# The Question of Technology, or How Organizations Inscribe the World

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## Abstract

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This article relates technology studies to organization research and examines the technology-as-text metaphor. The study of organization is incomplete as long as tangible technology remains in its blind spot. Linguistic metaphors and analogies, while capturing and indeed amplifying much of received understandings of technology, succeed only partially in repairing the situation. The image of the palimpsest is used to highlight this critique and to visualize ways out. Thus, while the main concern of the paper is to re-situate technology to the study of organization, an argument is also put forward for a specific approach to the study of technology.

**Descriptors:** technology, organizations, institutionalization, technical norms, social norms, inscriptions

## Introduction: Silent Inscription

At least since Latour and Woolgar's *Laboratory Life* (1979), the notion of *inscription* has made a highly satisfactory passage from literary to social theory. Anthropologically minded, Latour and Woolgar observed that the exotic tribe who had previously been believed to be dedicated to the discovery of nature, in fact, spent 'the greatest part of their day coding, marking, altering, correcting, reading and writing' (p.49). Instead of producing mirror-like images of nature, they were discovered busily, almost compulsively, inscribing the world around them. Literary inscription, performed with the aid of inscription devices, turned out to be the core activity of life in the laboratory.

While this discovery met with anger by some, and amusement or enthusiasm by others, two misreadings were common. One was that the activity of inscription, when not produced at its proper (literary) site, was taken as a quaint activity of a strange tribe, living an isolated life in their sealed-off laboratories: natural science is special. Another was that inscriptions are authorial activities, performed by tool-using humans (groups or individuals) aiming to put a recognizable signature on the world.

We assume that literary inscription is of crucial importance, and also outside literature, but we wish to contest the two readings mentioned. Esteemed reader, please stop reading and look around! See? You are unable to fulfil

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our request — you will continue reading wherever you are. Far from being naked and appealing directly to your senses, your surroundings are completely inscribed. It is far from clear who the authors are of most such inscriptions. On closer inspection, they might reveal a signature, but not a human one. The closest signatures we can read, sitting now at Charles de Gaulle airport and revising this paper, are 'Delsey' and 'SAS'.

Our starting points are therefore that the worlds around us are carefully and completely inscribed, much like the worlds of science, and that the majority of these inscriptions are author/iz/ed by organizations, not persons. We consider organizations not as actor-networks, but rather as *action nets*: collective actions related to one another within a given institutional order. Production needs sales, sales need advertising. Action nets may sometimes affect a personal authorship ('Roy Buck, your shift manager'). As readers of many such inscriptions, we know better than to believe in Roy Buck; he is as much an organizational product as the late Alistair MacLean. Action nets always involve human *and* non-human actants, that is, '... that which accomplishes or undergoes an act' (Greimas and Courtés 1982: 5). Non-human actants are things commonly called natural or technical, but usually not considered 'social' in their own right by social scientists.

We will argue, then, for the acknowledgment of both the fact of pervasive inscription via technology and of its organizational origins in organization studies. We begin by pointing out the persistent unwillingness of many social scientists, including students of organizations, to account *conceptually* for the peculiar agency of material technical artifacts and reflect on some of the reasons for this state of affairs. Post-Marxian or post-Weberian approaches in organization research have, we claim, abandoned a concern with the place of machinery in a world of action. The metaphor of 'technology-as-text', which has come to inspire much of current writing on technology, has favoured the reappearance of machine technology (if mostly in the guise of information and communication machines). Relating this notion to the notion of inscription, we then attempt to reconcile a concern for institutional order — which inspires both classic Marxian/Weberian and recent organization studies — with an understanding of technology in organizing processes. We are presenting technical norms/technical normalization as the ways in which the patterns of organizing are inscribed in technology and the ways in which organizations inscribe the technical worlds they produce.

In order to display our concept of technical norms, as distinguished from other social norms, we chose the example of an everyday technical artifact, a mundane organizational product which demonstrates (better than familiar examples of production technologies) the referentialities and out-of-awareness-taken-for-grantedness of technical inscriptions to which we draw attention. The notion of technical norms as silent inscriptions of institutional order is then highlighted in the concluding image of technology-as-palimpsest.

## Technology and Organization

A social science based on the presuppositions of the Society/Nature dichotomy — as is most social science — runs into problems when confronting technology. Like human bodies, extrasomatic technical artifacts represent an order of reality that cannot be dissolved into either 'nature' or 'culture'. It is for this reason that the natural sciences do not teach us much about technology, either. In the engineering disciplines, curiously enough, technical implements are routinely ascribed genuine *socialness*, even if it tends to be extremely diluted. Engineers teaching construction or developing production technologies, for example, and, of course, ergonomists, do not see any problem in talking about machine-man-systems or machine behaviour, which Simon (1982) attempted to explicate by contrasting a general theory of constructing with 'discovering' sciences.

What about organization studies then, with their roots in both engineering and social science practice? Like other social science disciplines, organization studies have had and continue to have peculiar difficulties in grasping the 'the inner structure of the artifact', to take up Elaine Scarry's expression (1985). While technology studies have proliferated, much like the technologies themselves, the happenings inside machinery and other tangible technical artifacts were mostly described and explained in engineering or ideological terms. We will not attempt a full overview here, but point, rather, to a series of episodes in the history of the discipline which have set, it seems to us, the tone in debates about technology.

Studies in the Tavistock tradition, where the notion of *socio-technical* systems was first introduced systematically (e.g. Rice 1958), began to acknowledge the weight of the 'technical', but still focused their conceptual energy on the 'socio-' and firmly clung to the idea of duality. The concept has been revived by some authors, along with the turn to technology in sociology that came in the 1980s (see e.g. Mayntz 1988; T.E. Burns and Dietz 1991). These studies remained in the same dichotomizing spirit, even if the 'socio-' part of the term was noticeably enriched by notions of technological design, choice, regulation and the like. Contingency theory, the (still) dominant approach to technology in organization theory, originated from a strong interest in relations between technology and control systems (Burns and Stalker 1961; Woodward 1965), but ended actually excluding tangible technology, rarefying the notion of technology into task structures of various kinds (see, for instance, Scott 1990, even if he opens up somewhat to social constructivist arguments). Even in new institutionalism, there are attempts to separate and keep apart 'institutional environments' from 'technical environments', thus protecting the social world from intrusions of machines and other things (Meyer and Scott 1983).

