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REOPENING THE BLACK BOX OF TECHNOLOGY ARTIFACTS AND HUMAN AGENCY

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Abstract

The argument presented in this article is that the premises governing human-technology interaction partly derive from the distinctive ways by which each technology defines a domain of reference, and organizes and codifies knowledge and experience within it. While social in its origins and its implications, technology constitutes a distinct realm of human experience that is not reducible to social or institutional relations. Drawing on Goodman's (1976, 1978) cognitive philosophy the article proposes a scheme for analyzing the very architecture of items and relations underlying the constitution of cognition-based artifacts. Such an analysis is used as a basis for inferring the malleability and negotiability of technologies and the forms by which they admit human involvement and participation.

1 INTRODUCTION

The purpose of this paper is to reconsider the validity of the claims concerning the primacy of contextual factors—especially human agency—in shaping the functionality and use of information technologies (e.g. Clement 1993; Orlikowski 1992, 2000; Suchman 1987, 1996). There is undeniably a considerable variation in these claims. Yet, it would be possible to make a case for the fact that most of these studies embrace the core contention of *social constructivism* (Bijker et al. 1987; Bijker and Law 1992). These studies assume that information technologies are substantially malleable while the forms by which information systems become involved in local affairs are largely shaped by the commitments, capabilities, and preoccupations of situated actors. The functionality of information systems is seen as being negotiated locally under conditions that allow for considerable *interpretive flexibility.*

Social constructivist studies of information technologies have made an important contribution to a field that has been dominated by technologistic simplifications of work and human agency (Kling 1996). However, social constructivism has now achieved a state of dominance that betrays those unmistakable characteristics of paradigm consolidation, i.e., indifference to other ideas, arrogance, and a certain inability to accommodate alternative viewpoints. Efforts to understand technology in terms that question the malleability of technology and the degree to which it is amenable to local reshaping are faced with suspicion and are frequently deemed deterministic in an indiscriminate fashion (Winner 1993).

It is, however, a conspicuous fact that technologies exhibit an amazing diversity in the forms of human involvement they admit. For instance, large-scale information systems such as ERP packages differ substantially from cellular telephones in terms of the degrees of freedom their use admits, the organizational restructuring they may demand, etc. (Ciborra 2000). Similarly, single tools and implements differ substantially from large-scale technological processes or systems regarding the forms of human participation they admit. The former append human sensory and manipulative capacities while the latter stand opposite and apart from humans, embodying prearranged sequences of functions or tasks (Mumford 1934; Noble 1984; Zuboff 1988). Other technologies are embedded in complex technological and institutional dependencies that limit their contextual adaptability and still others operate in relatively isolated settings, under conditions of considerable manipulability (Kling 1996). The fact that the human-technology encounter exhibits a great diversity across technologies and contexts suggests that the impact of technological artifacts on human affairs and organizations must be gauged in terms that accommodate both the distinctive status of particular technologies and the unique character of situated factors.

In section 2, this paper provides a short advocacy of the distinctive character of technology and the need to frame and understand it in terms that do justice to such distinctiveness. Next, the claims concerning the malleability of technology are reconsidered. The last section of the paper draws heavily on the cognitive philosophy of Nelson Goodman (1976, 1978) to propose a scheme for analyzing the distinctive constitution of cognition-based technological artefacts. The analysis of the cognitive architecture of such artifacts is then used to infer the particular forms by which they admit human participation.

