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Socio-technical elements of e-Research and libraries

Abstract

This dissertation for the MSc ADMIS course examines the socio-technical issues related to the formation of a virtual organization (VO) with its infrastructural and social complexities in the distinct community of academic researchers. This type of VO is intrinsically related to the new data-centric forms of research known as e-Research. The case study presents the LSE Library's involvement in a project to develop a data repository, a tool to support e-Research that will capture and curate research generated data to disseminate them openly. This is yet another piece of the jigsaw of a complex VO specifically designed for researchers. Furthering the understanding on the process of formation of a VO will help to comprehend these key players of the new social order (Mowshowitz 2001). When observing this process as a series of actors, both technical and human, with their ongoing negotiations to protect their interest and the resulting alliances, then, new aspects are exposed that reveal the complex interactions between them. Through the lens of actor network theory the case study is examined in an attempt to answer how the LSE data repository is being developed by looking at the reasons why the different actors get involved. This interpretive account describes this process through the translation of a particular actor, the datasets, to reveal their importance. My additional role as a practitioner in this project could be seen as having a detrimental effect on the research undertaken. Nevertheless, this insider perspective has benefits (Schein 1987) and I have taken a self-reflexive stance (Venters and Mitev 2007) for the analysis and discussion sections.

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1. Introduction

The increase globalization and the advent of Information and Communication Technologies (ICT) are transforming organizations. The location where work takes place, the resources at hand, the way communities interact and are organized and the identity of organizations themselves is evolving (Orlikowski and Schultz 2001). These new entities are called virtual organizations (VO) and they are a key player in the new social order emerging because of their potential effect on the economic landscape (Mowshowitz 2001).

This dissertation examines the process by which the LSE Library develops a piece of technology that forms part of a VO of an academic research community. This social group is at an extremely interesting stage since ICT are significantly transforming their research practices. Moreover, and this is why the research is highly relevant, due to the large resources being committed to the development, this infrastructure is likely to have lasting consequences (Woolgar 2004). The term e-Research encapsulates these innovative activities exploiting ICT to further research by using unprecedented amounts of data.

Here, instead of just focusing on the technical aspects of the implementation, I am interested in understanding how communities of practice develop their new work environments. In this research exercise I argue that they do this through a process of negotiations and alliances that inscribes their interests and ambitions in the technology. For this reason, a conceptualization of VO is proposed to present them as social domains where communities interact using socially constructed technological solutions that in turn alter their practices and relationships. Therefore I will attempt to delve into the understanding of VO in scientific research communities to uncover the socio-technical complexities involved. In particular, I propose the following research question: how does engagement with e-Research occurs at the LSE Library and what makes the different actors enrol in these new forms of interaction and organization?

To help me addressing the previous question I use case study research to gather the data and examine the phenomenon of how the LSE Library, through the DataShare project, is developing a piece of e-Research infrastructure, a data repository. My first hand involvement in these developments, as part of my work as the LSE Data Librarian, could imply a potential lack of objectivity. Nonetheless, this insider role is suggested to have benefits (Schein 1987) and I aboard this challenge in the analysis and discussion sections from a self-reflecting

position (Venters and Mitev 2007) wishing to improve my understanding of my role as both practitioner and researcher. Actor network theory is then used to describe the sequence of events that led to the current moment with the hope that it will throw light on issues related to the formation of this working environment. The contribution of this research lies in taking part in the current discussion of the literature on e-Research and adopting a social theory that avoids the technical and social determinism of previous accounts. In this case study this allows appreciating the translation process during the earlier stages of the project of a key technological actor, the datasets.

The next section of the dissertation reviews the literature in VO in general and in scientific research communities in particular. After this, I present the theoretical framework and the methodology selected. The following section describes de case study, after which the analysis is undertaken. Finally, the dissertation presents the discussion of the results and conclusions summarizing the paper, outlining its contribution and suggesting options for further research.

2. Literature Review

The following review of the literature attempts to capture relevant aspects of virtual organization by exploring the insights produced by different articles in the subject. After this, I introduce the domain in which the concept will be studied, the academic research communities and their new forms of research. The literature in this area is also examined distinguishing between a majority of positivist accounts and a few selected interpretive ones. Finally a useful conceptualization, for the purposes of the dissertation, of the term virtual organization is proposed and the research question is presented to the reader.

2.1 Virtual Organizations in academic research environments

The concept of virtual organization (VO) has produced significant amounts of research literature. Foster et al. (2001) define VO, in a rather normative manner, as collaborative environments where communities of practice can communicate and share resources in a controlled fashion in order to achieve a common organizational goal. Yet, as pointed out by Mowshowitz (1997), the idea of the VO is linked to various terms with different meanings such as virtual reality, a simulated world experience such as a museum virtual tour; virtual offices that allow groups of people to work in dynamic work environments or virtual

communities involving the organization of social systems. There are numerous, complex and contradictory descriptions of what virtual organization are.

It is important for the aims of this paper to understand the concept of VO and the literature on the topic. Orlikowski and Schultze's literature review on VO (2001) recognizes the complexity and newness of the term. While its drawback is not using a real example, it also suggests valuable metaphors that offer insights into the various forms in which researchers are making sense of the phenomena. The set of metaphors of virtuality proposed includes architectural, location, resources, governance and identity aspects. While traditional organizations are perceived as buildings, a VO is seen as an open and exposed platform containing both the technical architecture and principles that govern it. The location aspects highlight how work is what is done and not where this happens, reducing the importance of the space where the work takes place. Resources in a VO refer to digitized assets, whilst in the traditional organization these take the form of physical objects in a VO these are digital code. Virtual organizations are also communities which need to be organized, this governance is suggested to be more friendly and open than in traditional forms of organizations. The identity of a VO is a "*dynamic collage*" (Orlikowski and Schultze 2001) made up of the different internal and external relationships. Some of the previous aspects can be easily identified in research themes from the management literature where issues on the process of communication in virtual organizations are explored in a special issue of *Organizational Science* (Volume 10, 1999). This include ways of mitigating risk (Grabowski and Roberts 1999), strengthening organizational identification (Wiesenfeld *et al.* 1999) or creating and maintaining trust (Jarvenpa 1999) in virtual organizations. An example of the location aspects from the information systems (IS) literature researches groupware (Ciborra 1996) as the logical evolution of technologies supporting work of individuals towards group-work (Failla 1997), encountering difficulties for integrating them into job practices (Orlikowski 1995) due to the combination of corporate inertia and organizational and cultural feuds (Ciborra 1997). When organizing a VO, Jha and Watson-Manheim (2007) realise how when coordinating what they called abstract resources, like knowledge or skills, the VO is decentralized and posses collaborative ties between the actors involved. On the other hand, when organizing specific goals, e.g. outsourcing a key component, centralized networks are more prominent and opportunistic behaviour abounds. The notion of *virtuality* to describe changing work environments is useful when classifying those based on lack of coherence in elements such as physical and temporal location or organizational affiliation (Watson-

