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ABSTRACT

The authors argue for a monist view of sociotechnical analysis, and, following Fleck and his colleagues, discuss ICTs as laboratories where knowledge, activities and artefacts emerge across different sites and different stages of development. Researchers at a number of mature research sites (what Gieryn calls 'truth spots') have identified distinctive sociotechnical phenomena. These have been objectified and described in a scientific nomenclature that allows research to cumulate and comparisons to be made at a level that transcends the individual agent, the individual artefact and the local context. Five phenomena are discussed in detail: sociotechnical interaction networks; computerization movements; innofusion; configuration; multi-level social learning. The approach outlined in the paper, the authors suggest, may improve the focus of research in the IS domain.

Keywords (Required)

ICTs, truth spots, sociotechnical fusion, objectification.

INTRODUCTION

The starting point of this paper is a review of two traditions of sociotechnical work – Social Informatics (SI) in the US, and Sociotechnical Studies (STS) in the UK – undertaken in two separate studies (Horton, Davenport, Wood-Harper, 2005; Davenport, 2008). These suggest that though there is considerable conceptual and methodological overlap in STS work undertaken on each side of the Atlantic, it is only recently that lines of work have emerged that draw on both traditions (Sawyer and Tapia, 2007). We claim in this paper that there is a shared conceptual base between SI and STS, and that the fusion of social and technical in the nomenclature across both SI and STS is, we contend, 'monist'. Recently, researchers in both SI and STS traditions have based their work on this fused vocabulary (or 'ontology') – thus, the fusion is between the social and the technical, and not – as one could perhaps, mistakenly, infer - between the traditions of SI and STS. We seek in the current paper to find an overarching frame that accommodates both lines of work, and that goes beyond describing their commonality in terms of a more or less commensurable bundle of terms and techniques. We do this in four steps. Firstly, we describe technology not in terms of an artefact alone, but as a laboratory extended in time and space, where 'knowledge and activities related to an artefact' (Fleck & Howells, 2001) emerge in different kinds of experimentation. Secondly, we provide a rationale for this approach and a brief genealogy. Thirdly, we consider the phenomena that are observed in the laboratory of technology and the names that have been applied to these, and fourthly, we discuss ways in which the naming process consolidates sociotechnical analysis as a distinct and unified domain..

TECHNOLOGIES AS LABORATORIES

Why take this stance? We sense that there has been a failure of nerve among some SI researchers in the US, where there has been much agonising about the institutional status of the subject. Kling (Kling, 2002) for example talks of a 'critical chill' among managers and researchers faced with organisational technologies. And the recent monograph by Sawyer and Rosenbaum (Kling, Rosenbaum, Sawyer, 2005) is largely concerned with embedding SI into the US academic curriculum, a project that is reprised in a subsequent paper by Sawyer and Tapia (2007). At one level, this failure of SI nerve may be seen as part of a larger malaise in the IS field (Galliers and Whiteley, 2007). We however take a different line – many SI and STS studies are not distinctive in domain terms; the focus is unclear, and they read like contributions to organisational science, or political science, or software engineering. In many of these studies, social practice and technical artefact are at best loosely coupled. An alternative framing, using terminology that expresses the fusion of 'sociotechnical' is required. Sociotechnical fusion may be observed by watching technology – the experimental activities and situated knowledge that emerge where ICT artefacts are in play – and naming the phenomena that are observed in the 'laboratory' of technology. It may be noted that Sawyer and Tyworth (2006) have also endorsed a 'monist' sociotechnical viewpoint in a recent paper.

To simplify (and shorten) our argument, we draw on Gieryn's notion of 'truth spots' (2006). These are persistent sites where empirical observation (in the laboratory or the field) and concomitant discourse evolve and are consolidated in a distinctive body of strongly legitimised knowledge. Such sites enjoy high reputation, and serve as reference points in their relevant

domains. Gieryn discusses Chicago and Los Angeles as truth spots for urban studies, where the streets are the laboratory. We suggest that there are analogous truth spots for social informatics or sociotechnical studies – UC Irvine/Indiana and Michigan in the US for example; Manchester University, the Said Business School, the Judge Institute, and the University of Edinburgh in the UK. These sites are truth spots because of their long trajectory of empirical, and theoretical, work that has been significant in the development of the respective traditions (e.g. see: Walsham, 1993; Russell & Williams, 2002; Kling, Rosenbaum & Sawyer, 2005).We have selected two of these – UC Irvine, and University of Edinburgh – for detailed discussion in the text that follows.