2 THE DISTINCTIVE CONSTITUTION OF TECHNOLOGY

The introductory remarks suggest the need for charting the distinctive contribution various technologies make in shaping the terms of the human-technology interaction. We need theories that describe technology as a distinct realm of social life and theorize in non-contextual terms the specific instrumental identity of what Orlikowski and Iacono (2001) call the *IT artifact*. Indeed, unless the distinctive constitution of particular technologies is acknowledged, the concept of technology becomes indistinguishable from other aspects of reality (i.e., structure, institutions, and nature). Thus seen, technology offers no more than an occasion of the basic condition of interpretability underlying social life, upon which humans construct the world in which they live. However, the openness of this interpretive game is subject to considerable variation. Commenting on W. I. Thomas' dictum stating "if men define situations as real, they are real in their consequences," Goffman (1974, p. 1) provides the following instructive remark:

> the statement is true as it reads but false as it is taken. Defining situations as real certainly has consequences but these may contribute very marginally to the events in progress; in some cases only a slight embarrassment flits across the scene in mild concern for those who tried to define the situation wrongly. All the world is not a stage—certainly the theater isn't entirely.

Some of the excesses of social constructivist studies of technology (e.g., Grint and Woolgar 1992; Woolgar and Grint 1991) have already been debated in the literature. Both Kling (1992a, 1992b) and Winner (1993) have forcefully contested social constructivism and the reduction of technology to social relations. Winner in particular has made a strong case for the fact that the constructivist black box of technology is nearly hollow and the concept itself almost devoid of meaning. On his account, social constructivism treats technology as an instance or expression of the social and tends to dissolve the distinctiveness of particular technologies into the dynamics of social networks and the institutions supporting them (Orlikowski and Iacono 2001). Technology is surely social in its origins and even more so in its implications. Nevertheless, the social construction and the institutional immersion of technology are far from incompatible with the distinctive character its influence acquires on human affairs.

Technology may have, as Orlikowski (2000) notes, a virtual status, which means that its effects are instantiated through its contact with volitional human agents. However, such a contact is not a presupposition-less encounter. Technological artifacts are *standing possibilities*, to use Searle's (1995) own words, proclivities to act in one way or another. Every technology obtains its distinctive status by the specific forms by which it defines *a particular domain*, organizes *knowledge* and *social experience* within such a domain, and embodies them in various sorts of *processes or artifacts* (DeSanctis and Poole 1994; Kallinikos 1999; Zuboff 1988). For instance, expert systems define nonroutine decisions in particular professional domains as basically an issue of *knowledge representation*, organize such knowledge, provide the standard algorithms for making decisions, and embody them in particular software packages. ERP technology, on the other hand, defines *integration* as the major issue of corporate governance and accordingly organizes knowledge and experience (e.g., best practices) in managerial matters to embody them in off-the-shelf software packages.

Limited as they may be, these examples suggest that technologies differ substantially in terms of how they define their domain of application, and organize and embody knowledge and experience in artifacts (Simon 1969; Zuboff 1988). Some of these differences are expressed in the forms by which items and relations are organized into larger processes or more encompassing artifacts. Others are manifested in the very constituent materiality of technologies, i.e., software packages or hard-wired machines (Orlikowski 2000). The premises through which humans encounter technology derive, at least partly, from such a *reified and embodied organization of knowledge and experience*. Technology is knowledge, insight, and experience objectified in a variety of ways. ERP systems, search engines, expert systems, or mobile telephony all differ, not only in terms of the different domains they apply to but also in terms of how they objectify and organize their major tasks and invite (or exclude) human participation (Introna and Nissenbaum 1999).

The formation of the premises governing the human-technology interaction must, therefore, be analyzed with reference to the *constitutive properties of technology* and the distinctive forms by which various technologies emerge as standing possibilities of one type or another. The crucial issue is not just to juxtapose technology as embodied intentionality with technology in use (Orlikowski 1992, 2000). It is also crucial to frame and understand such juxtaposition with reference to the distinctive premises through which technology and human agency encounter one another.

3 CONTESTING TECHNOLOGICAL MALLEABILITY

Observations of everyday encounters with information systems or technologies suggest that humans frequently use them in ways that have not been envisaged by their designers or developers. Such a state has been interpreted as evidence of the malleable and locally negotiable character of technology (Orlikowski 2000). The claim of the malleability of technology, based on the incongruity of embodied intentionality and actual use, is both reasonable and deceptive at the same time. It is reasonable in a commonsensical fashion and also in the sense of a longstanding criticism of rationalism in the wider social science literature (see, for example, March 1994).

