

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

The paper 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 analogues, 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 paper's main concern is to bring back technology to the study of organization, a specific approach to the study of technology is also argued for.

Silent Inscription

At least since Latour and Woolgar's *Laboratory Life* (1979/1986), the notion of *inscription* has made a highly satisfactory passage from literary theory to social theory. Anthropologically minded, Latour and Woolgar observed that the exotic tribe who was believed before to busy themselves discovering nature, 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 laboratory life, and scientists turned out to be writers and readers.

While this revelation was met with anger by some, and with amusement and/or enthusiasm by others, two tacit assumptions always accompanied a variety of reactions among natural and social scientists alike. One is, that the activity of inscription, when not produced at its proper (literary) site, is a quaint activity of a quaint tribe, living a well-isolated life in their sealed-off laboratories. Another is, that inscriptions are authorial activities, i.e. they are performed – with help of machines – by humans (groups or individuals) who at least attempt to put a visible signature on them.

We would like to concur with Latour and Woolgar in assuming that literary inscription is of crucial importance, also outside literature, but we would like to question the two tacit corollaries of that assumption. Dear reader, please stop reading and look around yourself! See? You are unable to fulfill our request, wherever you are. Far from being naked and appealing to your senses immediately, your surroundings are completely inscribed. Far from being clear who their authors are, most of such inscriptions, at a closer inspection, might reveal a signature but not a human one. The closest signatures we can read, sitting now at Charles de Gaulle airport, are "Delsey" and "SAS".

In this paper we will therefore suggest that the world around us is carefully and completely inscribed, and that the majority of these inscriptions are author/iz/ed by organizations - that is, systems of action, which include human and non-human actants, and which sometimes affect a human authorship ("Roy Lean, your shift manager"). As readers of many such inscrip-

tions, we know better than to believe in Roy Lean; he is as much an organizational product as the late Alistair MacLean. As social scientists, however, we tend to remain both to the fact of total inscription and of its organizational origins. Let us then take a look, first at possible causes of such a state of affairs, and then at possible consequences of accepting our claim (with an example in between). Among the former, we count the incapacity of social sciences, including organization studies, to conceptualize material technical artefacts. Among the latter, we point out the symbolic and political weight of the "invisible control" of organized inscription, while at the same time showing how the inscription metaphor will help us conceptualize the functions of technology or, to answer the question, what the machines actually do?

Technology and Organization

A social science based on the presuppositions of the Society/Nature dichotomy, as most social science is, runs into problems when confronting technology. Like human bodies, extrasomatic technical artifacts represent an order of reality that cannot be dissolved either into "nature" or into "action". It is for this reason that the natural sciences do not teach us much about technology, either. While technology studies have proliferated, much like the technologies themselves, that what happens inside machinery and other tangible technical artefacts was mostly left to engineers or ideologists.¹

What about organization studies, one may ask, with their roots in both engineering and social science practice? Like other social science disciplines, organization studies have had difficulty confronting technology's inner workings for conceptual reasons. Studies in the Tavistock tradition, where the notion of *socio-technical* systems was first introduced (see e.g. Rice, 1958), began to acknowledge the weight of the "-technical" (Woodward, 1965), but still focused their conceptual energy on the "socio-" and firmly clung to the idea of duality. The concept has been revived in the turn to technology in sociology that came in the 1980s (for instance Mayntz, 1988; Burns T.E. and Dietz, 1991), albeit much in the same dichotomizing

¹ The latter substituting ideology for analysis and interpretation of "things", as Durkheim put it in his *Rules of Sociological Method* (1895/1965, p.11).

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, started from a Tavistock view (Burns and Stalker, 1961), but ended actually excluding tangible technology, rarefying the notion of technology into task structures of various kinds (see for instance, if opening up to social constructivist arguments, still Scott, 1990). One could almost say that it took several serious catastrophes in order for social scientists to take material technology seriously (Rochlin et al., 1987; Weick, 1988; Vaughan, 1990).

