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The UK e-Social Science Research Programme: A Progress Report

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Abstract

The National Centre for e-Social Science (NCeSS) was established by the Economic and Social Research Council (ESRC) in 2004 as its key contribution to the UK e-Science programme. In this paper, we review the progress of the NCeSS programme towards its objectives and outline various initiatives which the programme has undertaken in order to pursue its goals. This provides the background for a discussion of how our understanding of e-Social Science – and with it how the research 'roadmap' – has evolved in the four years of the programme's existence. We conclude by reflecting on experiences of doing the 'translational' work that needs to be tackled for the NCeSS programme to be a success.

Introduction

Stimulated in equal measure by dramatic increases in the volume of the data being collected, by new and more complex research challenges and by the availability of increasingly powerful computational facilities, significant innovations in research infrastructure are beginning to emerge. The core NCeSS objective is to enable social scientists to make best use of these innovations ('e-Infrastructure') to develop new methods and to address the key challenges in their research fields in new ways. Pursuing this objective contributes to the ESRC's mission, which is to develop the world-class social scientific infrastructure that is essential if the UK is to remain a centre of excellence in economic and social research.

NCeSS aims to stimulate the uptake and use across the social science research community of distributed computational resources, data infrastructures and collaboration mechanisms by co-ordinating a programme of e-Social Science research, making available information, training, advice and support to the social research community, and leading the development of an e-Infrastructure for the Social Sciences that will provide new resources and tools for social research. The Centre is also responsible for providing advice to the ESRC on the future strategic direction of e-Social Science.

The NCeSS research programme is designed around two main strands. The ***applications strand*** aims to stimulate the uptake and use by social scientists of e-Infrastructure in order to make advances in quantitative, qualitative and mixed-methods economic and social research. The ***social shaping strand*** aims to understand how e-Science, including e-Social Science, is being developed, how it is being used and what its implications are for scientific practices and research outcomes. 'Social shaping' is defined very broadly to include all social, economic and other influences on the genesis, implementation, use, usability, immediate effects and longer-term impacts of the new technologies.

In Phase One of the NCeSS programme, the foundations have been laid and evidence of impact is beginning to accumulate. Research has been enabled that would have been impossible without the innovations in e-Infrastructure and methods that NCeSS programme members have developed. Progress has also been made in creating pathways which will facilitate the transfer of these efforts by the pioneering minority (the 'early adopters') to the wider social science research community. This has involved raising awareness of e-Infrastructure and tackling the barriers which might otherwise discourage or slow down adoption. In taking forward its research programme into Phase Two and beyond, NCeSS faces a number of important challenges.

In this paper, we review progress in Phase One. We then outline some of challenges NCeSS faces as it moves forward into Phase Two and how they might be tackled. In particular, we stress that while the programme will continue to seek to work with the early adopters to achieve advances in leading edge social science research, its impact will be measured by the progress the programme makes in bringing these advances in methods and tools to the wider social science research community.

NCeSS Phase One Overview

In 2004 the ESRC announced the formation of the National Centre for e-Social Science with funding of £6M for a first phase over the period 2004-2007 and funding for a second phase contingent on the outcome of a review. The Centre was to be structured around a co-ordinating Hub, a small number of large (£500K) projects or 'Nodes' and a larger number of smaller (£50K) projects. Subsequently, the Hub was awarded to the University of Manchester and seven Nodes commissioned:

- The Collaboratory for Quantitative e-Social Science Node (CQeSS: Lancaster University and Daresbury Laboratory) aimed to develop tools and services to advance the state of the art in quantitative methods. It focused on developing middleware that would allow users to exploit distributed research resources such as datasets and more powerful computational facilities while continuing to be able to employ their favourite desktop analysis tools (Crouchley et al., 2005; Grose et al., 2006).
- The Mixed Media Grid Node (MiMeG: Bristol University and King's College, London) focused on developing tools to support distributed, collaborative video analysis (Fraser et al., 2006; Tutt, Hindmarsh et al., 2007; Shaukat and Fraser, 2007). Digital video has become an invaluable tool for social scientists to capture and analyze a wide range of social action and interactions. Video-based research is increasingly undertaken by research teams distributed across institutions in the UK, Europe and worldwide but there was little existing technology to support collaborative analysis.
- The Modelling and Simulation for e-Social Science Node (MoSeS: Leeds University) aimed to develop a suite of modeling and simulation tools for application in policy making (Birkin et al., 2005; Birkin et al., 2007; Townend et al., Wu, 2007). The chosen policy applications drivers were healthcare, transport planning and public finance. Social science problems of this type are characterized by a requirement for extensive data integration and multiple iterations of computationally intensive scenarios.
- The Digital Records for e-Social Science Node (DReSS: Nottingham University) sought to develop new tools for capturing, replaying, and analyzing multi-modal digital records of people's activities (Crabtree et al., 2006; Crabtree et al., 2006;

