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Research article

Object lessons and invisible technologies

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Abstract

In this paper, we explore some of Claudio Ciborra's ideas about the technological object. We do this in contrast to recent analysis by Law and Singleton (L&S) that advocates a methodological radicalism that moves beyond epistemological uncertainties about the technological object to ontological concerns. L&S present a series of stages in this analysis that include fluid objects that change relatively gently and fire objects that have more radical discontinuities. This approach is applied to empirical work studying the engagement practices of a large, sophisticated information infrastructure research project, the Digital Business Ecosystem (DBE). At the start of the DBE engagement process, the DBE was an invisible technology that did not exist and this made the process of engagement with it particularly challenging. Drawing on the analysis presented by, however, the DBE appears to have the ontological characteristics of both the fluid and the fire object. In order to address this dilemma, we draw upon Ciborra's thinking, particularly around the information infrastructure and Gestell as a means that allows us to consider technologies like the DBE as being both fluid and fire objects. The paper ends with a discussion of the implications of this work on Claudio Ciborra's legacy for the study of information and communications technologies.

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Introduction

In lieu of conversation, there are many ways in which one can reconstruct an academic path that leads back to the richness of Claudio's[1] research interests and contributions. One such path draws on his empirical work on large-scale information infrastructures, technological innovations and IT strategies and combines it with his multi-disciplinary perspectives on the social study of information and communications technologies. On this path, one of Ciborra's many academic achievements can be seen in terms of his contributions to our understanding the information technology 'artefact'[2] (Ciborra and Hanseth, 1998).

Of course, being Claudio, he could never be content with an analysis that simply ended up with suggestions that technology is best seen as a tool/ensemble/computational device or a proxy for other human attributes. Indeed, in his later writings, Claudio was heavily influenced by the work of Martin Heidegger who argued that technology's essence was as anything but a tool.

As a research method, Claudio seemed to deliberately focus on difficult cases, those technological *objects* that were not easily classified and that could not be reduced to simply being one thing or another.

In this paper, we use a line of argument presented by Law and Singleton, 2005 (henceforth L&S) in their discussion of alcoholic liver disease to explore and develop some of Claudio Ciborra's ideas about the nature of information technology.

The topic of alcoholic liver disease is not an obvious one to apply to questions of information systems (although see Angell, 2005), nor is this paper chosen because of some striking relationships to themes that Ciborra also drew on (especially notions of cultivation and gardening; Ciborra, 1996b; L&S: 341), domestication (Silverstone and Haddon, 1996; Ciborra, 1999, 2002; L&S: 347) and Karl Weick's inspirational analysis of the Mann Gulch incident (Weick 1993; Ciborra, 2002: chapter 8; L&S: 347; Lawrence, 2005; Stahl, 2005).

Rather, the paper is chosen because it presents a particular analysis of complex, messy objects that challenges us to think about Ciborra's ideas about the nature of the technological *object*. We will argue that there are some

Table 1 First four stages presented by Law and Singleton

Stage from L&S	*Nature of 'problem'*	*L&S's case of alcoholic liver disease*
1	Technical competence	Are we doing poorly implemented research?
2	Managerialism	Are we attempting to impose a tidy managerial solution onto a fundamentally messy problem?
3	Epistemological	Does the messiness arise because of different perspectives on the problem?
4	Ontological	Have we misconceived the very nature of the object?

interesting similarities between Claudio's thinking and that of L&S, but that their paths also separate in important areas and arrive at the technology *object* from different perspectives. We will use these to continue our ongoing, internal dialogues with Claudio and his ideas.

The argument of the paper is presented as follows. In the next sections, we present the key stages of the argument presented by L&S and consider them in relation to examples of Claudio's own thinking in this area. We seek to integrate these two perspectives in the context of fieldwork undertaken around the engagement practices associated with a new technological infrastructure project, the Digital Business Ecosystem (DBE). A particular characteristic of the DBE at the time of the study was that it did not exist as a technological *object* and thus shares many characteristics with the problems being addressed by L&S. The technological character of the DBE, however, also relates to Ciborra's development of Heidegger's notion of Gestell (Ciborra and Hanseth, 1998). The paper ends with a discussion of the implications of this work on Claudio Ciborra's legacy for the study of information and communications technologies.