Manheim *et al.* 2002). To try to make sense of virtuality as a whole is crucial to look at factors which have not changed, in the organizational process as this, it is argued (Watson-Manheim *et al.* 2002), should enable researchers to integrate results from other bodies of literature to the virtual one.

All the previous provides a good summary of how the VO is understood and ways in which the literature has dealt with them. Now, different communities of practice have different needs and aims when developing and using a VO. An interesting one, and the one chosen here, is the scientific research community. Woolgar (2004) realises the need for transposing questions from VO to scientific communities where the actors involve, academic researchers, have their own characteristic forms of acting. Scott and Venters (2006) suggest that the mediation of technology to meet the information and communication needs of the scientific research community tends to be overlooked in the IS literature with the exception of few cases. Virtual Research Environments (VREs) are a piece in the jigsaw of a VO in the academic research communities and as noted on the Joint Information Systems Committee website (JISC 2007) “*a VRE will add value to the research process across all disciplines by complementing and inter-working with existing resources and by being flexible and adaptable to changing requirements*”. They comprise of the digital infrastructure and a range of services which facilitate research (Fraser 2005) and are intrinsically related to activities such as e-Research, e-Science, e-Social Science or cyberinfrastructure. All of them commonly used words to denote the current practices exploiting ICT for research activities, the first two used mainly in Europe and Australia and cyberinfrastructure used in the US. A definition of e-Research proposed in a recent workshop (Lewis 2007) describes it as an extension of e-Science’s remit to all sciences referring to the use of distributed resources across multiple domains to do science or further research. The key features of this type of research can be summarised as being collaborative, with diverse social research groups working together towards shared scientific goals; utilising GRID infrastructure technologies to complement current ones which are relatively inflexible with regards to sharing of resources like data, sensors or computing power; and managing the vast amounts of data that is generated and used during research process of this kind.

When specifically looking at the VO in scientific research communities, a major body of research literature conducted, the vast majority of it, some examples being (Defanti *et al.* 2003, Harvey *et al.* 2003, Hey and Trefethen 2002, Zhuge 2005), looks at issues associated

with the development and use of GRID technologies and e-Research from a rather technology deterministic perspective. This functionalist view presents the design of these systems as successful engineering practices where technologists and research communities built the infrastructure to conduct research in innovative ways. There are, of course, other perspectives analysing the new forms of academic research organizations. For example, Steve Woolgar's (2004) consultative study for the Economic and Social Research Council (ESRC) provides a constructivist account through a social shaping exploration of e-Research, one of the few using this type of approach. The report highlights how the structure and organization of e-Research is likely to have lasting consequences because of the large resources that have been committed to it. The study identifies an enthusiasm within the research community however it also perceives a lack of knowledge about the existence and purpose of grid technologies and their applications. One of the issues exposed, involves semantics and the restrictive connotation of the term e-Research. There are many questions with no definite answers such as how the existing patterns of communication between scientist are likely to be affected or what social and economic factors affect the uptake and use of grid technologies in different organizational settings. Kyriakidou and Venters (2007) also use the lens of social constructionism of technology (SCOT) to explore how the MammoGrid project, a European-wide Grid for clinicians, develops systems collaboratively and how this shapes the technology deployed. Now that the infrastructure for e-Research is being developed and the roles negotiated, Hunsinger (2005) calls for a reflexive approach towards its construction as it has the potential of radically transforming the current power relationships.

In sum, there is the risk of disregarding the social aspects related to the design and use of virtual organizations that make them social domains. The meaning of the word social that is most useful for my intentions here is one borrowed from Latour (2005): "*the word social is constructed first as following someone, then enrolling and allying and, lastly, having something in common*". For the purposes of this dissertation I want to propose a conceptualization of VO different from the one from Foster et al. (2001) defined in terms of sharing distributed resources through the GRID infrastructure. Here, a VO is understood as socially constructed community built through a process of negotiation and alliances. This resulting community has at hand technological solutions, which have been constructed socially and in use, that represent their interests.

I have identified a body of literature on virtual organizations for scientific research communities that is either technology or social deterministic. I want to avoid both forms of

determinism and contribute to the existing literature in virtual organizations studied through a social constructionist lens. To do this actor network theory will be used to transcend the distinction between the social and the technological (Howcroft *et al.* 2004) and help addressing the research question of this dissertation: how the LSE Library repository of datasets, a piece of VRE, is being built and what are the motivations for different actors to get involved in these developments?

3. Theoretical framework : Actor Network Theory

In this section I discuss the ontological and epistemological assumptions of the study linking them to consideration of the theoretical framework. After this I outline why I selected actor network theory (ANT) to finally describe the relevant parts and their value for this dissertation.

3.1 Philosophical stance and ANT

The dissertation carries out the research from an interpretive philosophical stance, more widely used in the IS field than as reported in the early nineties by Orlikowski and Baroudi (1991). Nevertheless, their article on the different philosophical perspectives for IS research helps me to introduce below the beliefs of this research approach with regards to the object of study, the notion of knowledge and the relation between theory and practice.

