

Sharing Techniques and Experience in a Collaborative e-Social Science Pilot Project

Bridgette Wessels¹, Max Craglia², Robin S. Smith³

¹Department of Sociological Studies, University of Sheffield

²Joint Research Centre of the European Commission

³Informatics Collaboratory of the Social Sciences, University of Sheffield

Email address of corresponding author: robin.smith@sheffield.ac.uk

Abstract. This paper draws on insights from a collective ethnographic approach in the development of a multidisciplinary and collaborative e-social science project. Our pilot demonstrator explored the multidimensionality of social exclusion with regard to young people, neighborhood and crime, and in so doing developed user-led and data-driven Grid technologies. This collective ethnographic approach fostered reflexive development, which we define as ‘situated innovation’. An interpretive approach allowed us to identify barriers to collaborative e-social science, enabling social science to shape the Grid. Enablers include trusted data and research networks, varied skill-sets and the team’s capacity to innovate. The paper outlines a complex and ‘messy’ (and perhaps ongoing) research story, which reflects the way academic debates were advanced, outputs were generated for policy-making and non-expert tools were produced to access the Grid.

Introduction

This paper analyses the activities of a collaborative pilot project funded by the ESRC as part of its e-social science program¹. This one-year project² was carried out at the University of Sheffield in 2003-04 with two main objectives: firstly, to consider the theoretical and policy implications of social exclusion in relation to how individual and neighborhood effects are able to account for the geographical variation of crime patterns; and secondly, to explore the opportunities and challenges offered by the Grid from a socio-technical perspective, i.e. how the different disciplines and theoretical traditions present in the research group could engage with this new way of working, and how they can shape this emerging technology. This paper focuses predominantly on this second objective, while the results of the data analysis and modeling are discussed in Craglia *et al.* (2005).

From the outset of the project, each member of the team and those of the wider policy consortium contributing to it (Police, and local authorities) were aware that they were undertaking an R&D project that involved a complex relationship of re-thinking research practice and developing technology in the construction of e-social science. This innovatory activity required a significant amount of imagination, breaking with established activities, and

¹ (<http://www.esrc.ac.uk/esrccontent/researchfunding/esciencespec.asp>)

² *Collaborative Analysis of Offenders’ Personal and Area-based Social Exclusion: A demonstrator project for e-social science* (Award no.: RES-149-25-0027).

the artful integration of different academic practices, communities and technologies. The research team defined these creative processes of co-development as 'situated innovation', leading to a need to understand the way in which change was achieved through their actions as developers and users. To this end, a reflexive approach was taken and the notion of performance was used to analyze the way in which the research team performed innovation in a situational context. The advantages of this approach were 1) the pilot was user-driven; 2) lessons for further development were identified from both user and producer perspectives; and 3) it was possible to make recommendations for training and awareness-raising.

The concept of user-driven development is, however, complex, ambiguous and multi-layered. As such, members of the team had to make a considerable effort to understand each other and each other's contribution. Furthermore, distinctive groups emerged that played a particular role in the project, with the vision and leadership qualities of the Principal Investigator (PI) being important in dovetailing the various discourses into a development trajectory. The interests and skills of the PI were to prove to be influential in pulling the activities together and achieving project and technological closure. Nonetheless, due to the collaboration between social scientists and computing experts, this closure remains open to further development. The reflective and reflexive approach helps to militate against premature closure in the shaping of e-social science. Our perspective has important implications for diffusion of e-social science, in that we wish to have as open a development process as possible, whilst realizing that early prototyping requires some technical push.

This paper presents an ethnographic interpretation of the social action that produced a form of e-social science. We argue that the way in which Grid technology was developed entails understanding the process not as applying and implementing Grid technologies within existing research practices but as creating and developing something called e-social science. Our working understanding of e-social science is as a process of re-configuring new and existing tools (technical and otherwise), a re-thinking of research practices and skills and re-imagining the production of knowledge.

