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Between transient constructs and persistent structures: designing systems in action[☆]

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Abstract

On-line observation and tracking of design processes reveal that design practices often display surprising features that defy our understanding, descriptions, and planning capabilities. Systems tend to be fragmented, untidy and unpredictable, often turning the designers' setting and practice into a "swamp". Drawing on stories of system development projects the author highlights the role of transient constructs as dynamic carriers of knowledge and effective vehicles for sensemaking. Transient constructs help resolve the dynamic tension between stability and change in design processes. On the one hand, given their unfinished and makeshift character, they allow for variability, online experimentation, and cognitive transactions; on the other hand, they may occasionally coalesce into more stable and persistent structures, which are continuously reconfigured by a never ending activity of *bricolage*. © 1999 Elsevier Science B.V. All rights reserved.

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My purpose is to tell of bodies which have been transformed into shapes of a different kind

Ovid, *Metamorphoses*, Book One

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1. Prologue

If we take a bird's eye look at the contemporary landscape of our organizations, we see it in a restless, never ending transformation. In the most diverse business areas as well as in the professions and the public sectors new software applications and IT-based innovations have reshaped our most familiar routines for working and communicating, for leading our daily life activities, and also for thinking. Composite, trumped-up webs of applications, technologies and systems have spread all over the organizational and institutional fabric of our societies. Traditional spatial and organizational boundaries have been trespassed by sideways connections linking multiple agents, and preexisting hierarchical arrangements have been eroded. Basic collective tasks increasingly rely on highly distributed systems. The mediating, networking and organizing qualities of IT have powerfully come to the fore. Virtuality has become a word in good currency and part of our familiar practice and jargon. Shapes merge into shapes of a different kind and new forms take their life from the ones that dissolve. Computer plasticity is ubiquitous.

Nowadays we live in an increasingly artificial, computer-permeated world which is dynamic, ever changing, and in a constant state of flux. The newest computer-based systems and informed environments comprise networks of multiple interacting agents who have diverse and shifting goals. In order to meet changing environmental and personal requirements agents continuously readapt and reinvent systems' features and functionalities. As a result, many of the properties of these complex dynamics artifacts and their evolving configurations seem to be the outcome of diffuse social interaction and evolutionary dynamics rather than of purposeful design and implementation. Although some components are intentionally designed, large systems go through metamorphoses, to the point that they should be more accurately thought of as open-ended processes, as artifacts in-the-making (Ciborra and Lanzara, 1990).

In the literature IT-based systems and artifacts have been mainly looked at as "closed boxes" — finished tools in the hands of the users — and their impacts on organizational settings and performances have been assessed accordingly. In the following I will try to move away from that perspective. The picture I want to offer is rather about the process of making these artifacts before they gain stable contours and shapes and *before* they actually become "usable tools". I am interested in exploring their state of "quasi-objects", when they are suspended in the midst of discontinuities, when they float on the waves of change and interact with the activity systems or the organizational settings in which they should be integrated. Rather than "opening the black box", as Bruno Latour does in his sociological analyses (Latour, 1993), this strategy entails tracking the process *before the box actually gets closed*, that is, focusing on designing in action. Designing in action is a practical, situated, context-sensitive mode of design that feeds on the dynamic tension between the requirements of change and stability. Its outcomes are both transient constructs and persistent structures, the ones merging into the others.

In Sections 2 and 3 the ambiguity of IT-based innovation is evoked and the puzzling, emergent features of designing in action are sketched. Then, as the main core of the paper, three short stories illustrate the role of transient constructs in design processes. The argument is more fully articulated in Sections 4–6, touching, respectively, the complex

relationships between transiency and permanence, the problems of practice, and the logic of *bricolage* as an inconspicuous but viable style of design.

2. Coping with technology: stability and change

When a new computer-based technology enters an organization or an established domain of practice a whole range of different phenomena can happen, depending on the nature of the technology and on the cognitive, social and institutional features of the setting or the domain. Stories of different kind are told about the process of innovation. In one kind of stories the artifact is perceived as an *invader* or *intruder* to be resisted or rejected, or it might be looked at as an “alien thing” to be wary about, something to be removed and ignored pretending that it is useless or nothing really new. But in other stories, agents host the newcomer and take care of it as a “guest” (Ciborra, 1999). The technology is often the occasion for opportunistic behavior and political maneuvering. In other instances the new artifact might trigger a process of joint exploration and testing, where people become curious and cautious at the same time, and keep experimenting with it to explore its potential. Or else, it might happen that people immediately catch the opportunities that it brings, and adoption and dissemination take place fast and smoothly. In the process, the artifacts and systems can be literally “reinvented” by the users (Rice and Rogers, 1980).

Whatever the phenomena observed, a complex game starts among the players, which is characterized by a dynamic tension between change and stability. The appearance of the technology generates basic dilemmas that people have to cope with: innovation and conservation, continuity and disruption, routine and improvisation, control and learning, compliance and transgression, “quiet living” and “surprise”. Most of the times we are not confronting either/or choices, because we value both and need them both. Such an emerging tension originates from the fact that technology is intrinsically ambiguous (March and Olsen, 1976; Goodman and Sproull, 1990; Weick, 1990).