But why should what happens inside machinery be of any interest to organizational theory at all? 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, but especially to the first two. The practical dimension, which prominently should represent technology, especially in a close connection with the other two, is missing. In their overview, Sproull and Goodman for instance, conclude:

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, p.260-1)²

This gap between what we prefer to call 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. Most technology researchers today seem diligently to avoid to refer back to what Niklas Luhmann has famously called "Old-European sociology". Let us nevertheless risk a glance.

² Of the contributions in their "Technology and Organizations" Goodman and Sproull count especially Weick (19990), but also Scott (1990) and themselves among the social construction oriented.

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.³ 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.

Secondly, 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 became possible through applications of scientific knowledge only. 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, p. 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, the machine tool has therefore remained the only type of machine accorded something like conceptual status in organization studies, only recently rivalled by the computer (Zuboff, 1984).⁴ Indeed, the root metaphor for the fundamental capitalist antago-

³ Read the 15th chapter of the first volume of *Capital* on "Machinery and Big Industry" – almost exactly in the middle of this text which begins with consumer goods (everyday technical artifacts) and ends with land (the natural base of production).

⁴ Which can in fact be viewed as the ultimate machine tool in as much as it is intended to simulate many other, simpler information processing machines.

nism, 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.⁵ And yet it is easy to extend Marx, thinking: the machine-tool took over the hammer from the fist as the computer took over the pen from the hand.

Marx, concept of machine work has survived only in its ideological version as *dead work* (although he also held highly enthusiastic versions of the social potential of machinery). In any case, unlike for latter-day social theory (see e.g. Göranson and Josephson, 1988), machines for Marx wrote history, they represented a central generative mechanisms 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 non-object for sociology. This is plausible if one sticks 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 like law, ethics or mores (not the least the *Skat*⁶ order). Machine action and human action (at least worker,s action) were put on the same plane. In his *Stammler*-essay, for instance, Weber launched an argument, in a strictly causalist lingo, saying that technology is first of all a "procedure following rules that have been set for specific ends" (Weber, 1907/1973, p. 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 calcu-

⁵ For the influential role of the evolutionary rhetoric in computer engineering and in computer sociology see Joerges (1989, 1990).

⁶ *Skat* is the quintessential German card game, like bridge in England. This is one of those rare occasions where Max Weber, who was a very serious man, permitted himself a joke in writing.

lated ,psychical, force" (caused by the *work order*, ethical notions and so on) or, whether, in the case of "thing-like 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 onto 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 it regulates non-human events, must be put on the same categorical plane as the work order.

While Marx in principle welcomed the transition from tool-like implements to machine, Weber seems to have held a deeply sceptical view. A precursor of latter-day technological pessimism, he held that action mediated through modern machine technology 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 which 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 or in spite of the Great Masters that the social scientists of the post-war period have, until 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.

Introducing Inscriptions: Technology-as-Text⁷

Nothing seems further apart than these classical terminologies of the classical instances above and the vocabulary of "technology-as-text". 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. But it is not difficult to translate computer studies back into Marxian or Weberian conceptual language, or to apply the rhetoric of information/communication to older technologies.

Within the symbolist perspective, some researchers have recently begun 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 Hörning, 1988; Gagliardi, 1990). In this paper, while welcoming a reader-oriented technology-as-text vocabulary, we nevertheless propose to take one or two steps back by looking at how all these meanings were put there in the first place.

