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Virtual Objects And The Study Of Organisations

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INTRODUCTION

On 20 March 1853 *The Sunday Times* reported on a fire at the royal residence at Windsor. 'A fire of very alarming and destructive character broke out at a late hour at Windsor castle…. Her Majesty displayed great coolness and presence of mind, and finding that firemen appeared to make some mistakes in carrying the hose gave orders to dispatch a "telegraphic message" to London for more firemen, who reached the spot by special train' (Blackstone, 1957:128). The quote from *A History of the British Fire Service* on Queen Victoria's use of the first electrical communication device presages contemporary associations: since the telegraph, technological objects have been associated with affording the potential for communication across greater distances and enhancing the immediacy of information. This emphasis on technological objects transforming space and time poses a significant challenge for those interested in understanding contemporary changes. How to appreciate the significance of such objects?

OBJECTS AND ORGANISATION

There is increasing interest in objects in the social sciences (Pels, Hetherington and Vandenberghe, 2002) including non-human objects such as information and communication technologies (ICTs). It is now well established that the design, implementation and use of technologies is thoroughly social (Williams and Edge, 1996) yet until the late 1970s the dominant analysis of technologies was based upon assumptions from evolutionary theory (e.g., Dawkins, 1986). Successful technologies were functional to certain environmental requirements with the diffusion and impact of technologies exogenous of social contexts. These assumptions have been challenged by a variety of approaches including the political process approach (e.g., Dawson, Clausen and Nielsen, 2000) and social studies of science and technology more generally (Pinch and Bijker, 1984). Drawing on empirical detail these approaches contend that technological change is an irreducibly political process comprised of 'heterogeneous engineering' (Law, 1987:111). This involves constituting an actor-world that provides the conditions for adopting a particular technology. Successful technologies are, then, those that have enrolled, aligned and stabilised people, documents and devices across times and spaces. Despite exemplary research on the social construction of technologies, there is something 'unsatisfying about a narrowly discursive reading' because what happens once we have learnt that X is a 'human kind, and that, like all social constructions, it is negotiated into being within discourse' (Brown, 2001:176). It remains unsatisfying partly because the focus shifts from specific activities: an emphasis on relations that 'work up' technological change has difficulty analysing how sociality is mediated by technological objects.

The actor-network approach or ANT as it is sometimes known (Callon, 1986; Latour, 1986, 1992, 1999; Law, 1987, 2002, 2002a) has been constitutive of an increasing interest in objects over the last two decades and, more generally, in questioning the reified and self-evident identity of subjects and objects. It is useful to introduce three analytical contributions that actor-network theory's approach to objects has made to social and organisational theory. First, the actor-network approach asserts that objects are relational and contingent enactments *and* 'immutable mobiles' in an actor-network. Here objects are objects so long as 'everything stays in place and the relations between it and its neighbouring entities hold steady…. The job of ANT is to

explore the strategies which generate—*and* are in turn generated by—its object-ness, the syntaxes or the discourses which hold it in place' (Law 2002:93, emphasis added). Brown (2001) suggests that actor-worlds can be elaborated into non-essentialist and mutually interdependent discursive and non-discursive achievements. Discursive and non-discursive are useful terms because they provide a connection to the etymology of technology as *techne* as an art of the mind *and* skilled use of techniques: 'a way of composing and reflecting upon the world … [and] an array of practices through which projects are realised' (Brown, Middleton and Lightfoot, 2001:125). Much recent analysis of technology has however concentrated on the former sense of *techne* as form giving. In contrast the non-discursive denotes practical and non-essentialist activities relating to the use of tools.[1] There is not an opposition between 'words and things, nor between discourse and materiality. It is rather between two kinds of mixed ensembles… or 'multiplicities'…. Taken together, the multiplicities form an unstable but nonetheless coherent, whole' (Brown, 2001:179-80). Thus what is required is analysis of discursive and non-discursive relations that account for the social shaping of technology *and* what is shaped by technology.

Objects are achievements of interdependent and mutually supportive discursive and non-discursive relations that are simultaneously subject to translation. Latour (1986:267) describes translation as

> the spread in time and space of anything—claims, artefacts, goods—in the hands of people; each of these may act in many different ways … modifying it, or deflecting it, or betraying it, or adding to it, or appropriating it.

Translations turn actors into someone or something else because neither subjects nor objects are a priori complete, but are relational effects that 'gain their ontological character through the position they occupy within the shifting relationships operating across' bodies of practice in which they are embedded (Brown, Middleton and Lightfoot, 2001:129). Objects are, then, more than singular 'things' but also more than arbitrary multiplicities. This means attending to 'levels of scale' of objects, that is to say, the relational networks which themselves constitute objects *and* how objects have an inter-objectivity (Latour, 1996) which denotes the possibility of stability beyond the present, but is an inter-objectivity which is, in turn, a relational effect.[2]

Second, objects are analysed symmetrically with other actors: for analytical purposes, subjects and objects are different in degree rather than different in kind. This controversial rule of method (Latour 1987), which was developed in part to reassert the proliferation of objects (e.g., devices, documents, etc.,) in the constitution and scientific facts against socio-cultural approaches associated with the Edinburgh School, challenges conventional assumptions of social scientific investigation. In terms of technological objects, the assumption of symmetry meant foregrounding the way in which technologies are constituted by *and* constitute social relations.[3] As a consequence, the relationship between a device's capacity (i.e., what it does, enables, constrains, etc.,) and the conduct of social and organisational activity becomes an

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[1] 'Non-discursive' rather than 'materiality' because language also has material effects.
[2] This means 'that when a (network) object is enacted, so, too, a (network) world is being created with its own spatiality' (Law 2002b:97).
[3] This is in contrast to materiality understood as symbolic objects of knowledge. Those associated with actor-network theory argue that culturalist approaches tend toward a separation of culture and nature.

explicit topic for analytical scrutiny and contestation. 'History is no longer of people, it becomes the history of natural things as well', says Latour (1993:82).

Third, the emphasis on symmetrical anthropology is part of an attempt to overcome the dualistic separation of society and nature and to replace this with an understanding of the translations and purifications of proliferating hybrids known as 'quasi-objects' and 'quasi-subjects', which are neither pure nature nor just cultural projections. The ontological status of these indispensable and innumerable quasi-objects and quasi-subjects is described by Latour (1988:80) in the following terms: 'Did the microbe exist before Pasteur? From the practical point of view—I say practical, not theoretical—it did not'. The argument here is that scientists, technologists, and so on, produce new (quasi-)objects, initially as responses to laboratory 'trials' or activities to produce a prototype, for instance, but that '[t]his situation, however, does not last. New objects become things…. things isolated from the laboratory conditions that shaped them, things with a name that now seem independent from trials in which they proved their mettle' (Latour, 1987:90-1). Here quasi-objects—or things—are constitutive of practices, participating in activities just as humans do. Actor-networks of human actors, non-human actors and variously coordinated relationships and activities between them, constitute historically specific cultures and natures. In the sense that quasi-objects are not only interpreted but have to be handled, responded to, they help to organise, are resources for activities, and so on, the actor-network approach has resonances with an emphasis on practices as 'a temporally unfolding and spatially dispersed nexus of *doings* and *sayings*' (Schatzki, 1996:89, emphasis added).[4] In short, there is good reason to argue that objects are significant in the constitution of organisational activities.