One could say, with some exaggeration, that it took several serious catastrophes to re-introduce material technology as a central concern in organization studies. Indeed, catastrophe studies (such as Turner 1978; Perrow 1984; Rochlin et al. 1987; Weick 1988; Vaughan 1990; Shrivastava 1993) have done more than traditional industrial technology research to prepare the ground for a broad re-evaluation of the 'question of technology' in organization studies (as opposed to both technology-related issues in particular industrial organizations and to technology and society issues at large).

Why, one might ask, should the activity inside machinery be of any interest to organizational theory? Presumably, most people would agree that any organizing takes place simultaneously in three dimensions: symbolic, political, and material — or practical, as we will also say (Czarniawska-Joerges 1993). Entire schools are dedicated to one or two of these aspects, recently, mostly to the first two. The practical dimension, which should prominently represent technology — in close connection with the other two — has gone missing. Goodman and Sproull, for instance, thus concluded their overview of the field:

> 'While there appears to be a movement to focus primarily on technology as socially constructed, we feel that some balance is necessary. There are issues that concern technology as a physical reality. These have not been well addressed and have implications for doing work on technology and organizations. (...) We feel that a fruitful approach would be to increase our understanding of both the social and the physical aspects of technology (...) The real contribution, however, will be understanding the intersection between both forms of reality.' (1990: 260-261)

The problem might have to do with treating the notion of 'socially constructed' as synonymous with 'unreal', or 'immaterial', or 'to be changed at will'. Considering, however, that all construction is social, the adjective is actually superfluous in this context. The point worth making is that, as Latour used to say, the better constructed, the more real things become (Latour 1996). Setting 'symbolic' *against* 'material' is thus a doubtful proposition, as there can be no immaterial symbols, while anybody, organic or not, human or inhuman, can be used in the work of symbolization. The gap between the symbolic and the material (both social) has its origins, we claim, back in time, in the ways the founders of modern social sciences (mis)treated technology, and especially in the ways they were subsequently (mis)interpreted by their followers. Nevertheless, we believe that there are insights to be rescued from the past, so even if most technology researchers today appear to avoid referring back to what Niklas Luhmann has called 'Old-European sociology', we will risk a glance.

Marx, for instance, was always quite alone among Marxists in making the question of the social nature and function of machinery a central theoretical concern (see e.g. the 15th chapter of the first volume of *Capital*). In Marx' concept of technology two points were critical. First, technology represented a process of delegating bodily functions to extra corporeal sites: tools and machines were, like all material artifacts, projections of the human body and its organs. The meaning of these projections — unfulfilled under capitalist conditions — was to liberate the human body from isolation and pain.

Second, technology represented science: historically, the decisive step in the evolution of technology was the transition from tools to machines (more precisely, machine tools). These were artifacts, according to Marx, in which tools that had previously been guided by human hands were now guided by a physical mechanism. This only became possible by applying scientific knowledge. Contemporary industry, he claimed, pursued the principle of breaking down every production process into its 'constituent movements', without regard and respect for possible ways of doing things by hand, and this was the foundation on which 'the new engineering sciences' had grown. 'The manifold, apparently petrified forms of the industrial process were now dissolved into so and so many conscious and systematic applications of natural sciences in order to achieve given useful ends' (Marx 1877/1959: 381).

The mechanism of the machine tool substituted for and expanded bodily intelligence and its unreliable discipline. For Marx, this historical transition was the crucial factor unclenching a build-up of ever more comprehensive technical developments and integrations in other technical domains, such as power and transmission machinery, transport and communication systems, and the mechanization of machine-tool production itself.

For a long time, machine tools remained the only type of machine accorded something like conceptual status in organization studies, only recently rivalled by the computer, which, in fact, can be viewed as the ultimate machine tool, in as much as it is intended to simulate many other, simpler, information processing machines (Zuboff 1984; Joerges 1989). Indeed, the root metaphor for the fundamental Marxian antagonism, Head versus Hand, could have led to an elaboration of the evolution of communication (rather than production) technology had Marx sided with the Head. Meanwhile, sociologists studying 'the Computer' prefer to take their metaphors from linguistics (Woolgar 1985) or, more frequently, from the evolutionism of so-called computer science, and not from Marxian analysis (Joerges 1989). Nevertheless, it is easy to extend Marx' thinking: the machine-tool took over the hammer from the fist, just as the computer took over the pen from the hand. Marx' concept of machine work has mostly survived in its ideological version as *dead work*, although he also held in esteem highly enthusiastic versions of the liberating potential of machinery. For him, machines wrote history; they represented a central generative mechanism of societal evolution.