First, technology has structuring properties when it is adopted and used by organizational actors: roles, tasks and routines, functional and organizational boundaries are occasionally restructured, although in ways that it is not easy to predict and assess. Analysts have mainly focused on pattern reproduction and on the control mechanisms built into the technology, highlighting the self-reinforcing processes of preexisting institutional frameworks. (Barley, 1986; Orlikowsky, 1991; Orlikowsky and Robey, 1991).

Second, technology is highly sensitive to the peculiar features of the hosting environments and the adopting institutions. Computer-based systems, independently of the designed purposes built into them *ex ante* and independently of the design logic, once introduced into an organizational setting and put to use, tend to evolve “spontaneously” along evolutionary paths that follow multiple logics.

Third, technology reshapes the basis for competence and practical knowledge of people at work. It can produce a displacement of the agents from their current routines and from their familiar cognitive and institutional frameworks. The boundary is shifted between what people tacitly hold as background knowledge and what they are aware of as

foreground “situational” knowledge, between the locus and focus of attention *and* what instead is taken for granted (Zuboff, 1988; Ciborra and Lanzara, 1989; Blackler, 1990).

These phenomenological distinctions are necessary if we want to understand what designing in action entails and what goes on in a process of change and innovation. A useful distinction that has been introduced into the field to appreciate the complex phenomenology of IT-based change is the one between visible routines and underlying “formative context” (Ciborra and Lanzara, 1994; Blackler, 1990; Unger, 1987). A formative context is a deep-seated texture of relations, rules, habits, cognitive frameworks and institutional arrangements which agents bring and routinely enact in a situation of action. Formative contexts are both a source of inertia and a nurture ground for innovation. They underlie many of the puzzling phenomena that we observe in processes of change and design in organizations (Blackler, 1990; Ciborra and Lanzara, 1994).

When agents uniquely redesign their own established repertoires of routines in order to accommodate the new technology, the restructuring affects not only the visible level of routines and transactions, but also the underlying, deeply engrained formative context. Computers and IT do interact with both the structural and institutional arrangements associated to a given system of practical activities *and* the assumptions and imageries that people hold while they routinely engage in those activities. The redesign can happen at varying levels of breadth and depth, and sometimes it can go so far as to really push at the boundaries of the discipline, the professional domain, or the organization (Rice and Rogers, 1980; Schon, 1983; Schon, 1992; Weick, 1993a,b; Ciborra and Lanzara, 1994).

3. Designing in action

Close-to-action observation and on-line tracking of design and change processes in organizational and professional settings reveal that such processes happen in ways that remarkably differ from the orderly, structured paths that most current theories and methods tend to assume. Systems design practices frequently display surprising features that defy our understanding, descriptions, and planning capabilities. We observe a variety of mundane building activities, recombinations of preexisting components, small scale practical experiments, local readjustments and repairs, extemporaneous improvisations, which taken together resemble what, by using a French word, can be labeled *bricolage* (Levi Strauss, 1962). These constructive activities and processes are full of ambiguities and discontinuities, and sometimes may even look like random, erratic wanderings apparently leading nowhere. Rather than “clean and neat” systems, the outcomes of such activities are makeshift, dynamic artifacts, patched-up components, or strange hybrids that occasionally turn out to be successful, are adopted, take roots, and may later merge into more permanent and pervasive structures surrounding and supporting the ongoing work and design activities. The processes may be inconspicuous, but the overall outcome is not. Indeed large systems often result from the unplanned interaction and the catalytic coalescence (or the occasional mixing) of a large number of smaller fragments. In many cases additional features and components are accrued or literally “hooked” onto a basic system core, leading to complex, multi-layered, loosely integrated structures whose behaviors can be quite undecipherable and unpredictable, and whose

further developments can be heavily path-dependent (David, 1985; Arthur, 1989). Processes are always “emergent” and follow multiple logics. Coherence, orderliness and meaning, if any, descend from ex post interpretation and sensemaking of a large number of dispersed agents rather than from ex ante planning and implementation of a central designer (Weick, 1993b). They are ongoing processes themselves, not properties or “states” that are bestowed on technologies and systems once and for all.

While systems might show pervasive inertia, surprises, novelties and other puzzling phenomena “branch out” of the currently practiced repertoire of routines. Rather than planned and orderly change we observe a process of “shifting and drifting” (Ciborra and Lanzara, 1994). As a result, change in organizational settings has a fragmented, untidy, ambivalent, and often unpredictable character. Indeed, if we closely observe an innovation process, we find evidence of fractures, discontinuities, inconsistencies, deviations from current routines, puzzling or random behaviors calling for interpretation. Few things seem to fall in place, and it is not easy to make sense of what is happening. Development projects fall off of time and track. In such conditions well-structured and sequenced implementation becomes a dream, or perhaps a nightmare. Design and decisionmaking processes soon turn into garbage cans and many stories of computer-based innovation tend to become idiosyncratic and unique, or so embarrassing that people do not even want to talk about.

In this complex, dynamic and elusive world, then, what is the place for design? How is design possible in the midst of these complexities? If interactions and interdependencies defeat purposeful planning, why even bother to engage in design? If causes and consequences are so loosely coupled and outcomes cannot be safely traced back to specific actions and plans, how can a designer ever expect to achieve intended goals, if not by a stroke of luck? Does a system development project make any sense? I believe some tentative answers to these questions can be found only by closely watching the designers’ practices, that is, what designers really do when they are busy at work in their unique settings.

