The Machine at Work
Technology, Work and Organization

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from home-based to factory or workshop production methods – and had benefited from it. Certainly, the Nottinghamshire Luddites were more inclined to attack errant masters than new machines, but for the most violent and sustained Luddite offensive, in the West Riding, it was the particular machine that was regarded as the cause of the revolt. However, this interpretation did not develop by way of an automatic reflection of the technical capacity and potential of the machine. The machinery was only one of many potential problems facing the Luddites and its potential was largely unknown – as indeed were and are the capacities of most technical innovations. Even where the Luddites had developed a reading of the situation that focused directly upon the machine as the problem, this still did not translate automatically into resistance. Spatial, temporal and gender differences all played a significant part in a very fragmented and differentiated response. While the government played a reactive role in suppressing the revolt, the crucial part was played by entrepreneurial masters who were intent on forcing through technical change and simultaneously breaking the back of the most strategically placed group of workers. By taking on the croppers, and by adopting the rhetoric of faith in technical progress which undermined the Luddites' moral justification for resistance, this new breed of masters coerced the government into draconian action. The freedom of the new factory capitalists to discard the shackles of the moral economy was won, at least in part, through the Trojan horse of new technology. What the Luddites tried to do was to adhere to Virgil's warning to the Trojans: 'Equo ne credite, Teucri. Quid id est, timeo Danaos et dona ferentis' (Do not trust the horse, Trojans. Whatever it is, I fear the Greeks even when they bring gifts). The Luddites failed not because they misrecognized the machine but because the alliance of forces arrayed against them was too great for their interpretation to prevail. Resistance to new technology did not, of course, die with those on the scaffold in York, but it certainly appears to have diminished and was eventually captured by the new left-wing political theories which accepted technology as the potential saviour, if temporary enslaver, of the masses.

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Configuring the User: Inventing New Technologies

Introduction

In chapter 1 we argued that attempts to develop alternatives to technological determinism frequently involve a residual 'technicism'. That is, even sophisticated efforts to take account of the social dimensions of technology and its uses depend on assumptions about the 'essence' of the technology. We argued for the need to maintain a sceptical anti-essentialist stance in the face of enduring preconceptions about the essence of the machine. In chapter 2 we illustrated the benefits of this stance, using the historical example of the Luddites. Our scepticism enabled us to open up a series of questions about the nature and effects of the threatening technology. We showed how both contemporary disputes and subsequent attempts to explain this historical episode involve the active construction of competing conceptions of technical capacity. The essence of this machine was constituted through the interpretations furnished both by contemporary players and by historians.

On the basis of the argument thus far, it would be easy to form the impression that determinations of technical capacity are largely unaffected by the ways in which the technology is put together. Thus, our analysis of Luddite stories concentrated on the diverging retrospective assessments of the (newly) installed machinery, rather than on the processes of its design and development. We implied that differing interpretations arose by and large from different 'interpretative communities' (Fish, 1980) rather than from any circumstances of the design and development of the technology. In other words, we concentrated on consumption rather than production.

By contrast, this chapter looks at the production side of technology.

It asks in particular to what extent, and in what sense, 'social dimensions' of technological development bear upon subsequent interpretations of technical capacity and use. To do this, the chapter is organized as follows. The nature of the connection between the production and consumption of technology is a vexed question which admits a variety of approaches. Hence a first task is to sketch these alternative approaches, some of which were briefly mentioned in chapter 1, focusing in particular on the extent to which they provide a means of understanding technological development as a process of 'building in' elements of the social. The key issue is the extent to which this construal of technology adequately accounts for its subsequent interpretation and use. How exactly is the upshot of social relations congealed in technological artefacts and systems? Secondly, we offer an empirical case study of computer development in order to explore various senses in which the process of technological development – by which we mean to include a range of activities (inception, design, manufacture, marketing, launch and sales) – can be said to have consequences for subsequent use.

The technical/non-technical dichotomy

The problem of trying to understand the nature of technology and its development in non-technical terms is especially difficult because it is a foundational premise of modern Western societies that the technical and the non-technical are distinct domains of discourse and expertise. The very idea of the technical by definition precludes the social. In certain usages – for example when one used the phrase 'sociology of science' in pre-Kuhnian times – the conjunction of social and technical terms can seem contradictory. Or their conjunction encourages an interpretation of one or other of the constituent terms which 'repairs' the apparent contradiction. In this example, 'sociology' was taken to refer to 'external' factors thought to impinge on the institution and practice of science (competition between scientists, priority disputes, bias in the allocation of credit and reward) rather than on the character of scientific knowledge itself. Or, notoriously, 'sociology' is taken to refer only to sources of erroneous knowledge. Again, the implicit notion is that the technical core of true knowledge is immune from mere social influences. The root distinction between the technical and the non-technical is so firmly entrenched in our most basic beliefs and expectations that attempts at transcending it are often greeted with incredulity or hostility. This is in part why Bloor's (1976) 'strong programme' in the sociology of scientific knowledge seemed so counter-intuitive and why its pursuit engendered especially strong reactions from objectivist philosophers of science (Woolgar, 1988a).

A similar problem is encountered in attempts to specify the social dimensions of technology. In some respects the conjunction is heard as oxymoronic. Arguably, this is less obviously the case than with attempts to specify the social dimensions of scientific knowledge. Practising technologists generally seem more willing than their scientist counterparts to speak of the social dimensions of their knowledge and practice. Everyone knows that politics are involved. This is probably connected to the fact that a well-developed and established philosophy of science tradition has no counterpart in technology. Even so, while technologists are sometimes willing to talk about the "politics" of technology in general terms, this does not usually extend to the technical core of their development work.

In the case of the relation between technology and 'the social', the extent of entrenchment of the technical/non-technical dichotomy is evident from the fierce debates over the weight to be given technical and social factors. For example, in simple terms, each of the following three positions (Bromley, 1994) distinguishes itself from the others in terms of adherence to one or other pole. First, the position of technological determinism, discussed in chapter 1, grants autonomy to technology. Technology is construed as the root determinant for either good (technophilia, utopia and hype) or evil (technophobia and dystopia). Second, by contrast, social determinism grants relative autonomy to society. Society is the determinant of technological development, leading to an emphasis on social shaping in the context of technological development. Third, technology is taken to be neutral, so that what matters is the way in which it is used. This leads to an emphasis on the contexts of consumption which includes consideration of the ways in which technologies are used or abused. Of course, the situation becomes rapidly more complex as different aspects of the technical/non-technical dichotomy are brought together. For example, the variant of social determinism which stresses that social relations (such as the prior context of design) become congealed in technical artefacts also aims to show how these congealed social relations subsequently determine the use and/or impact of the technology. In this model, a form of technological determinism is combined with a form of social determinism. But it is hard to escape the feeling that such efforts at combination are unsatisfactory. The root dichotomy remains intact, the two poles merely separated in time: first social determinism, then technical determinism.

One could attempt to meet the problem by deploying the interpretivist/ethnomethodological strategy of turning the dualism into a topic to be studied rather than just a resource to be drawn upon. The distinction between the technical and non-technical would itself become the object of study. How in practice do participants manage

this distinction? In other words, we would study the ways in which the distinction features in discourse, how it is used, when, by whom and to what effect. On what occasions and for what purposes is the technical distinguished from the non-technical? To what extent does this distinction perform different communities (Cooper and Woolgar, 1994), how does it implicate the actions and responsibilities of some actors, perhaps at the expense of others (Rachel and Woolgar, 1995)? This leads to a descriptive programme which inter alia, can focus on why different participants are themselves in practice technological determinists, social shapers, technophobes and so on, and how and why they can interchange the 'positions' listed above.