Object problems

In their paper, L&S outline the problems they faced while undertaking an academic study of alcoholic liver disease for a UK Acute Hospital Trust. Their study was to focus on the management and organisation of the treatment in the trust and beyond. They soon found, however, that it was more difficult to map the 'trajectories' of typical patients than they had expected. They were, however, unclear as to why this was the case.

L&S therefore consider four ways of responding to the difficulties they were facing. The first is a technological response that suggests that the problems they were facing were simply due to the fact that they might simply not be doing good research. While plausible, their sense was that perhaps there was something else going on in the case, and they consider that the problems they were facing implied the need for a managerial response to deal with the messy situation. As they point out, however, messy objects by their very nature defy knowing and, as a result, managerialism becomes an executive tool for creating apparent clarity when it might not exist (Ciborra, 2002; Strand, 2005).

Just because managerialism tries to hide the messiness of organisational life (Whitley, 2005) it does not mean that researchers should give up at that point, and so L&S propose two strategies for progression. Their epistemological strategy suggests that messiness arises because of differing perspectives on the situation (Dreyfus and Dreyfus, 1986) in a manner similar to notions of interpretative flexibility (Pinch and Bijker, 1987) that have been applied in both strong and weak forms to technological *objects* (Orlikowski, 1992; Pozzebon, 2001, but see Kallinikos, 2002; Cadili and Whitley, 2005).

Their final alternative is to question the ontological status of the thing they are studying: what exactly is the nature of the *object*. From this position, the *object* is not simply the same and subject to multiple interpretations, it is in fact different, according to the multiple realities that are enacted into being. Through the use of the word 'enacted' the question of performativity, familiar to ANT influenced studies, comes to light.

In Table 1 above, we characterise these four stages of the argument by L&S highlighting the questions that arise at each stage.

As an aside, it is interesting to note that the first three stages raise interesting parallels with the internal debates that have occurred within information systems, particularly as we reflect upon the nature and location of information systems faculty within academia, although few in information systems have taken the debate to the fourth stage proposed by L&S.

Of course, Claudio contributed to these debates himself. Stage one simply never applied to his work and he never had any doubts about the 'rigorous playfulness'[3] of his work. Stage two has direct parallels with his work on strategy and improvisation (Ciborra, 1991, 1996a), and on the role of formal methods (Ciborra, 1998). Stage three is more interesting. Claudio finally 'settled down' in a Department of Information Systems that has a strong history of interpretive research, and while he was clearly comfortable with this epistemological position of his colleagues, he was rarely explicit about this aspect of his own work.

Object solutions

L&S suggest that one way forward is to question the ontological status of the object and they propose moving from multiple perspectives of an object to multiple objects themselves and to question what it is for something to count as an object. Interestingly, as L&S move onto these later stages, their focus of study drifts from the study of alcoholic liver disease and they have to draw upon the work of other writers in the field of science and technology studies.

Again, this argument passes through a number of stages and L&S begin by drawing on recent, post-ANT studies that

Table 2 The next three stages presented by Law and Singleton

Stage from L&S	*Nature of the object*	*Example*
5	Immutable mobile 'able to maintain its shape despite being part of many (network) relationships'	Pedocomparator
6	Mutable mobile/fluid object: 'something that *both changes and stays the same*'	Zimbabwean water pump
7	Fire objects: 'sets of present dynamics generated in, and generative of, realities that are necessarily absent'	Design of aircraft wing

develop Latour's original notion of *immutable* mobiles. Immutable mobiles are often mechanisms of long-distance control that are able to maintain their shape despite being part of many (network) relationships. For example, Latour uses the example of scientific instruments such as a pedocomparator for comparing the colour of the soil in a Brazilian rain forest as a means of relating detailed empirical work to high level theories, in this case about soil erosion (Latour, 1999: Chapter 2). The role that these artefacts play in maintaining a network of relations is wholly dependent upon their unchanging nature. However, this maintenance of the network is only achieved and sustained through constant work (i.e., worknet rather than network), building and re-building associations around them (Latour, 2005).