I will tell a few short stories that convey a sense of what happens when an artifact or system is actually “designed in action”. The stories come from my own research experience as an observer and reflective interventionist within systems development projects in educational, institutional and professional settings. All stories highlight the tension between stability and change and the dialectics between transiency and persistence.

3.1. First story: designing by “for instances”

The first story is about the design of an educational software at a major academic institution. In the first stage of my field work I sat in the lab almost every day with the project leader (a musician and developmental psychologist) and her software programmer who engaged in developing a computer-based environment for music education. As I helped them with observations, descriptions and ongoing assessment of project activities, I was struck by the way they proceeded in designing. Let us step into the lab and have a look at what they do.

The designers are busy making a software procedure that would allow the students to have easy access to music, develop hands-on musical understanding, and gain abilities to

actually make musical structures. They face some crucial design questions:

- “what do we want to be “canned” and available to students?”
- “where should the entry points to the system be for the students?”
- “where should the boundary be between the music and the computer domain?”

The answers to such questions will determine what the system will end up doing in its final configuration (features, facilities, functionalities, interfaces, applications), and will determine, as a consequence, what the students will actually learn.

In designing the new system, the two developers continuously swing back and forth between the preexisting system that they have at-hand and the new software tools that the advancement of technology has made available. They keep updating old features and at the same time add new features to the system. In their designing they seem to be tacitly guided by what they already know about the old system and its operations. So, what they happen to design is dependent on the old system’s features in much deeper ways than they are aware of.

The musician does not know exactly what she wants or has a vague idea of it. She needs to see some instance of what is possible to do with the new system and play with it in order to tell whether she likes it or not. So, the programmer provides a “for instance”, that is, a version of the procedure, an enacted and embodied response to the musician’s educational requirements, *as the programmer understands them*. Says the musician:

The procedure he makes is basically a “for instance”. He makes a version of it. I have to come along and play with it in order to push it one way or another to see what else can be done with it, but out of that, whole ideas come out that were not there at all before. A “for instance” is necessary before one can think. It’s precisely because it doesn’t work right that it suggests a new possibility.

These “for instances” are not the real thing, they are just virtualities or “as if” worlds to play with, whose connection to the final solution is still unclear at this stage. Sometimes they have very little resemblance to one another. They are a sort of *transient constructs* that allow the musician to make ongoing practical experiments and discover what she likes. They embody what the designers know up to that point, and can be “reworked” time and again. Everytime the programmer makes a “for instance” for his partner to play with, somehow he seems to reset the clock in search for a solution. The whole design process is marked by discontinuities, interruptions, deviations, which do not seem to follow a regular, sequenced pattern. The programmer develops software versions or procedural options, and the musician tries them out, evaluates, modifies, and in the end eventually throws them off, into the garbage can. The process is very interactive: the designers are deeply immersed in a world where new kinds of virtualities can be created and modified with an unprecedented velocity (Winograd, 1996).

These versions of a software procedure are not only tools or devices in-the-making, but generators of ephemeral virtual worlds in which users temporarily live and act. They are “transitional” objects in the sense that they help designers recognize some problems, attach names and labels to component objects, make sense of local events so that they

are not overwhelmed by ambiguity and anxiety (Winnicott, 1953). “For instances” are basically “hooks” or “anchors” to fix a feature or relation that might turn out useful in the next steps of the building process. Yet, they are quite volatile: they are made, dissembled and reconstructed in an endless process. Most of them pass away forgotten, but it may happen that bits and pieces of them are re-used, recombined, and given new meanings as component parts of further transient constructs.

The constructs are also “transactional”, because through them the designers establish cognitive transactions with their partners and with their building materials, stay with them for a while, and then go ahead for the next move. In our story, in working with “for instances” designers keep acting and talking to each other from two distant worlds: music and computer science. The two worlds comprise different repertoires of relevant objects, familiar work tools, consolidated skills, cognitive mappings, implicit frameworks and criteria for design, and even a different sense of beauty. In many an instance the two partners misunderstand each other, and it is not quite clear if and how one really makes sense of what the other is saying and doing. But the final artifact takes shape *through* the moves of their conversation and *in spite* of their mutual misunderstandings, or perhaps just *because of* them, as they gradually merge their different domains of experience and practical knowledge.

Their way of designing resembles a kind of *bricolage*. They paste together a few components into “something”, see how it looks like, play with it, check if it works, evaluate, modify, or reject. This *bricolage* activity is not directed to any specific solution or configuration in particular, nor at solving pre-fixed problems, or at fixing specs, because neither of them knows in advance what the final configuration is going to be.

By playing with transient constructs the designers discover their own cognitive boundaries and how difficult it is to shift cognitive gears. Particularly, they discover that all design, construction, and learning in the process can happen only in terms of what they know already. As the musician declared:

I think I know what I want the system to do, but...only in terms of what I know already!

But at the same time she discovers that there is no other way to overcome such boundary than by engaging in further search, discovery, and design!

Thus, transient constructs play an important function in designing: they help overcome cognitive inertia when the problem is how to disconnect from a previous formative context (material, cognitive and institutional). For sure, they possess an ambivalent nature: on the one hand, they are just reenactments of previous knowledge, but on the other hand, they bring innovation when they introduce “branching outs” and “shifts of direction” in the process of designing. New objects to play with are given shape and, with them, new ways of thinking and acting emerge, new meanings and new forms of practical knowledge surrounding the use of the new system are enacted.