Overview of Study from an Ethnographic Perspective

The ethnographer participated within a 'co-construction' approach to the design of Grid-enabled social science. 'Co-construction' by technical developers and user-groups moves away from traditional notions of a technical expert 'capturing user needs' (Jirotko and Goguen, 1974; Crabtree *et al.*, 1999). In this vein, Dobson *et al.* (1994) argue for an approach where user requirements and design are symbiotic, where the system is constantly refined during activities with the aim of developing something relevant to users, organizations and institutions. Woolgar (1994) discusses requirements engineering and design, and argues that early ethnographic studies of system development provide pictures of the actual processes of development in contrast to the partial and idealized depictions that often occur in textbooks or in participants' retrospective reconstructions (*ibid.*: 201). Woolgar (*ibid.*) suggests that the results from ethnographic studies are, as yet, speculative and require further research. Randall *et al.* (1994) point out that ethnographic and ethnomethodological approaches developed in Computer-Supported Cooperative Working (CSCW) move towards a partnership of ethnography and design that provides insights into the social aspects of work. They argue, however, that there is some ambiguity surrounding the ways in which ethnographic insights can feed into design processes, a point reiterated by Hughes (2004).

Hence, the ethnographic dimension of our project was developed to enable a 'researched development' approach (Sloper *et al.*, 1999), meaning that the ethnographer took part in the research and fed back observations to the team as the project progressed. Through this participation, observation and reflection, a reflective dimension was encouraged within the project team. The knowledge gained through these activities informed the research process, generating a degree of reflexive development. The participation of the ethnographer generated a 'collective ethnography' within in the team. This ethnographic sensibility was partly the result of the researchers being aware that they were being 'researched', thus generating a more self-aware approach to all the research.

Performance and technological change

One of the key characteristics of this project was that the research team wanted to explore the ways in which they were developing e-science through 'learning by doing'. This meant that the team developed an approach to technological development, design and use that differs from many existing approaches (Jirotko and Goguen, 1974) by emphasizing the user as a producer of new technology. The team needed to be able to understand the ways in which they, as part of the research team, imagined new approaches to multi-disciplinary and collaborative research, developed new tools and methods, tried them out, reflected and evaluated on their action, and then used those reflections for further change and development. Our concern with the (re-) formation of agents' intentions and meaning in creating change, shows that the project needed to address the constitution of 'meaning' in the innovation process.

To this end, the ethnographer used the concept of performance to establish the link between culture and technological forms. This concept addresses the relationship between spontaneous action and reflexivity, in which artifacts, practices and values, become meaningful in various contexts of use. The image of action as performance highlights how actions affect situations and conveys the concept that actors create meanings of situations by their actions and strategies. This action is 'dramatic' because it includes conflict, purpose, reflection and choice (Burke, 1989; Turner, 1974). In the context of e-social science, this meant that the researchers, who were used to working tacitly within established social science methodologies, had to reflect on current practice and re-imagine tools (artifacts and practices) and interrogate theory and disciplinary boundaries (values) to be able to work in an interdisciplinary and collaborative way. They did this over time and in workshop spaces through 'playing with' research ideas and practice, asking 'what if?' and trying out different ideas and practices, which was experienced as dramatic. When seen in the context of the processes of technological innovation it creates an understanding of technological change that is embedded within culture, which gives that change its distinctive characteristic(s) and influences ongoing technological development and research practice. Thus, the specificity of developing (collaborative) e-social science can be traced and identified as distinct from other Grid applications.

The 'learning by doing' approach challenges the assumption that development processes can be prescribed through the construction of tightly adhered to plans. Project management tools (e.g. PRINCE) are invaluable in providing guidelines for the implementation of new technology in a variety of contexts. However, development processes are often achieved through situated actions in which plans are made and remade (c.f. Suchman 1987) in relation to emergent local circumstance and the emergence of new knowledge and intelligence. Our interpretivist approach, allows us to acknowledge the situated-ness of social action within the development process, giving us space to work with emergent phenomena in the process of

change. The concern with the formation of intentions and meaning by agents in development processes places the project away from conventional 'hard' and some 'soft' system approaches to design (Dahlbom, 2001) and distances it from social constructivist approaches (e.g., Byker *et al.*, 1987).