Greenhalgh et al., 2007; Knight et al., 2006). Social scientists worked in close partnership with computer scientists on three substantive research driver projects in order to explore the salience of new forms of digital record for research and to determine requirements for tools.

- The Geographic Virtual Urban Environments Node (GeoVUE: University College, London) focused on developing geographical information systems (GIS) tools and research environments to enable users easily to map and visually explore spatially-referenced socio-economic data (Batty et al., 2006; Milton and Steed, 2007). Driver applications included urban planning and design.
- The Semantic Grid Tools for Rural Policy Development and Appraisal Node (PolicyGrid: Aberdeen University) brought together social scientists with interests in rural policy development and appraisal with computer scientists with experience in Grid and Semantic Web technologies. The objective was to explore how Semantic Grid tools (Chorley, Edwards and Preece, 2007; Hielkema et al., 2007; Pignotti, Edwards and Preece, 2007) could be used to support social scientists and policy makers using mixed-methods research techniques (e.g., surveys and interviews, ethnographies, case studies, simulations).
- The Oxford e-Social Science Node (OeSS: Oxford University) addressed the inter-related social, institutional, ethical, legal and other issues surrounding e-Infrastructures and research practices. The focus was on confidentiality, privacy, data protection, intellectual property rights, accountability and trust and risk in distributed collaborations (Axelson and Schroeder, 2007; Carusi and Jirotka, 2007; Dutton, 2007).

Under this first tranche of research funding, twelve small grant projects were also commissioned.[1]

Node Research Themes and Synergies

The Node awards can be broken down into six applications strand Nodes and one social shaping strand Node, although it is worth remarking that all applications strand Nodes addressed social shaping issues (e.g., usability) in their work plans. Of the applications strand Nodes, the majority (MoSeS, PolicyGrid, MiMeG and CQeSS) had data analysis tools as their main focus and one (DReSS) had data collection and management as its main focus. A more detailed analysis of Node research themes (as defined in the call for Node submissions) is shown in Table 1. Unsurprisingly, because of their established use of computing, quantitative methods (i.e., statistical analysis, simulation and high performance computing) figure quite prominently in the Node themes whereas qualitative methods figure less prominently. Table 1 also reveals an interesting gap in this first phase of the NCeSS programme with the absence of any contribution to the text/data mining theme.

Table 1 suggests a significant number of potential synergies between the Nodes. For example, DReSS and PolicyGrid form a cluster around data description / discovery / management/re-use; CQeSS, DReSS, PolicyGrid and MoSeS form a cluster around quantitative methods and, within this cluster, CQeSS and MoSeS form a mini-cluster around high performance computing and MoSeS and PolicyGrid form a mini-cluster around simulation. Similarly, a cluster (MiMeG, DReSS, PolicyGrid, GeoVUE, OeSS) exists around the theme of collaboration.

[1] See http://www.ncess.ac.uk/research/sgp/ for details.

	Data infrastructure			Data analysis								Collaboration		Social shaping				
	Datasets from multiple sources	Data description/discovery/management/re-use	New sources of social data	Quantitative methods	Simulation	High performance computing	Tools integration, user portals	Visualization	Text/data mining	Qualitative methods	Mixed methods	Collaboration tools	Inter-disciplinary collaborations	Usability	Confidentiality	Sustainability	Social, economic and other determinants	Implications for nature and practice of science
CQeSS	+			++		++	+					+		+				
MiMeG										++		++		+				+
DReSS	++	++	++	+			+	+		++	++	+	++	+				+
PolicyGrid	+	++		+	+		++			+	++	++	++	+				+
MoSeS	+			++	++	++		+					+	+	+			
GeoVuE								++				+		+				
OeSS			+									+	+		++	+	++	++

Table 1: Node research themes, Phase One.