The assumptions of the interpretive perspective include the ontological belief that reality is not given, as opposed to the positivist perspective, but constructed socially. Subjective meanings are then given a special importance as they have a relationship with the constitutive behaviours. Individuals act towards things because of their unique understanding of them, these appreciations are the product of social interaction and are created and modified through time. Epistemologically, it also challenges positivists' accounts and their belief in universal laws. The language used to describe the practices becomes those practices and thus interpretive researchers construct interpretations of the ways meanings are created and transmitted in particular contexts. With regards to the relationships between theory and practice, this research approach assumes that the researcher is always involved in the phenomena being studied. The following quote is from Orlikowski and Baroudi (1991) paraphrasing Gibbons (1987) :

“the interpretive research philosophy is that it reveals the underlying connections among different parts of social reality, by examining the social rules and meanings that make social practices possible”

The IS literature is full of positivist accounts where technology is understood as a value neutral artefact capable of enabling change by itself, autonomously from the social context where it is embedded. On the contrary, constructivists' accounts like Social Shaping of Technology (SST), view technology as something that is made, a consequence of the social antecedents. SST is a “*generic label for approaches that are committed to open the ‘black box’ of technology for social analysis*” (Howcroft *et al.* 2004). It proposes that technology is socially shaped in such a form that the resulting artefact will reflect the socio-political interests of those involved in its development.

More specific areas within SST are social construction of technology (SCOT) and actor network theory. SCOT is concerned with understanding where the technology comes from, not just from laboratories but also in society and use. It examines the different understandings of technology different groups have and how the social aspects of the technology are unfolded by looking at the different meanings the relevant actors have given to it. SCOT is usually accused of being socially deterministic as the social choice is over-stressed. ANT attempts to avoid the social and technological determinism.

3.2 Why do I use ANT?

Actor network theory is both a methodology for empirical work and an analytical tool. In this dissertation it is only used for analytical purposes. ANT provides the researcher with a vocabulary to describe how, where and to what extent technology influences human behaviour (Walsham 1997) and it is specifically useful to study new topics (Latour 2005 p. 142) like the one proposed in this dissertation. I have chosen this theory for the previous reasons but also as it has been widely used in the IS literature to study hybrid networks of humans and not-human elements. This will help me to trace back and describe how the LSE Library has arrived to the current point in the development of a piece of e-Research technology. Furthermore, as explained earlier in the review of the literature, most of the research on the VO in academic research environments is either technology or socially deterministic. ANT is suggested to avoid this by treating the social and the technical as inseparable (Walsham 1997). Consequently it will allow me to contribute to the current

discussion on the VO in scientific research environments by providing a theoretical apparatus to deliver a different perspective.

Actor network theory finds its origins in texts from Callon (1986) and Latour (1987) within the field of science and technology studies (STS). A distinctive approach to social theory dedicated to understand change and order (Monteiro 2000). According to ANT stability and social order are “*continually negotiated as a process of aligning interest*” (Monteiro 2000).

ANT helps to describe how actors, both human and non human, create alliances and enrol others by using technology to reinforce the networks made up of humans and non-human artefacts (Sarker *et al.* 2006). Some of the main issues reflected through ANT are the inclusion and segregation of actors, the origin of privileges and status and how politics and power come into place (Cordella and Shaikh 2006).

3.3 Key Concepts

Although ANT is not a stable and unified body of knowledge since its creators tend to often revise it (Walsham 1997), it does have some key concepts which I anticipate will be useful for the dissertation.

Actors in ANT represent elements which “*bend space around itself, makes other elements dependent upon itself and translate their will into the language of its own*” (Callon and Latour 1981). Actors include both human and non-human artefacts, key differentiator of the theory. Consequently an actor-network represents an “*heterogeneous network of aligned interests*”(Callon and Latour 1981) where all elements, human and not human, can and should be described in the same terms, this is known as the principle of symmetry.

The actor-network is created through a process that includes negotiations between the actors to align their different interest. There is a central actor that identifies others and speculates on their concerns and intentions. This actor attempts to impose the previous vision using various techniques and if successful the actor-network will be formed. The moments of translation in the ANT vocabulary refer to this process of creation of an actor network and provides insights into how communities interact through different power relations to decide how and when activities take place (Scott and Wagner 2003). It consists on four stages known as problemization, intersement, enrolment and mobilization. The first moment of translation, problemization, is where the focal actor defines identities and interests of other actors

making itself indispensable and establishing itself as an obligatory passage point (OPP) through which the other actors must pass through. Then starts the process of convincing other actors to accept the definition of the focal one and thus imposing stability in the network, this is *interessement*. Allies are involved in the problematization of others. *Interessement* consists in building devices between one actor and the rest so that the identification originally given is stronger and more prominent. Different strategies used include simple force, seduction or simple solicitation (Callon 1986). The next stage, known as enrolment represents the moment when another actor accepts the interest defined by the focal one, "*interessement achieves enrolment if it is successful*" (Callon 1986). Finally, the last moment of translation, mobilization, "*to render entities mobile were not so beforehand*" (Callon 1986) uses the idea of a few representatives of the different populations speaking for the whole populations. Once the enrolment and mobilization have occurred, a phenomena takes places by which the interests of the different elements of the actor-network get carved into the technology being developed, this is know as inscription. It is a metaphor to show how designers' predictions of morality, politics, technology, etc are present on the innovation and get "inscribed" on the object. Patterns of use will be inscribed and will include programs of action for users in the technology. This also makes the technology to become another actor who can impose its inscribed programs of action to the user. I foresee most of the ANT concepts described above to be reflected in situations found during the process by which the LSE Library is building a piece of e-Research technology, a data repository.

4. Methodology

This methodology section explains why choosing case study research strategy, the data collection methods used and justifies the benefits of my role as a practitioner involved in the study.

4.1 Case Study as a Research Strategy

Case study research is chosen here as my strategy to examine the phenomenon of VO in research communities and helps me to address the research question proposed previously. Two reasons for selecting this approach, as suggested by (Benbasat *et al.* 1987), are the importance of the natural setting and the focus on a contemporary event.

As the unit of analysis for this case study I will focus on the technologies the LSE Library is developing to support e-Research through the DataShare project. The aim is then to obtain

results on how these technologies are being constructed that can be generalized to other virtual research environments and virtual organizations built by other communities.