Another crucial influence was that of Max Weber, who has often been reproached not only for ignoring technology, but for declaring technology (in the form of tools or machines and their use) as a non-object for sociology. This is plausible if one stays with his theory of social action, as enunciated in *Economy and Society*. Elsewhere, Weber had accorded what he called the *technical order* — the systems of technical norms and rules — the same categorical status as other legitimate orders such as law, ethics or mores (not the least the Skat order, *Skat* being the quintessential German card game, like bridge in England). Machine action and human action (at least workers' actions) were put on the same plane. In his essay on *Stammler*, for instance, Weber argued that technology is 'first of all a procedure following rules that have been set for specific ends' (Weber 1907/1973: 324ff.). He then elaborated that the cooperation of machine components followed 'rules set by humans' in exactly the same logical

meaning as the cooperation of 'workhorses, slaves or — ultimately — "free" human workers' in an industrial plant. It is completely irrelevant, he said, in view of the meaning of the terms 'social order' or 'regulation', whether workers were tied to the 'overall production mechanism' by 'correctly calculated "psychical" force' (caused by the *work order*, ethical notions, and so on) or whether, as in the case of 'thinglike machine parts', it was a question of their physical and chemical qualities. For Weber, it was thus the technical order which causally contributed to the cooperation of machine parts, just as the legal order contributed causally to the human action, and thus shaped the regularities of social life 'most fundamentally'. Thus, even if one wishes to hold on to Weber's concept of social action, one may still allow 'nonhuman events' to figure as links in action chains, capable of 'causal explanation and meaningful interpretation' because they follow legitimate order. The technical order, insofar as it regulates nonhuman events, must be put on the same categorical plane as the work order.
While, in principle, Marx welcomed the transition from tool-like implements to machines, Weber seems to have held a deeply skeptical view. A precursor of latter-day technological pessimism, he maintained that, in principle, action mediated through modern machines loses its capacity to reflect autonomous values. At the very least, he remained ambivalent, becoming increasingly dysphoric. Marx, in contrast, was optimistic, envisioning a historical movement that would, one fine day, shed the chains of the capitalist order.
It would be a matter for historical and sociological studies of science to clarify whether it was because of, or in spite of, the Great Masters that the social scientists of the post-war period have, until quite recently, treated technology as an exogenous factor. Lutz (1983), on behalf of German industrial sociology, and Coleman (1986), speaking for Anglo-American mainstream sociology at large, offered explanations based on a loss of institutional autonomy and an increasing dependence of research on powerful external agencies. The implication was that this made for the uncritical adoption of images of society (here: of technology) entertained by those who underwrote research. Propositions to search out the genuinely social meanings of engineers' constructions, whether they came from the Left (unions) or from elsewhere, were fended off, more or less ritually. This stance not only accorded with what everybody took for granted, it also helped to shield the technological core of the industrial system from criticism, and, in this sense, to keep it sacrosanct.

## A Turn to 'Technology-as-Text'

Nothing seems further apart than Marxian and Weberian terminologies and the vocabulary of technology as literary inscription, or more generally the turn to 'technology-as-text' that has characterized more recent technology studies. There are indeed those who see a secular break between 19th century technology and social science (both 'mechanistic') and 20th century technology and social science, tuned to information/communication or immaterial culture (see Rammert 1992). True enough, sociologists currently interested in technology privilege information machines and indulge in a rhetoric of immaterialism and dematerialization.

It is not difficult, however, to translate computer studies back into Marxian or Weberian conceptual language, or to apply the rhetoric of information/communication to older technologies such as clocks or sailing ships, and while most attempts to bring back machines to the field take a different course than the one we propose, we are certainly not the only ones to try to keep together the symbolic, the political and the practical.

One apparent place to look for antecedents are anthropological approaches, which tend to take for granted that cultures include practically operating machinery and its ecological base. Departments of anthropology with Marxist orientations, for instance, in erstwhile Eastern Europe, cherished the notion of 'material culture', but succumbed to the strict rule that anthropology must not study its own culture, and therefore arrested their interest in pottery-making machines. In contrast, a lively Foucauldian school, which came to appreciate all kinds of technical metaphors for organizational discipline, power and control, largely assimilated the two sides of the equation. Thus, over-writing the social with the technical has been achieved only too well — technology proper has again been lost from sight. As Anne Loft, discussing time technologies, observed with respect to the great model: ' ... Foucault's use of machine metaphors to describe techniques of discipline led him to conflate techniques and technologies and to ignore the role of machinery in discipline' (1991: 8).

In neo-contingency organization studies, there is one way of understanding 'workflow' which promises to focus on exactly the matters that we consider to be central. According to Sorge:

> 'Workflow is the process whereby inputs, including raw materials, manufactured components and parts, machine capacity and human effort are organized in order to transform them into output. It presupposes differentiated arrays of machines, jobs, organizational sub-units, people with specific skills and knowledge, and it consists of the technical and social arrangements that allow human effort, machine capacity and material inputs to be brought together to achieve output goals (...) "Work" may be done by machines or by humans or by a combination of the two. In the course of technical change, boundaries between human and machine work are changed, and combinations of the two also change. Variables should therefore be able to reflect such shifts rather than be biased by them.' (Sorge 1989: 27).

With the exception of the traditional contrast between 'technical' and 'social', we could not agree more with this message. The problem is, that the variables favoured by the neo-contingency theorists are so abstract ('workflow continuity', 'product variability'), that although they do not counteract the point of blending human and non-human work, they do little with it. Useful as evaluation variables, they do not do their work as explanatory variables. This is perhaps unavoidable, in that they rely upon ostensive rather than performative definitions (variables are treated like physical attributes), and aim at structural correlations, even when focusing