The same claim may be misleading, however. Technology is often the outcome of a complex and diachronic texture of contributions that renders its understanding in terms of a legible set of intentions fruitless. In technologies, especially those with substantial historical involvement in human affairs, the intentions of numerous and successive designers and developers mingle in ways that make the charting of a single group of intentions difficult (Hughes 1987). By reference to whose intentions, then, is the malleability of technology to be assessed? The attribution of a singular intentionality to particular artifacts or technologies considerably simplifies the complex texture of technologically embodied functionalities. It also attributes to designers an omniscient and too-powerful identity. Usually, the designer of a particular artifact or technology operates within the context of a wider system (or discourse) that significantly shapes the designer's contribution. Such a system is not shaped or controlled by any single agent. It grows out of the choices and commitments of many agents employing diverse strategies, materials, and resources that preclude one-to-one correspondence between intention and artifact (Foucault 1980, 1991).

Take, for instance, the widespread technology of computer typing. Word processing now represents the cumulative development of approximately 20 years of smaller or larger innovations that have improved both the functionality of the software and enlarged the scope of that technology. Word processing has, in addition, been influenced by wider developments in hardware and software technology that have impinged considerably on its functionality and leverage. Out of this dense texture, it is impossible to isolate a single set of intentions, even though the technology is obviously used for writing verbal texts of many kinds. The attribution of a singular intentionality approaches the limit of absurdity when word processing is placed in the background of the long history of writing (Bolter 1991; McArthur 1986; Ong 1982). Word processing transcribes and embodies some of the practices and techniques of handwriting, mechanical writing, and printing. Out of this complex and historically constituted texture that is computer-based word processing, one can certainly isolate specific intentions (e.g., correcting, deleting) and designs, but the technology as such can never be reduced to a single group of intentions.

Differences notwithstanding, similar arguments could be made with respect to the majority of processes or artifacts that comprise the universe of information technologies. Overall, each particular technology represents a delimited (although large) and reified texture of possibilities that have accrued in a complex pattern of development that defies description in terms of singular intentions. Major inventions undeniably imply breakthroughs. Most often, however, prior commitments and choices prefigure developments of a particular technology at a given moment. Technologies often evolve in path dependent patterns that entail incremental improvements that accommodate the needs of technological compatibility and interoperability (Hanseth 2000; Hughes 1987; Kling 1996). Isolated intentions projected by a designer or an observer onto the technology can never become the arbiter of technological malleability. They can never exhaust the spectrum of embodied intentions that characterize a particular technology nor predict which zone of the population of embodied intentions the user is going to enact.

These observations suggest that technology influences human agency not by imposing a single and mechanical functionality but by *inviting specific courses of action*. Such courses of action are engraved by the distinctive way by which each technology frames its reference domain (e.g., writing, driving, decision making) and organizes its basic functions. They are also shaped by the learning histories of each particular technology and the complex texture of intentions and functionalities it embodies. The range of tasks that could be accomplished by using a particular technology is certainly a significant aspect of it. However, the degree by which humans use smaller or larger enclaves of the spectrum of possibilities embedded in a particular technology does not represent evidence, as Orlikowski (2000) suggests, of the malleability and interpretability of technology. The influence a technology has upon human agency is not reflected in the (non)exhaustive use people may make of the possibilities it offers. It is rather captured by the distinctive ways by which a technology invites people to frame a delimited domain of tasks or activities and organize their execution.