Even this characterisation, argue L&S, may also be too restrictive as in many cases these instruments, objects or things might actually be *mutable* mobiles (Moser and Law, 2006). They present de Laet and Mol's (2000) description of a water pump in Zimbabwe, which changes constantly both in form and function as it is moved between locations and repaired with ready-to-hand materials as parts of it breakdown. To them, this suggests that there is not a core of stability, and there is no essence to the technology (Grint and Woolgar, 1997); 'Oxymoronically, it is something that *both changes and stays the same*' (Law and Singleton, 2005: 338).

It is important to recognise that the fluidity of the Zimbabwean water pump extends far beyond the ability to replace bolts with steel bars, or the leather seals with a bit of an old tyre (de Laet and Mol, 2000: 238–242), the pump is also fluid in terms of what it produces (exactly how pure must the water be for the pump to 'work' (de Laet and Mol, 2000: 242–245)) and how closely the local community must be involved in the creation and maintenance of the pump (de Laet and Mol, 2000: 245–247). The fluidity is therefore enabled by the extensive network that the pump is a part of (Law and Singleton, 2005: 338).

The final stage of their analysis is a post-ANT consideration of how to address issues of invisible work and the colonisation of the other. There is a sense of safety in ANT where networks are built around resilient actors, immutable mobiles or perhaps mutable mobiles that nonetheless change gently, fluidly. The unknown, the other or the unexpected are not the focus of these networks, which tend to centre themselves around powerful, influential actors. For L&S, as for other critics of ANT (Star, 1991; Lee and Brown, 1994) this is unsatisfactory, not only from a socio-political point of view but also because the unknown or 'not present' can have a huge impact on the course of innovation or the shaping of networks. L&S use the example of a British aircraft company that engineered features of an aircraft wing specifically to cope with flying situations that would occur in a European war against the Russians. 'The war' and 'the Russians' were never present but they were still influential in the design of the aircraft. Thus, 'we cannot understand objects unless we also think of them as sets of present dynamics generated in, and generative of, realities that are necessarily absent' (Law and Singleton, 2005: 343), and in doing so, we cannot rely on gentle flows from one to another but rather jumps and discontinuities. Such objects, they label fire objects: objects that depend upon otherness and that otherness is generative (Law and Singleton, 2005: 344). They use the fire metaphor because 'fires are energetic and transformative, and depend on difference – for instance, between (absent) fuel or cinders and (present) flame. Fire objects, then, depend upon otherness, and that otherness is generative' (Law and Singleton, 2005: 344), see Table 2.

At this point, we present our empirical work on the DBE. We will then consider the DBE both in terms of the stages from L&S and Ciborra's own later writings on the nature of the technological *object*.

The DBE

The DBE is a concept, a European project and a technology (DBE, 2006). It aims to provide a flexible, distributed infrastructure to tie economic development to the region, supporting local trade and industry through the development of software. The intention is that local ecosystems will gradually federate creating in-regional cooperation by fostering nodes of innovation and integration pan-European, national and local initiatives (Nachira, 2002). The project has drawn inspiration from physical and biological concepts of self-organisation and evolution to produce a technological platform that will facilitate the flexible composition of software services. The evolutionary aspects of the DBE set it apart from similar proprietary models such as Microsoft's.Net or SAP's forthcoming business process 'appli-structure', as does the fact that it has been designed as a non-proprietary public infrastructure.

Although the DBE is funded as a European research project, the innovation ecosystems cluster in the EU is equally concerned to ensure that projects like the DBE combine useful scientific advances with major contributions to practice. In the case of the DBE, this meant ensuring that SMEs became actively engaged with the DBE. To achieve this, a number of 'regional catalysts' were responsible for co-ordinating the engagement activities and

involving local SMEs. Our involvement in the project was to be actively involved in, and study, the process by which small- and medium-sized enterprises in three regions of Europe (Tampere, Finland; Aragon, Spain; West Midlands, UK) became engaged with the DBE. The fieldwork reported in this paper associated with the engagement activities was undertaken by one of the authors, who was a full-time research officer on the project. The research involved attending the DBE engagement events that took place between February and July 2005. In addition, for the engagement study, we carried out interviews in each of the three DBE regions. From 'first contact' to formal engagement, the aim was to describe how the interest of driver SMEs was captured and then sustained.