The specificity of e-social science

Given the early stage of development, there is ambiguity surrounding the definition of e-social science (Woolgar, 2003). We, therefore, devised a sensitizing framework to explore the development of e-social science using the Grid, which was enabling. It provided a 'frame for action' that neither imposed nor prescribed what e-social science is/was *a priori*. Therefore, the social science research shaped the development of the Grid, rather than the Grid shaping the parameters of e-social science.

The framework needed to cover 'technology' and 'innovation', in developing theoretically informed research and used a social shaping approach, taking MacKenzie and Wajcman's definition of technology as a 'set of physical objects ... human activities ...and knowledge' (1985: 3) and Williams and Edge's view of innovation, as:

1. "a complex social activity - a process of struggle as well as a technical process. It involves processes of interest articulation, and learning processes.
2. [involving] types of expertise possessed by different actors in the innovation process and the flows of information between them.
3. not a linear process, but an iterative, or spiral process. It takes place through interactions across a network of actors.
4. [which] gives rise to significant differences in the form and content of the emerging technology" (1992: 18).

A key organizing principle in developing e-social science is the nature of academic research and the particularity of social science research. There are several key dimensions to this: the generation of academic knowledge; the changing nature and focus of academic debates; theoretical issues; and issues of method and research practices. Significantly, the development of e-social science is about 'ideas' as much as 'technology'. There are three main dimensions in relation to ideas: 1) a re-thinking of substantive research such as the multi-dimensionality of social exclusion; 2) re-imagining research processes, including the representation of 'ideas', such as the integration of data-sets and GIS to address the dynamics of location over social and individual factors; and 3) the re-configuration of tools and technique when using the Grid.

Early 'innovatory work' (c.f. Haddon, 2003) is a distinctive phase which, for the researchers, was a case of "making up as we go along", discovering what was needed and drawing on the team's relevant skills in the R&D process. This raises ethnographic research issues, as the ethnographer was researching the ways in which users develop systems and technologies as they were doing it, being neither a classical user-needs analysis nor an ethnomethodology of already existing work practices. The research needed to address the ways in which 'ideas' fuel tangible developments at multiple levels. The researchers had to understand infrastructure, programming, to develop statistical skills and new forms of representation. Similarly, they needed to articulate what the Grid could be and then how to shape it for their research, develop interfaces, develop data-sharing across organizations and integrate different datasets. The work was, therefore, more than designing a user-interface or developing techniques, it was about trusting and understanding e-social science as they were developing it.

Doing the project

Before discussing the actual research process, it is useful to outline the actors in the project and the resources that were needed to address the substantive and technical aspects of the research, grouped under four headings (see Figure 1. Collaboration and Actors in the Demonstrator Project.).

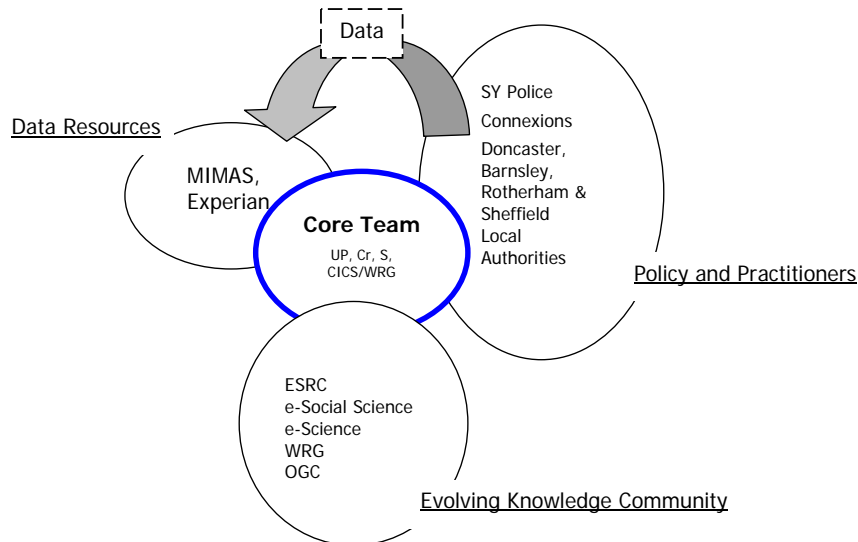


Figure 1. Collaboration and Actors in the Demonstrator Project.