processes. As a result, the affinities between technologies and institutional orders have been observed but, as Sorge admits himself, the nature of these affinities 'is not precise enough' (1991: 168).
Within a symbolist perspective in organization studies, researchers began to demonstrate that artifacts tell us something, that they are more than 'mere physical matter'. They are symbols that can be read, above and beyond their practical use (see e.g. Hörning 1988; Gagliardi 1990). While these authors would undoubtedly agree that tools and machines not only symbolize, but also do work, they still seem to assume that it is necessary to separate, or even contrast the two uses. Even Karl Weick, so keenly tuned to the role of technology in organizing says, for instance: 'The odd twist in traditions is that concrete human action, know-how embodied in practice, persists and is transmitted only if it becomes symbolic' (p.115). If symbolization was all there is, we would have no tradition to speak of. It is not only that memory needs to be material: the very action is preserved and perpetuated in machines which carry out the actions previously, or alternatively, performed by humans.
In this paper, we wish to show that symbolization requires materialization, and how work to be repeatedly done requires abstractification into norms and rules: the two faces of inscription. At first glance, this position seems close to those constructionist approaches in science and technology research where non-human components are unquestioningly embraced and allowed to speak and act (for introductory texts, see Woolgar 1988; McKenzie 1992; Bijker and Law 1992). Authors such as Steve Woolgar (1985), Michel Callon (1988), Karin Knorr Cetina 1988), Bruno Latour (1993), and many others, conceptualize technical artifacts explicitly and more or less literally as actors, and as social subjects of action. Machines not only partake in actions here, but become autonomous political actors.
We consider such claims too strong and overshooting the aim of coming closer to genuinely technical practices and their material components. With respect to the autonomous actor issue, it is important to see that the operations of heterogeneous complexes of technical artifacts always figure in a great many human action and ecological patterns. This is suddenly revealed in cases of failure. Technologies are better conceived of as institutionalized organizing patterns than as organizational members. Charles Perrow has applied the terms 'systems accidents' to misadventures which cannot be accounted for by recourse to decisions and actions of persons or to 'individual' components of machinery (Perrow 1986). Perrow thus properly recognizes the socialized character of practically every technology, but again fails to differentiate the ways in which machine operations and other social actions can be coupled or decoupled to each other and to human operations. In turn, trust in machinery is 'system trust' (Kaufmann 1973; Giddens 1990) as distinct from personal trust.
It is a task for organizational research to spell out why the delegation of personal autonomy or of trusteeship to materialized technical systems is, in many situations, preferred to handing them over to other humans. Notwithstanding a rhetoric of 'Let us look for social, not technical solu-

tions for our problems!', a closer look almost always reveals that new forms of problem solution imply more, not less technology (if of a different kind). The label *social* usually means more accepted (or morally more acceptable) technical, not less technical in the sense of materially inscribed. Transferring autonomy and discretion to impersonal, extrasomatic systems seems to incite and require massive resymbolizations of the organizational space, both for those who pursue an advantage and those who are threatened with loss.

All this only means that technically normated things are instances of phenomena which have always engaged sociology: realities and relationships that resist explanation by accounting for actions attributed to individual persons or even groups. Instead, in the following, we will present technical artifacts as exteriorized institutions, engraved in the material ('natural') bases of societal processes, rather than as *homunculi* in their own right.

How, then, can one account for what machines do? How far does the technology-as-text(s) concept carry us? What kinds of inscriptions do technical norms represent? What distinguishes them from other social inscriptions and prescriptions? The most persuasive meaning of the metaphor has to do with the notion that machinery does some kind of writing. This notion of 'inscription devices' is already central in Latour and Woolgar (1979), who showed how impossible it was to separate the knowledge produced by scientists from that produced by practical technology, i.e. experimental apparatus.

'... there might be an essential similarity between the inscription capabilities of apparatus, the manic passion for marking, coding and filing, and the literary skills of writing, persuasion, and discussion. Thus the observer could even make sense of such obscure activities as a technician's grinding the brains of rats, by realising that the eventual end product of such activity might be a highly valued diagram.' (1979: 51-52)

Latour and Woolgar spoke of the inscribing which the laboratory apparatus — the grinder, in the example quoted — performed. They were not particularly interested in how the inscription potential, as represented by laboratory technology, has been generated, how technologies are inscribed into nature, and how they acquire inscription capabilities and begin themselves to inscribe. They watched organizing in progress, and noticed that it included machines which make inscriptions. They aptly concluded that this is how science is being done. We wish to go further and claim that this is how organizing is being done. What they showed for one modern institution — science, we want to do for another — modern organization. All organizing, in its symbolical, political and practical aspects, needs to be inscribed into the matter in order to make organizations durable (indeed, possible).

Here we re-make the argument formulated by Latour (1992) who said that technology is society made durable. We agree, in general terms, although organizing comes in between. Technology makes organizing durable, thus contributing to the institutional stability of one of its products — modern organization — and through it perhaps many others. We would like to push the argument even further by saying that modern organizations, as users of machines for producing machines and other artifacts, are given the task of inscribing the institutional order into the matter.

Perrow (1991) claims that we live in societies of organizations. We would like to attempt to gain an understanding, on a modest scale, of how it has come to be so. Organizations have been given the task, to resort to functionalist parlance, of inscribing institutions into the matter. If organizations are envisioned as action nets transcending face-to-face interactions (rather than some precarious entities in the realm of social meanings, located somewhere between a world of Platonic concepts and human brains and bodies), it is easy to see that the existence of any such action net requires a more or less permanent lock into large technical systems. Through the telephone into satellite-based, global telecommunication systems; through the toaster into integrated electricity grids fed with nuclear energy; through wrist watches into a technical system called World Time, anchored even deeper in the universe.

These extended and expansive technical systems and their countless terminals represent overlarge and hyperfast amounts of elementary part-actions, easily overlooked by the sociologist and organization theorist. One can gain access to them via an inspection of technical norms.

## Technical and Other Social Norms

Max Weber once said that capitalist organization could do without the 'ethical props' of inner-worldly asceticism once it was put on 'mechanical foundations' (Weber 1904/1972: 203). We will now consider how organizing processes are partly exteriorized and develop extrasomatic form: how the ethical props of rigid work orders which Weber described have been replaced by 'mechanical' and, lately, by information technologies. While Weber, and most sociologists since, have looked at the organizational preconditions and consequences of technicization, they have not examined its mechanism as such. We view it as a particular mode of institutionalization: the exteriorization of organizing norms onto tangible technical installations and apparatus.

Our argument runs as follows: over time, societies have transferred various institutional responsibilities to machine technologies and so removed these responsibilities from everyday awareness and made them unreadable. As organized actions are externalized in machines, and as these machineries grow more complicated on ever larger scales, norms and practices of organizing progressively devolve into society's material base: inscribed in machines, institutions are literally 'black-boxed' (Whitley 1972). Two effects merit attention.