Studies that focus on SMEs and IT adoption in a generalised sense invariably run into problems of specificity. The varied and distinctive situations facing SMEs together with the range of technologies that form part of their business practices are far ranging. SME classification schema can provide a helpful way of contending with this diversity, as can tools for measuring IT adoption. However, at the stage this research was carried out, narrowing the field was not an issue. Having identified three target groups as part of its engagement strategy (Drivers, Users and Implementers), a significant shift in DBE engagement priorities was agreed by the project. Instead of focusing on recruiting user SMEs (those companies who would use services running on the DBE infrastructure) engagement efforts were focused on driver SMEs (those companies who would provide services) and on influential regional actors such as policy makers. Therefore, the SMEs referred to in this paper are small European software houses involved in the development of business systems and services. The targets set for regional catalysts were to recruit 3–5 driver SMEs by the end of the first 18 months of the project. All three regional catalysts achieved this target so, in this sense, engagement in this phase of the DBE was deemed to have been successful.

The process of engaging the SMEs with the DBE project raised many and varied issues from a rich and wide ranging set of perspectives. These are detailed elsewhere (Darking and Whitley, 2005). For this paper, we wish to focus on one particular set of concerns that arose with regard to engagement with the DBE, concerns that mirror those of L&S and Ciborra, namely why the DBE engagement process was so problematic. This relates directly to the question of what exactly is the object that these SMEs were supposed to be engaging with.

Data collection

The process through which data were collected for this research involved being a participant/observer at engagement workshops and meetings across the three DBE regions. This fieldwork activity was supported by a programme of interviews with regional catalysts and both actual and potential SME drivers. This last point helped us to understand why some SMEs lost interest as well as the motivations for others to become involved with the project.

The beginning of fieldwork was timed to coincide with the first in a programme of training/engagement events, which took place in Finland in February 2005. While there were still no technological components of the DBE to show SMEs, this workshop was designed to focus specifically on the technological concepts and architecture of the DBE. Following this event, the researcher attended every training or recruitment event that took place from this point until mid-June 2005.

In addition to the attendance of engagement events, a programme of interviews was scheduled on behalf of the researcher by regional catalysts. While in the West Midlands interviews took place with driver SMEs only, in Tampere regional catalysts felt it was important that the researcher also speak to companies who had opted not to become involved with the project at that stage, and in Aragon a local politician and an academic were included. An important aspect of the practice approach taken was to retain the emphases that emerged in each region, rather than seeking identical sets of empirical data. Details of the interviews undertaken are given in Table 3 below.

The SME engagement experience

The period in time that this research refers to is a distinctive one because it depicts a period of transition where engagement in the DBE as a technological entity went from being purely conceptual to something tangible. Following actor-network theory, it is not simply status or weight of numbers that governs why a particular preference or point of view is significant (Latour, 2005). It can be the part that point of view plays in achieving a stable network

Table 3 SME engagement interviews

Date	*Interview*
17.03.05	Interviews: West Midlands Regional Catalysts
	1. SME Business Consultant
	2. Interview West Midlands Regional Catalysts
02.05.05	Interviews: Tampere
	3. Driver SME Tampere 1
	4. Meeting with Regional Catalysts
	5. Driver SME Tampere 2
	6. Driver SME Tampere 3
03.05.05	7. Driver SME Tampere 4
	8. Driver SME Tampere 5
	9. Driver SME Tampere 6
11.05.05	Interviews: Aragon
	10. Professor of Economics – University of Zaragoza
12.05.05	11. Local Politician
	12. Interview Aragon Regional Catalysts
	13. Driver SME Aragon 1
	14. Driver SME Aragon 2
23.07.05	Interviews: West Midlands
	15. SME West Midlands 1
	16. SME West Midlands 2
	17. SME West Midlands 3

of associations. For example, the first contact any SME had with a DBE technological component was a significant test of credibility and therefore the opinions and feedback offered at that moment were important, even though they concerned just one SME.