Recent interest in objects is also associated with new spaces and times of sociality. Knorr Cetina (1997) suggests that objectual-relations are constituting 'post-sociality'. This means, most simply, that 'the expansion of object-centred environments which situate and stabilise selves, define individual identity just as much as communities and families used to' (Knorr Cetina, 1997:1). Knorr Cetina and Bruegger (2002) focus on the object relations of market traders' dealing screens. Before integrated screens, traders had to spend a considerable amount of time locating the market in institutional spaces. The market was 'hidden' in a 'network market' of banks and other financial institutions. In contrast, the introduction of integrated dealing systems meant that 'the market became fully available … for the first time…. The market on screen is a "whole" market and a global presence' (Knorr Cetina and Bruegger, 2002:163). This emphasis on 'full availability' and 'global presence' is important as it suggests that previously dispersed spatial and asymmetrical temporal relations are reconfigured and integrated by ICTs.

Drawing on insights from actor-network theory and claims of post-sociality, this paper provides an analysis of the shift to screen mediated sociality and the suggestion that it is constituting all-encompassing forms of interaction. The domain explored here is not traders but the introduction and use of an integrated incident management system (Vehicle Mounted Data System or VMDS) for firefighters at a UK fire service (Combined Fire Service [CFS], a pseudonym). Like traders, firefighters' use of

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[4] This does not however resolve the question of symmetric or asymmetric approach to objects by human actors (see contributers in Schatzki, Knorr-Cetina and Savigny, 2001).

VMDS screens is associated with bringing together previously dispersed spatial and asymmetrical temporal activities: with the VMDS, firefighters no longer need to spend their time locating information that differs in space and is temporally dislocated. This paper argues that firefighter sociality is indeed increasingly occurring through VMDS screens, and this is having significant implications for fire service provision, but claims of post-sociality demand analytical scrutiny of screens 'as close as one can get to delivering a stand-alone world that includes "everything"' (Knorr Cetina and Bruegger, 2002:166).

The paper develops three senses of objects as virtual: virtual as linked to virtue, virtual as constitutive of transformations and virtual as the resolution and deferral the identity of an object. The paper is comprised of six sections. The following three sections introduce Combined Fire Service, the VMDS and the research methodology. The fourth section develops the first sense of virtual object through an examination of how and in what circumstances the VMDS was reconstructed around particular forms of technological information failure. It is suggested that this involves acts of ontological activity which open up questions of power and value and re-establishes a link between virtual and virtue. The fifth section sets out how the VMDS was introduced to overcome the spatial fragmentation of firefighters and temporal asymmetries of information and was translated into providing enhanced firefighter mobility. In order to understand this transformation in firefighters' activity, Deleuze's notions of virtual-actual, possible-real are introduced in order to account for of an object, which has become associated with the wider problematic of organising fire service provision. The sixth section describes VMDS screens in use and examines whether this constitutes a 'stand-alone world' of post-sociality. This notion of virtual object describes the inconsistencies and ambiguities associated with use of the VMDS and how various forms of ambiguity resolution and deferral of inconsistency is involved in sustaining the VMDS as a coherent and unified object.

UK FIRE SERVICES AND COMBINED FIRE SERVICE

Fire services in the UK respond to emergency fire calls and have a statutory duty under the Fire Services Act (1947) to attend fire related incidents. The VMDS at Combined Fire Service was the first of its kind in the UK fire service and is considered to have important best practice implications for the provision of information to operational firefighters across the UK. Paradoxically the relative geographical remoteness and small size of CFS compared to metropolitan brigades, which had meant that it had also been distant from many other innovations, had turned into an advantage with the VMDS.

Despite increasing demands for CFS to audit its activity through various performance indicators, the managerialism and decentralisation of responsibilities associated with other public institutions is less predominant in the fire service (Fitzgerald and Stirling, 1999). The 'Grey Book', for example, is a set of national rules, negotiated by the national joint council (NJC), comprised of conditions of service and working practices (e.g., shift patterns). Fire cover standards are similarly decided at a national level, with six categories (A to D, Remote and Special Risk) of fire cover. National response times are also related to categories of fire cover.

Since the publication of the Audit Commission's (1995) report *In the Line of Fire* (ILF) there has been increasing emphasis on more effective front-line incident management, with the intention of allocating resources on cost-benefit assessments, risk calculations and population movements. Fire services have also had to increasingly demonstrate 'best value' performance to the Fire Service Inspectorate (HMFSI). According to the recent *Independent Review of the Fire Service* (IRFS) (Bain, 2002), fire services remain characterised by a 'weak managerialism' that requires urgent modernisation. The report concludes that despite initiatives managers 'are squeezed between national standards of fire cover … and national terms and conditions designed for working conditions of a generation ago [in future]…. There will be national principles, standards and expectations—though fewer than there are now—but these will be coupled with sensitivity to local circumstances' (IRFS, 2002: 29, 31).

Combined Fire Service is one of 50 fire authorities in England and Wales and is responsible for a geographical area of over 390,000 hectares and a population of over 700,000. It has over 700 wholetime (full-time) and retained (part-time) staff and just over 100 non-uniformed support staff. Wholetime shifts at over 95 per cent of all UK fire services, including Combined Fire Service, are organised around two day/two night shifts and four days leave (IRFS, 2002). Retained firefighters work voluntarily and part-time and usually cover rural areas although retained crews also cover some urban areas. Combined Fire Service also follows the national practice of separating wholetime and retained crews.

Each firefighter is allocated to a particular station watch.[5] Although it is customary for firefighters to occasionally undertake a 'detached' duty, that is, stand in for firefighters on leave/undergoing training, the conventional practice in fire service is that the majority of activities are undertaken with the same watch. This structure is well recognised throughout the fire service as providing the basis for strong bonds of commitment and solidarity amongst wholetime watch crews (Salaman, 1986).

Combined Fire Service attended 10,191 incidents during 2000-1 (Annual Report, CFS, 2001-2), and is comprised of 27 stations including 24 hour crewed, day crewed and retained fire stations. There are 43 fire appliances/fire engines, 14 special appliances and a mobile unit for prolonged incidents. Each of the 27 stations has a designated 'turn out' area. This sets out the geographical boundary of station and watch responsibility. Turn out boundaries are determined by a combination of national fire cover categories and local legacies. Fire crews are mobilised by CFS command and control centre using standardised procedures based on turn out boundaries and national risk classification. Crews only move outside of boundaries for major incidents or concurrent incidents that require the deployment of extra resources.

THE VEHICLE MOUNTED DATA SYSTEM

It is widely accepted that the provision of ICT mediated information to front-line firefighters at incidents will improve workplace health and safety, and operational effectiveness (ILF, 1995). Yet compared to other emergency services there has been

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[5] 'Watch' and 'crew' is used interchangeably.

an under-investment in front-line ICTs across UK fire services throughout the 1990s (see Ackroyd, Harper, Hughes, Shapiro and Soothill, 1992). The recent review of the UK fire service argues that this reflects the fire service's low political priority (IRFS, 2002).