This 'discourse analysis' response to the problem has the advantage of encouraging a healthy scepticism about our unthinking adoption of the technical/non-technical dichotomy. However, it is not clear to what extent this helps us transcend the dichotomy. We dodge the root question: are social or technical factors pre-eminent? But by attempting to step back from the dichotomy in this particular way, can we be sure we have avoided it? On the basis of existing discourse-analytic approaches the answer has to be 'no'. To the extent that analyses of discourse have focused on the argumentative devices, persuasive strategies and techniques used in conversation and practice, they have tended to prioritize the 'non-technical' horn of the dilemma. With few exceptions, very little discourse analysis has concentrated on what could be described as technical practice.

The difficulty stems from the fact that the particular distinction between the technical and the non-technical is just one particular instance of the more fundamental dichotomy between, in its classic formulation, free will and determinism (see Grint, 1995: 210–31; Woolgar, 1989, 1991b). This dichotomy centres on two broadly competing ways of explaining human behaviour: the notion that humans are largely free to decide their own fate (and hence free to decide how to behave, think and build institutions, structures and social systems) and the contrary notion that their behaviour is largely determined by circumstances (history, the essential nature and characteristics of human beings, the aforesaid institutions, structures and social systems). This way of putting it replays a key problem in social theory. Do characteristics reside in, or are they attributed to, entities? As we have suggested, our answer to this question has important implications for the adequacy of explanation and for issues of responsibility. For example, on the question of the difference between natural and social science, the Winchean (Winch, 1958) view that social subjects must not be treated as natural objects is premised upon profound assumptions about the difference between social and natural objects. Are human actions to be understood primarily as the exercise of free will or as the result of forces outside of, and

beyond the control of, individuals? This dualism recurs in a whole series of particular examples. Thus, in classical Marxist terms, humans are free to make their own history (free will) but not under conditions of their own choosing (determinism). A more recent incarnation of the same debate discusses the relative influence upon human behaviour of structure (determinism) and agency (free will), a dilemma raised again in, for example, Berger and Luckman's (1966) discussion of the sociology of knowledge: humans are free to create and construct new knowledge but the facts thus created acquire the capacity to determine the course of subsequent actions.

Each of these analogous tensions turn on fundamental assumptions about the basis of human behaviour: does it originate in the human or in circumstances external to the human? Put this way, it is easy to identify other related examples, some of which are consequential for social and political action. For example, in conservative philosophies, responsibility for deviant behaviour resides with the deviant. The origin of the behaviour is essentially located within the deviant and, as a result, remedies emphasize the virtues of removing such deviants from society. By contrast, more liberal philosophies locate the origin of deviant behaviour outside the deviant, and largely beyond the deviant's control. The focus of responsibility shifts to various circumstances antecedent to the deviant: upbringing, family background, peer relationships. From this vantage-point, the deviant's characteristics do not inhere but are attributed, assigned as part of a social process. As a consequence, remedies are directed more to addressing the external causes of deviant behaviour, that is, the effects of antecedent circumstances (through counselling, treatment) than to removing a presumably unchangeable deviant. Similar examples are found in the social problems literature, where differences between assignation and inherence views also emerge in debates about various non-human and inanimate objects: for example, drugs and other substances, coffee, margarine, alcohol and so on. Do the (allegedly detrimental) effects of a particular substance arise from the nature of the substance itself, or from its interpretation and use at the hands of particular users?

These examples[1] show how the technical/non-technical divide is but one example of a more general phenomenon: the dilemma of locating the origin of action and behaviour either in the essence of an entity or in circumstances antecedent to the entity. As we discuss below, this problem also recurs in literary theory: does the meaning/interpretation/use of a text derive from its inherent/essential character or from the various circumstances (interpretative communities) of its reception and use?

Technology as text

We thus see that the particular dualism we are confronting in the technical/non-technical dichotomy has deep roots. In the following case study we offer a way of starting to modify our reliance upon the straightforward use of this dichotomy. It adopts part of the 'discourse analysis solution' by focusing on the ways in which the dichotomy is constructed and sustained. However, it also suggests that the precise form of the achieved dichotomy turns on the accomplishment of a significant social boundary. This boundary defines the nature of relations between technology and its users, and so makes possible certain prescribed sets of actions in relation to the technology.

Our strategy for tackling this problem is the exploration of a metaphor: the machine as text.[2] The idea is, to begin with, the supposition that the nature and capacity of the machine is, at least in principle, interpretatively flexible. This then sets the frame for an examination of the processes of construction (writing) and use (reading) of the machine; the relation between readers and writers is understood as mediated by the machine and by interpretations of what the machine is, what it is for and what it can do. To suggest that machines are texts is, of course, to deconstruct definitive versions of what machines can do. There is thus a sense in which the exploration of this metaphor challenges some intuitive beliefs about technology; the 'actual' effects of technology are usually plain to see, and often brutally incontrovertible. At the same time, then, the exploration of the machine–text metaphor deals with a particularly hard case in interpretation. Precisely because it is counter-intuitive to think of a machine as a text, this case might provide insights into more general questions about textuality.

It is worth stressing that the idea is to explore the metaphor, rather than merely to apply it. We have no wish to insist that machines *actually* are texts. Rather the point is to *play against* this metaphor, to see how far we can go with it.[3] What happens to the structure of our discourse when we introduce the notion of machine as text? What, if anything, is special about machines by comparison with other texts? What are the limits of talking in this bizarre way?

The following case study is an attempt to play against one specific aspect of the machine–text metaphor: the notion of the reader as user. As writers like Friedman (1989) have pointed out, the 1980s saw considerable attention devoted to 'the problem of the user' amongst the designers and builders of computer systems. We take the line that the emergence of a new range of microcomputers crucially entails the definition, delineation and emergence of The User. We could say that this process amounts to the (social) construction of the user. However, it is

not just the identity of the user which is constructed. For along with negotiations over who the user might be, comes a set of design (and other) activities which attempt to define and delimit the user's possible actions. Consequently, it is better to say that by setting parameters for the user's actions, the evolving machine effectively attempts to configure the user.

We set out a framework for addressing these problems by way of a brief description of an eighteen-month participant observation study carried out by one of the authors (Steve Woolgar) in a company which manufactures microcomputers. For reasons elaborated below, it is useful to construe this empirical study as an ethnography of computers. Particular attention is then given to a study of the 'usability trials' carried out by the user products section of the company towards the latter stages of the project.