The core team was composed of urban planners (UP), criminologists (Cr), Sociologists (S, including the ethnographer) and computer scientists from the university's computing service / White Rose Grid (CICS/WRG). This group conducted the research and interfaced with the other actors. The South Yorkshire Police provided a unique combination of highly confidential data on the location of known offenders, offences and victims over a five year period (1998-2003). Similarly, the four local authorities in the region provided spatial information (policy boundaries) and South Yorkshire Connexions provided data on young people not in employment, education, or training. It is important to note that obtaining this information was dependent on relationships of trust that the researchers had built with these organizations over several years, particularly the police. This is important to underline, because 'access' is often purely couched in technical terms, while prior social and working relationships are absolutely critical to "open the door" to data. In addition, Experian (a private company producing the Mosaic (UK) geo-demographic classification) made available its data at no cost to this project and infrastructure and development tools were made available through the WRG to access Grid services. Similarly, the Open Geospatial Consortium (OGC) supported the development of a platform based on its web service specifications for sharing the results of the project among the stakeholders.

Our development work combined with the substantive research was iterative and with a clear beginning but no definite end. The figure below (see Figure 2. Stages and Actors in the Demonstrator Project.), gives an overview of the progress. The stages were not linear but included blind alleys, parallel developments, iterative loops and instability in research staff with people having other projects and activities to attend to, sabbaticals, new job opportunities, and so on. These variations are reflected in the discussion below.

activity triggered a series of meetings to discuss the ways in which the different disciplinary aspects of the project could be integrated, especially in relation to the substantive research.

The team undertook extensive discussion of theoretical issues, especially in relation to the multi-dimensional character of social exclusion, which continued in meetings throughout the project. The S working in the area of young people at risk strongly pushed this aspect. He was concerned to develop a theoretical framework that would inform the multi-disciplinary research, help to select datasets and (qualitative and quantitative) research methodologies. He was also stressed that we should take a critical stance to policy research and that we should not produce an empiricist analysis. Both the Cr and the UP agreed, and the two research questions penned by the S informed future work, these were: 1) Can we construct a reliable set of measures for community-based risk factors that allow us to measure them at ward or neighborhood level? Can we also create a 'national norm' in which to compare; 2) If so what relationship might exist between levels of risk and levels of crime - are those neighborhoods in communities with high-risks levels also areas with high risk factors? What relationships might exist between levels of risk and levels of crime?

These questions prompted the UPs and the Cr to consider how their understanding of 'place' and of 'crime' related the observations by the S and what data would be needed. As the meetings progressed, a clearer idea of how to 'operationalize' the research emerged. The CICS worker attended these meetings, admitting that he was "somewhat confused" and could not see "how this was a Grid project". He understood the Grid as being useful for "high-powered quantifiable analysis based on clearly understood concepts". He found that he had to understand the rather contested nature of social science, the problems encountered when researching worlds that were not in the lab and the 'wooliness' of concepts. He was concerned about how to develop the Grid for our use and what kind of training we would need. This was the start of a process in which data analysis and tool development occurred in parallel. This was also the case for the OGC work that required significant technical development on their part on their own products parallel to the data modeling.

Whilst the above debates were going on, the UP, Cr and S made an initial identification of which datasets to use (see above). The re-usability of qualitative and survey data coming from other projects (interviews with young offenders from Cr, and surveys from the Community that Care program from S) proved difficult. The use of this data had been envisaged in the original proposal but, following analysis, they seemed to lack good geographical descriptors which diminished their value when balanced against the potential Data Protection and contractual issues that their re-use entailed. It was, therefore, decided only to use insights from qualitative research. It took a few months to negotiate access to the data and prepare the necessary contracts with the data owners (police, Experian) and technology providers (OGC). Additionally, bureaucratic delays required a two month extension, which was frustrating. As indicated above, without the strong basis of prior collaborations and reciprocal trust between researchers and providers, it would have been impossible to gain access to such data- delays are to be expected and were ultimately worthwhile. During this time, the CICS worker thought through how to develop the Grid for us and devised our training program.