3.2. Second story: shifting stories

Unexpectedly, I discovered a similar pattern of shifting entities at a later stage in the

project, when developers came to the issue of how to disseminate the computer music system in the music curriculum.

As they carried out the project, participants told shifting stories about computer-based educational innovation: not only they would have multiple views and perspectives on the same event or situation at a specific point in time, but also, as time elapsed, the same actor would have shifting interpretations of the same event, depending on the evolving situations and contexts (Lanzara, 1990). As people kept recalling and talking about previous events and situations that they had lived through, they also shifted and reshaped their boundaries, making new meanings and telling different stories about them. The stories originated within a conversation between the participants and the interventionist.

Indeed, one of my tasks in the project was to write *stories of perceived facts* — sort of “thick descriptions” (Geertz, 1973) — and feed them back to the participants in order to get their “backtalk”. The stories would provide an account of the design process, which was accessible to the participants for inspection, reflection, discussion, and evaluation. As I tried to make sense of the design process, the repeated backtalk of the participants led me to rewrite the stories that at different stages I had just laid down as a “faithful” representation of the facts. Thus, what was initially described as a *controversy* among opposing factions about computers in music subsequently was told as a joint *learning experience*, and then evolved into a story of *political cooptation* of junior faculty members into the project — not an uncommon case in academia.

Through the backtalk, many events that have been lived through and many behaviors that have been acted out unreflectively become objects of inquiry and reflection. They are turned into spot-like events in a flow of many other happenings, continuously rearranged within a changing plot. By such reflective move the actors can look at themselves in the past while they are engaged in action *as they have been portrayed by the observer*. A space for collective reflection and discussion opens up, creating a sort of *video* where the actors look at themselves as *dramatis personae* and eventually reinterpret their parts and behaviors. By such move the design process *doubles back on itself* and turns self-referential (Olafson, 1979). Thus, both reflexivity and historicity are cast onto the design process and, indirectly, onto its products, although it is not easy matter to say how.

There were other shifting stories in the project. The developer’s initial story of personal confinement and isolation in the Music Department shifted into one of conflict and struggle to make the project break through the assumed resistances and skepticism, and then turned into a story of cooperation, of mutual recognition, of “making *the thing* (i.e. the system) together” with the teaching staff. On their part, members of the teaching staff, who after the first round of observations were pictured by the observer and the developer as “opposing” or “resisting” the innovation, later on variously described themselves as “raising the educational issue”, “being curious but cautious about the thing”, “willing to experiment”, “probing and testing the system”, and finally “coping with the situation”. All these stories had their own internal coherence, their argumentative plausibility, and their context-dependent validity. They were all, in a way, “true stories”, which helped the participants construct order in time, make sense of situations and frame their own roles in them as the project progressed and the situations evolved. Most importantly, these stories were closely associated to the participants’ choices and actions in carrying on the project and developing the system. They tell us about the ongoing changes taking

place in the minds of the people and in the institution at different stages of the process of institutional adoption.

For sure, one of the discoveries that I believe is relevant for my argument is that a complex thread runs from the designers' basic educational assumptions, either explicit or tacit, to the choices regarding the making of the software, to the educational choices that music teachers will make about how to teach music in the computer medium, and then to changes affecting the overall configuration of the music curriculum, to the broader institutional and professional implications of such changes at the academic level. In other words, the virtual objects and interfaces, that are actually designed at the software level and that the students will play with, will also interact with the broader institutional context, having implications for the teachers' skills, their sense of mastership, their career paths, their elective affinities, their institutional affiliations, their professional identities, and so forth.

I submit that shifting stories are an interesting instance of transient constructs, having an important reflective function. They are intermediate and incomplete accounts, that the project participants create to cast some temporary, makeshift coherence onto a flow of events, some plausible meaning to complex and ever changing situations of action, and some fragile order to a chaotic array of ambiguous and ever evolving facts. Based on them, some actions can be taken, some choices can be made, some changes can be introduced. The stories embody transient knowledge — what the actors know about the project and the process, as they proceed with it, *up to that point*. Once created and told, a story becomes a reference entity and a tool for future action. It restores some kind of provisional integration and cognitive coupling between an agent and its world, and by so doing it helps the agent cope with the cognitive and the political complexity of the situation. When situations change, stories must be rewritten. Thus, stories are relevant design tools, because they store knowledge and meaning and carry them in time (Boland and Tenkasi, 1993).

3.3. Third story: switching medium

Consider that even a trivial, domestic technology can produce a remarkable effect of displacement and disconnectedness, depending on the kind of institutional and technical features of the domain of practice. The introduction of VCR technology into the courtroom is a nice case in point.

When a computer-controlled VCR system was introduced and tested as a prototype in six Italian courtrooms, judges and lawyers stumbled in a new artifact: the videotapes containing the proceedings of the trial. Relevant judicial data were transposed from the paper medium to the visual medium. Switching medium turned out to be a sort of "cosmological episode" for the magistrates (Weick, 1993a,b). The use of the videotapes conflicted with the treasured norms and habits of their profession (since the times of the ancient Egyptians!). They were confronted with the problem whether the videotapes should be assumed and adopted as the official record of the trial, having legal validity. Furthermore, by switching medium the quality of the data was also changed. Indeed, the videotapes contained *different* kind of data than paper, such as immediately rehearsable and inspectable inscriptions of nonverbal behavior. The *videodocument* inscribed nonverbal data,

which the magistrates thought should not be used in making judicial decisions of conviction or acquittal. According to the code of criminal procedure and to the current practice decisions should be based only on the paper transcripts reporting the verbal, declarative data released by the processual actors. Explicit appreciation of nonverbal behavior (for example the “look” of the defendant or the attitudes of the witnesses) was considered to be unlawful — too subjective and personal. But at the same time, as some judge acknowledged, the new medium revealed that indeed the judges tacitly used appreciation of nonverbal behavior in their decisions.