Promoting Programme Synergies and Outreach

Theme clusters are important to the NCeSS programme for strategic reasons. NCeSS is a managed programme where the objective is not only to ensure that research projects individually achieve their potential but also that they work effectively together, that collaborations and synergies flourish and that, collectively, the programme is able to establish partnerships with the wider e-Science community in the UK and internationally. A problem of research programmes is that individual projects often find it hard to release the effort to take on the additional burden of collaboration. As we will consider later, communication appears to be a key issue for the success of interdisciplinary projects, but this has to be complemented with resources if collaborations between programme members are to work in practice.

In NCeSS, alongside administrative arrangements introduced to foster synergies and cooperation between the Nodes, the most effective measure has been to initiate a joint project that provides motivation and a focus for collaborative activities by the Hub and Nodes and, most importantly, funding for them. This is the e-Infrastructure for the Social Sciences Project (Daw et al., 2007). Its main objective is to deploy demonstrators selected from the research resources being developed within the Nodes and Small Grant Projects. In this way, the project aims to:

- provide a platform for disseminating the benefits of e-Social Science to the wider social science research community;

- enhance understanding of issues around resource discovery, data access, security and usability by providing a test bed for the development of metadata and service registries, tools for user authorization and authentication, and user portals;
- lay the foundations for an integrated strategy for the future development, support and sustainability of e-Social Science infrastructure and services.

By providing the Nodes with the motivation and resources to work together, the e-Infrastructure project has proved an effective response to the challenges of promoting synergies across NCeSS and other ESRC investments, and of coordinating activities and identifying areas in which to promote the benefits of common policies and technology standards.

Challenges for Phase Two

Today, four years on from the foundation of the NCeSS programme, being an 'e-Social Scientist' is still far from a routine undertaking and it carries a significant amount of risk. The pursuit of the objectives of the NCeSS programme is still largely 'work in progress' and the Centre faces a variety of challenges, such as the lack of experience with the technologies involved, uncertainties about the development paths of these technologies, doubts about the future sustainability of both resources and technologies, concerns that the technologies impose epistemological constraints on research that are inappropriate to the social sciences, cultural resistance to innovations in the social organization of research, and problems in managing processes of change on both large and small scales.

Widening Adoption

From the beginning of the NCeSS programme, it was evident that the most important of these challenges would be to translate the innovations generated by early adopters within the programme first to the 'interested' and subsequently to the 'unengaged', and through this bring about the wide adoption of e-Infrastructure across the broader social science research community.

The *early adopters* are largely already part of the NCeSS programme and are keen to push to the limit what e-Social Science makes possible. The Hub supports early adopters by facilitating networking and encouraging the sharing of technical expertise. The e-Infrastructure Project is playing an important role in this.

The *interested* form the test-bed for e-Social Science applications. In return for their assistance in helping to identify requirements, NCeSS offers them demonstrators of how e-Infrastructure might aid their research. NCeSS also supports their adoption of new tools and services (produced by early adopters) and monitors their experiences to feed back into the development process. The Hub has used an action-oriented ethnographic approach in a series of small-scale case studies to understand the needs that arise in the everyday research practices of the interested and, in parallel, promoted e-Infrastructure developments to address their needs.

Not all of the *unengaged* have the same view of e-Infrastructure. Some simply do not know what is available (Lin et al., 2007), and they are the target of NCeSS's awareness-raising efforts that again employ demonstrators to illustrate the potential of new tools and services. Others are aware but do not have the time or inclination to invest in new ways of working. Yet others are epistemological sceptics, believing that any use of computational tools taints the resultant social science. These will be the hardest to win over.