An ethnography of computer development

In order to maintain ambivalence about the appropriate unit of analysis and thus enable us to explore assignations of agency and changes in the moral order, we have designated the study reported here an 'ethnography of computers'. An eighteen-month participant observation study was carried out in a medium-sized company which manufactures microcomputers and allied products, primarily for education. (Since certain members of the company are uncertain about the benefits of publicity arising from the kind of analysis undertaken in the study, the company is referred to anonymously).[4] It is phenomenally successful, having been founded some fourteen years before the date of the study and grown in size by an average of approximately 20 per cent per year over the last five years, and its turnover had increased by an average of about 35 per cent per year in the same period. By the time of the study it had achieved a position such that both the company and its main competitors were claiming in excess of 50 per cent of the market share.[5]

The original research design was to follow a major project in detail from inception through to launch, first shipment and after-sales feedback. Steve negotiated with the company that he should join them as part of the newly expanded project team. We felt this would be a strategic position from which to carry out the study since, as a project manager assistant with responsibility for liaison and co-ordination between different sections within the company, he would be able to enjoy relatively free access across disparate parts of the company. In particular, he worked as a project manager assistant on the project designated 'DNS'.[6] In broad outline, the aim of the project was to produce a new

range of microcomputers built around the new 286 chip. As fairly soon became apparent, this entailed following the lead established by IBM in the production of their IBM PS/2 standard.

The DNS range was the third in a recent series of microcomputer product ranges which brought the company more into line with IBM compatibility standards. The first of these – the 'Stratus PC' – had been built around the 186 chip in order to 'provide an educational computer which was appropriate for schools'. Steve was told that the marketing section had received the acclaim of the press for the Stratus PC with some glee, especially when one review went so far as to praise the machine by speaking of the IBM PC as a good Stratus clone. In fact, the Stratus PC was not designed as IBM-compatible, and although IBM was not at that point seen as the main competitor, a further range – the 'X series' – was developed to compete with the IBM XT at the high end of the market. Subsequently, DNS (later marketed under the name Stratus 286) was developed to fill a position between the two previous ranges, combining the educational virtues of the Stratus PC (186) with the IBM compatibility of the X series (286).

Configuring the user

We start from the position that the machine (in this case, DNS) should be understood in terms of its relationship with other entities of its phenomenal world. However, this recommendation is not simply a call for understanding technology 'in its context', since the nature of 'the context' is itself subject to all we have said about the nature of the machine (cf. Cooper, 1990). The character of both entities is essentially indefinite; and the character of both entities is also reflexively tied (Garfinkel, 1967). In other words, representations (descriptions, determinations of many kinds) of 'what the machine is' take their sense from descriptions of 'the machine's context'; at the same time, an understanding of 'the context' derives from a sense of the machine in its context. The sense of context and machine mutually elaborate each other. For that aspect of context called the user, the reflexive tie is especially marked. The capacity and boundedness of the machine take their sense and meaning from the capacity and boundedness of the user.

Less obscurely, perhaps, our textual metaphor makes the same point. Construing the machine as a text encourages us to see that the nature of an artefact is its reading. But in trying to escape the dreaded technological determinism, in disassociating the upshot of reading and interpretation from any notion of the inherent quality of the text (what it actually says, what it actually means), we do not mean to suggest that

any reading is possible (let alone that all readings are equally possible), although in principle this is the case. For example the dictates of sceptical ethnomethodology (or of ethnomethodology at the hands of some interpreters) pose an idealized User/Reader, one unfettered by relationships with other texts.[7].

If, however, we wish to acknowledge that in practice only a limited set of readings are possible, our question is how to account for this delimitation. Following Smith (1978), we can suggest that the organization of the text makes one or other reading differentially possible.[8] For Smith, the important point is that the organization of the text is isomorphic with the concept we use to make sense of it. In other words, for example, a text 'about' mental illness will be organized in such a way as to make this reading possible. By direct analogy, we suggest, the machine text is organized in such a way that 'its purpose' is available as a reading to the user. In her analysis, Smith notes how certain organizational features of texts provide 'instructions' which enable readers to make sense of content in terms of conclusions stated at the outset. To adapt Smith's terminology to our concern with technology, the user is encouraged to find in her dealings with the machine an adequate puzzle for the solution which the machine offers.

A small extension of this analytic stance on texts suggests that the organization of the text hinges not so much on mundane features like the length of sentences, the amount of space devoted to different topics etc., but rather on associations made available within the text and between text and reader. Textual organization refers critically, as far as the sense to be made of it is concerned, to the relationships made possible between the entities within and beyond the text. Certain characters become central to the story and others peripheral; groups of actants join forces while others disperse; the activities and achievements of some are highlighted, while others are relegated to the background, silent and unnoticed. The reader (who is, we are afraid, the writer) of the text is invited to join with certain groups and disassociate herself from others. A simple example is the invocation of community through the use of the royal 'we'. (Of course, this is an example with which we are all familiar. Do you, gentle reader, wish to say you are not familiar, and hence risk being excluded from our text?) The text might be said to be designed (perhaps implicitly, perhaps unconsciously, but always within a context of conventional resources and expectations) for the reader. What sense will she make of this (or that) passage?

In configuring the user, the architects of DNS, its hardware engineers, product engineers, project managers, sales, technical support, purchasing, finance and control and legal personnel and the rest, are both contributing to a definition of the reader of their text and establishing parameters for the reader's actions. Indeed, the whole history of

the DNS project can be construed as a struggle to configure (that is, to define, enable and constrain) the user. These different groups and individuals at different times offered varying accounts of 'what the user is like'. Knowledge and expertise about the user was distributed within the company in a loosely structured manner, with certain groups claiming more expertise than others in knowing what users are like.

Organizational knowledge about users

Difficulties of knowing the user from within

Steve's first vivid introduction to the socially structured character of knowledge about users occurred during an early meeting of a group of technical writers in the user products section. The discussion centred on plans for carrying out usability trials. Who should be invited to act as subjects for these trials? The problem was that constraints of confidentiality made it difficult to select subjects who would know nothing about the new machine. Getting in 'the man on the street', as they put it, was not a realistic option. At this point, parties to the discussion started to consider the possibility of finding 'true novices' amongst the workforce in the company.

In a fit of helpfulness, Steve offered his services. If they were really stuck, he said, he would be very happy to act as a subject since he would have no problem in acting as a naïve user. He was very surprised when Sally P turned on him vehemently. Didn't he realize how differently users approached this? Didn't he realize how extraordinarily difficult it was for anyone in the company to appreciate the way users looked at things? People in the company couldn't possibly appreciate the user's point of view. Indeed, this was a major problem which pervaded the company: a failure to understand what it was really like to be a user.

Steve realized he had inadvertently stepped out of role. As a relative newcomer to the company, he had expressly volunteered his naïvety about the Company Perspective. But Sally P was apparently unaware of his 'real' identity as participant observer. She assumed he was part of the project management team, and it was in that guise that she was addressing him. He had unwittingly reaffirmed her worst fears about insensitive 'techies' and their inability to see beyond a company mindset. So he was admonished for presuming to be able to act like an outsider.

Alleged deficiencies in company knowledge about users

As this last anecdote suggests, certain individuals could claim the right to speak authoritatively on behalf of users. At the same time, it was said

that some of the individuals and groups you would expect to know about users were manifestly deficient in just this kind of knowledge. For example, one of the technical writers spoke of her amazement in discovering the attitude towards users in marketing:

> You can find the same thing at marketing. I remember going along and saying 'Excuse me but can you tell me who the target market is for this?', you know. And they'd looked at me, sort of thing. Well I always thought marketing had, you know, like a list of and a target market would be durhrhrhrhrhr education, a sort of list of generalizations. No way! Nothing like that! So there's no guidance like that.