One would have thought that symbolist and other cultural or anthropological approaches to organizations had supported the notion that cultures include practically operating machinery and its ecological base. East European departments of anthropology, more faithful to Marx, cherished the notion of "material culture", but succumbing to the strict rule that anthropology must not study its own culture (Czarniawska-Joerges, 1992), arrested their interest on the pottery-making machines. Something else happened: a lively Foucauldian school has come to appreciate all kinds of technical metaphors for organizational discipline, power and control, largely assimilating the two sides of the equation to each other. This over-writing the social with the technical has been achieved only too well – technology proper has again been

⁷ Etymologically technology-as-text is a pleonasm, given that text derives from the Latin *textus* = fabric, structure..., and technical from Latin *textare* = to weave, to build... But then since Latin times common usage has long reserved the word *text* exclusively to words, as distinct from other signs, and quite specifically to the written word. Seen from the common language position the metaphor indeed needs justification, lest it become literally oxymoronic.

lost from sight. As Loft (1991, p. 8) observed with respect to the great model: " ... Foucault,s use of machine metaphors to describe techniques of discipline lead him to conflate techniques and technologies and to ignore the role of machinery in discipline."

How to account for what machines do? How far does the technology-as-text(s) concept carry us: what kinds of inscriptions do technical norms represent and 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 very central in Latour and Woolgar (1979/86), who show how impossible it is to separate the knowledge produced by scientist and 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 realizing that the eventual end product of such activity might be a highly valued diagram. (1986, pp. 51-52)

Latour and Woolgar speak of the inscribing which the laboratory apparatus - the grinder in the example quoted – performs. We are not yet shown how the inscription potential represented by laboratory technology is generated, how technologies are inscribed into nature in such a way that they acquire inscription capabilities and begin themselves to inscribe. In order to better understand this process we will now introduce materialized technical systems as a particular type of *institution*, through which organizing processes are partly exteriorised and thus inscribed onto and into extrasomatic "nature". Later, a series of distinctions concerning technical and other social prescriptions, or norms, and their intertextual relationships will be suggested.

Inscribing Institutions Into Nature

Max Weber once said that capitalist organization could do without the ethical props of inner-worldly asceticism once it was put on "mechanical fundamentals" (and guaranteed by the work order) (Weber, 1904/1972, p. 203). We will now consider how organizing processes are partly

exteriorized and develop extrasomatic form: how the props of rigid work orders which Weber described have been replaced by informational (at one level by no means less mechanical) technologies and how such technical systems become institutionalized. 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 institutionalized inscription: the exteriorization of organizing norms onto tangible technical installations and apparatuses.

Our argument runs as follows: over time, societies have transferred various institutionalized responsibilities to machine technologies and so removed these responsibilities from everyday awareness and made them unreadable. As organized transactions are externalized in machines, and as these machineries grow more complex and on ever larger scales, norms and practices of organizing progressively devolve into society's material base: Latour's "black box" of organizational practices and norms sealed off from inspection (1986). Inscribed in machines, institutions are literally "black-boxed" (Whitley, 1972).

Unlike works of art, contractual forms, and many other kinds of social inscriptions, technical systems can be expanded and re-inscribed forever, more or less desultorily, and more or less without mercy. What began as treating nature as if it were removed from the social realm, continues as the relative decoupling of the orientations, practices and regulative mechanisms dominating engineering and related scientific areas from political, moral, and other institutional realms. First Nature, then Technology were institutionalized as non-social. Two effects merit attention.

First, and very obvious, is the risky penetration – deep inscription – of ecological systems. In interpreting the risks of overloading and destroying natural life bases in the course of enlarging real technical systems, we customarily employ the metaphor of nature as a limited good, devoured by technology. But 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) 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 everybody'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 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 multiplication and spread of organizational forms, meanings, and ways of life (Perrow, 1991). Inscriptions multiply and their circulation accelerates. And although it is difficult to conceive this historical movement without taking into account the support of technical media, the tangible aspect of these media have become "naturalized", too. Although public opinion stands on its guard as to what concerns the message, to the point of understanding and accepting that "media is the message", it still fails to see how literally this dictum must be taken. It is not (only) television (a media institution) which is the message, it is (also) the TV and VCR machines which are messages.