Even the more tractable of the unengaged will adopt new tools and services only when these are 'hardened' to production level (that is, become easy to use, stable, documented and supported); when they offer immediate benefits that quickly outweigh the costs of learning to use them; and when they complement existing research practices. Only when NCeSS has moved beyond proofs of concept, demonstrators and prototypes to near production level tools and services can it begin to engage them. It is the ease-of-use and utility of e-Infrastructure, and its contribution to advancing social scientists' substantive research, that will persuade them to adopt new ways of working, not the provenance of the technology. In this respect, the major breakthrough in wider adoption of e-Infrastructure will be when its e-Science origins become invisible, just part of the normal landscape of research methods. In this way, even the epistemological sceptics can be enticed into the fold.

Understanding and Tackling Barriers to Adoption

Complementing its small-scale, focused studies, the Hub has also been involved in mapping the adoption of e-Infrastructure across disciplines at the UK and European levels. This mapping provides the groundwork to develop mechanisms to tackle barriers to adoption and improve outreach (Barjak et al., 2007; Voss et al., 2007). The e-Infrastructure Use Cases and Service Usage Models (eIUS) project aims to gather and document evidence of how e-Infrastructure is currently being used to facilitate research processes. The Enabling Uptake of e-Infrastructure Services project (e-Uptake) aims to develop strategies for widening adoption of e-Infrastructure. Both projects are funded under the Community Engagement strand of the UK Joint Information Services Committee's e-Infrastructure program.

What this work confirms is that, as with any innovation, barriers that potential users of e-Infrastructure face are numerous and, singly or in combination, they can delay or even prevent adoption (Rogers, 1995; Molina, 1997). For e-Infrastructure to be widely adopted, costs as perceived by users must be outweighed by the benefits. Potential users must be aware of e-Infrastructure, must understand the advantages it can bring to their research, must be willing to invest in new skills, and must have access to the facilities and support they need for successful adoption. At the same time, e-Infrastructure services must be reliable, robust and easily usable if researchers are to be persuaded to trust their mission-critical work to them. Moreover, users must be confident that services will not only continue to be available but also improve in response to their needs so that the benefits increase over time.

Having mapped the adoption of e-Infrastructure and identified how users respond to barriers, strategies then need to be devised that enable uptake, for example, by providing clear and well-supported migration routes. These routes are likely to be different for late adopters drawn from among the unengaged compared with early adopters at the forefront of e-Social Science. Late adopters, for example, may require direct and personalized support in the form of staff development courses (both face-to-face and self-paced on-line learning); specific consultancy to develop new applications to utilize services in novel ways; and a single well-curated source of information about technical components and services, along with exemplars of their use.

As users' requirements mature, their support needs may also change. Moreover, different user communities will be at different phases of the adoption cycle at any one time and so support has to be provided for all phases simultaneously. Explicitly or implicitly, e-

Infrastructure users will go through cycles of evaluating requirements and assessing the appropriateness of services, while providers will go through cycles of improving services and developing new ones to meet emerging needs. Accordingly, potential user communities – and their experiences of barriers and responses to them – are likely to be highly diverse. Extensive, flexible and varied resources will be needed to promote e-Social Science to them effectively. Furthermore, technical and social issues cannot be separated given the dynamic between them – which is the focus of NCeSS's social shaping research agenda. Accordingly, e-Infrastructure adoption will only reach full maturity when social, organizational, cultural, ethical and legal issues are resolved in tandem with the creation of technology-based tools and services. This is the main message of studies of previous efforts to develop large-scale infrastructures: success depends on aligning technical components and stakeholder interests (Edwards et al., 2007).

Sustainability

A variety of factors conspire to make issues about the sustainability of e-Infrastructure impossible to ignore. First, UK e-Science has reached that point in the innovation lifecycle where it must seek engagement with users beyond the early adopters and it is important that the pace of adoption does not falter. To progress, the interested must be supplied with tools and services that meet their needs and they must be supported as they seek to embrace innovative practices, or their enthusiasm will wane. Second, the existence of competing technical solutions can be a disincentive to the adoption of innovations, and recent divergent developments are a cause of confusion within the e-Infrastructure community. Five years ago, the e-Infrastructure technical roadmap was indistinguishable from that of the 'Grid'. Now, however, the rise of Web 2.0 has caused many to consider alternative, more lightweight approaches where sophisticated Grid-based solutions are not required. While this may have the effect of promoting adoption in some quarters, it also carries the risk of deterring others from engaging, at least until a clear technical winner has emerged. Third, if the accumulation, sharing and re-use of resources called for by the e-research vision generates a substantial increase in both the numbers and the types of research resources available, then priorities will have to be established to determine which will receive continued support, given that funding is unlikely to keep pace.