In 1993 two of Combined Fire Service's firefighters died at a major fire incident at a large poultry factory attended by fire crews from across the brigade. Firefighter deaths are however relatively uncommon with 13 fatalities across the UK between 1990 and 2000. In May 1994 a Health and Safety Improvement Notice stated that CFS was in contravention of the Health and Safety Work Act (1992) because

> the information held by the Brigade and available to fire crews and officers on particular hazards … is insufficient to ensure … the health and safety of firefighters (*The Grapevine*, CFS, Summer, 1997:8).

Combined Fire Service installed the VMDS on 36 fire appliances in March 1996 in response to the Improvement Notice (CFS, 1996:34). The VMDS is a fire appliance based integrated incident information management system that is comprised of a range of technologies. In this paper I attempt to examine the reciprocal relationship between the specificity of the VMDS at Combined Fire Service and the broad promise of fire service modernisation associated with the VMDS. The VMDS provides standardised and real-time on-screen information to firefighters on the move and at incidents. Screens bring together a wide range of operational information that was previously station based, communicated by radio or kept by watches. The device is updated by Combined Fire Service's Operational Intelligence Department, which is responsible for updating risk records from fire safety inspections, amending operational procedures and providing CAD/CAM (computer aided design and manufacture) drawings. The VMDS is also connected to Combined Fire Service's command and control centre at the headquarters, which receives emergency calls and mobilises crews.

VMDS screens provide risk information on buildings including CAD/CAM drawings of major risks, first response tactical plans for large-scale risks, standard incident procedures, chemical information (CHEMDATA) and Ordnance Survey maps detailing water hydrants. The VMDS is mounted on the front dashboard of fire appliances and linked to a cabin printer. The VMDS can be understood as an Enlightenment (from 'light' meaning 'to bring light' *and* 'of little weight') device: the connectivity the VMDS offers and its smallness compared to previous forms of information provision means that firefighters' spaces and times can be reconfigured around unprecedented levels of information.

RESEARCHING THE VMDS

Research was undertaken over nine-months during 1997-98.[6] The VMDS provided the opportunity to contribute to research on ICT use on the move (cf. specific workplaces) at different times and in different places (see Urry, 2000). Research focused on firefighters' use of the VMDS but also on implementation. Observations and interviews were conducted at six stations. The six stations, including the four with

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most incidents, comprised of three stations crewed 24 hours, two stations with retained firefighters acting as backups to wholetime crews and one station that was day crewed and on night call. A week was spent at the Operational Intelligence Unit and the command and control centre undertaking interviews, observing and consulting archives.

The majority of Combined Fire Service firefighters and headquarters staff interviewed were wholetime or full-time non-uniformed staff. All levels of the hierarchy at were interviewed including: firefighters, leading firefighters, watch commanders, Station Officers, Assistant Divisional Officers, Divisional Officers, command and control centre staff and the deputy Chief Fire Officer. Interviews focused on how the VMDS was used and why and how it was introduced although interviews typically began with an individual's role and their views on changes in the fire service. Interviews were conducted both with individuals and with entire watches. Firefighters were interviewed in breaks and during the 'stand-down' time in the evening when firefighters could be interviewed and observed at length. It was during the stand-down time that firefighters usually demonstrated the VMDS. Observations also involved accompanying crews on building/risk inspections. Nearly all interviews were tape-recorded and all recorded interviews were transcribed. Notes were also made at interviews and watch discussions and subsequently written up together with reflections in a research diary. Archival research was undertaken at the National Fire Service College.

INFORMATION FAILURE AND PUTTING THE VMDS IN PLACE

A brief orientation to the etymological roots of the word 'virtual' provides an initial way into a reanimated conception of the virtual. The *Oxford Dictionary of English Etymology* traces the word virtual from the Medieval Latin *virtuãlis* to the old French *virtū* and the Latin *virtūs*. The root of virtue comes from *vir*, or man, a man who acts with valour and courage, and conveys the notion of virtue waiting to be exercised:

> **Virtue** †power, influence; efficacy, conformity to moral principles; excellence XIII; (arch.) high merit or accomplishment XIV … f. *vir* man (see VIRILE). So **virtual** †effective XIV; that is so in essence or effect XVII (whence **virtually** XV).

The semantic overlap of virtue and virtual becomes evident with the etymological roots, but what exactly is the relationship between the two? *Virtue*, as illustrated by its etymology, has three principal senses: it denotes worth and value, affect and power. This latter sense, virtue as the power of things, resonates with phrases such as 'by the virtue of' which denotes 'through the power of', yet does not, in a commonly understood sense, convey any kind of moral quality. The two senses can be linked if virtue can be thought of as the intrinsic power of an entity which when actualised affirms a valued and moral quality. The etymology of *virtual*, however, contains little connotation to moral quality. As it is increasingly used, to be 'virtually safe' designates something that should not be trusted or valued, with phrases such as 'morally virtuous' rarely used nowadays. In contemporary usage the word virtual is synonymous with techno-scientific disciplines. For example, the current edition of the *Shorter Oxford English Dictionary* defines virtual in relation to computing as:

> Not physically existing but made by software to appear to do so from the point of view of the programme or the user.

This almost real, or apparently real, but still not quite real, is at the centre of contemporary understanding of the virtual. It illustrates an inter-related two-fold movement occurring with the contemporary usage of the word virtual. First, its link to virtue, to some kind of moral quality or value rationality, is discarded. And second, the word virtual becomes associated with morally neutral techno-scientific disciplines: this is a reconfiguration of morally virtuous into morally neutral techno-scientific virtuality. With this shift, it becomes increasingly difficult to conceive of techno-scientific objects such as computers as agents in evaluative terms that open up questions of power, value and affect.

The VMDS was introduced in response to the death of two of Combined Fire Service's firefighters. The subsequent Improvement Notice was understood as the result of a two-fold failure at Combined Fire Service. The first general failure was not to have taken advantage of the benefits of ICTs for firefighting: fire services lagged behind comparable organisations that had introduced new IT mediated ways of working across space and time. Before the VMDS, detailed paper records of risk sites, known as I(i)d risk files, were kept on risk registers in A4 lever arch folders in fire appliances. This risk information, required by statute, was produced by stations and was specific to each station's turn out area, with information on major risks distributed to neighbouring stations. Despite this sharing of information, paper records remained a 'system for deploying the people and resources … [that] was put in place decades ago; it was designed to meet different threats in different circumstances' (IRFS, 2002:iv). Combined Fire Service, like other fire services, was using what was considered an outdated and constraining paper based technology.

The second, and related, information failure was that paper based I(i)(d) risk records did not provide quick and mobile access to information to all fire crews. This compromised firefighters' health and safety. In response to the Improvement Notice, the Operational Intelligence Unit concluded that there were considerable constraints with the existing paper system (*The Grapevine*, CFS, Summer, 1997:8). These included the spatial dislocation of over 35 folders and the physical problem of storage; temporal problems of accessing risk information before arriving at an incident, especially outside of turn out boundaries; dubious accuracy of station based I(i)(d) records; difficulties of auditing; and, the time and cost of updating station-based information.