4.2 Data collection

The data for this case study has been collected using a variety of qualitative research methods, also known as triangulation, involving participant observation, interviews and personal documents.

The participant observation involved being present and active in the different DISC-UK DataShare meetings that have been happening at the LSE. This allowed me not only to observe and listen the participants of those but to contribute with my insights as the Data Librarian and leading person of the project at the LSE. From this position I was able to appreciate other's perceptions of the situation the LSE Library is facing.

To complement the participant observation a series of semi-structured and non-structured interviews were conducted with the different parties involved, i.e. technologists, librarians, researchers and data specialists. The selection of the interviewees also attempts to gather a wider perspective of meanings by cutting across the different hierarchy levels present (see table 1). The adoption of semi-structured or non structured interviews responds to the need to explore more deeply meanings from respondents that those achieved through the participant observation. These interviews were not tape-recorded, notes were taken to make the interaction more informal and similar to natural conversations and thus reduced what Brewer (2000 p. 65) calls the interviewer effect.

Finally, some personal documents like emails or personal communications and other documents including literature used and produced by the CURL/SCONUL Task Force on e-Research, reports from current projects and activities happening on VREs, e-Research and data curation were used to contextualized the developments.

Positions of Interview Respondents
Library and ITS Director
Library IT Manager
e-Services Librarian and Repository Manager
Library Projects Manager
Research Centres Data Manager
ITS Technical Support Manager
Researcher

Table 1. Interview respondents

4.3 The clinical perspective and a self-reflexive stand point

My involvement in the Library as the Data Librarian and my leading role in the project has allowed me to participate actively in the different meetings and the day to day environment in the LSE Library. As Brewer (2000 p.62) suggests, this way of studying people in their context can be seen as producing a partial view, lacking objectivity, being highly autobiographical and reducing the researcher's capacity to detach from friends.

In order to defend my research from the previous arguments, I want to bring to the forefront the clinical perspective suggested by Schein (1987). A clinical researcher enters an organization or community to study it but not just with the usual ethnographer's mission of observation. The clinician takes an active role helping the organization, "*the only way to understand the organization is by changing it*" (Schein 1987), this reduces the process of socialization and allows better access to data, as the researcher becomes a member of the community he is studying and working for.

In addition, in order to render the bias visible (Hardy *et al.* 2001), I take a self-reflexive stand-point (Venters and Mitev 2007) in the analysis and discussion sections to examine how myself and the other actors involved saw the early stages of the DataShare project (Hardy *et al.* 2001). Reflexivity is a "*question of recognizing fully the notoriously ambivalent relation of a research text to the realities studied*" (Alvesson and Skoldberg 1999 p.8). Drawing on this contribution of postmodernism, I disengage from the authority of external constraints to consider both the historical context and my own subject position (Johnson and Duberley 2003).

5. Case Study

The case study introduces the LSE Library historically and currently situating it in a existing environment of innovative scientific activities happening and libraries positioning themselves to support those. Finally the activities related to the support of the new forms of research in the LSE Library are presented by introducing the DataShare project.

5.1 The LSE Library and e-Research

As explained in a book celebrating the first one hundred years of the LSE Library (Hunt 1996), the British Library of Political and Economic Science was founded in 1896, one year after the opening of the London School of Economics, by the School's fathers Sidney and Beatrice Webb. Sidney, who acted as the main Librarian until 1938, defined the LSE Library as a 'laboratory' of the social sciences. The original mission statement enunciated:

“to promote the study and general knowledge of political, economic and social science, statistics, history and jurisprudence and all matters relating to progress and development of communities and of mankind generally” (Hunt 1996)

The academic Library has always played a crucial role in supporting scientific research by selecting and organizing material with relevance to research. Moreover, libraries have acted as curators of those research materials preserving them for the future.

Currently the LSE Library, with over 100 members of staff, has a collection to support research and teaching of more than one million items in its main collection complemented by an extensive collection of electronic resources such as electronic journals, bibliographic databases and datasets. Since 1997, the LSE counts with one of the few Data Libraries in the country with a dedicated member of staff to support researchers providing a reference service to locate and access datasets. This data service is complemented by the LSE Research Laboratory Data Service established in 1999 to provide data support for the LSE research centres (Macdonald and Martinez 2005).

In 2004 the LSE Library set up an institutional repository (IR), LSE Research Online, to provide a single place where to store, curate and provide open access to peer-reviewed articles produced by LSE academics. As Rumsey (2004) explains, this development was encouraged across the UK by the Government through the Research Councils after a number of initiatives in recent years to promote open access to scholarly communications (Budapest Open Access Initiative¹ and the Berlin Declaration²).

In addition to this, during the last seven years the LSE Library has developed several in-house middleware services for authentication to Library resources and systems and has been involved in other innovative research and development activities.

While the LSE Library is providing new services to researchers, current new forms of research of the e-Research type include activities happening both in the natural and social sciences. Good examples of those are GridPP³ in Physics where data provided by a particle accelerator will be analysed across 100 computer centres and the Mix Media Grid project⁴ building tools for social scientists to analyse audio-visual qualitative data collaboratively and in a distributed way. These should help the reader to appreciate the variety and wide range of communities and practitioners, with their accompanying needs and goals, and how they respond and use technology and data in a multitude of ways. Nonetheless, senior members of the LSE Library are unsure of e-Research-type activities involving LSE researchers *“we are*

not aware of the any e-Research taking place at the LSE, this could be because it is not happening or because researchers are not coming to the Library's attention". Even the need for the infrastructure to support this forms of research is questioned:

"...data in big sciences is infinite and thus their requirements for data transfer and analysis are huge compare to the ones from social science researchers with significantly smaller sets of data".