According to actor-network theory, likely sites of engagement between users and new technologies are not as difficult to pinpoint as one might imagine. The work that goes into processes of group formation and enrolment is almost always conspicuous, as it not only involves people but also material and symbolic resources (Latour, 2005). Developing interests and associations together with amassing resources lends substance to the process of enrolment and creates opportunities for the values and objectives of the group to be inscribed. In the case of the DBE, an important form of this kind of opportunity was created through the programming of engagement and training events. These events marked important moments in time when project machinery, technological components and SMEs were brought together for the first time. Through the support of dedicated regional catalysts, consequent events helped to construct a sense of group as familiar faces were seen again.

Throughout the period of study, an important element was missing from the picture: the DBE technology. This means that interest in the DBE often had to be generated before technological components were physically available for inspection. This is not an uncommon situation when it comes to the dissemination of new technologies. Potential users are commonly asked to engage with a concept, an idea of what a new technology is capable of before they can see it for themselves. By definition, it is almost always too late to start engagement activities at the point when technological components are finalised and so pre-emptive engagement action is invariably required. However, the reality of this situation was that early recruitment events lacked any applied examples or technological demonstrations. This was a 'pre-prototype stage' where even communicating the basic concept of the DBE presented difficulty due to the advanced nature of the technology.

Another of the distinctive features of the original DBE proposal was that it brought together contributions from many different disciplines. In particular, the project was organised into three distinct domains: science, which was concerned with developing the underlying theoretical foundations of the ecosystem element of the project, drawing heavily on theories of autopoiesis and evolutionary development; computing, which was seeking to implement the service architecture, based around open source standards and peer-to-peer networks; and business, which was working with regional development agencies and the SMEs who would populate and use the DBE system when it was up and running.

Inevitably, at the early stages of the project there were many examples of CP Snow's two cultures problem (Snow, 1959; Labinger and Collins, 2001) with each of these different domains finding it very difficult to understand and relate to what researchers in the other domains were doing. When members of, for example, the computing team came to speak at early SME engagement events, finding the right level at which to present the key features of the architecture was a serious challenge.

Additionally, higher level 'scientific' or 'business' overviews were often met with a 'so what?' attitude from SMEs. There was also criticism at engagement events and in SME interviews that project partners were indulging in marketing speak. For example, the idea that the DBE was a 'unique technology' that would 'revolutionise European software development' quickly drew criticism. Presentations that focused on higher order concepts rather than what the technology would 'do', coupled with the fact that the technology in question did not exist in any appreciable, tangible form, led to accusations that the project was attempting to sell 'vapourware'.

Thus, at one level, it would appear that the difficulties faced by the DBE during the engagement process were not that dissimilar to those experienced by innovative projects, especially when the innovation was driven by researchers from a wide variety of differing epistemological backgrounds.

Interestingly, when faced with such problems, the SMEs made repeated and forceful requests for tangibles – documentation, release dates, components to test and code to compile; they wanted to be able to see something of the technological *object*. The absence of these elements hindered the process of gaining the trust of SMEs but it did not altogether quash their interest. For some, when asked why they had remained involved in the DBE given these criticisms, SMEs would most commonly talk about the architectural principles of the DBE. With its 'meta-approach' to standards, languages and ontologies, the potential this architecture suggested for 'levelling the playing field' with respect to small and large software companies was something that carried wide appeal. For others, this was a question of software design methodology. Those familiar with open source methods were happy to proceed with technological components that were works-in-progress, while others wanted to see the finished product.

Difficulties associated with communicating the exact nature of the DBE technology coupled with the lack of prototypes and demonstrations created serious challenges for early engagement activities. Regional catalysts were placed in the position of having to reassert the fact that the DBE was a research project and that SMEs were being asked to engage in a process of innovation rather than test an existing technology.

Fortunately, the technological architecture of the DBE was one of the most widely cited reasons for why SMEs had remained engaged with the DBE, despite initial doubts they may have had about the project and despite the absence of technological components for them to assess. The 'meta-level' aspects of the DBE technology and their implications for the development of business services were difficult to convey, but once they had been successfully communicated, generally after a prolonged group discussion, SMEs could see an intrinsic value in what the project sought to achieve. Some SMEs were also drawn to the explicitly open source design of the DBE, although questions were raised about whether the project was sincerely open.