First, obviously, the risky penetration — deep inscription — of ecological systems. In interpreting the risks of overloading and destroying material life bases in the course of enlarging technical systems, we customarily employ the metaphor of nature as a limited good, devoured by technology.

However, the risk lies just as much in the enlargement and delimitation of practically accessible nature via the implantation of technical systems. Each technical leap expands practically known and accessible (thus socially relevant) matter, or 'nature', removing the limits of the once unknown and uncontrollable. Space flight creates new operational spaces which require social regulation, genetic engineering creates new domains of bodily processes which need social control, information technologies expand organizational environments and markets well beyond anybody's good. Informatics, however, is only the most recent example in this context. What multinationals do with the help of the computers, the Dutch merchants accomplished centuries ago with the help of their boats. Technological stretching of the world is a process as old as civilization itself, and stretching is only the other side of shrinking.

The second effect lies in a hitherto unique historical increase in the variety and spread of organizational forms, meanings, and ways of life. The more organizations inscribe society into machines, the more non-technical inscriptions multiply and their circulation accelerates. Weber illustrated it well by using the example of the well-tempered piano and the grand orchestra. The technical normalization of all musical instruments and their tonal product, inscribed materially into the modern piano through the introduction of quasi-metric ('tempered') scales, occasioned the enormous growth of musical forms and presumably experiences that came with large symphonic orchestras (what Weber called 'rational music', see Joerges and Wagner 1997). Similarly, the increasing standardization of internets entails a bewildering growth of multi-medial content.

Although they are all about norm-oriented action and thus about problems of regulating and ordering social life, 'technical norms' or 'rules of technology' remain conspicuously absent from the indexes of social science textbooks, be it sociology or organization theory. Social scientists are declared competent in social norms; technical norms are placed in charge of engineers. A clean division of labour is securely in place.

By such machinations, one is tempted to say, the inscribed world of material artifacts, tools, machines, instruments and implements, apparata and automata, ever ready to continue inscribing, is made into an illegitimate subject for social science. We do research on organizations which develop and operate highly complicated and risky machinery, on people who have opinions and knowledge about them, on societies in which technology figures as powerful ideology or as a central cultural symbol. However, since materialized technology remains shielded from analysis, the ubiquitous phenomenon of technical norms escapes our notice — things like DIN A4, 220 Volt, 600 becquerel per kg, or ISDN.

In sociology, the term 'social norms' usually refers to legitimate collective expectations and prescriptions for action. One may ask then, to what kind of expectations, prescriptions and legitimations the term 'technical norms' refers. Of course, there are numerous studies concerned with the politico-economic functions of bodies and authorities responsible for technical normalization and standardization. In this literature, the notion of technical norms is explicated, if at all, by recourse to official definitions. The German Institute for Normalization, for instance, defines a technical norm as 'the exemplary result of the work of normalization' and as 'planned uniformity of material and immaterial objects (formulas, definitions, procedures) carried out jointly by interested circles on national, regional and international levels in the interest of the common wealth'.

Abstract explications by engineers specializing in technical normalization provide little help (Bauer 1982). Otto Kienzle, nestor of German normalization engineering, put it flatly, yet more instructively: 'A norm is the singular solution of a repetitive task'. Occasional attempts by engineering scientists to reap more fundamental insights from the dry subject are instructive, too: Charpentier, a high-ranking French normalization official, noted, for example, that:

> 'Simplification according to the spirit of normalization namely means searching for the essential; recording the fundamental rhythms of nature to which man is attuned. Likewise, simplification includes the search for the guiding threads that make it possible to clarify the inextricable and contribute to a state where everyone can be afforded common knowledge.' (1977: 652, translation BJ)

Such formulations stress that technical norms apparently have much to do with cognitive economy and with making technical knowledge available in the form of a public good. They also connote romantic conceptions of nature and society, although neither aspect is related to societal analysis in this literature. Nor is it very helpful, at least initially, to turn to the highly systematized lists of technical norms from which DIN A1, 2, 3, 4 or 110 V, 220 V, 300 000 V, 500 000 V and things like that are taken.

In order to get closer, one must turn to technical things actually functioning in their 'natural', that is social, contexts. In and out of organizations, computers offer (too) easy examples. When we start the new Powerbook we just bought, a smiling face will welcome us and softly lets us know that we are about to learn and be instructed in, the norms (mostly technical-procedural) of the Mac community, to be imbibed into us via a step-by-step action programme. It does not take a social scientist to observe that the instructor in the programme is a man and the learner is a woman, or to predict that this order of things may soon be reversed on a wave of political correctness. Most users know by now that gender is not written into the computer via technical norms. True, much in the constructivist sociology of technology is devoted to the argument that gender order, or capitalist order, or democratic order for that matter, can be and is written into specific types of machinery. This kind of 'unmasking' analysis has been systematically performed in other contexts, for instance showing the use of technology in managerial control (Noble 1984; or Burawoy 1979, who shows how it is sometimes reversed).

Those are cases of intentional managerial control. Shifting the focus to *institutional control*, we point to instances where the controlling power stems from the fact that a given practice has been institutionalized and therefore is taken for granted. No doubt, individual and group actors often seek to exploit institutions for their political purposes (see e.g. Jansson

1992, on how the institution of investment calculus is used in public-sector power games). In contrast, we wish to draw attention to one of the ways in which society controls itself, so to speak; socializes its members by unobtrusive measures, and thereby constantly re-constructs itself.

Recognizing technical norms as social norms of a particular kind also means recognizing that there is no reason to assume a determinist connection between the content of the technical and non-technical norms they may or may not promote. A computer in a matriarchal society would speak a female voice, but it would still be recruited into supporting as well as subverting the dominant institutional order. Rather than unmasking particular power games or positing deterministic structural relationships, the inscription perspective entails something like an 'ethnomethodology of machines'. An ethnomethodology, though, unlike its classics, is vividly interested in the translocal and transtemporal connections that machine actions help to achieve (Czarniawska 1996; Czarniawska and Joerges 1996).