Dovetailing into the above, we took part in the series of technical and statistical workshops. This focused on how the WRG worked, beginning with learning how to send jobs to different machines in UNIX and the team getting passwords and identifiers to work on the WRG. UNIX was completely new for many, as was the architecture of the Grid, as the PI said, "We

don't know any of this, but it's a good opportunity to learn". Although some did not understand why they had to learn the basics, the CICS worker thought that it was important for researchers to understand the processes behind a user-interface. The CICS worker took the workshops in good humor, as he was teaching some who were not especially technical. The second half of the workshop series involved social researchers learning the basics of a powerful statistical package (SPlus) and a geographical information system (ArcView GIS), getting access to the various datasets and starting to use the Grid. These workshops were led by a statistics trainer and the CICS worker. During these workshops, different levels of technical competence emerged between the social scientists. The Ups, with their GIS skills, found their way through fairly easily, followed by the Cr and then the S. However, once the team members were competent, and could access data, a cry went up, "Ahh... data at last". The S said, "Now I just want to get on with the research, I'm not interested in the technology". However, the researchers did feel that by understanding the Grid they could trust it. Thus, the CICS training was important, as it enabled us as developers to 'go behind the tools' and understand how the Grid and statistical packages could work. The 'learning by doing' approach, therefore, informed all aspects of the project— multi-disciplinary research, technical development and training programs.

Then, the allocation of tasks in the group started to be made in relation to skills. For example, the UP_{GIS} researcher and the CICS worker teamed up to do some technological development. The Cr and UP actors worked together on the unique crime dataset provided by the South Yorkshire Police and area-based statistics produced from a variety of datasets by the UP_{GIS} academic. It was also at this point that the significance of different analytical skills became apparent, with the UP researchers being the most confident on the technical level, and the Cr feeding into this process with his deep understanding of the data. The research focus then narrowed to obtain a research output. As a consequence, a UP and Cr discourse became dominant, with the sociological discourse having served its sensitizing role.

We then returned to the research questions, and evaluated the available datasets to see if they could be integrated in a meaningful way. This linked into the first phase of data analysis by seeing what preliminary work suggested, further refinement and some early modeling. This was run on laptops and UNIX workstations as it was becoming painfully clear accessing the Grid was far from trivial. Calls to the CICS worker for "help" resulted in further technical development, especially in designing and constructing a user-interface, with most of the work being done by the UP_{PI} and the CICS worker.

Making use of the output led to further development of web services, which involved working with the OGC and local stakeholders. This also involved a workshop with the stakeholders in which the proposition for sharing data between organizations (within the Crime Reduction Partnerships) was raised and secured. Discussions with the local authorities on data-sharing had been going on for at least 10 years, with only moderate success (Signoretta and Craglia, 2002). UP_{PI} was, therefore, using this project to have "another bite at the cherry" and show to the local authorities that it was possible to share information whilst retaining local control (without creating a one centralized database). At the same time, the OGC was keen to demonstrate the technical validity of their approach, while local authority technical officers were curious to see what could be achieved, given the opportunity of doing it for free. The intersection of multiple agendas across different organizations and individuals characterizes projects of this kind that have many stakeholders.