I was told by a long-serving member of technical support that 'typically, the engineers don't have a clue about users'. She told the tale of an early attempt by 'engineering' to encourage users initially to configure their new machines by inputting a long line of characters which would have been 'meaningless to your average teacher'. She poured scorn on what she saw as the engineers' presumption that users would be happy to have to do this.

Stories about users

Members of the user products section felt that their conception of users was affected by a wide range of influences, ranging from their own first time of using computers through to 'hearing tales about what happens outside'. Knowledge about users thus involved the circulation of stories and tales about the experiences of users. Frequently, stories about 'what happens outside' seem to have originated in the technical support and service sections of the company

These sections were generally reckoned to represent 'the sharp end' of dealings with customers. The view was that whereas, for example, the engineering and design sections worked in some isolation from users, those in technical support had much more experience of users since they dealt with user complaints and queries at first hand. Some of those in tech support had themselves 'moved out' from working in the engineering sections and seemed keen to emphasize their new-found responsibilities in dealing with users.

Significantly, these stories about users were nearly always couched in terms of insider-outsider contrasts: what was happening (or had happened) 'on the outside' was a recurrent motif. The boundaries of the company thus played an important part in the telling of these tales. For example, one respondent recalled the experience of one particular 'outside' visit in the following way:

> Some of us have been out to visit users but it was something that was thought of as a good idea but never really took off ... I went out once something like back in '84, a long time ago and it was actually a [roadshow] because I went up to a school and I just remember seeing this room of computers, a square room and they were in sort of an L shape against the wall. And pinned above them were very very simple instructions for what to do. And they weren't, they looked like they'd been used, you know? It was almost as if they'd been unpinned, taken down and pinned up again and again so that someone had had them right by the machine.

This experience of an 'outside' visit thus led to the realization that in schools someone, perhaps a teacher, had had to devise extremely plain instructions for use alongside the machine. The same respondent related a story passed on to her by a colleague in technical support: 'Another tale I remember hearing is that a school who had a machine up to like four months. They wouldn't unpack it or anything, they were too scared. There was no one around they thought was able to do much with it ... Yes, I mean GOOD GRIEF!'

User singular and users multiple

Whereas participants often referred to 'the user' in the singular, it is not clear they thought users of the Stratus 286 would all exhibit identical, monolithic sets of attributes. They could presumably imagine a wide variety of purposes and uses; they would have been aware that the marketing section stressed the versatility of the machines when promoting the company's products. Clearly, one criterion for a successful text is precisely its appeal to a wide range of readers.

> There's a limit to how far you can take what any user or set of users wants into account when you're designing a product. It would have been very easy for us to say we want this product to be suitable for teachers in secondary schools, what they want to get out of the machine. We could have produced a very watertight specification of what the thing had to do. But what we knew was we wanted to cover primary schools, secondary schools, colleges, universities, business users, government users, CAD people. The trick was not in finding out what one set of users wants, because if you limit it to a small enough number that's fairly easy, the trick was trying to find that area of overlap that would suit them all, get the best fit. What do you mean by best fit? Who knows?!

The text sells well if many different readers find a use for it. One might even go so far as to say that an author's attempts to prescribe readings, to delimit ways in which the text can be read, is a sure recipe for disaster, at least in the sense of guaranteeing early returns from the bookshop. So a strict and narrow definition of user would seem counter-productive. Similarly, user configuration which restricts the range of possible readings will not generate success.

All this makes curious the continued singular reference to 'the user' in the company, until this is understood as a generalized formulation produced for purposes of establishing contrasts between insiders and outsiders. The generalized user provides a more successfully stark contrast with us/the company/members of the company, than would a heterogeneous rag-bag of customers with varying attributes. The contrast is rhetorically important for example, as we have seen, in stressing the difficulties of knowing what precisely it is that users want. Given the extent of the (claimed) difference between the way 'we' look at the world, and the way 'the user' looks at the world, it becomes necessary to rely upon especially skilled spokespersons – those few with knowledge of these very different entities. When someone in user products says that engineering have no notion of what the user expects, the achieved distinction between the monolithic entity – the user – and the monolithic entity – the engineer – makes a political point about the inadequacies of all members of engineering. More pervasively, this generalized formulation reaffirms divisions between us and them. Company boundaries, differences between insiders and outsiders, are more strongly emphasized through deployment of 'the user' than by admitting that some users are more familiar with our machines than others. This rhetorical rendering of the generalized user also afforded some interesting variations on the more familiar examples of prejudiced rhetoric: he was a user, but he seemed to know what he was talking about.

Users don't necessarily know best

References to the user emerging from the engineering sections of the company included the view that, although it was important to have an idea of who 'the users' were and what they wanted from the machine, users' views should not be unproblematically adopted in design.

> The user isn't necessarily able to see in a clear enough way each feature at a price that they're prepared to pay for it. I don't believe you can go to a user and say: right, each of these functions we're thinking of putting in the machine, tell me how much you are prepared to pay for each of these? I don't think you can construct a product specification like that.

The suggestion was that design should respond instead to ideas about 'where the market was going' or 'where things were going', a more generalized conception of the future requirements of computing. Significantly, such conceptions were frequently referred to as 'visions' of the future, which seemed to stress technical progression and which were couched in terms which transcended individual users' desires for particular technical features.

> Where the clever bit comes in is people like [the Managing Director] having a vision and saying we're going to do this and being able accurately to predict that if we don't do that we'll still sell the required volumes of the product without delaying it. Or without putting in this feature which [the users] might have said was desirable but which they didn't really want to pay the cost of.

A variant of this line of argument was the more familiar view that there was no point in asking users what they wanted because they themselves didn't know. According to this view, such ignorance arose primarily because users were unaware of likely future developments:

> Users can only know about what's available at the moment. So they'll tend to give you an answer that's based on different combinations of what's available at the moment. What we're trying to do is to make available to them something that isn't available at the moment. Which is where the [Managing Director] visionary idea comes in: We ought to be doing this because I say so and because I know what I'm talking about!

We see here an effective rationale for not placing too much emphasis on users' views. According to this perspective, configuring the user involves the determination of likely future requirements and actions of users. Since the company tends to have better access to the future than users, it is the company's view which defines users' future requirements.

Articulating the configured user: the usability trials

The usability trials were just one occasion where articulations of 'what the user is' featured prominently. Myriad other events and occasions during the course of the project included fairly explicit attention to the question of the character of the user.[9] More generally, of course, determinations of the user could be seen taking place throughout the construction of the machine–text. It is thus possible to argue that

participants' notions of the user are available to us, if only implicitly, through an inspection of, say, the day-to-day work of the hardware designer. The interest of the trials, however, is that they involved explicit articulation of whether or not prevailing ideas about the user were correct. The matter was made explicit, in the case of the trials, through an assessment of the different courses of action which a user might engage in.

We have already mentioned that the company encompassed a variety of perspectives on the importance of taking users' views into account. This makes it difficult to be clear to what extent the upshot of these particular trials had any consequential effect on 'settling' the question about the nature of the user. Although there was, as we shall see, some concession to experimental method in the design of the trials, the results were never written up in a final form, to be circulated to designers and other members of the project team. Instead the 'results' tended to be fed back piecemeal into the production process. For example, when one of the test subjects had trouble understanding a diagram on page 34 of the Stratus guide, this information was quickly passed by word of mouth to one of the technical writers, who then redrew the diagram for the next draft. So it is difficult to discern any clear outcome of the trials which might stand as a definite milestone in the ongoing configuration of the user. Nonetheless, these trials were thought important, at least by members of the user products section of the company. This section devoted approximately six person-weeks to carrying out the trials; it would have been more but for the delays and time pressures already mentioned above.