Over time, as questions of what the DBE was meant to be became clearer, the nature of the concerns from the engagement process changed. Whereas at the start, they were concerned with how to understand what the DBE

might be and what it might deliver, over time the driver SMEs became increasingly concerned with other aspects of the DBE. In particular, they were concerned with its scalability, its longevity and its ability to deliver on all the innovative features that the DBE offered.

Understanding the DBE

In order to understand the technological *object*, L&S argue that we must be prepared to accept 'that a fluid, shape-shifting and name-changing object is indeed a conceivable possibility' that is 'not ruled out by prior methodological commitments to particular and limited versions of clarity' (L&S: 34). However, even if we are prepared to accept this possibility their distinct stages are perhaps less helpful for understanding the problems that the DBE faced throughout the engagement process.

Thus, in stage 6 (mutable mobiles), they propose the ontological category of the fluid object, so called because it 'flows and *gently* changes shape, bit by bit', that is, the changes 'cannot be abrupt' (p. 338). Indeed, the process of staying the same might even *depend* on such changes (p. 339). However, in stage 7, the *fire object*, these changes are not the gentle flows of fluid objects but instead 'take the form of jumps and discontinuities' (p. 343).

These qualitative differences between the two stages strongly suggest that particular objects can *either* be fluid objects *or* fire objects. However, the DBE appears to fit into both and this dual character of the DBE might form the basis for some of the problems with the engagement process. It could be argued that L&S are referring to a single object as opposed to an infrastructure and that therefore the either/or is likely to be more empirically relevant. However, the complex, composite character of objects and technologies appear to be precisely their focus and so another option is required.

In terms of gently changing shape, many aspects of the DBE clearly satisfy the criteria for a fluid object. Perhaps, the most straightforward illustration of this can be seen in the open source nature of the software development process. In common with most open source projects, many parts of the DBE software infrastructure are continuously changing and it is this change that will remain central to the sustainability of the infrastructure.

For example, Table 4 below shows the various releases of the DBE Studio (one small part of the DBE infrastructure). As the table shows, the software changed ('gently') approximately every 2 weeks shifting from being more 'concept than technology' to more 'technology than concept'.

However, if we use this gentle change as a basis for understanding the DBE and argue that the DBE is best characterised as a fluid object, then this does not explain the problematic engagement process. There is now extensive experience of developing open source projects and if the DBE was *simply* an open source project, then questions of SME engagement with the DBE would simply have been those that any open source project would encounter. Over time, even open source projects have some jumps and discontinuities between versions and this is normally indicated in a change in the major version rather than minor version number (e.g., from version 0.1.0 to version 1.0.0 rather than, as in Table 4, from version 0.1.0 to version 0.1.1). Moreover, the empirical evidence from the SME engagement strategies indicates that for many of the SMEs, the open source aspect of the DBE engagement process was relatively unproblematic although some SMEs asked interesting questions regarding the practice of open source development in the DBE project, for example, when the 'first' public release of one element of the DBE was found to be version 16, see Darking and Whitley (2005).

Table 4 Version information for DBE studio, taken from (DBE Studio, 2006)

Version	*Date of Release*	*Days since last version*
Version 0.2.0	2006-02-28 06:54	34
Version 0.1.11	2006-01-25 03:15	16
Version 0.1.10	2006-01-09 15:43	19
Version 0.1.9	2005-12-21 09:10	16
Version 0.1.8	2005-12-05 08:26	14
Version 0.1.7	2005-11-21 09:17	5
Version 0.1.6	2005-11-16 03:54	20
Version 0.1.5	2005-10-27 15:21	2
Version 0.1.4	2005-10-25 15:27	14
Version 0.1.2	2005-10-11 15:47	0
Version 0.1.1	2005-10-11 15:41	6
Version 0.1.0	2005-10-05 19:35	

In many cases, it was other aspects of the DBE that caused them concern. The vision for the DBE project was much more than simply the development of non-proprietary service architectures for SMEs to use. Thus, the engagement strategies could not simply rest upon the provision of a series of smoothly developing set of software tools that mimicked existing commercially available alternatives. They could not, therefore, put-in-stone too many of the distinctive elements of the DBE that had not yet, at that time, been developed into fully fledged aspects of the ecosystem.