This brings us to a fundamental question for sustainability, which is how research resources originating in time-limited projects can be re-built to production level quality, then curated, maintained and managed so that they remain viable for use by the whole research community in the long term. In particular, where, in a landscape of multiplying, diverse and distributed resources, will the necessary effort and expertise come from, and what funding models are most appropriate to pay for it (Voss et al., 2007b)? Funding bodies are concerned that sustaining the burgeoning body of research resources will consume an ever increasing proportion of their budgets. The existing institutional infrastructure as represented by current service providers and the funding models that support them are in tension with the opportunities that the new technical infrastructure affords. It is time to consider whether a blueprint for a new institutional infrastructure, possibly with a greater number and diversity of service providers, is necessary, but there are few signs as yet that the relevant stakeholders (existing or potential) are ready or able to explore and agree how to best exploit – and fund – the options available to them.

Impact and Its Measurement

Measuring the impact of the e-Social Science programme is vital for planning its future strategic direction. However, evaluating the impact of innovation is notoriously difficult, especially in the short term since results take time to disseminate and their significance may only become clear after a considerable delay. Moreover, impacts do not flow solely from technical advances; these are mediated by a wide range of social, institutional, cultural and economic factors. Impact can manifest itself as improvements in research performance, for example, efficiencies in data integration, or in novel research outputs, such as new findings that could not have been achieved without innovative technologies. In addition, impact in terms of added value obtained from innovations can be economic, social, personal or more diffusely realized. For these reasons, conventional uni-dimensional impact measures (such as peer reviews, citation analyses and other bibliometric approaches) have severe limitations. Other approaches, such as impact modeling, which involves extrapolating from previous trends, are not suited to e-Science because it is fluid and fast changing. The problem is not the lack of data; there exists a deluge of data from sources such as bibliometric databases, e-repositories and the Web. It is the techniques that would enable this abundant data to be transformed into evidence for impact assessments that are not equal to the task.

Measuring impact exemplifies the kinds of challenge that e-Science was devised to address. In this sense, the solution to creating an evidence base for the e-(social) science roadmap lies in its own hands: the use of network analysis, data and text mining to extract and analyze information from extensive sources, within a research programme that will foster the necessary interdisciplinary collaborations. The recently announced NSF Science of Science and Innovation Policy programme represents a very interesting and timely step towards this.[2]

Conclusions

A feature of the current state of e-Social Science is that, despite the substantial investment by the ESRC, its adoption remains piecemeal. Although bids for Nodes and Small Grant Projects obviously had to attend to the strategic direction set out in the specification of the calls if they were to be successful, nevertheless the proposals reflected the interests of the groups who authored them, as they slotted their e-Social Science projects into their ongoing, wider research programs. The upshot is that the outcome of a large-scale e-Infrastructure programme like NCeSS cannot be guaranteed through top-down strategic planning. Instead, many of the Hub's coordinating activities, and especially the e-Infrastructure for the Social Sciences Project, aim to harness bottom-up innovations that are driven by experimentation by the Nodes and Small Grant Projects as they respond to requirements posed by their local, substantive social science driver projects. A future 'Whig history' of the emergence of e-Infrastructure will no doubt identify a clear line of development but the reality along the way is of uncertainty and risk-taking, only some of which will issue in what are later recognized as successes.

In this environment, user capability becomes central, and this requires striving to provide e-Social Science tools and services that enable social scientists to improve their research practices and generate results that would not otherwise have been possible. NCeSS must therefore continue to work very closely with social science researchers to seek out their requirements and it must be catholic in the selection of technologies to meet them, broadening out from the original emphasis on Grid computing. At the same time, it must

[2] See http://www.nsf.gov/funding/pgm_summ.jsp?pims_id=501084 for details.

be remembered that the technical and the social are inextricable, requiring attention to awareness-raising, training, support and other activities designed to reduce the cost of adoption.

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