Boundary work: the importance of the case

The start of the trials was delayed several times. The user products section was caught, as it seemed to be on several other occasions, between the need to ensure usability testing took place as early as possible in the development of the product, and the delay in procuring a 'finished' product to test. It was reasoned that the most fruitful assessments of usability could only be carried out with the product in a form as near as possible to that which would be experienced by the user. One of the main reasons for the delay in the project as a whole centred on the availability of the case. Members of user products took the view that usability trials could only properly take place when a cased version of the machine was available. Some negotiation ensued when the first prototype case appeared, but product engineering argued that it was too risky to loan the sole case for purposes of usability testing.

It is significant that user products felt the necessity for a physically bounded entity for use in usability testing. The machine would not be a

real machine unless it was in its case. 'Real' in this usage specifically denotes 'the kind of machine a user would expect'. This contrasts markedly with what counted as a real machine within the company. Particularly within the engineering sections (notably hardware design and engineering quality), machines were mostly left open on desktops and workbenches, their innards displayed, precisely so that the engineers had quick access to the inside of the machine. In these sections, it was unusual to find a machine inside its case.

The following contrast between the treatment of computers 'outside' and 'inside' the company was provided by one of Steve's students who was employed by the company for a summer work placement:

> When I joined the company I was a 'soft' user (Turkle, 1984). Although I did not believe the computer was 'magical', I could not recognize the internal parts of a computer and had never taken the casing off a computer. In fact I had always been deterred from doing so. However in the EQ [Engineering Quality] section, no such squeamishness was expected. Machines were perched on 'breadboards' – metal frames or boards, or they were missing their top covers . . . At school I had been told that the ideal place for computers was a dust free atmosphere kept at a controlled temperature. In the company, there was no such reverence for the computer. They were regularly taken apart. In fact, when a machine which was in its case did not work, the top was removed immediately and the boards were jiggled around just to check that the connections were all right. (Dobbins, 1990)

The surprise of finding the innards of computers regularly on display around the desks and benches in the company was part of the experience of moving from the outside to the inside of the organization. The machine's boundary symbolized that of the company, so that access to the inner workings of the machine was access to the inner workings of the company.[10]

The symbolic importance of the machine-case/company boundary also featured in the 'induction programme' – a series of meetings and events arranged over a period of two or three weeks for those starting with the company. Steve visited or had meetings in product engineering, hardware design, purchasing, personnel, marketing, engineering quality and so on. But the generally acknowledged highlight of the programme was the visit to manufacturing. When they learned Steve was undergoing 'induction', a first question from friendly colleagues was whether or not he had 'been down to manufacturing yet'. This meant spending an hour on the assembly-line under the tutelage of Rose. Rose did all the manufacturing inductions. She explained the sequence of

operations for building a Stratus (at the time of Steve's induction, the Stratus PC) and then asked the learner to try his hand. Steve could not believe he was to be entrusted with putting one of these things together! Like his student and most others new to this experience, he was amazed that mere novices were encouraged to handle the very insides of such a revered item of technology. Rose guided his nervous efforts with a matter-of-fact patter born of long experience with similarly incredulous newcomers. 'Just turn over the frame now. This way. That's it. Have you got your board? Right. Put your first screw in there. That's it. See, it's not so difficult . . .'. Although ostensibly just one of a series of events designed to familiarize new employees with different parts of the company, this 'hands-on' experience can be understood as a symbolic welcome into the company (machine) by way of disabusing computer primitives (like Steve) of the mysteries of computers.[11] As a result of this experience, Steve remembers thinking that the 'real' sophistication of the machine must lie elsewhere, perhaps in the printed circuit boards. He felt he had penetrated the outer shell of the company, but not yet its heart, the nitty gritty of technical design (hardware engineering).

During the later stages of participant observation, the possibility arose of Steve buying one of the new Stratuses. As a bona fide member of the company he was entitled to a discount. But in deciding whether or not to purchase he was struck by the way his assessment of the machine changed according to his (and its) location. On days away from the company, he had a good sense of what the machine could do, was for, looked like. He had confidence in it. (It was, after all, a very nice machine). These feelings were not unconnected with the fact that he was its representative on the outside. He could talk authoritatively to his Brunel colleagues about this new machine; he had privileged information about it. Clearly, on these occasions the machine he knew about was 'Marketing's Machine'. It is with some embarrassment he now recalls conversations with Bob T, the sales director for higher education, about sounding out the market for the company's products at Brunel. There was even an occasion when he handed out Stratus 286 brochures as part of a talk there. It was, after all, a very nice machine.

By contrast, on days in the company, he often found it difficult to imagine how the thing could ever work (cf. Collins, 1986; MacKenzie et al., 1988: 161–2). The case was delayed again, the toolmakers had been taken into receivership, the chip-suppliers had welched on their delivery dates yet again, the Winchester access times were way down on target, Martin K had been taken off the project because of problems with 186 deliveries, and so on. When Ted J, a senior member of the hardware team, told Steve it would be wise to wait at least six months after launch before buying his own Stratus 286, he had a point. He was sharing

his view from/on the inside of the machine. Insiders knew that although the initial machines would look okay, a great deal of patching up had gone into them for purposes of just 'getting them out of the door.'

These and similar examples underscore the symbolic importance of the machine's (text's) boundary. The video record of the usability trials shows putative users working out how to relate to (and in one instance, literally, how to connect to) a technology which had already been black-boxed. Or, in this instance, beige-boxed. The task for the subjects of the usability trials was to work out how to access the interior of the beige box, in order to extract what they needed from the machine/company. The machine's task was to make sure these putative users accessed the company in the prescribed fashion: by way of preferred (hardware) connections or through a predetermined sequence of keyboard operations. The user would find other routes barred and warnings posted on the case itself. Labels bore warnings of the dire consequences of unauthorized boundary transgression: electrocution, invalidation of the warranty and worse:

WARNING
LIVE PARTS ARE
EXPOSED IF COVER
IS REMOVED

Guarantee of safety and product warranty void if seal is broken.[12]

Inside the case (assuming we allow ourselves access for a moment), users would find that different modular components of the PC were similarly labelled, thus structuring and guiding access within and around the machine (company). In particular, various makes of disk-drive bore a variety of warnings:

Warranty void if cover is removed or this seal is broken
(IBM 30Mb Winchester)

Warranty void if this seal is broken
(IBM 60 Mb Winchester)

The 40Mb Seagate drive bore three labels:

Product warranty will be Void if this label is removed
Do not apply pressure to top cover
Delicate Equipment
HANDLE WITH CARE
Disk/Head damage may occur

For those modular products supplied by the company as replacements or upgrades to the machine, warnings posted on the product were sometimes accompanied by injunctions to contact the company in case of doubt. For example, the following appeared in black capital letters on a glossy yellow sticky label, affixed to a replacement hard-disk drive:

WARNING:
STATIC SENSITIVE DEVICE
FAILURE TO OBSERVE THE FOLLOWING WILL
INVALIDATE YOUR WARRANTY
- DO NOT DISCONNECT THIS HARD DISK DRIVE WITHOUT USING A WRIST BAND
- NEVER DISCONNECT THE CABLE FROM THE DRIVE
- NEVER TAKE THE GOLD FINGERS OFF THE DRIVE OR CABLE

IF IN DOUBT CONSULT YOUR USER DOCUMENTATION
OR TELEPHONE [THE COMPANY] TECHNICAL
SUPPORT HOTLINE ON 0898–239239

Here we see that, in the event of uncertainty, users are redirected back to sources – either 'user documentation' or the company technical support hotline – which can re-establish the correct pattern of user action, in line with the approved configuration of the user's relationship with the company.