The switch to the visual medium affected the judges’ and lawyers’ judicial practices and their ways of thinking about their own profession. Specific activities such as paper-based data recognition, skills and routines, and self-reassuring habits like labeling, taking notes on the edge of the paper documents, underlining with a color marker, were displaced and could not be applied properly in the visual medium. Judges felt that, when using the videotapes, they could not concretely “fix the relevant points”, as one of them said. They even spoke of an “evanescent”, untangible tool. As a consequence, the sense of personal mastership was affected and a whole professional cosmology was perturbed.

In order to cope with the ambiguities and the dilemmas raised by the new technology, some judges started to try out local practical experiments. They designed and tested microprocedures in the new medium, so that they would meet the conflicting normative requirements. However, their experiments always had an ambivalent and confusing character, as they oscillated between the challenge and the risks of innovation and the tranquillity of traditional practice.

Parallel to their deared paper-based practices they designed and tried out emergent technology-induced practices, and created hybrid procedures resulting from a recombination of old and new component procedures. For example, in the courtroom judges experimented with different arrangements of the physical and functional layout, with multiple spatial positions, with the reassignment of roles and tasks, with different patterns of control, with alternative procedures. Their efforts were directed at creating a computer-controlled environment — a sort of informed courtroom — compatible with the production and management of a “good” videodocument and the virtual events inscribed in it, but at the same time respectful of the judicial requirements of the real event taking place in the courtroom. Not different in their job from what a film director does in making a movie, but certainly with a lot more legal and procedural constraints. The judges were trying to meet old and new sets of procedural and normative requirements — those imposed by the code of criminal procedure and those induced by the recording technology and the new medium. Thus, transition from the paper medium to the visual medium is not an instant switch, nor a linear path. It is marked by oscillating behaviors and by the design of makeshift, transient arrangements to cope with the displacement of context and with the sudden loss of meaning. These transient constructs help the judges and other relevant actors to face the cognitive displacement induced by the technology and to re-establish some new type of integration with the new medium and the new computer-based judicial environment. By making some kind of action possible, they fill the vacuum of order and meaning that arises when a new technology intrudes into an established professional or institutional setting.

4. Between transient constructs and persistent structures

I believe these stories convey the sense that what really happens in the practical “designing” of a system only vaguely resembles the image that formally “canned” procedures and grid-like structured methodologies would make us think and do. Rather than on method the stories focus on practice, on mundane forms of action; they tell about what people actually do, rather than what they are supposed to do.

Real-life processes of change and innovation look not so well ordered and well sequenced than we may want to admit. They are more messy and untidy, more fragmented, and for sure less “designed” than our theories assume. There is a great deal of routinized disorder, recombination, apparently undirected evolution, “shifting and drifting”, and no central design intelligence. Change and innovation exhibit a richer phenomenology than, in general, we are ready to acknowledge.

Evidence of the emergence and role of transient constructs can be found in many organizational, institutional and professional settings. They can take many forms: material or symbolic objects, routines, stories, and whole environments or design worlds. They tend to emerge in all situations where an established activity system is affected by an innovation (technology, routine, rule, idea) and actors are displaced from their preexisting formative context. A microecology of uses, practices, skills and meanings is perturbed and needs to be balanced again. An order is broken and a new order needs to be reestablished, but it is difficult to proceed “fast and smooth” because of the rising ambiguity, and also because the familiar tools supporting the practice are not as adequate as they should be (Weick, 1993a). Previous codes and frames are not effective or reliable, but new ones are not available yet and need to be created and learned. Routines cannot be executed, or are ineffective, or do not make much sense. Behaviors oscillate from preexisting to novel patterns, and back, from new to old ones (Van Maanen, 1984). What was thought to be obvious becomes an object of inquiry.

In such circumstances action must become a form of exploration. All people can do is to design and make practical experiments, tinkering and testing with the available materials: make something, see how it works, and evaluate it. Makeshift local orders are built and tested. Transient constructs emerge, do their job for a while, then get discarded. New ones are assembled and often disassembled. People keep stumbling, but keep going. In the process, a new configuration may eventually take shape, yield increasing returns and become stable.

The problem is that in designing and innovating we pursue both change and stability (Pettigrew, 1987). To be sure, change never comes without stability: if something must change, something must remain the same, and we always confront the dilemma of how to combine the urge and variety of innovation with the conservation and stability of experience. Both horns of the dilemma require learning. Transient constructs and long standing structures are indeed embodiments of different kinds of learning. The former bring plasticity, the latter bring historicity into our systems and practices. We need them both.