Technical and Other Social Norms

To explain this, we will now draw on the notion of technical norms, familiar in practical engineering and organizational discourse. But, although they are all about norm-oriented action and thus about problems of regulating and ordering social life, , terms like "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 labor 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 are developing and operating 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.⁸ But 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 social science, 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. There are few organization studies concerned with technical norms and those we have come across concentrate on the politico-economic functions of bodies and authorities responsible for normalization and standardization.⁹ In this literature, the notion of technical norms is explicated, if at all, by recourse to official definitions only. 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 (see 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, notes for example:

Simplification according to the spirit of normalization namely means searching for the essential; recording the fundamental rhythms of nature to which man is attuned. Simplification includes likewise the search for the guiding threads making it possible to

⁸ The occasional reader may advance the argument, that influential authors such as Jacques Ellul or Herbert Marcuse have said a long time ago what is to be said about the place of technology in contemporary society. But (apart from the implausibility of their sweeping cultural critiques) neither of them has bothered to inquire into the special nature of technical as opposed to other social norms. Rather, they both have postulated the subsumption of the entirety of social norms under "technological rationality". They did not talk about the social nature of machinery but rather about some inexorable machinization of modern capitalist society.

⁹ Such as, for instance, the *Deutsches Institut für Normung* (DIN) or the *Verein Deutscher Ingenieure* (VDI) and corresponding European and international organizations (see Bolenz, 1987).

clarify the inextricable and the contribution to a state where everyone can afford common knowledge. (1977, p. 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 society. But 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.

To get closer, one must turn to technical things actually functioning in their "natural", that is social, contexts. Technical apparatus at any level of complexity, or rather complicatedness, may serve a sophisticated social control purpose. One can break technical systems down as often as one wishes and yet the normative structure of the overall system reappears.

A Mineral Water Bottle, For Example...

The point can be illustrated by a mundane object: a bottle of mineral water brand-named *Christinenbrunnen*, representing a tiny splinter of the technical consumption apparatus. Consumer goods have become highly semioticized things and the example is rich in inscriptions, prescriptions, proscriptions and engravings. There is much that can be read from it regarding relevant technical and other social norms.

Insert figure about here

Let's begin at the top of the cap, where the royal symbol appears, the crown – a metaphor far removed from technology. In the label on the middle of the bottle the crown is repeated in gold, linked with the attribute "premium quality" – a rather highflying value signifier for water, and, in addition, a commercial standard for top class consumables. On the cap the messages continue with the advice to turn anti-clockwise in order to open – a fully internalized quasi-technical norm inscribed in our fingers, tied up with deeply engraved behavioral rou-

tines. (Note that there is an extensive body of literature devoted to the international war on screw pitches.) Right below the cap is an additional "safety lid" which complies with a series of technical cap standards, presumably formulated in a regulation imposed by the VDI 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 cap's material. It cannot be seen but our fingers know it. Then it continues by saying "Natural Mineral Water": read in context with the association-rich name *Christinenbrunnen*, another super-ordinate 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. And 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 – the calendar norm, a high-ranking technical time standard is brought to bear). Here 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 various 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 some enigmatic letters and signs are inscribed, presumably referring to inner-organizational technical and accounting norms of the water producer.

At the upper margin of the label appears the message "Quickdrink" – one more reference to non-technical time standards and an allusion to the cultural standardization of refreshing liquids. Maybe, too, an 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. Another hint that there is no standard commercial way of trading back the bottle, in-

formation about a normative vacuum, as it were. Instead, right next to this, a signal that it is capable of recycling – environmental quality norms are brought in focus – together with an imperative to all "join in!", a non-technical norm of solidarity with little mandatory power. Finally, above the bar code another inscription: "With valuable minerals and trace elements for the ambitious, for whom quality of life means everything" – an ultimate value resumé, to agree with the philosopher Nicolas Resher (1969), for a multitude of cultural, health-related and moral standards – including the somewhat vague linkage between mg/kg trace elements and the Good Life.