Attending major incidents outside of turn out areas has always been a part of firefighters' work. It was rather the potential lack of visibility and implications of this that became problematic for CFS. Movement outside of demarcated spatial boundaries is a constitutive of a future vision of fire service provision (IRFS, 2002) and thus the search for a solution to such issues through which this future can be enacted. The Chief Fire Officer comments on the conclusion by the Principal Health and Safety investigator into the firefighters' deaths; he states that coordination and accountability necessitates the provision of better information and

> was surprised that a fifth and subsequent appliances … at the scene did not have information that was required to ensure crews' safety and that because of this the

Officer in Charge was 'fighting the fire with one hand behind his back'…. *the Officer in Charge cannot issue instructions or supervise employees without information* (CFS, 1996:33, emphasis added).

In contrast to 'out of date' paper records the provision of front-line incident management through the VMDS promised coordination around *information*. This provides 'greater control over the material and social world through enhanced clarity, transparency and visual certainty *at a distance*' (Cooper, 1997:33), that is, firefighter activity outside of stations and turn out boundaries. Yet the provision of information on firefighter deaths remained differentially available at Combined Fire Service particularly for those at a distance from the deceased firefighters watch. Combined Fire Service's reports into the factory fire, which very difficult to access and were similarly not available to firefighters, constituted an invisible intermediary[7] that relied upon other intermediaries. The invisibility of official reports, but deployment of particular extracts in internal communications emphasising enhanced technologically mediated information, helped constitute a further simplified intermediary that worked across distance at Combined Fire Service and defined the loss of lives as a particular information and communication failure. This 'discursive space' (Bloomfield and Vurdubakis, 1997:86, 104) is important because it is involved in shaping 'the form and content of the project' before a 'move back to the world' in the form of the VMDS installed on fire appliances.

In this discursive space the attribution of problems to technical, social or organisational failures is inherently flexible and subject to translations by various actors (see Bloomfield and Daneli, 1995). This is an important point as claims of inherent problems, such as 'technological information failure', are performative and help stabilise causalities and the problem 'at hand' that might otherwise be considered contingent. During interviews and observation there was however little controversy that the loss of two colleagues was a technological failure of paper records—an important issue to which I return later in the paper. Once loss of lives was congealed around 'technical information failure', choosing between options (e.g., mobile faxes) was demarcated within technologically mediated assumptions: the current failure of a paper technology presupposed an ICT solution.

Situated realities at incidents that outstrip a community's of practice experiences (e.g., Orr, 1996) or accounts that recover marginalised histories (Dawson, Clausen and Nielsen, 2000) are neglected when the controversies and negotiations relating to the production of ontological boundaries and, thus, in turn, the conditions of potentiality are foreclosed. The lack of ontological politics (Law, 2002a) on what counts as 'technical information failure' should not, however, be taken as an assumption that those at Combined Fire Service are 'epistemological dopes' with firefighters, researchers and others 'unproblematically understood as contests different groups of true believers' (Knights, Noble, Vurdubakis and Willmott, 2002:108). The VMDS is rather taken seriously as the future of front-line firefighting at Combined Fire Service because various situated discursive and non-discursive relations are drawn on, elaborated, recruited and consolidated to construct an actor-world with obligatory passage points (Callon, 1986) through which the VMDS can pass.

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[7] Intermediaries represent someone/thing and are stable if movement across space and time is associated with reliability (Callon, 1986).

The heterogeneous engineering involved in the construction actor-worlds has been criticised for its managerialism and bias to 'big men of history'. Star (1991), for example, argues that enrolling actors simultaneously involves a failure to enrol and the marginalisation of those non-enrolled whilst Winner (1993) has argued that constructivism reproduces pluralist assumptions that neglects assumptions and issues which may never become part of decision-making processes (see also Lukes, 1974). Firefighters were sometimes reluctant to talk about the death of colleagues although one firefighter, who had been with Combined Fire Service for over 25 years, recounted the death of two firefighters in 1974, five days after several risk assessment inspections and widespread communication of risks. This account emphasises the situated realities of fire incidents that cannot be completely known completely in advance (Weick, 1992), but also that information failure is demonstrated by absences. Absent accounts presage questions of inconsistency and disenrollment (Star, 1991) as much as what is made visible by 'information failure'. Here, loss of life, reducible to the failure of information is challenged:

Firefighter: [We] lost two firefighters in 1974…. they died on a Friday.
Researcher: So they had actually been there almost that week; … it was that week.
Firefighter: … a crew from another watch went there the previous week, looked at it—shock horror—better let the other watches know … because of the concern expressed by the crew who had visited the place the previous week on the Monday.

He continues that after the risk assessment there was a fire five days later with two firefighter fatalities:

that fellow that died in the incident, went [with two others] off on Monday morning to go and have a look at it …. they went along and said there's definitely a need here to get risk visits on it so luckily we did have a fair bit of knowledge about the building before we went in …we also found out they had disconnected the sprinkler system…. No matter what information—sometimes you could provide people with every scrap of information that is available on a particular risk, but there is the occasion when no matter how much knowledge you've got tragedies will still occur … [fire] places people in situations that you can't always train either physically or mentally for.

The firefighter's account of an incident over 25 years ago gives rise to a double sense of failure of information. The first sense is the impossibility of complete and a priori knowledge of the future. The second is that the absence of this firefighters' account is an instantiation of information failure that demonstrates that what counts as information failure, which VMDS screens resolved, is an act of ontological production that occurs in specific circumstances and delimits what is considered possible. Here narratives from long-serving firefighters that reopen controversies around firefighting activity are absent and have few implications insofar as existing working practices are considered technologically 'out of date' and a 'cause for concern' (IRFS, 2002). The adoption of technological innovation is instead presupposed and reliant upon comparison with existing and failing paper based technology. More analytically, the importance of entangled relations of visibility, invisibility and absence of 'information failure' is not to prove whether particular accounts are accidental or intentional, although these are important empirical

questions, but rather to suggest that the constitution of information failure at depends at least partly on processes by which information was maintained, shared and consulted across space and time prior to the VMDS: the failure of paper based technology is a condition for introducing new technology.

The neglected connection between virtual and virtue, between issues of value, affect and power, presages broader questions of research activity. Put another way, if the constitution of the problem at Combined Fire Service as 'technical information failure' is an ontological act, what are the implications of this for researchers, who, by implication, are also intimately involved in more than providing accounts that describe, but are intimately implicated in making certain ways of thinking and acting plausible. Should research be concerned with recovering the contingencies of social and organisational life, intervene in existing relations and attempt to transform them, or criticise dubious practices? A productive way into the asymmetries, coercions and coalitions of research activity is to include observations on the tensions of conducting research and make a virtue out of the performative quality of research. To the extent that research is engaged in ontological politics (see Law 2002a), it is incumbent upon researchers that research roles and interventions are opened up to tensions between such questions, not to resolve them, but so as to expand the sense of what is 'worked on'. This prefigures involvement in collective negotiations over contested boundaries and attributions causality, accountability and agency. It also includes in its most challenging and vigorous form an examination of the relations between observation, intervention, judgement and value rationality.