Transient constructs — makeshift artifacts, recombinant routines, minimal structures, ephemeral organizations, disposable symbols, fugitive meanings — result from different ways of chunking and grouping the materials or the flow of events, revealing shifting criteria for designing and organizing the world. Moving from one construct to the next,

new features and relations are “liberated” and rearranged in different configurations, while previous ones are kept or wiped out. Sometimes they surge as reflective responses to the agents’ backtalks and experiments.

We need transient constructs to make sense of the world when sensemaking becomes difficult, because our preexisting framework is lost, unusable, or inappropriate to the situation (Weick, 1993a,b). They work as “fixes” to assure some provisional order and meaning, “pithons” to pull ourselves up on a cliff — perhaps upward to the safest high grounds of more established certainties, always to be re-examined. They are “embodied and enacted descriptions of what the agents know so far” (Bamberger and Schon, 1983). They help us keep active and alive in an apparently meaningless situation. Thus, they are not only tools for ephemeral ordering and structuring, but also tools for “anchoring” identities in a complex and ambiguous world. Order, structure and identity will often emerge *ex post facto*, as a result of our *bricolage* activities and interactions.

Indirectly, transient constructs help us establish some direction in time and some inter-temporal depth. Continuous rechunking and regrouping of components, features, and events lead to chains of revisions, and to revisions of revisions, and this gives rise to some kind of sequencing, some temporal ordering in our activity. The next — next — next chain provides for some orientation in time. We proceed in designing *across* and *by means of* discontinuities and disconnections from previous arrangements. In the process there is a great deal of revision, too. In a way, we are compelled by the shifting nature of situations to do “instant historical revisionism” (Schon, 1983).

By making this back-and-forth linking activity possible, transient constructs point to the future, connecting time past to time present and time future. They work like arches of a bridge thrown across time. Because at one point they fade away, and new ones come to the fore, they indirectly help us mark the difference and the discontinuity between “before” and “after”. It seems that we keep re-setting the clock time and time again and take a new start, but indeed the design process has some kind of irreversibility. Transient constructs are continuously reshuffled, recombined, and reworked along a main stream of sense, and in the long term these ongoing processes of recombination and restructuring tend to generate stability. Thus, riding on the saddle of transient constructs, past experience travels across time, subtly penetrating into our new designs in ways of which we are largely unaware. It might be said that they embody the dynamic component of our experience.

Inconspicuous traces of previous choices and actions are left imprinted in the track and in the artifact. These traces may have long term influences on the configuration and behavior of a system. Choices are not completely reversible. Not every design can be discarded, and most new designs are built up on previous ones. Constructs that showed successful are rehearsed and re-used over and over again, and finally stabilized. Then they become “templates” for further designs, or usable “routines”. Unstable components are assembled into hybrids that perhaps do not look very elegant but “make do”. Interaction among smaller components triggers emergent system properties, and some of these properties turn out to be exploitable (March, 1991). As a result, cross-temporal structures are stabilized: they are plots that connect many events or layers of designs and give them a sense of place and direction.

The overall outcome of this building activity and interaction based on transient

constructs are larger, loosely connected structures, that, taken as a whole, possess a high degree of stability and resilience, but locally are always up for grabs. These structures carry history and tradition, bringing continuity and connectedness, both spatial and temporal, to our world. They do not exist as reified entities (except in our theories and methods) independently of the agents who enact them in situations of action. As they possess a highly contextual, situated quality and carry the background, hidden component of practical knowledge, they work as formative contexts. They represent the world as it is — what we act and think *with* and need not to think *about*, except in cases of major breakdowns. As we take them largely for granted, they tend to gain an aura of “naturalness” and an institutional valency.

However, due to intrinsic ambiguity, the distinction between transient constructs and persistent structures is not so sharp. I would like to suggest that transient constructs are less transient than we usually imagine, and persistent structures are less persistent than we usually think. Indeed transient constructs are with us all the time, being a visible, pervasive expression of our inquiries and constructive activities in a variety of domains of practice. They do not constitute a second-best, minor form of reality — minor deities or lesser gods, so to speak, but a crucial way of worldmaking (Goodman, 1978). The knowledge they convey is not necessarily of lower status with respect to institutionalized knowledge, formally packaged and canned. The things that we forget or throw away are at least as important for knowing as the things we happen to remember and keep. The very idea of practical inquiry, as it was first set by John Dewey and then developed by Donald Schon, must necessarily rely on transient constructs and revisable forms of knowledge. If there is some value to this perspective, then the idea of knowledge as a manageable commodity or asset becomes a more complicated matter than the latest mainstream approach would lead us to think (Nonaka and Takeuchi, 1995; Davenport and Prusak, 1998; Sanchez and Heene, 1998; Boisot, 1999).

Persistent structures on their part are less static and more movable than we might expect them to be. Precisely because they emerge and coalesce as multi-layered sedimentations of local and global arrangements from a pasted-up combination of everyday practices and tinkering activities, they are always locally amendable and adjustable. They are subject to continuous *bricolage* and local restructuring.

Persistent structures exhibit an intrinsically ambiguous dynamics. On the one hand, they are sticky, showing high inertia and resilience; they do not change overnight, representing the static, conservative component of our experience. Indeed, because of their functional and existential “fixedness”, they can become cognitive and institutional traps. But on the other hand, due to their patched-up character, they can be exploited to introduce local rearrangements and reinventions (Rice and Rogers, 1980; March, 1991). They never represent a conclusive state, but are further manipulable: new features and components can always be accommodated or hooked onto them.