To this point, there have been mainly two groups of actors driving the development of e-Research, academic researchers and technologists. Now also librarians have started to explore the role they can play to fill the gaps not yet covered as it demonstrates the set up of groups such as the e-Research Task Force from the Consortium of Academic Libraries (CURL) and the Society of College National and University Libraries (SCONUL). As a member of the LSE Library explained *"librarians' main abilities are their organizational skills"*. These organizational skills are an essential requirement to deal with the *"data deluge"* challenge (Hey and Trefethen 2003) posed by e-Research. This, refers to the management and curation of the large volumes of digital data generated and used during the research process. So far in the UK the research councils' funded data centres, such as ESRC's Economic and Social Data Service (ESDS) or the Natural and Environment Research Council's (NERC) National Geosciences Data Centre (NGDC), have exercised the management and archival of research generated datasets. Additionally, some of these centres have started to grid-enable their holdings with projects such as GEMS and GEMS II⁵. However, not all the research generated data ends up in the national data centres (Burton 2006) and as a recent RIN-CURL survey (2007) suggests, the management of research generated digital data is a role that libraries can take on. Different funding bodies and agencies in North America have already starting addressing this new role in data curation as it demonstrates the organization of different workshops (For example, NSF/ARL "Workshop on New Collaborative Relationships: The Role of Academic Libraries in the Digital Data Universe" in September 2006 and Science Commons Workshop in October 2006).

After collaborative scoping study, between the LSE Library and IT Services, on data repositories during 2004-05, in September 2006 the Data Librarian with the Data Information Specialist Committee-UK (DISC-UK) participated in a successful bid submission to the Joint Information Systems Committee (JISC) to establish a network of institutional data repositories. The project, known as DataShare, runs from April 2007 until February 2009 and aims to capture and curate research generated datasets and test new models of data archiving

in the UK. The members of DISC-UK are Data Librarians/Managers from LSE and the Universities of Edinburgh, Oxford and Southampton and this is the first time that data specialist will work together with IR managers, librarians and technologists to accommodate new forms of research outputs in repositories. Moreover, following the open access movement, in 2004 the Organization for Economic Co-operation and Development (OECD)⁶ brought the concept of “open data” which represents a new paradigm at the core of the DataShare project aims.

Through this project the LSE Library will implement a repository solution, a piece of the e-Research technology jigsaw, to deal with the storage, curation and publishing of LSE research generated data. The repository technology in used at the LSE is e-Prints, a piece of open software. It was originally designed for other types of materials like research articles. Now, it will have to be adapted to accept datasets. Since the project started, one of the main activities has involved the preparation of the project plan. This formalised plan for the project-funder includes quantifiable objectives with technical requirements and it will drive the development work in the next months.

6. Data repositories in the LSE Library: an ANT account

As previously explained the scenario in which the case study takes place includes e-Research activities emerging in both the natural and the social sciences with the big sciences leading the way. Academic libraries are beginning to consider and develop solutions in which they can provide the support needed for the new activities of their researchers. Archiving, curating and disseminating datasets is one way in which libraries can contribute to the new forms of scientific research VO. Data are different, diverse and highly complex making the previous task a real challenge for libraries.

The description that comes next follows the Data Librarian from the moment of joining the CURL/SCONUL Task Force on e-Research in the fall of 2005 until the summer of 2007. At this stage, the DISC-UK DataShare project had already started and a detailed project plan with the technical requirements that will lead development had been submitted to JISC, the funding body. The starting point, the Data Librarian joining the task force, signals the beginning of the Library’s intention to embrace developments happening in the area of libraries and e-Research. The Data Librarian increases his domain knowledge through active participation in the task force and exposure to relevant information from meetings,

workshops and various reports. From then onwards the Data Librarian shares his insights and experiences across the School through occasional updates and articles via LSE's internal communication.

I identify within the case study situations involving actors with their negotiations and alliances that reflect the moments of translation and the notion of inscription previously described. Particularly, the analysis below focuses on data and their translation within the DataShare project in the LSE. The four moments of translation are used as headings to add some form of structure to the narrative as ANT serves as a language to describe the scenario and sequence of events of this case.

6.1 Creating a new network - Problematization

In the early stages of the case study discussed, the Data Librarian faced the challenge of enrolling the LSE Library in e-Research developments. This time mirrors the first moment of translation as the Data Librarian tried to determine a series of actors and their identities in order to be able to work together and establish himself as an OPP. He defined himself as a librarian with specialist skills, knowledge of data used and produced by researchers at the LSE, that seeks to advance knowledge and practice in data archiving and curation across the School. By doing this, he expected to develop a technical solution to preserve research-generated data, improve access to it and help the LSE Library to engage with e-Research and the support for the new forms of research. At this stage, in order to achieve the previous, the Data Librarian realised how the LSE Library, datasets, technologists and researchers will need to form part of the network. I proceed below to describe the Data Librarian's original perceptions of these actors and their identities:

Firstly, the LSE Library seemed interested in not falling behind supporting the new forms of research and particularly in getting closer to researchers by supporting them through the research life cycle. Preserving and curating materials in printed format has been one of the traditional core Library functions. With regards to digitized resources, the LSE Library has successfully started archiving and curating journal articles produced by LSE academics in its own repository, LSE Research Online. It made sense for the Data Librarian to believe that the LSE Library wanted to promote and expand this new service and have a member of staff involved in e-Research initiatives to keep an eye on Library developments in this arena.

The next actor that needed to be involved are data. They are a great example of socially constructed technology. Data in the social sciences are computer files with information, in text, numerical or other forms, generated by researchers to capture information on their research subject. This information can then be manipulated using other software packages to analyse it and inference results. The Data Librarian knew that researchers produce data but not necessarily deposit them in the national data archives for their curation. Data are then at risk of being lost or forgotten as in some cases researchers keep them in their desktop computers or CD-ROMs.

Technologists at the LSE are organized in several groups within the School. IT Services, Library IT and Library Projects are the pertinent ones in this case. For the purposes of this dissertation I will represent them under one entity and identity with several interests. This community manages the computer systems of the Library and the School and supports research and teaching activities. In particular, they are also responsible for the maintenance and development of LSE's repository technology and some of them are also involved in security-related development projects on access management middleware tools. The Data Librarian perceived at this stage how technologists are increasingly facing the need of having to store and provide access to masses of data being used and produced by researchers. But he was unsure on whether they thought the Library has a role to play here.