FROM UNIVERSAL CONNECTIVITY TO GLOBAL MOBILITY

The VMDS is not a simple cause or determinant of change at Combined Fire Service. Neither is the VMDS merely a neutral means that can be implemented to a particular end as some sociologists of the negotiated character of technological change have suggested (e.g., Wilkinson, 1983; cf. Latour, 2002). The VMDS is rather constitutive of the *problematic of organising* firefighting that includes boundaries and interrelations between, for instance, firefighting practices; community safety; risk management; best value; auditing activity; and, collective bargaining agreements.

The second sense in which the VMDS can be understood as a virtual object demonstrates how the implementation and use of objects can be analysed through the activity associated with translation rather than diffusion. Deleuze (1968) proposes four modes of existence delineated into two pairings, 'real-possible' and 'actual-virtual ', and suggests that, most broadly, what is understood by the human condition is reinvented through these four modes of existence.[8] For the purposes of this paper, however, Deleuze's ideas are used in order to rethink the predominance of diffusion-centred assumptions of technological objects. In Deleuze's terms, the relations of real and possible denotes a concern with what exists and from this the realisation of the possible: here, Deleuze's suggests, the relation between the real and the possible is bound up with retroactively constituting the identity of an object as a series possibilities. In contrast, Deleuze argues that the virtual is not the possible, that is to say, not an unfulfilled reality, but rather the virtual is a kind of problematic complex, the 'knot of tendencies or forces which accompany a situation, an event, an object or

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[8] In a little referenced speech Latour (1998) briefly acknowledges Deleuze's work, particularly Deleuze's understanding of the virtual and how this relates to translation.

whatever entity and which invokes a process of resolution: the actualisation' (Levy, 1998:24). In Deleuze's terms, 'information failure' actualises the VMDS in particular ways but this does not delimit, as the pairing of possible-real do, what the VMDS can do. In contrast, Deleuze argues for relations of virtual-actual, where the VMDS can become a device associated with, for instance, new activities such as firefighter mobility and brigade performance assessment, to take two examples. For Deleuze, what something actually is must be understood as its power to become virtually and is not *a priori* given. The virtual, then, is not a 'derealisation (the transformation of a reality in a group of possibilities), but a mutation of identity, a displacement of the centre of ontological gravity of the object considered: in place of principally defining itself by its actuality (a "solution"), the entity henceforth finds itself within a field of the problematic' (Levy, 1998:16).

In order to develop this sense of the VMDS as a virtual object I examine how the VMDS has been transformed from a device to rectify the failures of previous forms of information retrieval to a device for enabling new firefighter mobility. Technologies are often delegated the role of reconstructing order (Latour, 1992), but the problematic of order is not reducible to 'technological glue' that holds everything together. Nor are delegations to the VMDS without disordering effects. UK fire services remain premised on nationally negotiated standards and policies, but the negotiation of order through these national frameworks has been partially supplemented and contested by the VMDS that made the introduction of global[9] crewing/mobility possible.

Global crewing/global mobility became possible at Combined Fire Service because of the delegation of order to the VMDS.[10] The VMDS provided a solution to the lack of brigade-wide information but was also a technological device that constituted a new form global firefighter mobility. According to an Assistant Divisional Officer when firefighters crewed the same watch at the same station, nationally negotiated working practices and station based information infrastructures worked relatively effectively. But the VMDS solution to the failed provision of incident and risk information was translated into a technological solution to a problem that went beyond the provision of enhanced information: the VMDS was also constitutive in providing a technological solution to watch crews attending incidents outside of usual turn out boundaries by providing the possibility of enhanced firefighter mobility.

During the 1990s attending incidents outside the usual turn out boundaries became visible in at least two ways. First, the death of two firefighters outside their usual turn out boundary. Second, crews provided cover for neighbouring stations. At Combined Fire Service this led to reduced performance against national incident attendance standards because crews sometimes attended incidents at a distance. The VMDS

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[9] 'Global' has associations with contemporary concerns such as mobility in time and space and advanced technological innovations.

[10] For Law (1994) *the* question in social science is ordering and disordering whilst others argue that the notion of disorder makes little analytical sense (Tsoukas, 1998:292). The issue for Tsoukas is rather of undesirable organisation or competing forms of orders. These ethnomethodological assumptions are useful in foregrounding for whom order serves the wrong purposes, recovering marginalised accounts, examining how definitions of order and disorder are observer dependent and are 'worked up' into a taken for granted understandings. Notwithstanding these insights, positing ordering as competing forms of organisation privileges order too much without simultaneously attending to disordering effects.

provided a technological solution to this particular performance issue, that is to say, the device was a solution to the disorder made visible by loss of lives and under-performing attendance times.

Before the VMDS, firefighters were allotted to a particular watch at a station. This constituted distinct spatial and temporal ordering based on specified station collaboration, demarcated turn out boundaries, localised watch discipline, distinct boundaries between wholetime and retained firefighters, and situated knowledge of risks and geography. Even though station based coordination was subject to disorder in the sense that there were effects on incident attendance times outside of turn out boundaries and watches were not subject to centralised control, this was not an unworkable practice. Stations officers told me that watches routinely responded to the immediate needs of other stations for fire cover. Here station based coordination of fire crews took the form of station and watch spatial rigidity before incidents with flexibility in the mobilisation of wholetime watches from various stations during incidents.

The delegation of order to the VMDS constituted new mixtures of spatial and temporal order and disorder at Combined Fire Service. Prior to global crewing station officers were responsible for ensuring watch crew levels were maintained to national standards and arrangements for detached duties were arranged between station officers. Global mobility meant that individual firefighters were increasingly spatially dispersed and firefighters mobility was centrally coordinated and monitored. This had implications for station discipline, where order had been previously delegated to station architectures and wholetime watch practices. Station officers and watch commanders were less able to coordinate and monitor watches and this enacted a spatial dispersion of wholetime firefighters that made crews visible increasingly through VMDS screens.

The delegation of order to the VMDS reduced local flexibility in the mobilisation of firefighting crews and increased, according to many watches, the operational risks to wholetime and retained firefighters. Combined Fire Service's wholetime firefighter availability had been below the national average since the mid 1990s and had been worsening whilst attendance times had been improving. An Inspectorate Report stated that the

> exceptionally low wholetime shift availability levels still cause concern [and] have an impact on service…. The percentage of shifts when wholetime appliances were crewed in accordance with Brigade policy has reduced from 60.3 per cent in 1999-2000 to 42.4 per cent in 2000-1…. this downward trend has continued with provisional performance of 27.5 per cent being reported' for 2001-2 (HMFSI Report, CFS, 2002:3, 10-11).