Let us attempt to exemplify these claims by referring again to the technology of word processing. The influence computer-mediated writing has on humans is manifested in the various forms by which it reframes the activity of writing and supports it materially. The screen, the keyboard and the mouse, a number of semi-automated functions organized in groups epitomize these forms. An important effect of these forms is the overcoming of the linearity and rigidity of handwriting and print (Bolter 1991). New possibilities emerge from the distinctive forms by which word processing transforms the activity of writing, e.g., hypertext and text links, cut and paste, traceless deletion or substitution of words and sentences. Most significantly perhaps, the influence of computer-mediated writing is reflected on the specific procedures by which it organizes its various functions. For instance, choosing fonts, formatting a text, and checking synonyms represent delimited corridor activities that are organized in a series of procedural steps.

The distinctive character of computer typing is primarily reflected in the way it reframes the activity of writing and instruments its various tasks, and only secondarily on how many functions it offers. Even if people vary significantly in terms of how many of the functions embedded in the program they use, this does not represent straightforward evidence of the malleability of the technology. It rather suggests that the technology is capable of accommodating a variable distribution of human capabilities across contexts. The malleability of computer-mediated writing and the influence it has on humans should be judged by the ability of people to reshape, through everyday use, the core properties of technology. For instance, a core property of computer-based writing is the procedural, step-wise constitution of functions and their execution in a series of chained steps. Procedural action is known to contrast with holistic forms of involvement informed by a tacit understanding of situations (Nonaka 1994) and improvised patterns of behavior (Ciborra 1999). How far such core characteristics of computer-based writing are contextually negotiable and adaptable to the needs of situated actors is, of course, an empirical question. But it can be conjectured that they do not lend themselves to easy manipulation, at least in the short run.

4 MAJOR TYPES OF ARTIFACTS

What has been said so far suggests that the local negotiability of technology is contingent on two major groups of factors. The first derives from the institutional web of relations into which a particular technology finds itself embedded. Designers and developers, vendors, suppliers, consultants, and users mingle together with institutions and social and material practices (i.e., markets, laboratories, organizations, and regulative bodies) in complex and historically embedded patterns (Hughes 1987). Consolidated systems of this sort tend to exert an influence on situated actors that is scarcely negotiable in the short term. They frame reality, define options of courses of action, reasonable strategies, and methods of evaluating outcomes. The way we sought to analyze the texture of intentions embedded in word processing partly derives from the understanding of technology as a complex and institutionally embedded pattern of relations.

The analysis of technology in these terms has hitherto received considerable attention within the wider field of the social studies of technology (e.g., Bijker et al. 1987; Bijker and Law 1992) and specifically in information systems research (e.g., Ciborra and Lanzara 1994; DeSanctis and Poole 1994; Lyytinen and Ngwenyama 1992; Orlikowski 1992, 2000). While showing the ensemble of constraints within which situated actors operate, the institutional analysis of technology tends nevertheless to bypass the crucial issue of how the internal constitution of particular technologies participates in the making of the premises that govern the human-technology interaction. To be sure, the forms by which technologies organize and embody experiences in artifacts or processes (i.e., the black box of technology) are socially constructed. However, once constructed, such forms matter and they matter a lot. The closure or openness of artifacts and the premises by which they admit human participation are heavily contingent on the way they are internally organized as systems.

Thereupon we arrive at the second group of factors influencing the human-technology relationship. Orlikowski (2000, p. 409), after making a strong case for the situated enactment and reshaping of technology through everyday practice, makes the following remark:

> It is important to bear in mind that the recurrent use of technology is not infinitely malleable. Saying that use is situated and not confined to predefined options does not mean that it is totally open to any and all possibilities. The physical properties of artifacts ensure that there are always boundary conditions on how we use them. Conceptual artifacts (such as techniques and methodologies expressed in language) are more likely to be associated with a wider range of uses than software-based artifacts, which, in turn, are more likely to be associated with a wider range of uses than hard-wired machines.