This entire system of technical and extra-technical standards is rather recursive and probably self-referential, and it is therefore only natural that the Teutoburger Mineralbrunnen GmbH is, as notified in the lower margin of the label, located in Bielefeld.

Varieties of Technical Norms or Three Genres of Technical Inscription

The example points to a variety of normative terms. In naming some of them technical, others non-technical, we have applied the explicit or implicit reference to a quantitative measure as a criterion. It seems to us reasonable to posit the following: technical norms are all those action prescriptions with recourse to measures and/or formal procedures (algorithms) justified by natural or engineering science discourse.

In a technical norm for lying, reference is made to galvanic skin resistance, for instance. A non-technical norm may refer to 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 judgments of social prestige. Even at this stage of our argument, it should be emphasized, however, that all technical norms and their standard events or standard operations necessarily rely on non-technical orientations and choices.

We will now argue that within this category of technical norms, different kinds can be usefully distinguished, depending on the processes on which they operate. In introducing these distinctions we may seem to be falling back on the notion that ontological differences between society, technology and nature are relevant to our theme. But it must be repeated: we

consider technical norms no less "social" than non-technical ones; and technical norms can be imprinted on hardware technology and "nature" as well as on "society", to put it in terms of commonsense ontological notions. More importantly, we wish to point out that the trichotomy and the de-socialization of two of its elements are not the basis for our distinction but the product of its application: we generate and stabilize the three realms of reality by imposing this view. 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 genres are interrelated and related to yet other genres of inscription, called non-technical here.

We distinguish then, first, norms for human action, defining human rights and duties. Technical action norms of this genre are, for instance, prescriptions like "turn bottle cap clockwise" or "so many units per hour" in piece work. "14 m² per scientist office space"¹⁰ would be another example. These norms indicate how one has to behave vis-a-vis a machine or some other material artefact. Scientist is to occupy 14 m² of a building! Such norms will have to be inscribed into human actors, so that they know better than to demand 15 m² for their desks.

We distinguish, secondly, norms for machine behavior, for example 20 miles per gallon, or the familiar DIN A4, a standard page in Europe; 220 V, the regulation voltage in Europe, future super-norms such as ISDN, and so forth. Such norms prescribe how specific technical artifacts are to be constructed but also how they are to function. We will call such norms technical norms properly speaking. 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. Consider for instance that about 75% of German drivers are said to deviate from regulation tire pressure and compare a tire with the regulation standard of, say, 1.8 atu pressure, with devices for self-regulation of pressure deviations.

Thirdly, one may speak of norms for the natural environment, for example "600 becquerel per kg reindeer!". Other environmental technical standards are for instance emission

¹⁰ The German office-territorial norm, cemented in by the BAT (public employees' wage scale), under which one of the authors operates.

and immission limits for SO₂ air pollution or nitrate content of ground water or radiation exposure of the human body 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.

In the remainder of the discussion, we will focus on technical norms properly speaking – those norms and orders imposed on real, materialized technical systems. To talk about technical norms as action prescriptions (or proscriptions) of a particular kind would be trivial if this meant only prescriptions for designing, constructing, producing, eventually operating and using technical artifacts. Non-trivial and rich in conceptual consequences beyond definitional exercises, is the proposition to interpret one 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 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 pre-structured 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, p. 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 pre-form the action patterns of those who consent to have them.

These are then the three genres of technical inscription we propose. Evidently, like with all institutionalized genres, their boundaries shift all the time and, seen in processual terms, remain fuzzy most of the time. As always, closure remains a rare achievement.

The Intertextuality of Technical Norms

The examples above indicate 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 (in turn for non-human artifacts, for humans, and for nature), 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 fundament or DNA of technical norms. Secondly, they are linked to technical *super-text* consisting of a multitude of interrelated general procedural norms and maxims, including the crucial prescriptions concerning normalization procedures and capabilities themselves, as laid down, for instance, in DIN 820. Thirdly, technical norms are always referring back to non-technical ones.