## A Mineral Water Bottle, For Example...

It is often implicitly assumed that organizational control is exerted 'within' organizations. This is perhaps an unavoidable price for reifying the notion of organization, but it produces a peculiar blindness, as control exerted by organizational products used daily, unreflectively, escapes the researcher's attention. Take a bottle of mineral water, brand-named *Christinenbrunnen*, representing a tiny splinter of the technical consumption apparatus. If, on a walk in the mountains, we take a sip of water from a source, we quench our thirst, compliment the taste, and go on walking, possibly nurturing a romantic dream of life close to nature. Each contact with an industrially produced bottle of a mineral water, this simple machine, however, is an opportunity to imbibe a portion of an institutional order. Consumer goods have become highly semioticized objects and the example is rich in inscriptions, prescriptions, proscriptions and engravings. Needless to say, inscriptions are not only made in numerical or lexical codes. Shapes, sizes, colours, textures are also inscriptions. There is much that can be read from those, with regard to relevant technical and other social norms.

Let us begin at the top of the cap, where the royal symbol appears, the crown — a metaphor far removed from technology. On the label in the middle of the bottle the crown is repeated in gold, linked with the attribute 'premium quality' — a rather high-flying value signifier for water, and, in addition, a commercial standard for top-class consumables. On the cap, the message continues with the instruction that one has to turn it anti-clockwise in order to open it — a fully internalized quasi-technical norm inscribed in our fingers, tied up with deeply engraved behavioural routines. (Note that there is an extensive body of literature devoted to the international war on screw pitches.) Just below the cap, an additional line says 'safety lid', signalling compliance with a series of technical cap standards, presumably formulated in a regulation imposed by the VDI(*Verein Deutscher Ingenieure*),

Figure 1
What is Written on and What is Written in a Mineral Water Bottle

Perforated Twist-off Cap

Print on top:
blue crown (emblem)
R
Christinen
Source
Premium Quality

Print on side:

OPEN (3 arrows)
Safety cap

Label:

do not litter ... (Pictogram)

Quick drink

0.33 l e
no deposit

With valuable minerals
and nutrients –
for people with high-level expectations
for whom quality of life means
everything.

Golden crown (emblem)
(R)
Christinen
Source

PREMIUM QUALITY
(on golden banner)

NATURAL
MINERAL WATER
CARBONATED, FLUORIDATED,
FROM THE CHRISTINEN SOURCE,
BIELEFELD
THE CROWN OF REFRESHMENTS

Excerpts from the Analysis by Chemical Institute Fresenius, Aug. 19,

| Cations: | mg/l. | Anions: | mg/l. |
|---|---|---|---|
| Sodium Ions (Na+) | 472,0 | Hydrocarbons Ions ($HCO_3$–) | 537,0 |
| Calcium Ions (Ca++) | 4,8 | Chloride Ions (Cl–) | 372,0 |
| Magnesium Ions (Mg++) | 1,6 | Sulfate Ions ($S0_4$) | 73,7 |

(blue jet of water)

TEUTOBURGER MINERALBRUNNEN GMBH & CO, D-4800

Bottom of bottle
34.5
49 0.33 l
(glass works' stamp)

and therefore quite mandatory. Cross-references to safety and liability legal norms would have to be researched. Note here, especially, the perforated twist-off cap. This norm for breaking at a pre-inscribed place and pressure is embedded in the material of the cap. It cannot be seen, but our fingers know it. Then it continues by saying 'Natural Mineral Water', and read in context with the association-rich name Christinenbrunnen, another superordinate value is evoked here — naturalness — immediately exacted, however, by the 'R' in the circle — the water from the well has a registered trademark, implying another series of legal–commercial norms. The pale-blue script underneath says 'carbon acid added', the natural water, in fact, being an artificial product, regulated through specific technical and legal standards laid down in food acts. An 'excerpt from the analysis of the Chemical Institute Fresenius' follows, still in a prominent place (dated 17.02.1986, a high-ranking technical time standard is brought to bear — the calendar norm). At this point, things become very technical indeed: the content of six cations and anions is given in appropriate measuring units — it is left to readers to imagine the measurement technology and requisite apparatus of the chemical lab.

On the left side, an internationally standardized bar code is presented, in which all information relevant for producers, distributors and buyers are encrypted, so that the registration machine at the point of sale can read, store and print it. At present, another standardization war is going on about unifying such product labels; the bar code is to be made relevant for banks, too, in order to link up with non-cash, electronic payment and account systems. Opposite the bar code, some enigmatic letters and signs are inscribed, presumably referring to inner-organizational technical and accounting norms of the water producer.

The upper margin of the label displays the message 'Quickdrink' — one more reference to non-technical time standards and an allusion to the cultural standardization of refreshing liquids and also, perhaps, to the advice to drink faster while at work. On the other side, we find the volume measure of the bottle content, further illuminated by an engraving on the base of the bottle. This can be taken as another hint that there is no standard commercial way of trading back the bottle — information about a normative vacuum, as it were. Instead, right next to this, there is a signal that it can be recycled — environmental quality norms are brought into focus — together with an imperative for everyone to 'join in!', a non-technical norm of solidarity with little mandatory power. Finally, above the bar code, there is another inscription: 'With valuable minerals and trace elements for the ambitious, for whom quality of life means everything' — an ultimate value résumé, to agree with the philosopher Nicholas Rescher's (1969) term, for a multitude of cultural, health-related and moral standards — including a somewhat vague link between mg/kg trace elements and the Good Life.