Two claims are worth distinguishing in this passage. The first is that situated action is constrained by technology. While use is situated, it is constrained by what Orlikowski calls "physical properties of technology." The crucial issue then would be to identify the extent to which situated acts are instances (i.e., situated expressions) of a more general logic embodied in technology (i.e., physical properties of artifacts, or forms of embodied knowledge) or shaped by contingencies other than technological (e.g., beliefs, local relations, institutions). The second claim responds to this question. It construes technologies as having variable closure/openness (depending on whether they are conceptual artifacts, programmable artifacts and hard-wired machines), which, in turn, is closely associated with technological malleability, i.e., the range of uses each particular technology admits. The greater the closure of a particular technology, the less malleable it should be. Under these conditions, situated use of technology is confined to a set of predefined options and reflects the instantiation of a context-free logic embedded in the artifact. The cardinal question to address, then, is how the closure of technological artifacts becomes constructed.

Conceptual artifacts, Orlikowski suggests, are usually associated with a wider range of uses than *software-based artifacts*. This is due to the very organization of verbal versus technical languages. The semantic space of verbal language is organized such that the cognitive grid of conceptual artifacts is less tight than that of software-based artifacts, leaving open more and wider corridors of initiatives and interpretation (Goodman 1976; Kallinikos 1996). Obviously, a huge variety of artifacts exist within each of the two categories mentioned. It is thus of utmost importance to express the key properties of cognitive organization in terms abstract enough to allow comparability between major types of technological artifacts. Such a venture inevitably trades off intratype variability for intertype comparability. The variable closure/openness of major types of cognition-based artifacts (e.g., conceptual-linguistic, alphanumeric, and software-based) and the appreciation of the degree to which they are malleable and contextually adaptable presupposes such an intertype comparability. Let us now move into this task.

5 TECHNOLOGY AS A FORM OF ORGANIZATION

Nelson Goodman's (1976, 1978) work deals with the closure versus openness of cultural artifacts (i.e., texts, music works, paintings) and the forms by which they admit human participation. He systematically tracks differences in the cognitive organization of cultural artifacts and employs them to account for variable forms of human involvement with these artifacts. Goodman addresses the cognitive organization of cultural artifacts in general and he does not deal explicitly with technology. However, his work is concerned with the relationship between the artifact and the agent, and the structured forms such a relationship obtains as the result of the standardization of the cognitive procedures by which artifacts are constructed and utilized. Brought into the technological realm, his ideas could be deployed to capture the degrees of freedom entailed in the processes of enacting and using technologies.

The cognitive organization of cultural artifacts is ultimately related to the semiotic status of the systems of notation and symbol schemes by which they are objectified and made socially available, durable, and context-free. While cognition takes varying forms, Goodman (1976) identifies three basic forms of objectification and semiotic expression that epitomize the archetypical activities and products of musical notation, verbal writing, and pictorial representation. Each of these forms is associated with the production of different cultural artifacts that Goodman refers to with the jargon names of the *score*, the *script,* and the *sketch* respectively. The ways by which the score, the script and the sketch are cognitively organized account for the distinctive forms by which they invite human participation and the degree to which they are amenable to contextual reshaping and adaptation. Specific as they may seem to the activities and products of music, textual writing, and pictorial art, the constitutive principles underlying the score, the script and the sketch can be brought to bear on the understanding of a large variety of cognition-based artifacts and the forms of human involvement for which their cognitive architecture allows. Let me attempt to clarify these claims.

Pictorial representation is thus organized as to have no standardized marks, the equivalent of an alphabet, as it were, at its disposal. For this reason, the sketch is marked by greater zones of ambiguity than the score and the script and can never be procedurally reproduced (unless copied in its entirety) in identical fashion. Seen as a process (i.e., the act of painting) and an outcome (i.e., the picture) the sketch lacks the very cognitive organization of rule-based combinations of standardized marks that is underlying the composition of scripts and even more musical notation. It is analog rather than digital. Pictorial representation certainly obeys a number of culturally embedded rules, which, however, do not have the cognitive status (i.e., standardization, explicitness, precision) of rule-based manipulations of standardized tokens.