Although experience, memory, and tradition are sealed in them, and often self-sealed, yet they change all the time in a never ending, ever evolving process of “shifting and drifting” or “redesigning”. If we look at them with a sensitive eye, they are always in a constant state of flux. Within them, local disorder and incoherence are endemic and, I should say, necessary.

Agents are continuously “at work” around these structures, heedfully attending to them

and cultivating them (Hanseth, 1996). Even if some revolutionary episode can occur bringing dramatic changes, a great part of the restructuring activity is peripheral, at the margins of the structure, and obeys to multiple logics, while the core is much more resilient and harder to access and change.

For sure, one of the most powerful instances of a persistent structure is the Internet, or some of the newly emerging global information infrastructures, or even some large business software systems. The Internet, for example, is a powerful tool for dynamic interaction and interconnecting, but it is also a virtual world, or better, a regime of multiple virtual worlds, which are themselves the outcome of a process of designing in action. Curiously enough, these structures are not being designed by a central designer. Most of them had an almost accidental birth, grew organically, evolved by component additions or “accretions” and local, peripheral transformations. For sure, they do not seem to be the outcome of a carefully planned design and project management. Rather, they look like “swampy”, meandering systems, congested and chaotic, but overall not performing too badly.

Global infrastructures on their part look less standardized and more fragmented than we want, but, I submit, it is precisely fragmentation and multiple standard regimes that give them more flexibility and reliability (Genschel, 1997). They are imperfect, but perfectionable. In this connection I would like to advance the idea that “being global” does not necessarily mean *overall uniformity based on a universal standard*, but rather should be understood as “being translatable”, where communication among multiple regimes and mutual recognition of diverse identities are a crucial factor for social coordination and social learning. Princeton anthropologist Clifford Geertz has pointed out that the more we try to make the world “global” the more the world responds with the emergence of multiple “local worlds” and identities that seem to be irreducible to one another (Geertz, 1996).

5. Swampy systems

I have tried to illustrate instances of designing-in-action. My emphasis has been on design as a “situated practice” to distinguish it from design as a method, although practice and method in principle need not be at odds with each other. A method, in the technical disciplines, immediately evokes the idea of a “how to do it” recipe applicable to a broad variety of cases and situations. It necessarily implies some degree of abstraction and a reference to general patterns. In such perspective, design is immediately configured as “how to apply the prescribed procedures of the method to the case at hand”. It is basically a disembodied problem-solving procedure.

But a design practice is more than that: it implies contextuality, experience, situatedness, uniqueness of the setting where design is undertaken. A method is like a highway. It is intended to take you fast and smooth right to your desired destination, travelling through territories that you do not really need to explore in depth. You cross woods and prairies, rivers and swamps, mountains and valleys, cities and wastelands without really touching them or being touched by them. A method, if it is to be such, must necessarily abstract from the specific and idiosyncratic features of the territory. It has been said by French

sociologist Jean Baudrillard that a method buffers the researcher from the whims of the object researched (the “shrewd genius” of the object). Precisely the opposite of what “good practice” would require.

Skilled design practice would require having a “feel” for the diversity and the qualities of the design materials, being able to make instant evaluations, learning how to cope with surprises, being alert to chanceous occurrences, exploit situational cues and opportunities, develop a capability for on-line intervention and a drive for creative violation of routines. Often sound practice does not take straight directions, but follows more modest and tortuous paths. In other words, practice calls for “complex sensing”, a kind of understanding and skill that method could inhibit, making us blind precisely to what we should be aware of in designing. Indeed, we might encounter situations where we need the hunter’s cunning rather than more powerful weapons. To wit, a practice might well imply that, in order to invent smart solutions online, we must give up the method, that is, drop our tools and resort to improvisation and *bricolage* (Weick, 1993a,b; Weick, 1998; Ciborra, 1998).

Borrowing a metaphor used by Donald Schon, the world of practice is a swamp (Schon, 1987). And *down here* in the swamp things are quite different than what they look like when we watch them sitting on the high hard ground of design methods and formal theories. They do not quite fit our models and frames. *Down here* in the swamp space is not so well ordered and time is not so well sequenced. Rules are local, and only applicable in restricted domains, like in Alice’s Wonderland. It is a strange world. We can always cast a grid-like structure onto the swamp and feel contented with it, but it is like pretending to catch Proteus. The ground is either sticky or slippery and we can hardly walk. Most of the times we cannot do much else than groping and coping. The swamp is populated by strange creatures all around, having their own odd, idiosyncratic behaviors. Things are ambiguous, shifting, unique, and quite unmanageable. In such environment messy, confusing problems defy technical solution (Schon, 1987). If we want to be effective, technical rigor must be sacrificed to practical relevance (Argyris, 1980). Definitely, a “science of muddling through” seems to be more appropriate than canned planning and engineering methods (Lindblom, 1959). There is a gap between the method, no matter how smart, and the practice of designing. Methods can hardly grasp the complexities and the ambiguities of designing in action. Something is always left out of the picture.

But on the other hand, staying with Schon’s imagery, the swamp is a nurture ground for a rich variety of forms of life, innovations, and experiments. It is a land of opportunities that wait to be explored and exploited. Perhaps the swamp is not a dry and safe place as the high ground, but it is a place for discovery and invention. Indeed, there is a lot of underground skunkwork going on *down here*, and some of it can be surprisingly productive, as in-depth research of product development processes has shown (Abetti, 1997; Ciborra and Lanzara, 1994).