Finally, academic researchers working at the LSE are again many and diverse groups with their own interests, identities and needs. Nonetheless, most of them tend to deal with multiple research projects at different stages with collaborators in other countries. As one of them explained: *“research has move from walking down the hallway to collaborate with academics in your building to do this in a virtual and global manner through emails and the Internet”*. This results in vast and increasing amounts of digital information that needs to be managed. As explained by the researcher:

“I have twelve research projects at the moment and it is very hard to manage all this information. Last week I re-wrote a version of an article that I had already done but which I forgot. A facebook for academics where I could see my projects with deadlines and collaborators. A place where I could have the datasets I am working with and even run my STATA analysis there. That would be fantastic!”

It is for this reason that user-friendly tools to allow researchers to administrate their projects more efficiently whilst supporting them through the research process would be useful to this community.

With regards to data, researchers are both producers and consumers. The Data Librarian assumed at this moment that data creators would want their data to be archived and curated. On the other hand, data consumers would mainly be worried with data availability and thus would support any initiative that would help increasing it.

6.2 Definition of OPP

The Data Librarian specified the DataShare project to be the OPP of the network presented. The interests of all the actors described before lie in collaborating and accepting the aims of the project which will engage the LSE Library with e-Research support activities. If Libraries want to support new forms of research and improve their infrastructure to preserve research outputs; if data wants to be preserved; if technologists want to be able to deal effectively with data storage issues, want or need more resources to administrate and develop repository technologies and want to use their technologies; if researchers (data creators) want their data to be preserved; if researchers (data consumers) want more access to data then all actors should know that is in their interest to have the LSE Library engaging in supporting e-Research by establishing data repositories and recognize how their alliance around the question can benefit each other. In this way the Data Librarian has made sure that he becomes indispensable, obligatory passage point, for the other actors to realise their interests. Figure 1 below shows in an schematic form the problematization describing the alliances needed, the defined OPP, the interests and the obstacles present.

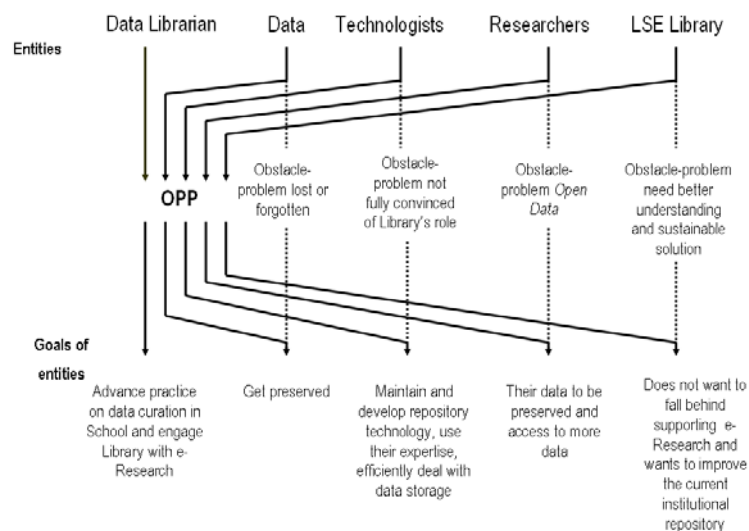


Figure 1. Different interests and obstacles in the problematization, inspired by Callon (1986)

6.3 Negotiations and alliances in the network formation: Interessement and Enrolment

Although the Data Librarian envisaged identities and relations, these had not been tested yet. Things needed to adjust and form still. There are two crucial moments during the DataShare project, the work on the bid submission and the project plan, when the focal actor attempted to impose his previous conceptions of others' identities and interests. Here the Data Librarian reproduced the process of interessement. At international conferences, he has seen systems developed and used in the US and Australia that deal with the archival curation and preservation of data. Using repositories for data dissociates the data from researchers protecting them from disappearing while it allows libraries to fulfil the role of curators.

The previous mechanism did not interest all other actors. The Data Librarian was not intending to convince each and every one of them but some representatives from the different groups. For the LSE Library, technologists and researchers the Data Librarian uses seduction and solicitation through reports and active participation on the e-Research Task Force to show the importance of the engagement with e-Research activities. In an attempt to identify early adopters, groups of researchers were regularly informed highlighting the benefits for them. Through this process that echoes interessement, all actors are cornered to avoid competing associations in between them that would attempt to change the original problematization.

Several negotiations between the Data Librarian and the other actors took place during the writing up of the bid and the project plan. During the preparation of the bid submission, the first negotiation occurred between the Data Librarian and other members of the LSE Library. The Library wanted to have something sustainable and thus using LSE RO was the best solution because of the long term plans for it. The LSE IR was a complete success including over five hundred items, policies for depositing in place and a repository manager leading several projects to develop different aspects of the system. This had an effect on the project bid as this included how the LSE Library wanted to adapt the existing IR to accept datasets. Also at this stage, during meetings and conversations with technologists, they were critical and sceptical with some areas of the project, mostly aware of developments on e-Research and institutional repository activity but not sure whether the creation of virtual research environments or e-Research support technologies was a Library role or not. One of the technologist interviewed describes this below:

“Libraries’ traditional functions are to collect, catalogue and preserve material and this should be their purpose with technology developments. Building research environments is not their role but the Library can and should encourage others and even lobby for it”

Another technologist explains his reservations on the role of libraries and the need for VREs in social sciences:

“is it the job of libraries to support the new forms of research? IRs is a very Library thing to do per the tradition of preserving and disseminating but not sure about VREs. I am not even sure that Social Science researchers need them! It is a good thing for the Library to try to persuade the School that is the Library's job to this stuff and get resources to do it.”

The bid was submitted in September 2006 and in March 2007 it was announced that the DataShare project was successful. In spite of the initial reactions from technologists, they realized the potential of these innovative activities and more importantly, the project brought resources and new possibilities that helped convince them. DataShare generated funding for a technical officer to work on repository development and it offered the opportunity to use the in-house expertise in access management technologies while promising a solution for data storage and curation. The LSE Library had already been convinced and no further negotiations with them were needed. Nonetheless, the success in getting the funding meant that another round of negotiations to realign interest of the other actors identified needed to take place.