The lack of standardized marks governed by well-understood and explicit rule-based combinations makes the steps underlying the (re)production of sketch-based representations hardly codifiable and transferable across contexts. The agent encounters the task of sketching without explicit and standardized rules that codify the very process of production and reproduction of sketches. An important consequence is the greater degrees of freedom involved in the (re)production and interpretation of pictorial representations. On the other hand, the cognitive constitution of the sketch renders the (re)production of sketches heavily contingent on the capabilities of the agents involved. While the quality of the final outcome can be judged as more or less successful, the very process by which it is produced remains vaguely defined. In this respect, the production of sketch-based representations becomes a shortcut for all forms of human behavior in domains that are marked by ambiguity and low procedural standardization (Lindblom 1981).

The differences between the script and the score are more difficult to convey. We need to make a distinction here between semantic and syntactic organization. Verbal composition obeys the rule-based combination of alphabetic tokens only at the syntactic level. At the semantic level, verbal language is subject to ambiguities too. It is organized in semantic layers or units that often crisscross one another and cannot be separated in the ways alphabetic tokens stand distinct from one another. One-to-one correspondences between discrete syntactic tokens and disjoint meanings are rare. The semantic constitution of verbal texts is therefore ambiguous. This is why legibility at the syntactic level does not automatically guarantee identical interpretations of verbal texts.

The score, on the other hand, is, according to Goodman, both syntactically (standardized musical marks) and semantically differentiated. Musical marks correspond to distinct sounds (the equivalence of semantics in music) whereas syntactically separate units in verbal language (e.g., words) can mingle at the semantic level (e.g., mammals, humans, and animals), leading to overlapping zones and unclear boundaries of semantic units and fields. The ambiguity of the script is precisely due to the unclear semantic boundaries of the units of which it is made. By contrast, the musical score is disjointly organized at both the semantic and the syntactic level. For that reason, the musical score, Goodman (1976) contends, provides the test for deciding whether a performance (i.e., situated act) is an instance of a musical composition or not. It only admits highly structured forms of human participation. It can certainly be interpreted and performed differently but always within a range that allows us to identify it as this piece and not another.

Goodman's account of the organization of cognition-based artifacts could therefore be used to produce a continuum along which human involvement with artifacts in general and technical artifacts in particular can be graded in terms of predictability (i.e., confined to a set of predefined options) versus local negotiability and interpretability (i.e., malleability). At the one extreme, the score becomes the archetype of an elaborate cognitive scheme that highly prestructures the premises of human-artifact interaction and can thus be used to evaluate the degree to which human behavior conforms to the prescriptions or options embodied in the artifact. At the other extreme, the sketch remains the exemplary case of an undercoded and loosely standardized process where situated performance (and use) is not the instantiation of predefined options but rather the enactment of possible courses of action. These ideas, somewhat simplified, could be portrayed as shown in Figure 1.