It would be interesting to try and decode technical norms, including their extra-technical references, by way of linguistic analysis. Yet such approaches may not be sufficient here for two reasons. On the one hand, there is so much tacit knowledge embodied in technical practice that escapes transcription. On the other hand, technical artifacts may resist reduction to scripts, forever reverting to silence in their more interesting operations.

Two forms of intertextuality may be derived from these observations. One concerns inner technical references. Technical norms, in the proper meaning of the term given above, that is materials- and machine-operating standards, always refer in manifold ways to environmental technical norms on the one hand, and technical norms for users, or producers, actions on the other.

On the other hand, one finds 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 "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 programs are mutually reflected and in a way copied onto 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); norms for artifacts such as "220 V" as prescriptions for consumers not to employ devices that do not comply with this standard.

Presumably, there are good reasons for the fact that in the day-to-day business of normalization, such distinctions are not performed. The reasons for avoiding them in the social study of organization and technology are less plausible, however. Charles Perrow (1986), for instance, takes from organization research the concepts of loose and tight coupling (Weick, 1979) and applies them to an analysis of large-scale technical systems, such as nuclear reactors. He fails, however, to distinguish between loose and tight coupling of human (i.e., somatically based) action components (in design, construction, operation), of the operations of machine components, and of the natural systems carrying them. In doing so, he rather detracts from insights into the conditions for change of risky, over-complex technical systems.

Take an atomic plant: notwithstanding the dense web of cross-references between relevant behavioral 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 in case of 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 ma-

chines cannot reside in machinery itself. Technical artifacts cannot be made responsible or irresponsible, creative or noncreative, because these attributes cannot be judged against technical norms. The notions producing a sense of responsibility, or creativeness, or horror cannot be transcribed onto natural events outside our bodies. The joys of reading Asimov or Eco revolve around the knowledge that practical machines are different from theirs. Should their machines become real one day, they will be different, too (and literally boring), other fictional machinery taking over at the symbolic level. To paraphrase Eco himself, facts, once they are known, are uninteresting; metaphors are interesting (Eco, 1979/1983).

What differentiates technical inscriptions from other texts is that they tend to operate completely out of awareness of their habitual readers. Smoothly and reliably normated machine-technical operations and assemblies are sealed-off from analyzable organizational life, successfully black-boxed. The phenomenon is familiar in the legal order, for example public transportation acts. Once past drivers' school, nobody consciously activates these acts in daily traffic. None has complete knowledge of them. Partial activation in awareness follows deviant behavior.

So with artefactual standards, too, and more so: only if and when technical artifacts stop, or never begin, to act according to their inscriptions and when intertextuality is lost or becomes absurd in salient parts of the overall normative texture are public discourses set off. One of the more obvious cases of intertextuality becoming absurd is the current mythologization of computing machinery: the cultural propaganda that makes advanced computers, and sometimes even our little Macs into humanlike, at times veritably superhuman beings.¹¹

Technical Artifacts: Actors or Inscriptions

It should be emphasized then that there are good arguments for two claims: that the operations performed by tangible technical artifacts can be conceptualized as steps in more inclusive pat-

¹¹ For a critique of this particular version of breaking down the man-machine distinction see Joerges (1989).

terns of social action; and that technical norms can be conceptualized as those social norms that give *machine action* legitimacy - or fail to do so.

It would be presumptuous, of course, to claim that we are alone in our interest in these matters. The engineering disciplines, for a start, ascribe genuine *social-ness* to technical implements, 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 behavior. At the level of engineering science the languages used always combine descriptive and prescriptive elements into what Mario Bunge called, in analogy to nomological, nomopractical discourses (Bunge, 1966; see also Simon, 1982). At the level of a philosophical theory of technical systems, some authors conceive of technical rules and norms as the structural conditions of technical artifacts, i.e., literally built into them (Müller, 1967).