It is here when data played an important and centric role. Data are diverse and the repository technology has not been designed to cope with the complexity of data and their special requirements. Negotiations with data were probably the longest and most difficult. The first important thing to understand is that data in their widest meaning cover a whole array of digital materials ranging from numerical tables, geo-spatial or geo-referenced resources (i.e. maps with tables), pictures, videos, recordings, websites, statistical models, algorithms, etc. The first negotiation carried out with data involved the decision that just a few of the preceding types, numerical and geo-spatial, would be the ones chosen to be deposited in the repository. Datasets have their own distinctive requirements, a good example is metadata, the information that describes the data. The default standard used by the LSE IR is slightly different from the one used to describe social science data, DDI (data documentation initiative). Also while other types of digital material like articles use a small set of standard formats (PDF, MS Word or txt), data are again different. They can come in a variety of

formats: excel, SAS, SPSS, Stata, ArcView, etc. Not only that, datasets need to be accompanied by documentation files also known as data dictionaries. These help data users to make sense of the numbers on the data file by describing the context in which the data were collected, the collection methods, the structure of the data, source, variables, confidentiality, etc. In addition, bidirectional linking between datasets and the articles that use them adds value to both types of materials. All the previous represented the requirements of the data actor.

Researchers at this point had expressed their opinion through surveys (Burton 2006, RIN-CURL 2007) and several meetings with the Data Librarian at the LSE. Those who are data consumers seemed to be fully convinced of the benefits of data repositories. The development of these technologies will automatically translate in an increased access to data resources that will profit their research. Data producers on the other hand, felt that they needed to have some form of control over their data. They wanted to make sure that they can publish several articles using the data and exhaust its usefulness before it can be release to others. Moreover, they were worried about their rights as producers and want to ensure that there are mechanisms in place to protect their rights and provide credit to their research for sharing data.

All the previous negotiations in the actor-network described ended up with the enrolment of all the different actors by adapting the original identities and interests. The initial scepticism of technologists was turned around by the resources and possibilities offered by the DataShare project. The LSE Library did not need to be convinced further and accepted the terms of the project once it was agreed that the current institutional repository would be used. Data were reduced to a few particular types and requirements with regards to metadata, formats, accompanying files and linking to publications were taking into account. Researchers' concerns about the way in which data is made available to others so that they can protect their interest and copyright were also considered.

6.4 Representatives of the groups: Mobilization

All the negotiations between the Data Librarian, data, researchers, technologists and the LSE Library involved individuals acting as representatives of their respective groups. A few data types and a small number of researchers, technologists and librarians were selected to speak for the groups they formed part of.

The DataShare project was presented in conferences with an audience of technologists and librarians like the “Support for e-Research: Filling the Library Skills Gap” event⁷. In the slides of the presentation snap-shots of datasets and percentages representing researchers’ attitudes were used to convince attendants while mobilizing data and researchers and representing them in front of the other groups. At this stage the Data Librarian became the representative of all these populations.

At the beginning all the entities were somehow dispersed. At the end, the Data Librarian first says what they are and want to displaced all actors and reassemble them together later on. These actions reflect the notion of mobilization.

6.5 Identification of Anticipations: Inscription

All members of the actor-network described here have inscribed their vision of how they believe data repositories will be used, how they will support e-Research and the way in which they will integrate with VREs.

There are many types of inscriptions with different materials and strengths (Monteiro 2000). In this case the interests of data, researchers, technologists and librarians got inscribed in the DataShare project plan. This document included detailed information on work packages with their time-scales and outputs covering all aspects of the DataShare project. Of special relevance to this case study is the technology work package which included the following deliverables: customising repository technology to accept datasets; linking articles with datasets; adapting repository to use DDI as the metadata schema and applying federated access management to data to allow access control.

In other words, the data will be accommodated in the current LSE IR, as the Library wanted, with their own metadata standard and linking to publications, as data wished, and access management technologies, area of expertise of LSE technologists, will be applied and allow researchers to exercise control over their created datasets.

The previous deliverables will drive the development of the LSE data repository technology and include the visions of all actors of the actor-network proposed. Therefore they can be seen as the inscriptions at this stage of development.

7. Discussion of results

In the previous sections I have described the process by which an actor-network has formed to develop some e-Research technology, a piece of virtual organization for scientific research communities. The process ended with the writing and submission of a project plan that included the technical requirements that will drive the development of the LSE Library data repository.

My involvement in the DataShare project as the leading person in the LSE Library has given me the advantage of a prior knowledge and understanding of the context, in addition to having relatively easy access to information and people. This insider role, am aware of the potential biased perspective but has also benefits as suggested by Schein (1987). The self-reflexive approach has helped me to think about my role both in the project and as a researcher to understand the relation between the two and how the former affected the latter.

The examination of this process through the lens of the social constructivist's actor network theory has provided an account on how the LSE Library, researchers, technologists and datasets are led to a series of negotiations by the Data Librarian. These negotiations help the imposition of certain identities and consequently enrolled actors in a network of interests and alliances that allows them to work together on the DataShare project. ANT has been helpful in the analysis by providing a useful vocabulary to conduct the description of the formation of the actor-network at the LSE. Its main relevance lies in allowing, through the principle of symmetry, to examine the translation of a non-human actor, data, using the same conceptual apparatus as with human actors. This approach revealed the importance of the datasets showing how they managed to impose conditions and inscribed their interest in the final project plan document. The inclusion in this document of types of data to be deposited with its specific formats, the standards to describe them and the need to link bi-directionally with publications are the results of the negotiations with data. Undoubtedly, data has been a key actor of the actor-network described. Nonetheless, it is still early days in the development of these repositories and it is not clear yet how well data will be accommodated in the institutional repositories.

The role of researchers has not been overly prominent at this stage of the DataShare project. Nevertheless they have expressed their views on virtual research environments, data

repositories and the “open data” movement during meetings and through some surveys. The Data Librarian’s first description of their identities and interest was modified at a later stage to make sure that data producers have some control over their data. Once the technology is operational, it would be interesting to see the use researchers make of data repositories, whether this affects the forms in which they conduct their research or even interact as a community. It will be critical for data repositories to find ways in which to interested researchers so that they deposit their data. Will persuasive methods work, such as preaching for the benefits of “open data” for the research community and society at large? Or will methods using the force be more appropriate, such as research council or institutional mandates to deposit data in repositories?