RATIONALE AND GENEALOGY

Fleck and Howells (2001), describe the processes by which artefacts are adopted or appropriated into different settings in terms of a 'technology complex'. The complex (a framing that is analogous to our 'laboratory') consists of elements that may be arrayed on a continuum that stretches from the social to the technical. All artefacts fit somewhere on this continuum; all have social elements. The artefact is not commensurate, as technology includes the artefact and 'knowledge and activities related to it', more or less embedded in what is installed. Different elements of the complex will be primary or secondary drivers of design in any specific technology implementation - it is more often an experience of 'devising working operations around the new artefacts after, rather than before, installation' – in a process that Fleck calls 'innofusion' (1988a), a concept that we discuss in more detail below. In treating ICTs as laboratories, we have also drawn on earlier work undertaken in Edinburgh, in the Social Studies of Science Unit in the 1960s and 1970s. Pinch and Bijker's 1984 paper (1984) provides a succinct account of that shows the conceptual links between the Empirical Programme of Relativism ('EPOR') at Edinburgh, and the Social Construction of Technology ('SCOT'). In EPOR, scientists explore scientificity, or the emergence of an acceptable fact, from a number of competing claims/claimants. In SCOT, analysts explore the emergence of a stable or acceptable artefact from a number of competing constituents. Outcomes, more or less stable, in SCOT emerge in activities that are a form of open laboratory experimentation. These activities are undertaken in different localities at different stages of development - designated R & D departments, prototyping and beta testing, post-installation adaptation. These extended assemblages are, in our terms, technology.

Fleck (1988) speaks of 'learning by trying' and 'learning by struggling' in his discussion of innofusion. The level of control over experimentation with artefacts in these ICT 'laboratories' varies. As Fleck points out, some artefacts find a home in congenial settings, and innovation will be relatively smooth. He cites the case of robotics in Japan, where cultural and work practices could accommodate the artefact with little modification. In other cases, elements of the artefact may stabilise quickly, and can be treated as black boxes. Fleck describes such an implementation in BP (1988b). In contrast, Mumford and Banks (1967) in a highly interventionist account of First Generation Computing in the UK describe technology as 'like a bomb….if no precautions are taken, panic and confusion will follow.' Williams and his colleagues (2000) have described the very large sectoral level infrastructures that characterise 21st century computerization in terms of 'trials and pilots', and take experimentation as the *raison d'etre* of large triadic alliances between academe, consultancy and corporate institutions. The laboratory of technology extends across institutions and national jurisdictions in such cases, and implicates government and policy-makers in novel ways. Inquiry into the role and utilization of artifacts and componentry takes an experiential turn, no longer a task in and for itself, but part of an interactive, dialogic , and necessarily incremental process of inquiry and change.

SOCIOTECHNICAL PHENOMENA IN ICT LABORATORIES

Within the SI/STS tradition, a specific vocabulary that fuses social and technical has emerged in accounts of empirical work. This lexicon, we suggest, describes the phenomena that are observed in ICT laboratories. In this part of our argument, we focus on work at Irvine/Indiana and Edinburgh and have selected a small number of phenomena to discuss in more detail. We return to the parity of construction of fact and artefact invoked by Bijker and Pinch (1984). In both processes, some phenomena have more success than others in achieving status as constituents as claims made in the laboratory. In the interests of brevity, we discuss technological phenomena here that have achieved some degree of success – by this we mean that they have been invoked in studies other than those where they were originally described. Examples are 'sociotechnical interaction networks' (STINs) and the closely related concept of 'social actor', and 'computerization movements' at Irvine/Indiana, and 'innofusion', 'configuration' and 'multi-level social learning' at Edinburgh. (Less successful candidates include 'poles of attraction' at Edinburgh, or the 'guild model of publishing' at Indiana).

The Irvine/Indiana Truth Spot: STINs and CMs

Kling and his colleagues in a number of papers (e.g. Kling, McKim and King, 2001; Meyer and Kling, 2002) acknowledge the historical impact of loosely coupled socio-technical systems models, but expose their limitations and proffer an alternative socio-technical network model, the Socio-Techncial Interaction Network, or STIN. This is:

'A network that includes people (including organizations), equipment, data, diverse resources (money, skill, status,), documents and messages, legal arrangements and enforcement mechanisms and resource flows. The elements of a STIN are heterogeneous, The network relationships between these elements include: social, economic and political interactions' (Kling et al, 2001. p. 3).