Among sociologists, those coming closest to such practical and theoretical positions belong to a group of social constructionist science and technology researchers (see, e.g., Bijker, Hughes and Pinch, 1988; Woolgar, 1988, Bijker and Law, 1992).

Social constructivist technology research embraces nonhuman components unquestioningly, allows them to speak and act. But some authors go further (see e.g. Woolgar, 1985; Callon, 1988; Knorr-Cetina, 1988; or Latour, 1992). They conceptualize technical artifacts, explicitly or implicitly, more or less literally, as actors, as social subjects of action. Machines do not only partake in actions here, they become autonomous political actors. We consider such claims as too strong and overshooting the aim of coming closer to genuinely technical practices and their material components. Maybe normated technical artifacts should better be envisioned as exteriorized institutions, engraved in the natural fundament of the societal process, rather than as homunculi in their own right.

Envisioned, however, they must be. Much as we accept the fact that we live in societies of organizations (Perrow, 1991), we tend to see these organizations in a realm of social meanings located somewhere between a world of platonic concepts and human brains and bodies. But the locus of any organization transcending face to face requires a more or less permanent lock into large technical systems - making them do work for us as they let us work for

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

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 patterns and ecological patterns. This is suddenly revealed in cases of failure. 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).¹² In turn, trust in machinery is "system trust" (Kaufman, 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 solutions 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* almost always means more accepted (or morally more acceptable) technical, not less technical in the sense of materially inscribed. Organizational symbolism plays a crucial role here. Transferring autonomy and discretion to impersonal, extrasomatic systems seems to incite and require massive re-symbolizations 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. In these situations, recourse is taken

¹² Perrow thus properly recognizes the socialized character of practically every technology but again fails to differentiate the ways machine operations and other social actions can be coupled or decoupled to each other and to human operations.

traditionally to the concept of social institution. *Technical norms are the institutional structure of machinery.*

Technology as Palimpsest

We are written as we write, teaches Derrida. 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 section title acknowledges a debt to Derrida. 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, 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*. Large-scale machinery would then be something like Super-Magic Memo Pads, as it were, technologically superior to earlier versions of literal palimpsests in that they allow for many more layers and interpretations, for a deeper engraving as much as impenetrability of original text and meaning. Or, think of corporate electronic information processing machinery as a gigantic mechanic pen who writes always anew on the ever patient screen.

The presumed super-naturality of the source supports powerful illusions that only one correct inscription is possible at a given time, which results in a taken-for-grantedness much stronger than in the creation of other organizational texts. It is a future task to examine more closely the relationships between technological and in the familiar sense of the word, organizational texts, and thus bring to bear the hitherto divergent research traditions in organization and technology. In particular, work in organizational accounting and beginning work on metrological aspects in the generation and control of technology needs to be brought together in a general social metrology.

In this sense, three somewhat different tasks are posed: First, if reified technologies can be understood as texts, and share certain properties with non-technological texts, the specificity of technological texts must be explored further. Secondly, if extrasomatic techno-

logical texts (the deepest layer of the palimpsest) share with other technological discourse numerological properties, the specifics of the former must be explicated further. Thirdly, the focus on a particular grammar of technological texts (i.e., general metrological issues) raises again the problems 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. Accordingly, mechanics (or post-mechanics) erases ethics. But 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 argue that the social study of technology should retrace the processes by which the continued generation of complex systems and machinery occasions a multiplication of meanings, cultural variants and moral projections. We can now rephrase this notion in accordance with the text/palimpsest metaphor: materialized technology represents those deepest levels of inscription which not only allow for but provoke and necessitate endless over-writings and hidings of the initial scripts.

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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) Quickdrink 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, 1987

Cations:	mg/l	Anions:	
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 (SO ₄)	73,7

(blue jet of water)

TEUTOBURGER MINERALBRUNNEN GMBH & CO, D-4800 BIELEFELD

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

Figure: What is written on and what is written in a mineral water bottle