The report concludes that this is 'likely to place the Brigade almost if not bottom of the national performance table' (2002:11). Combined Fire Service has, in contrast, improved its performance on the percentage of incidents crewed by national standards of fire cover (over 97 per cent in 2001-2), but the report continues

> this performance is only being achieved as a result of wholetime shift personnel from primary crewed aerial or emergency tender/special appliances moving to crew

pumping appliances during periods of insufficient riders (HMFSI Report, CFS, 2002:12).

Here as firefighter mobility becomes institutionalised meeting national standards for wholetime crew levels is only achievable by taking wholetime firefighters from specialist appliances. This means that specialist equipment used for major and prolonged incidents are increasingly crewed by retained crews acting as specialist backups to wholetimers: it had temporal effects in terms of the boundaries between wholetime and retained firefighters. Here the delegation to a technological order for augmented information provision, which was translated into a device for global mobility, has constituted particular disordering effects that the VMDS was introduced to overcome, that is, firefighters being out of place and out of time at major incidents. The ramifications of the dispersion across space of global mobility is also a temporal fragmentation with part-time retained crews undertaking specialist roles previously allotted to wholetime watches. The translation of the VMDS from an information repository to global firefighter mobility was not however significantly contested at Combined Fire Service. Interviews confirmed that VMDS has been well received by fire crews because of the widespread consensus that

> Officers in Charge have more information to deal with fires … greatly improving the Brigade's efficiency, effectiveness and Health and Safety' (*The Grapevine*, CFS, Summer, 1997:8-9).

With the VMDS present at every incident, firefighters would always, it was argued, be in the appropriate place at the correct time. Yet the VMDS was more than a paper to screen exercise as firefighters would now crew any watch at any station: firefighter mobility between stations now pre-empted incidents as the VMDS constituted new spaces and times of order and disorder. I have suggested that the translation of the VMDS can be understood in terms of Deleuze's pairing of virtual and actual where the virtual and actual is a manifestation of the heterogeneity of the VMDS. The actualisation of the VMDS as a virtual object, takes place by translations from notions of information failure. It is in this sense that the actualisation of the VMDS breaks with the resemblance model of diffusion and constitutes another object. In Deleuze's terms, for a virtual object to be actualised is to create divergencies in activities as much as the fulfilling intentions based initially, in this instance, on claims of technological information failure. The VMDS is a virtual object in the sense that it can become many things over time and space: it is constituted through a relational performativity which means that what it can do is circulating admixture of virtual-actual, possible-real relations.

The VMDS is a virtual object with what Deleuze (1968) describes as 'internal differences' (see also Middleton and Brown, 2001) which distribute ambiguities, inconsistencies and activities against the problematic of organising fire service provision not only rectifying information failures: the VMDS is, in other words, a 'hook' on which hang fire service activity. The assertion that the VMDS is internally differentiated denotes two points. First, in contrast to a notion of external differentiation, which suggests different uses of the VMDS depending on external contexts, that is to say, the same device in deployed in various ways, internal differentiation treats the VMDS symmetrically and as an object with the potential to become different—a multiple object. Second, the trajectory of the VMDS as an object

is not only a relation of possible-real but also virtual-actual. In simple terms, the VMDS makes firefighters wait for its screen responses, it interrupts existing fire crews' practice so that firefighters have to work in new ways and it enacts a new temporal and spatial distribution of firefighters. It is in this sense that, as a virtual object, the VMDS is constitutive of the problematic of organising fire service provision.

Given the translations and divergences from information repository to firefighter mobility described above how is it that the VMDS held together as a more or less coherent object associated with the provision of information? Put another way, I was struck as to why the association of the VMDS with global mobility was not deemed an inappropriate use of technology at Combined Fire Service and puzzled as to why this was the case. In order to answer this question I introduce the third sense in which the VMDS is a virtual object, that is, how a technologically mediated device to enhance front-line firefighter activity is sustained as a singular and unified object through the constitution of times and spaces.

THE VIRTUAL WATCH: THE VMDS IN ACTION

Since 1996 other fire brigades have introduced a VMDS and nearly all are reassessing front-line incident management: the VMDS is associated with modernisation despite a lack of evidence that the VMDS is leading to increased firefighting effectiveness and efficiency. Observations at the VMDS demonstration stand at the annual fire conference/exhibition in 1997 illustrated how the VMDS is becoming integral to the future of UK fire services because as something that is already used at front-line incidents—in the sense of working beyond the confines of the exhibition stand—it is involved in producing a trajectory towards, and enacting, a particular future. Law (2002a:217) describes 'virtual objects' as 'objects that are projected as pre-existing behind the practices in which they are represented'. In this sense, a virtual object appears as something singular, integrated and unified and outside of practices and activities that constitute its effects. The paradox here is that for virtual objects to be taken as pre-existing and outside of practices a tremendous amount of work has to take place to hold actors together yet without all kinds of intermediaries, devices, texts, and so on, virtual objects would disappear.

Demonstrations of the VMDS, conducted by an Assistant Divisional Officer and VMDS company representatives, were popular at the exhibition. They comprised of short and informal presentations of the VMDS with fire service officers standing around a mock-up VMDS. The VMDS demo was introduced by the officer referring to the robust casing, compact size and widespread use at CFS, followed by description of the speed and simplicity of accessing information. The officer remarked to onlookers:

> No more need to keep those bulky folders … all you do, when mobilised, is press a button [the officer presses a button] and whatever's on screen is printed [sound of the printer starting next to the VMDS] there and then.

Before leaving the stand those interested were given a brochure with general and technical information on the VMDS (see Law, 2002a:12-37). Latour (1999) describes the desire for speed as the imperative of the 'double click'—a 'double click' that

overlooks the transformations accorded by information and communication technologies. Like the officer at the stand, firefighters at Combined Fire Service often describe the VMDS in various ways, one of which is that it is a self-contained device. I was interested in problematising the assumptions of the VMDS as a stand-alone device and many at Combined Fire Service did this too, many simultaneously described the ontological status of VMDS as a self-contained device.

One of the most amusing and enduring examples of the way firefighters articulated the discursive rhetoric of the VMDS as a stand-alone device was the 'hedgehog story' widely told at internal demonstrations to firefighters. The relevance of this story is that through it the VMDS became conceived as a discrete entity that imparted relevant knowledge. Before the introduction of the VMDS firefighters did not have a comprehensive officers' handbook to which they could readily refer. This changed with the VMDS and the introduction of an on-line officers' handbook. Nearly every firefighter I talked to related the 'hedgehog story' when asked about the on-line handbook. This was that, with the introduction of new guidelines for animal care and welfare, the officers' handbook provided a step-by-step procedure for rescuing a hedgehog trapped down a ditch. As an endangered animal, knowing how to rescue a hedgehog, I was told, becomes important, although no firefighter could ever remember such an incident occurring. The question I began to ask myself was that if this incident never, or very rarely, occurs, why do so many firefighters describe it when asked about the handbook? I put this question to the VMDS Operational Intelligence Unit. One of the seconded firefighter's replied:

Firefighter:	Oh, that's easy. When we were implementing the VMDS we would go and talk to the crews and tell them about it.
Researcher:	You mean something like a VMDS road show around the stations? But where does the hedgehog come into this?
Firefighter:	Right. The example we always gave for the officers' handbook was the rescue of a hedgehog. Nearly always. So that's, simply, where they've [firefighters] got this from.