## Three Sub-Genres of Technical Inscription

We can now say: Technical norms are the institutional structure of machinery. Let us take a more systematic look, then, at the manifold flora and fauna of technical norms that make up the technical order. The example points to a variety of normative terms inscribed by organizations onto their object matter, with the help of machines. In naming some of them technical, others non-technical, we have applied two criteria: in the first place, technical norms are inscribed by organizations — inscriptions made by non-organized agents (initials on a tree bark, a handwritten label on a homemade medicine) are not legitimate technical norms. Second, technical norms contain an explicit or implicit reference to a quantitative measure. We call social norms technical, then, to the extent that they represent organizationally imposed action prescriptions that have recourse to measures and/or formal procedures (algorithms) justified, in turn, in natural or engineering science discourses. In a technical norm for lying, reference is made to galvanic skin resistance, for instance; a non-technical norm may refer to the appropriate legal definitions of trustworthiness. A technical norm for housing need is linked to measures such as square meters per person, a non-technical one to judgements of social prestige.

Within this category of technical norms, different kinds may be usefully distinguished, depending on the processes on which they operate: cultural, natural, or material–artifactual.

A caveat is in order: availing ourselves of such distinctions does not mean that ontological differences between Society, Technology and Nature are relevant to our theme. Technical norms are no less social than non-technical ones, and they can be imprinted on 'machinery' and 'nature' as well as on 'humans', to put it in terms of commonsense ontological notions. This trichotomy and the de-socialization of two of its elements are not the basis for the distinction, but the product of its application: organizations contribute to the generation and stabilization of the three realms of reality by imposing this world-view. (The human body is one category that does not easily fit into any of the classes, or rather it fits in all three at once; thus the interest of constructivist social studies in that subject/object.) In other words, the view is part of the inscribing, and we must account for its obvious efficiency in terms of the ways the three sub-genres of technical norms that we distinguish are interrelated and related to yet other, non-technical genres of inscription.

The first sub-genre covers norms for human action, defining human rights and duties. The technical action norms of this genre are, for instance, prescriptions such as 'turn the bottle cap clockwise' or 'so many units per hour' in piece work. '14 $m^2$-per-scientist office space' would be another example. These norms indicate how one has to behave *vis-à-vis* a machine or some other material artifact. The scientist is allowed 14 $m^2$! Such norms will have to be inscribed into human actors, so that they know better than to demand 15 $m^2$ for their desks.

The second sub-genre contains norms for machine behaviour, for example

20 miles per gallon, or the familiar DIN A4, a standard page in Europe; 220 V, the regulation voltage in Europe, future supernorms such as ISDN, and so forth. Such norms prescribe not only how specific technical artifacts are to be constructed, but also how they are to function. There is a great variety of modes for inscribing technical norms into tangible artifacts: durable or transient, strict or with ample tolerance, superficial or deep, self-controlled or in need of external control, self-adjusting or requiring outside repair, and so on.

These may be denoted as technical norms in the narrow sense of the term: norms and orders imposed on material technical systems. To talk about technical norms as action prescriptions (or proscriptions) of a particular kind would be trivial, however, if this meant only prescriptions for designing, constructing, producing, eventually operating and using material technical artifacts. Less trivial and rich in conceptual consequences would be to interpret this class of technical norms as action prescriptions for what technical artifacts do themselves: how they have to behave, quite independent of continuous human intervention. A clock in the Central Station obeys in its normal operation neither the expectations and interventions of passers-by nor those of its producer or serviceman. It may be justified to say: the clock works by itself, and those who want to use it, or must use it, inescapably have their time prestructured by it.

Accordingly, Norbert Elias can say, at the beginning of his essay *On Time*, that clocks are 'socially normated natural events with recurring patterns' (Elias 1984: vii) It is easy to generalize this notion to all machines. The 'natural' chains of events within machinery itself are to be regarded as socially normated. The normation is implemented through technical norms. Such technical norms are temporally stabilized action prescriptions for artifacts based on a legitimate order. Artifacts normated in this fashion preform the action patterns of those who consent to have them. One aspect of this process, however, uninteresting to Elias but central to us, is the authorizing role of organizations in the process of social normation. However, in deciding what is the proper timing for a given process, organizations are themselves dependent on machines produced by other organizations to measure this, and so on in this never-ending chain.

The third sub-genre consists of norms for the natural environment, for example '600 becquerel per kg reindeer!'. Other environmental technical standards are, for instance, emission and immission limits for $SO_2$ air pollution, or the nitrate content of ground water, or the exposure of the human body to radiation, measured in REM. These norms prescribe the extent to which incursions of ecological or bodily environments by machinery and other technical undertakings are to be tolerated. Such norms, and their value references, cannot be inscribed into actors and/or technical artifacts — unless one wishes to acknowledge and is able to read Nature's Own Rights.

All these examples show that technical norms are strongly intertextual. First of all, all three kinds of technical norms are specified by recourse to a variety of prescriptions for measuring and testing (for humans, for non-human artifacts, and for nature, in turn), in the last analysis to the globally obligatory meter/second/gram/bit notation, on whose prescriptions and standard events all other conventional measures are based. This is, so to say, the foundation or DNA of technical norms. Second, they are linked to technical *supertext* consisting of a multitude of interrelated general procedural norms and maxims, including the crucial prescriptions concerning the normating procedures and capabilities themselves, as laid down, for instance, in DIN 820. Third, technical norms are always referring back to non-technical ones.

Two forms of intertextuality may be derived from these observations. One concerns intra-technical references. Technical norms, in the narrow meaning of the term given above, that for the operations of materials or machines, are always being connected to environmental technical norms on the one hand, and technical norms for users' or producers' actions on the other.

Second, organizations establish and maintain manifold intertextualities between all kinds of technical norms on the one hand, and extra technical-action orientations, institutionalized rules and cultural symbols on the other. Remember the naturalness of the mineral water, the Good Life, the invitation to 'participate'!, the royal symbol. One can show that there is a peculiar reciprocity between the normative structures embedded in technical artifacts and the (technical and non-technical) norms governing their production and use. The same holds for both these structures and environmental quality standards. Parts of each of these normative programmes are mutually reflected, and, in a way, copied on to each other. It can be shown, in other words, that every machine norm implies a producer and/or user norm and every producer/user norm contains a machine norm. Similarly, each of these kinds of norms reflect certain normative images of natural contexts, and vice versa.