The process of engagement with the DBE also had to incorporate the 'realities that are necessarily absent' (L&S: 342) as 'not everything can be brought to presence' (p. 342) and the DBE is performed by the 'enactment of *different objects* in the different sets of relations and contexts of practice' (p. 342).

In the context of engagement, one of the most conspicuous examples of absence was the ecosystem element of the project. Drawing on the work of the science domain, a key element of the project is the ability of the infrastructure to flexibly combine and recombine software services available on the DBE. While many such trial combinations may not necessarily be viable, a distinctive element of the DBE is this ability to make connections between available services to provide new opportunities for user SMEs to interact.

Any engagement activities with SMEs must therefore account for this aspect of the DBE, as this is one of the long-term strategic benefits of integrating services with the DBE. This innovative element could not be present in the earliest stages of the DBE engagement process as it both depended on the practical development and implementation of the evolutionary environment (EvE) and the population of the

DBE infrastructure with sufficient services for this element to begin to make realistic experiments in combining services.

A key element of the engagement process, therefore, had to include this other side to the DBE, which was discontinuous from the existing software services provided and, unlike some key technologies for the DBE, could not draw upon pre-existing software tools.

Getting out the dilemma

At this stage, the limitations of the analysis presented by L&S become apparent when they are applied to the DBE and we turn to Ciborra's work to help us address the paradox that has arisen: the process of engagement with the DBE had to deal with a technological object that had, at the same time, characteristics of what L&S label in their stage 6 a 'fluid object', which underwent only minor changes over time and their stage 7 'fire object' that was defined, in part, by what was not present and was discontinuous from the existing versions of the technology.

The pre-prototype character of the technology is one way in which this complexity can be seen. The tension between absence and near-presence was a tangible reality for those involved in DBE engagement work. However, in trying to organise training and engagement events, the absence of the technology was instinctively countered by participants through brainstorming activities through which they developed their own sense of how the technology could be integrated with specific business ideas and capabilities both now and in the future. In this way, the DBE was drawn into multiple realities, regardless of its physical absence.

Despite their call for ontological radicalism, we find that L&S do not consider the situation where an object can have characteristics of both fluids and fire, perhaps because the empirical base they draw upon does not highlight these diverse characteristics. In this section, therefore, we draw on the DBE case study to draw out themes that we feel are implicit in Ciborra's writing about technology. In doing so, we are able to develop Claudio's intellectual legacy by using his, sometimes implicit, ideas about ontology to contribute to both theory and practice in information systems and science studies.

To begin, we note that too much emphasis on the fluid nature of the DBE during the DBE engagement process, could create a formative context (Ciborra and Lanzara, 1994), which could stifle the ability of the SMEs to engage with and incorporate many of the advanced, distinctive features of the DBE that would become available when the project ended. As Ciborra and Lanzara state: 'once designed and introduced into the organisation, they (i.e., systems) tend to evolve along paths that are often unexpected and irreversible, subtly changing the ways people design and carry out their work practices, experiment with alternative arrangements and routines, or implement alternative visions and designs' (Ciborra and Lanzara, 1994: 63). In the same way, too much emphasis on the not-yet-available future capabilities of the DBE would make it unattractive for SMEs to become involved with the DBE, especially the driver SMEs, as they have a particular desire to work with running code and implementable services.

In his later work, however, Ciborra was able to combine the gentle aspects of technology development such as tinkering and bricolage (Ciborra, 1996a) with the more violent language of 'creative destruction', as found in his discussion of the platform organisation (Ciborra, 1996c) where 'schemes which prescribe how to set up efficient organisational structures around a complex, primary task lose part of their normative relevance, for one cannot know in advance the complexity of the task, nor its precise nature and contours' (Ciborra, 1996c: 114). In both instances, there is a desire to challenge the ontological security inherent in disciplines that reduce the technological *object* to a simple tool as is inherent in the work of L&S.

The fusion of what L&S would call fire properties with the gentle properties of fluid objects is implicit in Ciborra's account of information infrastructure. The idea that an object or infrastructure can 'enact a reality' is common to both, as is the idea that realities can shift and change in sometimes gentle, sometimes violent and unpredictable ways. Absence, or a sense of what lies beyond, are recognised and valued by both L&S and Ciborra.