These kinds of boundary markers are relatively common in the information technology industry. For example, printed in seven languages on the cover of the Microsoft WINDOWS 3.0 package is the following warning:

> By opening this sealed package, you are agreeing to become bound by the terms of the Microsoft License Agreement.

Analogously, academic papers often circulate in draft form with warnings appended to the cover sheet: 'Please do not cite or quote this paper without permission'.[13]

In all such cases, the authors/producers are attempting to delimit the nature and extent of access to the text; they are trying to control the relationship between the reader and the text by specifying constraints upon how it can be used. Readers may only cross the boundary and access the text if they agree to use it in certain prescribed ways.

User documentation: correct readings of the manuals

Ostensibly, a central concern of the usability trials in which Steve participated was to evaluate the draft documentation which was to accompany the machine on its shipment. The main body of documentation comprised the setting-up card, the Stratus (286/386) guide, the reference diskette, the MSDOS4 users' guide and the WINDOWS guide. The first three of these were produced by the company and related specifically to the operation of the Stratus 286. The latter two related to bought-in proprietary products supplied with the machine. In addition, peripheral equipment supplied with the machine, such as the printer, came with further documentation specific to its own use. The company-specific documentation was a main focus of the trials, but participants were also keen to evaluate the relationship between the other items of documentation. Would users be able to select the correct item of documentation when attempting to solve a particular problem? Were the instructions in, say, the Stratus guide sufficiently clear in telling users which other parts of the documentation to consult and when?

The body of documentation at the centre of the trials comprised a set of texts which accompany the machine which, as we suggested from the outset, is itself best understood as a text. We can think of such documentation texts as peripheral texts intended to enable the operation/reading of a core text. They are, so to speak, captions for helping readers find and see the relevant features of the machine itself. These captions configure the user in the sense, discussed above, of defining the correct courses of interpretation and action to be followed. They help guide access to the machine-text. Long sections of the video records of the usability trials show subjects moving back and forth between manual–text and machine–text, seeking the sense of a described feature of the machine in the material object itself, and assessing the sense of one of the manual's instructions in the response of the screen to some keyboard operation.

A central concern for testers/participants was whether these peripheral texts were sufficiently 'clear' to users. They were sometimes said to be 'clear' if subjects were judged to have understood and/or carried out the tasks set them by the testers. The manual–text could thus be seen as having enabled operation of the machine–text. As we shall suggest, determinations of the relative reliability of different texts were managed by construing a distance between them, such that one was viewed as operating 'at a different level' from another.

We have already suggested that the trials included detailed articulations of 'what the user is like'. However, it was not enough to determine whether or not a subject could fulfil a task. The testers were also interested in knowing whether the subject had carried out the task in the manner a user would have done. Such trials can thus be understood as occasions where a machine and its documentation confronts (a version of) its user(s).[14]

What is especially interesting is that, at this stage in the project, the identity and capacity of the key entities involved was equivocal. This means, on the one hand, that the capacity of the machine, what it could do, what it was, whether or not it worked and so on, was not yet settled. By this, we mean to claim that the trials showed participants' awareness of the possibility that the machine was not (yet) working as required, that things might yet go wrong. In this usage, 'settled' refers to participants' projection of particular states of readiness of the machine, for example ready for launch, ready for shipment and so on.[15] Similarly, at this stage, the identity of the user was not settled. Although participants could and did trade versions of what users are like, the identity of the user of the DNS/Stratus remained essentially uncertain.[16]

This makes these trials interesting in respect of accounting for interaction between machine and user. Where IT novices use established IT products, a typical experience is that where things 'go wrong' the 'fault' is likely to lie with the user. Conversely, where experienced users of IT products come into contact with machines still under development, the fault can be more readily said to lie with the machine.[17] Of course, the determination of things going wrong does not rest solely with the human agent. The machine may declare 'error' as a way of indicating that the user is at fault ('Printer Needs Attention'), or the machine may self-diagnose error ('WP.SYS file not accessed').[18]

In the DNS/Stratus usability trials, neither machine nor user was settled/experienced/established. Consequently, the interactions were part of the process of establishing the identity of the interacting entities. In other words, in this situation, the interaction between machine and user invited assessment both of whether or not the machine was acting like a real machine and whether or not the user was acting like a real user.

Enacting the users' context

In planning the trials, particular attention was given to the selection of subjects and to choosing the right locale.

How can we find subjects who are most likely to act like users? A standard procedure for manufacturers, especially in the electronics and IT industries, is to use what are called 'beta sites' – trusted and privileged customers who are happy to try out new products. These customers gain advance notice of the release of the new product in exchange for feeding back information about how the product can be finally improved. But the company had little or no tradition in the use of beta sites.[19] In any case, a main aim of the trials was to try out the

machine (and its documentation) on relatively novice users. Trusted customers with a close relationship with the company were unlikely to fit this particular requirement. It was suggested that a group of students be recruited from the local polytechnic. This had the practical advantage of being easily arranged through a local contact; in addition, such a group obviously matched one of the main customer target sectors (further education). However, this idea was rejected because it wasn't thought possible to maintain the necessary level of secrecy.

The need for secrecy, in particular, forced the user products group to consider selecting people from the company. The problem about secrecy was thus effectively finessed, but the level of these subjects' expertise still remained a problem. As a result of drawing upon personal contacts in the company, the following individuals eventually served as subjects: two members of the night shift from manufacturing; the head of user products; a psychologist from the local polytechnic (who was working temporarily with the company); a technical writer; and a project manager assistant (Steve).

Where should the trials be carried out? As in most experimental situations, the answer hinged on a compromise between a setting which best approximated the subject's 'natural' environment and a setting which facilitated the kinds of observation thought necessary for the conduct of the trials. Some larger companies have a small closed-off office space for this kind of testing, which they designate 'the laboratory'. But at the company where Steve carried out this research, space (especially closed-off space) was at a premium and usability trials were not thought sufficiently important to warrant a specially assigned area. The trials were held in the main sitting-room of a Victorian terraced house, a few hundred yards from the main factory site. This house, recently modernized and refurbished, was being let to the company as temporary lodgings for newly recruited middle management.

The video record shows several features of what might be regarded as a typical user's environment. In addition to the test subject (the user), the Stratus 286 and its accompanying peripherals and documentation, there were table, cups of coffee, chairs, television, bookshelves, carpets and so on – all the various accoutrements of being in an ordinary home. Indeed, the video record suggests that coffee-drinking featured prominently in the recreation of the users' environment. The telephone line which enabled instant phone calls to the company proved an especially useful feature of this users' environment. The kinds of feature presumably not present in the typical natural user's environment included: the testers (observers) with their clip-boards, notepads and clocks; the video camera; the (audio-) tape recorder;[20] and other machines (such as the more powerful K series computer). When viewed from a non-specist perspective, this is a comical concatenation of entities.