At this point the project started to narrow in order to produce substantive output, which highlighted some blind alleys as well as the iterative nature of the learning process. UP_{PI} and Cr became certain that Community that Cares data may not add to the increasing GI/Criminological approach, leading to the S's decreasing engagement. This resulted, however, in doing parallel work to provide some useful material for S, so that he could get something out of the project too. We had to take decisions at critical junctions of the project. For instance, we analyzed the crime data with MOSAIC neighborhood classification with good descriptive results but ultimately decided to opt for a statistical model rather than a compositional one. This created both challenges and opportunities. Once a decision had been taken, we had to follow it thorough (given the limited time left in the project). We also found that some of the tentative work done at an earlier part of the project became useful for something else. For example, during the summer holidays UP_{GIS} and the CICS technical staff had developed an application to retrieve census data from MIMAS. The data itself was not much use since it was from the 1991 census, while the census data for 2001 was made available via CasWeb. Nevertheless, in the process we learned how to use an off-the-shelf environment (EASA) to publish an application on a portal so that it could be accessed by non-experienced users. This development proved very useful for the smoothing application (see below) and absolutely crucial as the key bridge between application software known to the users and the Grid processing capabilities.

The PI continued to work on the development of the statistical model and sought advice from a Cambridge spatial statistician (former colleague of PI) to validate the results. The outcome of the model portrays the spatial distribution of offenders across the whole of England at the 1 hectare level (see Craglia *et al.*, 2005 for details). In order to explore the spatial patterns of the model, it became necessary to generalize (smooth) results at different scales (see Figure 3. Modeled Distribution of Offenders, England at 5km).

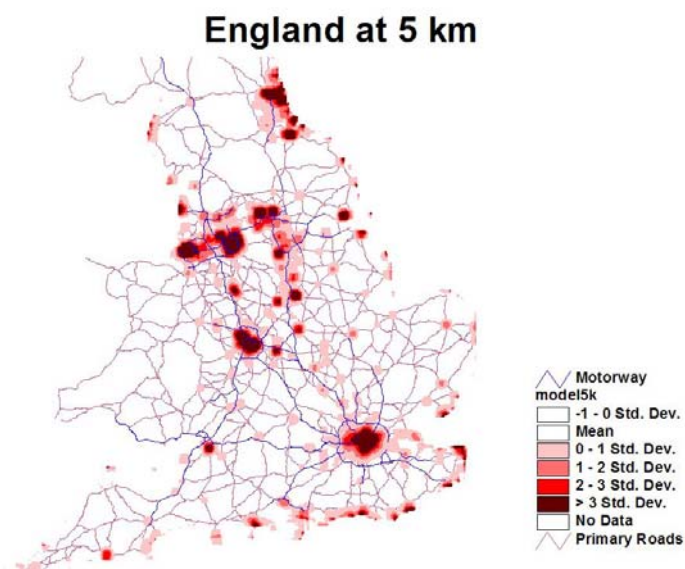


Figure 3. Modeled Distribution of Offenders, England at 5km.

It is here that we really “needed” the Grid, with great satisfaction for the CICS worker! Smoothing at 5 km. requires calculating the mean value of each hectare cell of the modeled number of offenders for the 50 surrounding cells and repeating the process for each of the 35 million cells covering England. The PI could only use the software he was familiar with

(ArcView), which took 20 hours on a UNIX workstation for this example. The CICS worker provided and published an *ad hoc* algorithm on the EASA portal so that the PI could access it from his machine and run the smoothing in about 1 hour (using 15 processors). The CICS worker was, therefore, a key resource in the project. He gained an insider understanding of the project, developed prototypes (often adapting off-the-self solutions), provided training and was on-hand for any *ad hoc* development work. Without him, we, as users, would not have been able to use the Grid because, crucially, desktop-based software does not support Grid processing. From a user perspective, while the Grid has considerable software for scheduling and processing jobs, it can be void of application software to “tell the Grid what to do”. We, therefore, demonstrated that not all work needs the Grid but identified to what context the Grid was beneficial (for example, smoothing hectare cells) for social scientists, and with the help from the CICS worker were able to develop the bridge (the EASA portal) to access this resource.