The tight integration between social and technical in the STIN model offers an explanatory power that differs from that of multivariate analysis or other numerical techniques. Kling et al. (2001) suggest that STIN modeling can be done before implementation (in comparison with actor network analysis which explicates post hoc), where it has some predictive power (comparable to stakeholder analysis). In a way that is typical of much of Kling's line of work at Irvine/Indiana, the article provides an 8-point activity list for those who wish to undertake STIN modeling. The authors instantiate the phenomenon with a secondary analysis of empirical studies of collaboratories, and of the stabilization of the IP standard.

The second phenomenon identified at Irvine that we have selected for discussion is the 'computerization movement', identified in secondary analysis of studies of ICT projects in organizations that are characterized by a dissonance between the expected and the actual outcomes. This could be explained, suggested Kling and Iacono (1994), by the fact that the goals of many projects were ideological as much as technical, with systems seen as 'instruments to bring about a new social order'. CMs 'communicate key ideological beliefs about the favourable links between computerization and a preferred social order which helps legitimate relatively high levels of computing investment for many potential adopters. These ideologies also set adopters' expectations about what they should use computing for and how they should organize access to it' (Kling and Iacono, 1994. p. 3). In addition to articulating ideologies, CMs are a means of setting agendas. Kling and Iacono present a number of societal computing initiatives as examples of CMs – artificial intelligence, home computing and remote working.

The Edinburgh Truth Spot: Innofusion, Configuration and Multi-level Social Learning

The phenomena that are discussed at this point of the paper emerged from research at Edinburgh into innovation and technology that was strongly supported by UK funding councils, notably the Economic and Social Research Council (ESRC) whose funding for the 10-year PICT (Programme for Information and Communication Technologies) initiative supported investigations at sectoral and societal levels. It provided resources for trans-sectoral longitudinal research, and, thus, supported extensively scoped social explanations of technology trajectories. Edinburgh was one of six major sites of research, with wide-ranging investigations of the manufacturing sector (focusing on robotics), the financial sector, and, in the 1990s, the then emerging field of multimedia technologies.

As we note above, a major finding by Fleck and his colleagues (Fleck and Howells, 2001; Fleck, 1994) investigating robotics is that innovation continues through implementation, consumption and use – a process that he labelled 'innofusion'. The potential uses and utility of a project cannot be fully understood at the outset of a project or programme of development. Innovation is a process of protracted learning that involves an array of actors, all with different commitments to a project in terms of each one's past experience and expertise. Such actors may be outside the focal organisation – producers of competing products for example – and artefacts typically emerge 'through a complex process of action and interaction between heterogeneous players – 'learning by trying', and, more strongly, 'learning by struggling.' Fleck identifies the phenomenon in a series of studies (1988, 1994) that account for a number of different artefacts – robotics, databases – and, as we note above, provides a means to characterise the phenomenon, a move that is as necessary in technology studies as it is in scientificity.

In a further series of studies, Fleck (1999, 2000) identified the second of the phenomena that we discuss here – configuration, a sociotechnical term for knowledge and activities that bring together heterogeneous and exogenous artefacts into componential assemblies. A configuration is a complex of standardised and customised automation elements, and a number of studies of configurational technologies were undertaken by Fleck's colleagues (e.g. Williams, 1997; Molina, 1999). Configuration shows that technology is always a site of conflict and controversy, where design 'presumptions' conflict with the actual circumstances and requirements of use and consumption. Complex technologies (infrastructures for e-science or e-government for example, or corporate integrated platforms) are configurations of heterogeneous technical and social components rather than finished systemic solutions, with offerings from one group embedded in the offerings of other players in a process of 'pick and mix'. Technologies develop cumulatively – and new applications are stronger when they build on earlier ones – EDI (electronic data interchange) for example, was built on the barcode.