“Swampy” systems live on delicate microecologies that have their own equilibria, and are at the same time persistent and locally vulnerable. When this fragile web of artifacts, activities and meanings is perturbed or disrupted by the invasion or the intrusion of an “alien thing”, people suffer a displacement from their treasured objects, their familiar routines and their preexisting formative contexts, so that they must cope with ambiguity

and loss of meaning. Some kind of balance needs to be restored. The “alien” needs to be integrated — or “hosted” — into the activity system (Ciborra, 1999). But at the same time the novelty, if it is really such, opens up a space for action and reflection, eventually leading to the reshaping of the system. New activities can be started out and new “bridges” across distant domains can be built. Action is local and anticipates thought (Starbuck, 1985). We keep assembling and recombining components in an endless process of *bricolage*.

6. The logic of *bricolage*

Designing in action as a style of systems development based on *bricolage* and on local, practical experiments might meet, among other things, crucial evolutionary and systemic requirements. Making and breaking transient constructs is a way of exploring possible design worlds around existing structures without affecting the structures too much or threatening their global stability. But it is perhaps this peripheral, “innocent” design activity that in the long run causes the shifting and drifting of systems and makes large cumulative changes possible. I submit that there are nontrivial reasons why designing in action often takes the unassuming and apparently inconspicuous form of *bricolage*.

First, at the present stage of functional and structural complexity, no system can be designed and implemented from scratch. Designers start building up with the materials they have at hand. So, they start small and rely on preexisting arrangements. A large part of designing consists in transforming and reshaping what is already in use, or creatively rearranging components. A convenient strategy is to convert old components and structures to new functions and uses, as it often happens with old buildings in our cities. In this connection, some highly successful information systems resulted not from Faustian reengineering projects, but from the imaginative exploitation of inconspicuous system’s features and resources.

Second, systems assembled by *bricolage* have an evolutionary advantage: being loosely connected and incoherent assemblies of mixed components, they can be partially reworked without much investment effort. *Bricolage* is a design strategy that makes sunk costs recoverable. In case of system’s depletion, obsolescence or low performance, regeneration can be done without having to throw away the whole structure. Old resources and components can be recovered and put to new uses and functions. As a consequence, systems are persistent and robust because cannot be changed or moved easily, but at the same time keep structural plasticity and exhibit some self-correcting properties. Innovation can be accommodated locally.

Third, systems designed and reworked by *bricolage* are history-dependent. Prior system’s history constrains the ways materials and components are reassembled and reinterpreted. Thus, structures embody some kind of historicity inasmuch as they are dependent on the specific sequence of moves, events or transient constructs that lead to their construction. Similarly to what happens in architecture, old “ramparts” can be used for new edifices. Basically, new systems are built, sometimes literally, *on the ruins* and *with the ruins* of old systems. Pieces of past codes become “building materials” and have

at least as much influence on systems' behavior as the new codes. Systems do not only operate or change in time, but are literally "made with time".

Fourth, the overall generative effect of *bricolage* seems to be more dependent on interaction rather than on some overriding design rationale. *Bricolage* privileges combinatory logics, loose coupling, and garbage can processes (Warglien and Masuch, 1996). As a practice, it leaves room for both deliberate human intervention and unplanned interaction. Thus, what we call diffuse, decentralized implementation often merges and mixes with evolving ecologies of interactions, that are generators of both organization and diversity. *Bricolage* seems to be compatible both with multiple design logics and with general ideas about systems' evolution (March, 1994).

For all of the above reasons, I think, *bricolage* has a vantage point as a strategy for designing. As it exploits the properties of existing structures for interactive and generative purposes, it successfully mediates the dilemmas of change and stability, innovation and conservation. On the one hand, by experimenting with transient constructs it allows for some variability and improvisation without incurring in the possible disruptions caused by excessive instability and radical change; on the other hand, by assembling robust but furtherly manipulable structures, it allows for some order and reliability without curbing the chances for system improvement and innovation. In short, it makes both radical innovation and complete unraveling unlikely.

In a broadly diffused engineering ideology *bricolage* is usually associated with second-best solutions, maladaptation, imperfection, inefficiency, incompleteness, slowness, but as a matter of fact in many design situations it is the only thing we can reasonably do when we are engaged in action. The outcomes of it are hybrid, imperfect, transient artifacts, which perhaps do not look very elegant, have lots of bugs and gaps, frictions and unusable components, but they do their job and can be improved. Living in a sublunar, Aristotelian world populated with corruptible bodies and imperfect agents, this is perhaps all we can do and all we can aim at. Perhaps not an ambitious target for the next millennium, but wise enough, and affordable.

To put a final seal to this paper, my claim is that the design of information systems and technologies should be more sensitive to the strategic opportunities offered by *bricolage*. Information technology is part of our swampy terrestrial world; indeed, as phenomenologists would say, it "constitutes" the world. Even when they evoke the most abstract and rarefied virtual worlds, systems and technologies are far from being heavenly bodies christened with the stigma of perfection. Rather, they maintain the status of everyday things (Norman, 1998). Despite their imperfection and murkiness, or perhaps just because of them, they embody evolutionary opportunities for novel practices and forms and lead to further combinations and transformations — "shapes of a different kind" — which are innumerable and unpredictable.

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