Technologists were enrolled due to the opportunities and resources brought by the DISC-UK DataShare project. They are not completely convinced about the Library’s role in the development of VREs or e-Research support technologies. Will the DataShare project and its outcomes help to fully convince this community?

The LSE Library has supported the development of data repositories and involvement in e-Research activities since the beginning. It seems to recognize the need for investigating and getting involved in these developments to not fall behind other institutions doing so internationally and provide its researchers a world-class service and infrastructure to support their research.

By examining the formation of an actor-network to develop technologies to support working practices, I have shown how a VO for academic researchers can be understood as a social domain. I can now revisit the research question set out at the start and argue that the process of construction of the LSE Library data repository has brought together the Library, data, researchers and technologists. Each of these groups had, as explained previously, different aims and needs originally described by the Data Librarian which later in the process had to be adapted to enrol all parties on the DataShare project. Those alliances resulting from the negotiations held during the process, allowed all actors to reinforce their identities and inscribe their anticipations and visions on the project plan. Since the beginning, the LSE Library was interested in engaging with support of e-Research activities and further development of their IR; datasets imposed their conditions on formats, metadata and linking to publications; technologists were convinced by the opportunities and resources brought by

the DataShare project and researchers were interested in having more access to data and curating theirs on IRs with certain control. This account has showed how the current development on the LSE data repository, seen as a piece of a much bigger VO infrastructure, is affected by the result of the alliances of the actors with their own interests.

8. Conclusion

This dissertation has examined how a data repository, a piece of VO, is being developed by the LSE Library. In particular, I have been observing how the multiple actors interact and negotiate their positions to finally inscribe their visions on the documents that will drive the development of this technology to support e-Research.

The research exercise contributes to the current literature on the VO using social construction theories. In this case, I have used actor network theory in an attempt to avoid both the technical and social determinism of other accounts. This has served its purpose by describing how a technical actor, datasets, have played a key role in the actor-network studied.

The results produced show issues related to the development of a piece of VO in scientific research environments at the micro-level, one participant of the DataShare project. One option to further research and complement the view presented here could involve looking at the macro-processes. At the macro-level four institutions (University of Oxford, LSE, University of Edinburgh and University of Southampton) are negotiating their recent status with well established national data centres under a climate of current discussions held by the RIN, the RCUK, the Office of Science and Innovation (OSI) and other international bodies. I believe that ANT could be helpful here providing the same analytical tools used in the micro-level account.

While writing the dissertation, it has been announced that the LSE Library in collaboration with the European Nereus Consortium of Economics Libraries⁸ has been awarded EU funding to develop a subject repository. The project is known as NEEO⁹ and it includes dataset workpackage aiming at incorporate data in IRs. In the coming months it is likely that the existing network of alliances brought by DataShare will need to be realigned again as new actors join in. What will be the new actors and interests added to the current situation? And how will those affect the development of the LSE data repository and support for e-Research?

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Acronym Index

ANT –	Actor Network Theory
BADC-	British Atmospheric Data Centre
CURL -	Consortium of Academic Libraries
DDI-	Data Documentation Initiative
DISC-UK	Data Information Specialist Committee
ESDS-	Economic and Social Data Service
ESRC –	Economic and Social Research Council
ICT –	Information and Communication Technologies
IOVO-	Inter-organizational Virtual Organization
IR-	Institutional Repository
IS –	Information Systems
JISC –	Joint Information Systems Committee
LHC –	Large Hadron Collider
NERC -	Natural and Environment Research Council
NGDC-	National Geosciences Data Centre
OECD-	Organization for Economic Co-operation and Development
OSI-	Office of Science and Innovation
RCUK-	Research Councils UK
RIN -	Research Information Network
SCONUL -	Society of College, National and University Libraries
SCOT –	Social Construction of Technology
STS-	Science and Technology Studies
SST –	Social Shaping of Technology
VO –	Virtual Organization
VRE –	Virtual Research Environment

Notes

¹ **Budapest Open Access Initiative** (<http://www.soros.org/openaccess/>) arises in 2001 as an international effort to provide make research articles freely available.

² **Berlin Declaration** (<http://oa.mpg.de/openaccess-berlin/berlindeclaration.html>) in 2003 supports the Budapest Open Access Initiative and promotes internet as the medium to disseminate knowledge.

³ **GridPP** (www.gridpp.ac.uk) is a collaborative project between particle physicists and computer scientist in the UK and CERN. In 2007 the world's largest Large Hydron Collider (LHC), the world biggest particle accelerator was built to probe deeper into matter. The LHC will generate vast amounts of data, too much to be just one institution to handle. Thus 100 computer centres spread across 31 countries will share their computing resources to help with the statistical Montecarlo simulation.

⁴ **Mixed Media Grid, MiMeG** (<http://www.ncess.ac.uk/research/nodes/MiMeG/>) is an interdisciplinary collaboration between computer science, social studies and education to generate tools for social scientist in different locations to analyse audio-visual qualitative data and related materials collaboratively in real time.

⁵ **GEMS and GEMS II** (http://www.jisc.ac.uk/whatwedo/programmes/programme_eresearch/project_gems.aspx) are projects to grid-enable the datasets of major national data centres such as MIMAS and make them available on the national grid service.

⁶ **OECD Principles and Guidelines for Access to Research Data from Public Funding** (www.oecd.org/dataoecd/9/61/38500813.pdf) in 2004 published the principles for providing open access to research data generated from public funding.

⁷ **Support for e-Research: Filling the Library Skills Gap** (<http://www.nesc.ac.uk/esi/events/770/programme.cfm>) in June 2007. This event organized by the CURL/SCONUL e-Research Task Force for librarians and information professionals to hear about developments in e-Research.

⁸ **Nereus Consortium of Academic Libraries** (http://www.nereus4economics.info/about_us.html) is a consortium of European Academic Libraries with expertise in Economics.

⁹ **Network of European Economist Online (NEEO)** (http://www.nereus4economics.info/neo_intro_press.html) is the continuation of the collaborative Economist Online project between EU economic research institutions.