In particular, Ciborra's concept of Gestell, taken from Heideggerian phenomenology, emphasised a 'light' understanding of infrastructure as something that triggers reflexivity and remains inherently flexible (Ciborra and Hanseth, 1998). As Heidegger states: 'What is decisive about technē does not lie at all in asking and manipulating nor in using the means, but rather in the aforementioned revealing. It is as revealing, not as manufacturing, that technē is a bringing forth' (Heidegger, 1993: 13). Ciborra challenged management perspectives on infrastructure as something fixed and controlled by suggesting that the infrastructure has the power to 'enact a reality' but which cannot be mastered (Ciborra and associates, 2000). However, while calling for a re-orientation of ideas on infrastructure around these concepts, Ciborra simultaneously encouraged focus on what lay beyond Gestell. For example, he emphasised the 'moment of vision' where insight from beyond the pervasive influence of the Gestell could be experienced. He talked about the need for infrastructural engagement where the ability to 'jump or switch' was valued along with marginal practices and an openness to the unknown. In so doing, Ciborra was implicitly pointing at the need to address *both* the fluid object and the fire object advocated by L&S.

Ciborra's work emphasises the need to release infrastructure, allowing new relations to be formed and new organisational visions to emerge. Instead of trying to control or govern innovation, he spoke of tinkering and bricolage as approaches to infrastructure and technology design that were, in fact, commonplace among engineers and developers. Likewise, Ciborra (1996c) speaks about 'broken cosmologies' and 'creative destruction' as new realities are brought about during the course of an organisation's life span.

Conclusion

In this paper, we have drawn a parallel between Claudio Ciborra's seminal works on information infrastructures and technologies with the work of L&S on object lessons. Through the case of engagement and the DBE project, we

have identified a paradox where an 'invisible technology' *object* can contain properties that are at once fluid and fire based. We draw upon Ciborra's work to help us address this paradox and argue that through his work on information infrastructures and his use of phenomenology, the fluid and fire properties of an *object* can be held within the same frame or Gestell. Throughout this paper, we draw similarities between the work of L&S and the work of Ciborra based upon their common aim to study complex, messy objects and show how their distinctive paths achieve complementary but compatible perspectives on the technology *object*. Ciborra's thinking on this issue was rarely directly articulated but the analysis presented by L&S allows us to develop his ideas in ways that are of direct relevance to information systems researchers.

If we accept the challenge of ontological radicalism Ciborra's ideas highlight the risks of creating formative contexts that present too much emphasis on either the fluid or the fire aspects of the *objects*. Information systems researchers, therefore, need to be able to balance the fire with the fluid, and see the *object* as a Gestell that has the power to 'enact a reality' but which cannot be mastered. We should not be content with this but should always also focus on what lies beyond Gestell.

As can be seen in the case of the DBE, the questions being raised are not simply about stakeholder 'perspectives' or 'balancing interests'. They are complex questions that are to some extent intractable. These are not very palatable observations to make during a time of tension and uncertainty but they are a useful place to start from. The differences between management work and policy work are not always easy to elicit but the need to challenge assumptions and provide a corrective to the power of these professions and institutions is clear. We hope to continue our internal dialogues with Claudio and carry his work forward where it will continue to serve us and benefit this field of research.

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Notes

1 Both of the authors worked closely with Claudio Ciborra, especially teaching the M.Sc. specialist option *Interpretations of Information*, where Mary was the class teacher and Edgar shared the lecturing duties. Much of our understanding of Claudio's thinking comes from this invaluable experience. In this paper, we use 'Claudio' to refer to the particular insights we gained from working with the person, while using 'Ciborra' for the author of the texts.

2 The notion of the technology artefact has recently received prominence in the information systems literature following its use by Orlikowski and Iacono, 2001 Research commentary: Desperately seeking the 'IT' in IT research: A call to theorizing the IT artifact. *Information Systems Research* **12**(2): 121–134. In this paper, we will refer to the technology *object* to maintain consistency with L&S. We do so, however, fully accepting that neither Claudio (nor, we believe L&S) use the term technology *object* in the sense of subject/object dualism.

3 This expression was used by his friend and mentor Chris Argyris when he spoke at LSE in a seminar organised by Claudio in 2001.

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