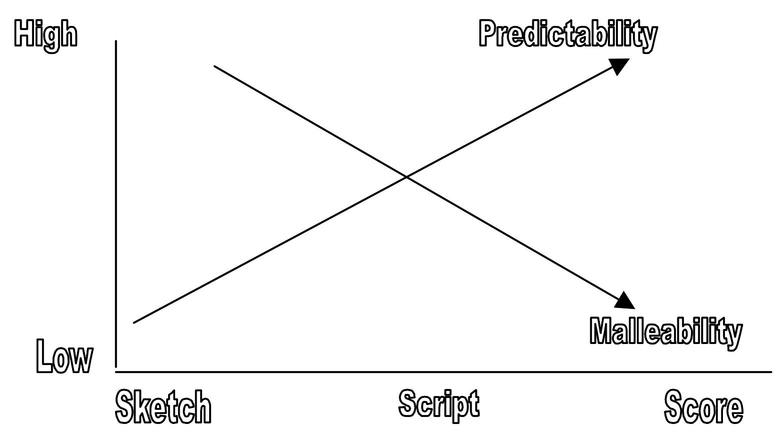

Figure 1. Artifacts and Human Behavior

Little wonder that significant steps have gradually been made (i.e., neural networks, fuzzy logic, approximate reasoning) in capturing part of the logic of undercoded modes of action and formalizing their production. However, software-based artifacts still exhibit considerable variety in terms of cognitive organization and, by extension, in the very forms by which they admit human participation, local negotiability, and reshaping. We definitely need ways of capturing such differences in a systematic fashion that allows the comparability of IT artifacts and the disclosure of at least part of the premises underlying the human-technology interaction.

6 CONCLUDING REMARKS

Although very brief and largely incomplete, the exposition of Goodman's ideas suggests that the objectification and organization of experience by means of various systems of notation and symbolic codification is of great relevance for understanding the relationship between humans and their artifacts. Building on his insight, we would like to suggest that an essential part of the conditions underlying human agency are given expression and shaped through the very *organization* of cognition-based artifacts and the *procedural standardization* of their construction, interpretation, and utilization. Information technologies currently represent a central social field whereupon a great variety of such cognition-based artifacts (methodologies and IT tools) develop.

The shaping and objectification of experience through the cognitive organization of IT artifacts is ultimately related to the status of the semiotic-cognitive means by which a domain of reality (e.g., writing, decision making, information search, networking and collaborative technologies) is framed, structured, and described. The more standardized and institutionally embedded are the notational systems and symbol schemes by which a domain of reality is addressed, the more predictable should be the processes by which IT artifacts are constructed and utilized. The standardization of marks and the stipulation of combinatorial rules and cognitive procedures are thus closely associated with the *procedural standardization of human agency*. In instances of high procedural standardization (e.g., expert systems, ERP packages), the use of technology in particular contexts largely coincides with the situated instantiation of some of the predefined options embedded in technology. Alternatively, low or modest cognitive standardization leaves open wider zones of local intervention whereupon technology is negotiated and even developed *in situ*.

Placed in this context, the cognitive organization of IT artifacts and the cognitive processes by which they are constructed and utilized becomes a central battlefield upon which basic strategies for structuring and directing human behavior develop. The crucial issue, then, is not the wholesale juxtaposition of the embodied intentionality of IT artifacts with their situated use but the charting of the *varying forms such a juxtaposition takes* depending on the cognitive organization of the IT artifact. Goodman's philosophy provides some of the conceptual means for analyzing the cognitive infrastructure of IT artifacts and inferring from it the forms and the degree of procedural standardization they bring into the very contexts whose operations are called upon to monitor. If IT artifacts are studied in their situated use, then such a study must incorporate as one of its essential elements the *deconstruction of the standing possibilities,* the very logic of action embedded in the cognitive organization of the IT artifact. Short of such an analysis, the study of technology in use becomes an exercise in situated interactionism.

The appreciation of the cognitive constitution and organization of IT artifacts as an essential element in the study of technology attributes it a momentum that *recognizes technology as a particular domain of social life irreducible to sheer social relations*. Far from being deterministic, the understanding of the distinctive character of various technologies offers a means to account for the significant variation in the forms by which humans encounter technology in various contexts. Such an orientation complements the overall framework institutional relations impose, and also represents a significant expression (instantiation) and specification of such relations. Institutions are not disembodied entities. They are themselves sustained by material forms (Foucault 1991; Searle 1995). Or to put it differently, the standardization and institutionalization of the cognitive processes by which IT artifacts are produced and utilized represents an essential means for structuring and directing human behavior (Kallinikos 1996). It is not by accident that cognitive closure has historically been a major means for constituting action along predictable, recurrent, and accountable paths (Beniger 1986; Cline-Cohen 1982).

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