The examples we have used for three kinds of technical norms are in no way unambiguous, and their attribution to one class or the other is usually controversial. Action standards such as '3.2 m max.' may as well be interpreted as operational prescriptions for artifacts (bridges), and norms for artifacts such as '220 V' as prescriptions for consumers not to employ devices that do not comply with this standard. However, this not only about, but more than, simple (or even not so simple) semantic classifications: it is a matter of ontology. How the norms are classified into three sub-genres has clear consequences, which can be pragmatically evaluated in a given time and space. Bruno Latour demands a parliament of things, but, for the time being, the norms of parliamentary action are not applicable to objects. People are seldom called 'human resources' straight in their faces, and few believe that sun temperature can be controlled by a thermostat.

This is not to say that the three realms of application of technical norms: humans, artifacts and nature, are safely and forever fixed within the three sub-genres. Blurring genres and redefining their boundaries is a matter of politics, jokes ('be nice to your computer!') and experiment. The notion of 'organization' blends, in fact, all three of them (this is why organizations can produce signatures on matter). The effects of blending are pragmatically decided: for some purposes it is important to keep them apart, for others, to blend them. Perrow (1986), for instance, performed a blending which may be considered dangerous by some. He took from organization studies the concepts of loose and tight coupling (Weick 1979) and applied them to an analysis of large-scale technical systems, such as nuclear reactors. In doing so, however, he did not distinguish between the loose and tight coupling of human (i.e., somatically based) action components (in the design and construction) of the operations of machine components, and of the natural systems carrying them.

Consider, now, a nuclear plant: notwithstanding the dense web of cross-references between relevant behavioural norms, technical standards imprinted in machines and limits for tolerable environmental pollution, the inscription, proof, correction and revision of technical norms proceed quite differently in each of these three domains. More importantly, the necessary links between technical norms and non-technical meanings and symbols, and, by the same token, these meanings and symbols themselves, are notoriously difficult to delegate to machine-type operations or to be repaired when there is insufficient delegation. The sense of beauty guiding highly calculated modes of composing or hearing music, the need for power driving the operation of a management information system, the horror induced by perfected war machines cannot reside in machinery itself. It is difficult to inscribe into technical orders governing technical artifacts attributes such as responsible or irresponsible, creative or non-creative, because these attributes cannot be judged against technical norms in the sense given above. The notions producing a sense of responsibility, or creativeness, or horror cannot be transcribed onto natural events outside our bodies.

Let us return then to our initial point about the silence of technical inscription. Technical norms tend to operate out of awareness of their habitual readers. Smoothly and reliably prescribed machine–technical operations and assemblies become more or less sealed-off from ongoing representations of organizational life. Parts of — and, if our argument is plausible, constitutive parts of — the action nets represented by the concept 'organization' remain invisible and are not given a voice in organizational accounts. As with the legal order inscribed in day-to-day urban traffic-action nets: once past the drivers' school, drivers never activate the knowledge of transportation acts, and even deviant behaviour prompts only a partial activation. Nevertheless, drivers, cars, roadside trees, pedestrians, bicycles, red lights, time tables and all the other actants associating in urban transport effortlessly follow this order through the trail of inscriptions it has left. Technical norms are the institutional structure of machinery.

## Technology as Palimpsest

We are written as we write, and in order to determine the place of things in a world of signs we must, in the first place, ask how it is written. The specificity of our project is that we wish to focus on a collective writer, organizations, whose text is institutionalized social norms, and genre — technical norms. In this, we believe we are following Cooper's (1989) appeal to concentrate on the organization of writing — in this case, the organization of writing done by organizations on and indeed into the medium of practical apparatus. As a textual metaphor for extrasomatic technology one could then suggest that of *technology as palimpsest*: writing material used many times after earlier writing has been erased. Large-scale machinery would then be something like Super-Magic Memo Pads, as it were, technologically superior to earlier versions of palimpsests in that they allow for many more layers and interpretations, for a deeper engraving as much as impenetrability of original text and meaning. Alternatively, one can think of corporate electronic information processing machinery as a gigantic mechanic pen which (not who) always writes anew on the ever patient screen.

The presumed supernaturality (super-personality?) of the Author supports the powerful illusion that only one correct inscription is possible at a given time. Technical inscriptions are taken for granted more easily than other organizational texts. A future task would be to examine more closely the relationships between technical and other organizational texts, and thus bring to bear the hitherto divergent research traditions in organization and technology. In particular, work in organizational accounting and the beginning work on metrological aspects in the generation and control of technology needs to be brought together in a general social metrology. If technologies can be understood as texts, and share certain properties with non-technological texts, the specificity of technological texts must be explored further. Such focus on a particular grammar of technological texts (i.e. general metrological issues) raises again the problems that authors such as Marcuse or Ellul have expounded, but not rendered researchable: the cultural significance of ongoing and seemingly progressive metrification.

One of the ideological master narratives of late modernity is that norms of a technical nature have grown into the silent majority, and thereby the moral majority, of norms. Dead work replaces life work; bureaucracy replaces charisma; metrics replaces ethics. This story subscribes to the old rationalistic paradigm, packed into that peculiar image of the zero-sum-game, according to which ever more technology is bought at the price of ever less meaning, culture, and moral order. The point could be made, in fact, that this is still the predominant interpretative figure in social science technology research, including critical post-structuralist strains.

Instead, we have argued that the organizational studies of technology should retrace the processes by which the continued generation of technical systems and machinery occasions a multiplication of meanings, cultural variants and moral projections. After all, materialized technology represents those deepest levels of organizational inscription which not only allow for, but provoke and necessitate, endless over-writings and hidings of the initial scripts.

## Note

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