Summing up the Socio-technical' Aspects of the Research. The demonstrator supported inter-departmental collaborative work between computational scientists and policy researchers, as well as the inclusion of public sector actors and external data resources. After users were introduced to Grid tools, several months were spent developing shared understandings of the data available. The modeling component utilized Sheffield's own computing cluster and the WRG cluster (that includes Leeds and York). The gap faced between the 'normal' software used by the social scientists and the Grid was bridged through the development of *ad hoc* applications published through the EASA portal. Having bridged this first gap, the next one was how to share the model results with the other stakeholders who had no access to the Grid infrastructure. Here, we used an OGC Web Mapping Services, to overlay distributed spatial information through web servers to map the model results with the policy boundaries provided by the local authorities and jointly query the results. In the 'End of Project Meeting' the regional service providers and policy makers were pleased with the output of the project, even though they still found the part involving the Grid was rather inaccessible to them. The police found the model potentially useful to share information on areas of relatively high risk with partners in the region without having to provide access to the data itself, and some of the local partnerships could see benefits in sharing data through the web mapping demonstrator. The Cr was excited by the outcome of the project as it had expanded criminological knowledge. However, the S was partly disappointed as he felt that the project had taken a direction that did not properly address his concern surrounding risk factors and young people.

Performance and Situated Innovation

The connection between theory and practice is significant within an interpretive approach. As computer technology is more malleable, design, in the form of interpretation and adaptation, generates more user-driven development (Dittrich *et al.*, 2002). The interplay of research practices and organization on the one hand, and ICT on the other, is highly situational. This interplay requires design methodologies that take this situational character into account. The pilot showed how multi-practice design constituencies, interlaced design and use, and reflective development of evolving practices and technology shape the definition of e-social science. Innovation, as we see it here, is occurring through configurations of designers, developers and domain experts that form constituencies and where scientific knowledge is confronted by requirements, constraints and possibilities of the specific situation. In this context, innovation requires artful integration of different professional practices, communities and technologies, in the co-development of research and technology. The role that researchers play when co-operating with others in 'situated innovation' is their contribution of

perspective as well as methodological and technological knowledge, which provokes a more reflective attitude among researchers. Thus, the way academic knowledge is adapted, rejected and provoked in the situation at hand by researchers' collaborative work develops a deeper understanding of the interplay of research and ICT. A key dimension in this is 'transformational spaces' (Wessels, 2000), which are different types of meetings and workshops in which various participants can share and exchange knowledge and where they can experiment with ideas in producing e-social science. There are, however, constraints in this process. These include the considerable amount of time needed to build bridges between the disciplines and the ways in which interdisciplinary research and developing new tools can lead teams up 'blind alleys'. Furthermore, there is the possibility that some aspects of research practice and particular disciplinary discourses may be excluded from developments in e-social science by not immediately being amenable to current configurations of the Grid, particularly during early phases of development.

Conclusion

The specific and partial examination of the social shaping of Grid computing technology through a collective ethnographic approach provides insights into how different academic traditions interacted in the project and how collaborative research interfaced and adopted Grid computing. The project took a user-led approach to the design and development of e-social science, which emphasized a 'learning by doing' approach within a situated innovation environment. The interpretive approach enabled us to understand the ways in which Grid technologies could be developed specifically for social science research. The research found that it is important to develop a sensitizing framework to guide, but allow for, imaginative approaches to technological development and the re-thinking of research to address contemporary (often complex) social research questions. Collaboration achieved a robust and secure user-led application, creating a project that was neither technically nor socially determined. The data itself was a driving factor, impacting on what information was seen as suitable and how access could be negotiated through trusted networks. The demonstrator has contributed to theoretical debates in environmental criminology, to the development of user-focused training opportunities and to facilities that make Grid computing easier for non-experts. The development work produced a technical and social infrastructure to generalize operational data on crime and youths on-the-fly, that can be served to researchers for modeling and (accessible) mapping, allowing local information to be used to address social issues which can inform policy at all levels of government. However, the project has also shown the existence of numerous technical barriers that could only be overcome through *ad hoc* developments and 'manual' bridges. To make the Grid more accessible, these barriers need to be removed for the users. Moreover, further research is needed in relation to understanding the dynamics of the production of social science knowledge through research practice, in particular the nature of interdisciplinary research and analysis within the development of e-social science.