Constructing natural users

Each trial started along similar lines. The subject was confronted with machine, peripherals and documentation. The tester explained the general purpose of the trial, pointed out the equipment available, set a task and asked the subject to say how he or she might go about it and to estimate the length of time it would take. The bulk of the trial comprised the subject then trying to complete the task. Finally, there was a 'post mortem' when tester and other observers would discuss the trial with the subject. The whole event was both video- and audio-taped.[21] On one occasion, the video record shows some initial confusion as the various human participants attempt to get into position before the start of the trial. The observers bump into each other as they move around the table. They strive to achieve what they regard as their appropriate juxtaposition *vis-à-vis* the machine for the purposes of the conduct of the trial.

The central part of the trials was particularly interesting. The testers cast themselves as objective observers in the sense of not wanting to intrude upon the 'natural' process of a user trying to make sense of the situation. They wanted an unbiased picture of how users 'actually' go about the completion of the tasks. On the other hand, a whole series of (thoroughly unnatural!) contingencies arose which demanded their frequent intervention. For example, where subjects were thought to be going hopelessly wrong, or where they were clearly about to get into trouble, it was felt necessary to retrieve the situation.

Quite apart from this kind of intervention, however, observers offered considerable commentary on subjects' performance:

1.
   A: You actually succeeded in this task, so there's no problem about that.

2.
   P: You're a technical author's dream – reading the manuals!

In a situation where the identity/capacity of both machine and user were unsettled, we might expect participants to have expressed concern over exactly who or what was being tested. The recurrent commentary on the subjects' performance – which was presumably not a 'natural' feature of the user's environment – can thus be understood as the observers' efforts at reassurance about the real subject of the test. Frequently some confusion – over who (or what) was carrying out the task – revealed itself in the observers' attempts to empathize with the subject:

3.
A: Let's assume we succeeded there which I think you did.

Observers frequently intervened to explain the origin of a problem in terms of a machine fault, where this prevented (or made difficult) the completion of the task by the subject:

4.
A: It's a hardware error [3-second pause] probably a loose connection [3.5-second pause] you always have these problems on pre-production. But why did it have to happen in the middle of a trial!

5.
R: I'm so pleased it wasn't me this time huh huh.
N: You've done fine so far Ruth.

A large number of prompts and interventions seemed to pursue the issue of whether or not the subject was acting sufficiently like a real user. In each case, the tester explored with the subject the way they would behave, if they were in fact acting like a real user:

6.
A: You'd know WINDOWS was on there.
[2-second pause]
A: I think you'd know that wouldn't you?
SP: Yeah.
A: That's one reason you'd buy it!
SP: Hmmm yeah yeah

7.
N: Just do it as if you were doing it normally.

8.
N: This wouldn't normally happen with someone who's been doing something with it already.

9.
A: Of course you would know how to use WRITE.
SP: I've used WRITE before so it would take me longer.

But the participants were not above ironicizing their own attempts at creating an objective test of 'natural' user behaviour:

10.
A: Do you want a rest now?
SP: Yeah.
A: A coffee?
SP: Is that one of my tasks? 'Make the coffee and tea. How long do you think it would take you? Hah hah.
SW: Subject drank thirteen cups of tea! Huhuhuh.

Error and identity: the 'wrong socket' episode

An especially vivid illustration of many of the themes already discussed occurred in one particular trial, when Ruth was asked to connect the (new) Stratus 286 to a printer. In order to see if the 'machine' worked – and by 'machine' we can here understand the configured relationship between Ruth and the Stratus – the observers used as criterion the successful operation of a 'peripheral'. This reflects the fact that satisfactory usage of a machine often requires users to invest in and deploy auxiliary items of apparatus. For this reason, it is worth considering this part of the interaction in detail.

At the time we join the scene, Ruth is confronted by the Stratus 286 (with its keyboard and monitor); various instruction booklets and an as yet unconnected printer. The Stratus is initially switched on. Ruth begins by asking the observers if she should switch off the machine before attempting to plug in the printer. Some time passes before she locates the main switch on the back of the Stratus. She then takes some time comparing what she reads in the instruction booklets with what she sees on the machine. This includes moving the booklets from the front to the back of the machine. Finally, she announces she is stuck:

R: (this point) oh gosh [4-second pause] hmmm [7-second pause] I must be extremely thick I I can't see where this plug goes (plugs in), at all. I'm going to ask for help Nina ha on this one hahahahahuhn

Her difficulty is eventually resolved by a sequence of a question from Nina and Nina's eventual declaration that the task is, after all, impossible. It turns out that Ruth had been asked to connect a printer to the Stratus 286 (referred in the interaction by its engineering designation 'DNS') using a lead designed for use with the earlier K series machine. Throughout this little episode we see Pete, Nina and Steve each moving in and out of (the video) frame to inspect, for themselves, the socket on the back of the Stratus.

We see here how the machine is being treated as a text which Ruth is asked to interpret. The machine as presented to Ruth most obviously

comprises the Stratus (CPU), its monitor and keyboard. She can achieve her task, it is suggested, by bringing the instructions into conjoinment with the machine in such a way that the printer can be connected. The trial is set up so that the adequacy of Ruth's interpretation can be assessed in terms of the adequacy and effects of her actions in making the connection. An adequate interpretation will make the instructions, the printer and Ruth herself all part of the (larger) machine. That is, in the event of a successful outcome, these entities can be said to stand in an adequately configured relation to the machine.

The adequacy of the interpretation, the achieved relation between instructions and machine, is adjudged by the commentators and observers who also participate in the trial. These observers provide comments which stand as further texts, captions on the core text. The 'observers' thus point out the key features of the text. They tell how it is organized and which aspects should be attended to in order to achieve a correct interpretation. They control the interaction by offering advice on whether or not Ruth is behaving 'correctly' *qua* user. The machine also comprises these observers in the sense that the subject is encouraged to interpret her actions in relation to the machine, and feels she has to display her actions in accordance with the observers' expectations of users.

In all this, the importance of the textual boundary is paramount. We observe the positioning and movement of humans in relation to the docile inanimate object: evidently there are preferred vantage-points for seeing 'through' the machine boundary. We notice that observers can speak authoritatively about 'their' text. They can speak as insiders who know the machine and who can dispense advice to outsiders:

> R: ... I'm going to ask for help Nina ha on this one hahaha-hahuhn.
> N: Are you. What are you looking for?

We see the importance of insider/outsider contrasts when it comes to attributing blame for (what turns out to be) the inappropriate task that Ruth has been set:

> R: Oh it's not just me being thick. Thank god for that hah hah! I came in the back an' as soon as I got round here, with the machine I looked at this and looked at that and I thought 'No I'm being stupid, now this is silly.' Well I wasn't hahahah!
> N: But in fact we were being silly asking you to do it.

Finally, the importance of the textual boundary is crucial to the

resolution of the problem which 'Ruth's trial' brings to light. Firstly, the resolution retrospectively defines who or what has been on trial: by virtue of the resolution we see that the DNS, not Ruth, has been the subject of the trial all along. Secondly, as Nina's declaration makes clear, it turns out that the DNS on trial is incompatible with the previous range of machines produced by the company. It turns out, in other words, that the entity at the centre of all this attention is an impostor. In this form, the DNS on trial is not a DNS (and certainly not a Stratus 286); it is a deviant, not (yet) one of us.