Multi-level Social Learning

The configuration phenomenon has proved to be a powerful stimulus. Williams and his colleagues, exploring the problem of aligning exogenous commodified artifacts with local practice have focused on standardization. Their recent work has addressed a complex and volatile artifact – very large knowledge infrastructures such as enterprise resource planning

platforms (Williams, 2000; Pollock and Williams, 2008). They describe knowledge and activities in terms of the phenomenon of 'multi-level social learning'. Some of the key decisions affecting the future prospects of a technology 'may be taken in the 'virtual space' of standards-setting committees where key players seek to align expectations around their particular offerings' (Williams, 2000. p. 254). Large trials and pilots (in more or less natural settings) are a way to learn how to develop as much as to learn about what products and services will look like – experimental projects may not need to proceed to roll-out/widespread use to be deemed worthwhile.

SOCIOTECHNICAL NAMING AS A SCIENTIFIC PROCESS

Our argument so far has proposed that the notion of technologies as laboratories can be a frame for a monist sociotechnical analysis. We have selected five sociotechnical phenomena that have been observed in such laboratories and described and named in a series of studies that draw on both primary and secondary data analysis. These phenomena have been elaborated in such studies, endowed with attributes and embedded in investigative schemas. In this section, we suggest that this process has resulted in a shift in status, from mere description to conceptualisation, a transformation that allows sociotechnical phenomena to function as scientific concepts. To support this argument, we draw on functional linguistics, and the work of Halliday (Halliday and Martin, 1993).

Halliday explores the process of 'objectification', to characterize scientific writing and practice. Objectification turns the world into nouns, terms for objects that may be further qualified, classified and described in terms of shared relationships; it is achieved by two linguistic processes, 'nominalization' and 'grammatical metaphor'. Through nominalization, processes and events are presented lexically/grammatically as objects, in a process of translation, or grammatical metaphor, where one function is 'dressed up' in the language of another. Objectification is a parsimonious and effective device, honed over centuries, for making scientific realities: it backgrounds some objects (as given) and foregrounds others (as available for exploration); in its most thrifty form, the database, it drives our institutions. Halliday continues: '…it is the practice, the activity of 'doing science' that is enacted in the forms of the language, and there has been a broad consensus about what constitutes scientific practice. It is this reality that is construed in scientific discourse…' (Halliday and Martin, 1993. p. 64).

Objectification in STIN and CM

The objectification of the STIN can be traced across a series of papers. The fullest elaboration combines STIN with the 'social actor' model proposed by Lamb (Lamb and Kling, 2003, Lamb, 2006) in a comprehensive grid that offers a schema with exemplars of what to look at in what order. A number of different ICT artefacts have been explored with STIN analysis for different purposes: evaluation (Tyworth and Sawyer's [2006] study of ARJIS, a criminal justice information system); requirements analysis (Letch and Carroll's (2007) attempt to model service delivery to indigenous communities in Australia). In each of these local case studies, an attenuated STIN model is used and the researchers complement STIN with additional analysis to capture agency. Our own experience supervising a doctoral student using a 'full' application (Ziba, 2007) is different. Here a sectoral approach was taken to explore computerization in high schools in Malawi. STIN analysis uncovered a tightly coupled complex of agentic and structural phenomena, and revealed sets of attributes ('thick' and 'thin' STINs) that were indicative of sustainable ICT domestication.

The second Irvine/Indiana phenomenon – computerization movements – was elaborated in a series of papers by Kling and Iacono. This particular objectification has proved to be powerful, as the scope of a recent edited monograph (Elliott and Kraemer, 2008) on CMs reveals. According to Iacono and Kling (1998), 'participants in computerization movements build up frames in their public discourses that indicate favourable links between internetworking and a new, preferred social order…changes in worklife are shaped (but not determined) by the prevalent discourses informing new technologies and the practices that emerge around them in actual workplaces' (p. 4). They describe this phenomenon as a technological action frame (TAF). This notion is an amalgam of two concepts. The first is the sociological concept of framing, presented by Goffman (1974) and elaborated by analysts of social movements such as Snow and Benford (1988), who present 'collective action frames' (CAF) as a political instrument, a means of aligning support and resources, and consolidating power. CAFs specify what is in the frame and what is out of the frame – one set of meanings rather than another is conveyed, or one story rather than another is told; CAFs are thus is 'more agentic and contentious' (Snow, 2004) than everyday interpretive frames. The second feeder concept is the 'technological frame' (TF) developed in the sociotechnical analyses of Bijker (1997) and Orlikowski and Gash (1994) to explain ways in which technology is perceived and appropriated in different contexts. Technological frames are an effective unit of analysis that supports explanation of the unintended consequences of organizational computing. The TAF, according to Iacono and Kling, combines the explanatory power of TFs and political power of CAFs and explains how groups achieve authority and legitimacy, and marginalise opponents. A strong TAF, or 'master frame' stabilizes a set of key meanings for a focal technology' (Elliott and Kraemer, 2008. p. 8).