References

- Bijker, W. E., Hughes, T.P. and Pinch, T. (eds.) (1987): *The Social Construction of Technology Systems*, MIT Press, Cambridge, MA.
- Burke, K. (1989): *On Symbols and Society*, University of Chicago Press, Chicago.
- Clematis, A., Mineter, M. and Marciano, R. (2003) 'High performance computing with geographical data', *Parallel Computing*, vol. 29, no. 10, pp. 1275-1279.

- Crabtree, A., Rouncefield, M., O'Brien, J., Tolmie, P. and Hughes, J. A. (1999): *There's something else missing here: requirements specification in changing work and design* in <http://www.comp.lancs.ac.uk/sociology/VSOC/RE99.HTML> [cited 31 October 2003].
- Craglia, M. Wessels, B. Griffiths, M. and Costello, A. (2005) 'Building bridges between social science, grid, and geospatial communities: a reflection on practice', *Proceedings of the 1st e-Social Science Conference*, Manchester 22-24 June 2005.
- Dahlbom, B. (2001): 'Towards a Theory of Network Society – from Sociology to New Informatics'. *The Social Study of Information Technology Workshop* LSE 19-20 March 2001.
- Dobson, J.E. Blyth, A. J. C. Chudge, J. and R. Strens (1994): 'The ORDIT approach to organisational requirements' *Requirements Engineering: social and technical issues*, Jirotko, M. and Goguen, J. (eds), Academic Press, London pp 87-106.
- Dittrich, Y., Floyd, C. and Klischewski, R. (eds) (2002): *Social thinking, software practice*. London, MIT.
- Haddon, L. (2003): 'What is Innovatory Use? A Thinkpiece', in *The Good, the Bad and the Irrelevant: the User and the Future of Information and Communication Technologies*, University of Art and Design: Helsinki, 3rd-5th Sept 2003.
- Hughes, J. (2004): 'Methodological developments in ethnographic research on information systems' *Keynote at ESRC/EPSRC workshop Towards Multi-Agency Service Integration and Excellence*, University of Newcastle June 10 – July 1 2004.
- Jirotko, M and Goguen, J.A. (eds) (1974): *Requirements Engineering: social and technical issues*, Academic Press, London
- MacKenzie, D. and Wajcman, J. (eds.) (1985): *The Social Shaping of Technology*, Open University Press, Milton Keynes.
- Randall, D. Hughes, J. and D. Shapiro (1994): 'Steps towards a partnership: Ethnography and system design' in *Requirements Engineering: social and technical issues* Jirotko, M. and Goguen, J., Academic Press, London pp 241-258.
- Sloper, P. Mukherjee, Beresford, B. Lightfoot, J. and P. Norris (1999): *Real Change not Rhetoric: putting research into practice in multi-agency services*, Policy Press, Bristol.
- Signoretta P and Craglia, M. (2002): 'Joined-up government in practice: a case study of children's needs in Sheffield', *Local Government Studies*, vol. 28 no. 1 pp59-76.
- Suchman, L. (1987): *Plans and Situated Actions. The problem of human-machine communication*, Cambridge University Press, New York.
- Turner, V. (1974): *Dramas, Fields and Metaphors*, Cornell University Press, Ithaca, NY.
- Wessels, B. (2000): *The Cultural Dimensions of Implementing New Information and Communication Technologies in Police Service Environments*, SPRU, Brighton.

- Williams, R. and Edge, D. (1992): *Social Shaping Reviewed: research concepts and findings in the UK*, Edinburgh PICT Working Paper No. 41.
- Woolgar, S. (1994): 'Rethinking Requirements analysis: Some implications of recent research into producer-consumer relationships in IT development' in *Requirements Engineering: social and technical issues*, Jirotko, M. and Goguen, J. (eds) Academic Press, London, pp 201-216
- Woolgar, S. (2003): *Social Shaping Perspectives on e-Science and e-Social Science: the case for research support*, A consultative study for the Economic and Social Research Council (ESRC)