on the lack of adequate financial support, which makes proper curation infeasible:

> "Another barrier is the long term support of databases [...] research funding bodies are proved to be quite reluctant to do that, the US government and NIH has been the best by quite a long way, and the European Union does help through European Bioinformatics Institute, the other major funders want scientists to share data but they are not showing enough evidence to me that they are actually putting money into a resource in which it can be shared." (researcher)

One respondent pointed to the problems that depositors face owing to current repository practices not being 'user-centric':

> "Repositories tend to provide a view of the world which is very much the librarians' view [...] it emphasises the description of an item rather than the item itself [...] we have tried to make the actual files or documents themselves [...] much more at the heart of dissemination process, rather than the metadata, the title or the abstract, the authors, all those kind of things which are given much more priority in the librarian standard view of how a repository should operate." (researcher)

16.4 Sustainability

16.5 Quality

16.5.1 Data Quality and Usability[5]

Most kinds of automated data manipulation and analysis require data to be of good quality, regular, well-defined and well-described. Very often, though, data in the Arts and Humanities, the Social Sciences and in Medicine (e.g., hospital records) is highly irregular, lacks adequate metadata and is of varying quality. Consequently, automated processing cannot be applied without further effort, workarounds or methodological compromises. For example, one researcher said:

> "[our project] kind of died a death because the data which was available wasn't good enough to use any of the tools that social scientists [use] to look at the data, to manipulate it because the nature of the data is that it is fuzzy, it is not scientific data. [...] that is on hold until we can get better data."

Data that is made available for research is often anonymised, for example, by removing, restricting or aggregating variables, which makes it less useful for research. A social researcher remarked:

> "in my view some of the survey data is unnecessarily reduced in its detail, sometimes I can fully understand why [...], sometimes I don't think it's necessary." (researcher)

16.6 Access

16.6.1 Access Regulations for Data Sets[6]

Access to datasets is often regulated for a number of reasons such as ensuring adequate usage, because of licensing issues or simply to keep track of usage.

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[5]This content is available online at <http://cnx.org/content/m24736/1.2/>.
[6]This content is available online at <http://cnx.org/content/m20184/1.3/>.

Example 16.1
 Even where datasets are generally available, there may be a requirement for researchers to notify
the data archive of their usage. Such notifications are often dealt with on an individual basis, so
where a group of people need access to a dataset for research or teaching, the process of registering
a particular usage needs to be repeated. Changes in the regulations place an additional burden on
researchers, lecturers and students.

*"The one thing, one aspect of working with UK Data Archive that produces challenges in the sort
of things that I am involved with might be in to do with sharing datasets between people and
indeed using datasets in teaching examples and in undergraduate and postgraduate workshops
that I am involved in training, training people to use specials survey datasets, special survey
datasets, [I: is the sharing problem, sorry] the process of instructing people how to individually go
about accessing the files and ensuring that people are allowed to access the same files individually
and in order to give the data to other people essentially, the process of doing that it changes, the
instructions that you need to pass on to people regularly change over time and that could make
it a relatively challenging thing and the expectation that every one is able to access the same
services, you know, well to me, that's the relatively minor problem in itself but if you think of
whether there is a room for improvements." (researcher)*

16.6.2 Heterogeneous Data Formats[7]

The existence of heterogeneous data formats can cause problems both for researchers and for service providers.
A social scientist respondent remarked:

"it's getting the stuff in a format that you actually know what to do with it." (researcher)

Another respondent lamented the lack of

*"common data formats so that you don't have to know a hundred data formats [...] there is a
need for core data services which serve fairly raw data and also value added services [on] top of
that, that package up the data in a way which could be more valuable for certain clients [...] you
just get the data that you need in a format that you expect it." (researcher)*

A member of information services discussed the problems of providing support for researchers working with
very different datasets:

*"I suppose the problem is that it's a complicated area, different people have data which is
structured differently, and I suppose we're grappling with whether you can give generic advice or
if it's got to be discipline specific or if it's got to be indeed project specific." (information services
staff)*

16.7 Semantics

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[7]This content is available online at <http://cnx.org/content/m24734/1.1/>.

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e-Research Community Engagement Findings

A collection containing findings from the JISC Community Engagement projects ENGAGE and e-Uptake (www.engage.ac.uk). The aim is to make the material available to a wide range of stakeholders in a form that enables them to analyse and repurpose it. The material from the e-Uptake project is based on over 100 interviews with researchers and with 'intermediaries', people working on the provision and support of e-Infrastructure services, e.g., in information services departments or e-Science centres.

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