Here the effect of the VMDS as a self-contained technological object could be maintained through the narration of an incident that would almost certainly never occur! It was, in other words, through such examples that firefighters constructed the ontological character of the VMDS as an unmediated knowledge resource. As I have already mentioned, there were, however, competing descriptions of VMDS use; a firefighter portrays his utilisation of the VMDS and how it is not a discrete entity in the following way:

> It's difficult to use the VMDS at night if we're on the way to an incident because the screen is set just at the angle that it reflects into one of the driver's side mirrors … We have to choose to use the VMDS and block the driver's rear vision or not use the VMDS. That's why we've put a tea towel over the screen—otherwise it makes driving dangerous.

Another leading firefighter describes usage of the VMDS whilst on the move in the universal machine:

It is really difficult to use the VMDS interface with our big gloves … the screen's not always very responsive. And if we're on the move, speeding through traffic, and so on, it's almost impossible to use the VMDS interface.

External and internal demonstrations of the VMDS were important in several ways. Demonstrations are implicated in the opening up and resolution of ambiguities and indeterminacies associated with the use of VMDS, that is to say, with the distribution questions of causality and accountability at Combined Fire Service.[11] Demos are also constitutive in reinforcing powerful cultural assumptions of techno-scientific progress through the enactment of a trajectory to the future through the deployment of a 'fully working VMDS' on the stand (see Downey, 1998:32-57). The non-discursive presence of the VMDS trade show 'reality demonstration' is taken as a faithful and successful re-enactment of the other 36 VMDS at Combined Fire Service insofar as records are located easily and printed quickly; that is, the VMDS is a virtual object that is reducible to hardware, operator and accompanying brochure. Here VMDS represents 'a kind of "furniture" of the future …. [the VMDS acts] as an adequate substitute for the abstract concept ("the future")' (Bloomfield and Vurdubakis, 2002:126) Here, at the stand, an already existing future can be witnessed first hand through the transformation already brought by VMDS screens although the demos carefully choreograph what the VMDS can do. It is through these choreographed activities that the collective imagination of the VMDS is of a virtual object ready to be implemented to any UK fire service is made: demonstrations help to produce the reality effect that the VMDS is a step towards a future time, as if the VMDS is *in* time and the future already exists. Yet this effect can only be achieved by displacing the way in which the presence of VMDS produces an abstract sense of the future as something to work towards, that is to say, it is constitutive *of* time as much as *in* time.

Demonstrations and brochures are involved in framing the capacities of the VMDS around rationalistic and rule-bounded activity. They lacked detail, however, on the specificities of the messy world of VMDS practice, contrasting with observations and interviews conducted with officers and watches about the VMDS. This research provided more familiar insights to those used to the minutiae of workplace practices (e.g., Suchman, 1987) and provided another interaction from the point of view of the VMDS (see Woolgar 1992). Combined Fire Service's firefighters also demonstrated how accessing information on the move was reconstructed with the VMDS, with two interdependent spatial and temporal effects. First, the VMDS reduced possibilities for mobile crew coordination and reconstructed the division of labour on the move. Before the VMDS was introduced each watch had an informal division of labour (i.e., one firefighter reading risk records, another locating water hydrants, another navigating) on the way to incidents that the VMDS made impossible. The VMDS was fixed to the dashboard in the cabin and this meant that only the Officer in Charge could access risk, map and tactical information on the move. This centralised watch crew activity to the Officer in Charge and compressed rather than expanded spatial relations on the move. Second, temporal pressures on the Officer in Charge intensified from this compression of space. Officers described the tasks they had to try and accomplish on the move, including helping to navigate, deciding on the position of the fire appliance, the initial 'plan of attack' and attending to radio communication.

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[11] In contrast to the SCOT tradition (e.g., Bijker, Hughes and Pinch, 1987), which focuses on how powerful groups achieve closure on a technology's use, Rappert (2001) suggests a form of analysis that examines the resolution and distribution of ambiguities associated with technologies.

The addition of 'pressing buttons' on the screen to initiate printouts was not self-evidently simple. Here spatial and temporal reconfigurations associated with the VMDS undermined the division of labour on the move and increased information disjunctures and communication failures between the Officer in Charge and firefighters. Universal access on the move had been delimited to the Officer in Charge.

The task of transferring paper records to the VMDS, and ongoing coordination activity, was undertaken by the Operational Intelligence Unit. It was quickly noticed, firefighters said, that a significant proportion of previously station-based records had not been transferred onto the VMDS even though these records had been sent to the Unit. 'Nor would these paper files be put onto the VMDS in the future as it did not have enough memory to store all records from every station and paper records,' said a sub-officer, and 'they're now in the process of being thrown away by Operational Intelligence'. Although stations were told to discard their paper records and paper OS maps many watches were reluctant to do this. Instead fire crews often kept paper copies of risk folders and maps 'hidden' in spaces under the seats of fire appliances and used as 'backups' (see Faia-Correia, Patriotta, Brigham and Corbett, 1999) to the incomplete VMDS. Here not only had an attempt to clear away paper records not succeeded but firefighters consulted concealed paper records *and* accessed the dashboard mounted VMDS.

The problem of station based and out of date records had been refigured into absent VMDS records. Firefighters said that some paper records did often contain out-of-date information although even scraps of information were useful. It was usually smaller sites that had been discarded as they were considered smaller risks. The emphasis on larger risks (e.g., industrial buildings) that would be out of turn out boundaries was contested by firefighters. A leading firefighter summed up a widely articulated view:

> It's crazy, really … because we all know about the big risks … so well 'cause we visit these regularly; it's the small ones we need to know about … [when] we get to major incidents [outside of turn out areas] the first crews are already there so most of the coordinating and information stuff is in place.

How are inconsistencies between what the VMDS was supposed to do and activities associated with the VMDS to be understood? I have already suggested that the 'information failure' of paper records has been translated into a device for global mobility and also suggested that ambiguities and inconsistencies associated with the VMDS remain important: in simple terms, the VMDS is involved in, and a resource for charting, the distribution of ambiguities and inconsistencies of fire service modernisation over time and space. The initial reasons for the VMDS as rectifying information failure were not forgotten and these helped sustain the VMDS as an uninterrogated 'black-box' (Star, 1992).[12] And yet, the reason for the introduction of the VMDS was to provide enhanced and instantaneous information to front-line firefighters, some of whom associated the VMDS with less information and difficulty in accessing information. With fewer records to access through the screen, the

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[12] Grint and Case (2000) analyse the introduction of technologically led change as a form of arranged amnesia that is bound up with resolving inconsistency. 'It is arranged in the sense that its cause is not accidental but a requirement; yet the precise form of forgetting is one that has to be subtly controlled. Organizations must forget some things but remember others' (Grint and Case, 2000:27).

intentionality surrounding the VMDS becomes a problem to be resolved. At Combined Fire Service these were resolved through a combination of collective firefighter fantasies about the technical capabilities of the VMDS despite current inconsistencies and, integral to this, a deferral of current ambiguities to the future.