We ourselves have explored e-government in a Scottish municipality as a CM (Author_paper, 2008) applying Kling and Iacono's 'technology action frame' (TAF) to a specific set of artefacts – mobile devices. TAF helped us clarify the dynamics of implementation in a way that a less ambitious TF analysis would not have achieved. If the case is seen as a specific example of a computerization movement (e-government), where a master TAF is at work then some puzzling features can be explained. These include the lack of local requirements analysis and the arbitrary provision of functionality in the pilot project for 'mobile working'.

Objectification in Innofusion, Configuration and Multi-level Social Learning

Once technology supply moves out of the firm, design (participative or otherwise) is not the main issue – explorations of 'purposive individual action' can only provide partial insight. Nor is it helpful to look for the social implications of a technology 'at the level of specific artefacts (particular components), or even at the level of the integrated artefact given the potential range of configurations available for the same function, but rather at how they are inserted into broader systems of technology and social practice' (Williams, 2000). To understand configuration, practitioners and researchers need to explore standardisation. According to Russell and Williams (2002), a number of challenges must be addressed by practitioners who wish to engage with standardisation: how to attain critical mass (by promising the right stuff); how to exploit the installed base particularly the delivery systems and end-user technology platforms in the workplace and home); how to engage with appropriate development partners to share costs and risks, and 'reduce uncertainties by foreclosing options in advance'. As we indicate above, the Edinburgh phenomena emerged in projects that were generously funded over time, and that supported meso and macro level investigation. The empirical studies that underpin the ongoing conceptualisation of innofusion and configuration have been amply documented in a number of monographs, the most recent of which (Pollock and Williams, 2008) explicates ERP as a configurational technology. In the interests of brevity, we focus here on the Edinburgh group's recent exploration of multi-level social learning in large scale demonstrator projects.

The framing of configuration in terms of 'social learning' is one of the important outcomes of the Edinburgh group's participation in PICT and subsequent projects: 'social learning is not restricted to the learning economy of supplier-user interaction around the design and appropriation of artefacts, but also encompasses the activity of public policy-makers, as well as promoters and other players in civil society in setting the 'rules of the game'. Williams explores the process of mobilisation around expectations and visions of new technological 'solutions' to problems that earlier generation products and services have failed to handle. Mobilisations often happen around demonstrator projects (think of the big EC IST programmes) that provide convincing evidence of technological futures. 'Governments (and other supra-governmental bodies such as the European Union and the G7 (as it was then) group of countries) are trying to match or outdo each other in setting up different kinds of experiments …This tie between government and industry elites is geared towards a consensus about the need for greater ICT investments in order to achieve competitiveness and social advance, associated with particular rhetorics about what ICTs will deliver (Williams, 2000). A key social learning ability is the capacity to unbundle different elements; to build upon relationships established to retain and transfer relevant 'knowledges' and creatively apply them in different settings – 'an intriguing aspect of many multimedia projects is the way they involve new relationships between public and private bodies and a rearrangement of the boundaries between them' – what Sorensen has called 'learning by regulating'. (1996).

SUMMARY AND CONCLUSION

Faced with a 'muddying of the waters' in the information systems domain where many recent studies have been as much organizational or political science, we have outlined an approach to the study of technology that is premised on the notion of sociotechnical anlaysis as a distinct domain. Drawing on an established body of STS work, notably the SST tradition at Edinburgh and SI tradition at Irvine/Indiana, we suggest that technology (and ICTs, the specific focus of Social Informatics) can be seen as a laboratory where artefacts emerge and evolve over time. The knowledge and activities that relate to artefacts, the phenomena of the laboratory, can be described in sociotechnical terms, and we argue that a distinctive vocabulary has emerged from studies across these traditions. This we demonstrate above through our analysis of a number of mature research sites. We have explored a selected group of terms, and suggest that they work as a scientific nomenclature that supports cumulative exploration of phenomena. In the interests of brevity, we have not explored methods in this paper, but issues such as point of view, point in time, bricolage must be considered, and await another paper.

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To be inserted later.

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