The example also makes clear the importance of a detailed and contemporaneous assessment of the machine at work. It would be easy to misunderstand what is at stake by way of a crude summary that, in the end, the 'actual' character of the socket/lead 'determined' the actions and behaviour of subject and observers. Crucially, however, the transcript emphasizes that participants did not have access to this transcendental, objective socket/lead. Instead they were preoccupied with assessing what the socket/lead was. Its character is the upshot of interaction involving complex considerations of identity and authority: who speaks for the machine and when? Only by virtue of the outcome of negotiated descriptions of the character of the machine, of the nature of the task, of the assignment of responsibility and so on, do participants retrospectively attribute 'objective' features to the socket/lead.

The new machine meets its users

We have implied throughout that user configuration is consequential for the reception of the new technology. What then was the fate of the Stratus 286 in the hands of its users? What happened when the 'configured user', enshrined in the artefact, met face to face with 'actual users'? Although there is insufficient space to answer this complex question in detail (see Woolgar, 1993a), it is worth noting that from many points of view the Stratus 286 was adjudged a success. For example, when Steve put this question to his informants both within and beyond the company, they responded in a variety of ways: the project had been accomplished largely within budget; the only delays that had occurred had been beyond the control of the project team; it really was a nice machine; and so on.

Of particular note is the fact that the Stratus received almost universally positive reviews in the computer press. The one exception – a wholly negative review by a highly respected computer journalist – became the object of considerable attention within the marketing section of the company. This particular journalist was well known to the company and had been identified as an important target. What could

have gone wrong? The ensuing investigation focused on the ways in which this individual had resisted the company's marketing efforts for the Stratus. It was noted that he had not taken up the offer of a special pre-launch press conference, and that he had further refused personal invitations to lunch with members of the marketing team. Commenting on his review, a senior member of the marketing team said that the journalist had made the mistake of assessing the Stratus as if it was just another 286 computer, when the whole point of the Stratus was that it offered added value for a particular set of well-defined educational applications. The complaint, in short, was that the journalist treated the Stratus 'as if it was just a machine you could go and buy off some shelf in the high street'.

The anecdote is instructive because it provides a clear (but in the case of this company, rare) example of the 'undisciplined' response of an 'unconfigured' user. In the company's view, the journalist had behaved inappropriately – that is, he had missed the virtues of the Stratus – as a direct result of not enjoining the sets of social relations offered by the company. In buying a technology, one necessarily buys into the social relations which both accompany and constitute it, and which thereby define its 'appropriate' use and assessment. By construing the Stratus as 'just an off-the-shelf machine' the journalist had, in effect, tried to interpret the new machine text as if it had a context quite different from that offered by the company.

Conclusion

We have argued that user configuration involves boundary work. The user's character, capacity and possible future actions are structured and defined in relation to the machine. As is dramatically illustrated by the usability trials, when there is still considerable ambiguity both about the capacity of the machine and about the character of the user, the machine becomes its relationship to the user, and vice versa. In this, the machine is a metaphor for the company so that, in particular, the boundaries of the machine are the boundaries of the company. The machine's case symbolizes the user's relationship to the company. Insiders know the machine, whereas users have a configured relationship to it, such that only certain forms of access/use are encouraged. This never guarantees that some users will not find unexpected and uninvited uses for the machine. But such behaviour will be categorized as bizarre, foreign, perhaps typical of mere users. More generally, of course, the more significant this boundary, the more likely will be the prevalence of this kind of separatist talk.

It is in this light that we might best understand the occurrence of

'atrocity stories' – tales about the nasty things that users have done to our machines (Woolgar, 1993a). Such tales portray nastiness in terms of users' disregard for instructions (violation of the configured relationship users are encouraged to enter into) and their disregard for the case (violation of the machine's boundary). Whereas many of the company members engaged in the exchange of such atrocity stories, it was also possible to identify liberals who were willing to speak up for the user: 'Users can't help the way they behave; they just need to be educated to understand what we are trying to achieve here'. Readers can't help the way they interpret the text; they just need to be educated. . . .

The analysis in this chapter has helped further to dispel the essentialism associated with our understanding of technology. We have concentrated on the processes whereby new technology emerges and is developed and manufactured. We noted at the start of the chapter the problem of transcending the technical/non-technical dichotomy. We argued that since this echoes a series of profound and entrenched dichotomies it is necessary to show how the dichotomy itself is constructed and sustained in practice. Hence, although the processes of technological development can be described in terms of the social construction of technology, their importance is in the ways they create and sustain the boundaries and dichotomies which we subsequently come to take as a natural feature of our relations with the technology. The import of these developmental processes is that users are configured to respond to the technology in sanctionably appropriate ways. The metaphor of technology as text is useful because, against essentialism, it stresses the contingency of interpretation. The especially important aspect of the metaphor is its stress on the tie between production and use. Users are free to make what they will of the machine, but can only do so 'appropriately' within an interpretative context. This 'context' does not exist in isolation from the machine; it is instead defined by the social relations which make up the machine (cf. Woolgar, 1996b). As is shown by the example of the case study of PC development, a crucially important part of this is the constitution of 'the technology' in terms of its discursive and organizational boundaries. 'The technology' is the machine's relations with its users.

This line of argument has major implications for our understanding of the notion of 'impact'. For it becomes clear that when we talk of the impact of a technology (or even more interestingly, the impact of any other kind of cultural artefact), we are necessarily emphasizing (if not adopting) certain definitions of boundedness, identity and appropriate behaviour/response. To talk of the impact of technology, then, seems to require us artificially to separate 'the technology' from some 'social group', in the service of assessing 'the effects' of one upon the other. This move thus requires us to force apart technical and non-technical

entities, the conjunction of which, we have argued in this chapter, is crucial to the very constitution of a technology. In chapter 5 we shall use this heightened scepticism about the notion of 'impact' in a reconsideration of the role of technology in work. First, however, we need to attend to some outstanding problems of anti-essentialism.

4

Some Failures of Nerve in Constructivist and Feminist Analyses of Technology

Introduction

We saw in the last chapter how the genesis, manufacture and production of technology entails a process of user configuration. Responses to a technology and, in particular, assessments of its impact and effectiveness, take place within a 'performed community' of social relations. The attributes of the technology are thereby interpretatively constituted. This is how the god – the apparent essence – of the technology gets put into the machine.

This chapter carries forward our critique of essentialism by considering feminist and constructivist approaches to the social study of technology. The shared promise of these approaches is the development of radical alternatives to traditional understandings of technology. Frequently, both approaches take issue with the spectre of technological determinism. As we noted in chapter 1, however, 'technological determinist' has become a rather vague term, yielding many different interpretations. In addition, even though one is now hard pressed to find anyone admitting to the label, it turns out that many of the critiques of 'technological determinism' themselves retain key elements of the condition. As a result, the target of criticism is both varied and diffuse, and many of the critiques compromise their avowed radicalism. A central aim of this chapter is to explore the extent and implications of these problems in some recent constructivist and feminist perspectives on technology.

A further reason for carrying our argument forward in relation to constructivism and feminism is that the assessment of different theoretical perspectives on technology is more than just idle speculation. They