Attributions, and activities in response to the distribution of uncertainties, occur in a number of ways at Combined Fire Service. The VMDS remains trusted because it is associated with front-line information provision and compared to distrusted managerial initiatives (see Fox, 1974). Paradoxically strong trade union (Fire Brigades Union [FBU]) presence at Combined Service worked against a thoroughgoing analysis of the VMDS given that the FBU focuses on workplace issues characteristic of traditional UK industrial relations.[13] The distinction between managerial concerns and technological imperatives was simultaneously maintained by firefighters' amnesia about the role of backup paper records in reproducing the effectiveness of what otherwise might be considered a failing technological innovation. In conjunction with forgetting, where paper records were remembered they were associated with the hope that at some point in the near future the VMDS would contain more risk records. This helped to sustain the VMDS as a benign device whose effects would be effective in providing enhanced information to front-line firefighters. Rather firefighting would be transformed if technical constraints (e.g., lack of memory) were sorted out. One station officer commented:

> We're just beginning to realise the full potential of the system. We've still got to iron out a lot of things—a lot of data management problems … it's going to take some time, but we're working on it … This is certainly the future of fire incident management.

In other words, if there are problems with the VMDS, it is with the current technical constraints and lack of resources for technical upgrading: the VMDS was understood as a neutral tool delimited to transferring records to screens and catching up with IT under-investment. The deferral of ambiguities to the future, through the distribution and displacement of ambiguities around current usage of the VMDS, is also constitutive of the VMDS as a working device. Here then the provision of fire crews with standardised information and the reduction in the number of local risk files accessible to crews is not significantly problematised: managing the inconsistencies and ambiguities surrounding the VMDS is deferred to the technical capabilities that future technologies will afford. Deferring the time for resolving ambiguities and inconsistencies surrounding the VMDS means that other actors', for instance, the government's role resourcing fire services and fire service managers' role in developing innovative ways of firefighting are largely neglected, that is to say, outside of questions of causality and accountability. It is in these senses that the VMDS remains an ongoing resource for distributing indeterminacies at Combined Fire Service after implementation. The VMDS is symbolic of the firefighters' future at Combined Fire Service and beyond: bolted to every dashboard, the materialisation of shimmering VMDS screens are a constant reminder of the real-time standardisation

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[13] Sorge and Streeck (1988:20) argue that British trade unions have largely conceived of technologies within pluralist-functionalist assumptions, with technologies understood exogenous to semi-autonomous social sub-systems. This means that unions 'have often been quite content to limit themselves to negotiating with industrial relations managers on wages and conditions, and dealing with technology only in so far as it affects the latter'.

and universality associated with ICTs. In as much as inconsistencies and ambiguities are resolved through various forms of technical displacement and temporal deferral, psychosocial boundaries including questions such as what is firefighting, how is work organised, what do we know about fire incidents, who is in charge are significantly neglected at Combined Fire Service (see Hirschhorn, 1988).

The sense of the VMDS as outside the boundaries of management control and as a potentially 'stand-alone device' can be understood in terms of boundary objects. Star and Griesemer (1989) suggest that boundary objects are simultaneously plastic and connect to situated practices *and* provide robustness and coherency across contexts. In Star and Griesemer's terms the VMDS is subject to multiple meanings as it circulates through Combined Fire Service interactions cohere around a shared general sense of what the VMDS provides: the VMDS is a boundary object that mediates expectations. At Combined Fire Service, associations with current technical limits and future technical capability substantially reinforce the coherency of the VMDS as a singular, self-contained object. The sense of the VMDS as an integrated screen for enhancing efficiency and effectiveness across contexts is a 'reality effect' achieved in various ways in different spaces and times rather than a given of ICT innovation.

VMDS screens can be better understood symmetrically as more than singular, integrated objects but also more than arbitrary, multiple objects. Here the VMDS 'speaks' in different ways in different spaces and times. This analytical concern with multiple objects denotes 'inconsistency between different performances reflects failing coordination between different object positions rather than differences between external perspectives on the same object' (Law, 2002a:8-9). Without this, multiple interpretations is asymmetrical towards objects. This means, says Woolgar (1992:90), rethinking research that 'emphasises those features of interaction which provide for an examination of human sense-making procedures and downplays those of the non-humans'. At the exhibition stand, at internal demonstrations, on the move, VMDS screens are coherent and self-contained only insofar as precise and unanticipated VMDS spatial and temporal deployments are displaced and deleted. 'Full availability' insinuates, on the basis of future innovations, essential characteristics of the VMDS above situated and particular interpretations. The VMDS was the outcome of a lack of appropriate information that culminated in two firefighters' deaths. Significantly, however, the VMDS is also involved in making new forms of lack at Combined Fire Service, specifically it is involved in producing the temporal gap between the present VMDS which will be resolved through technological innovation in the future.

CONCLUDING REMARKS

Social studies of science and technology have done much to demonstrate the contingencies of technological development, diffusion and use over the last two decades. Paradoxically less has been achieved in intervening and transforming technological changes despite the empirical specificity of these approaches. This paper has problematised the foundational function of technology in determining contemporary change *and* attempted to appreciate the significance of technological object. Three interrelated notions of virtual objects have been put forward in this paper: virtual as power and value, virtual as transformation and virtual as identity. The first notion of virtual attempted to re-establish a link between virtual and virtue through a concern with ontological politics. Before the VMDS was implemented

what counts as possible information failure is comprised of visible, invisible and absent relations that delimits what is considered plausible. The second notion of the virtual denotes a concern with the way in which objects transform over time and space. Here I suggested that Deleuze's pairing, possible-real and virtual-actual, are productive in analysing the VMDS. The VMDS does not simply collapse space and intensify time but neither is the VMDS circumscribed to the role of information repository. The VMDS is constitutive of new forms of firefighter mobility and reconstructs firefighting around new forms of spatial compression and constraint, and temporal connection and asymmetry. The third notion of the virtual was concerned with questions of identity and the attribution, resolution and deferral of tensions associated with the use of the VMDS. Here it was argued that the VMDS is a multiple, powerful and 'unfinished' object rather than an integrated stand-alone screen.

On 17 October 2002 the Budget Working Party set out the initial cost for the 'second generation' VMDS at Combined Fire Service, allocating a budget for 2003-4 of £250,000 (CFS, 2002:13). Upgrading VMDS screens demonstrates how ICT provision is an ongoing rather than one-off initiative and also illustrates that the VMDS is a stand-alone object only if the relationality that constitutes its effects are forgotten, neglected or displaced. The VMDS is a 'Trojan Door' (Star, 1992) that opens onto social, organisational and technical relations, and the future of the fire service. Whether the second generation VMDS will be implicated in further inconsistencies around firefighter mobility, ambiguities of accessing information and deferrals to a technologically mediated future that can resolve enduring information failures remains undecided and thus objects such as the VMDS become an important issue for analysis and intervention.

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