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Abstract

Architectures of buildings influence work relationships and organizational practices. The case of building architecture can be extended to other complex instrumental systems which constrain and enable, not only the activity of local teams, but entire organizational processes, across functions. This paper explores the potential contribution of "sociomateriality" research to analyze such "architectural instruments" (e.g. integrated management information systems - ERP). It is suggested that sociomateriality analyses lack a theory of collective activity. Pragmatist authors allow conceptualizing activity as the collective production of meaning through dialogical interactions mediated by triadic signs. Beyond multiple classes of tooling, the basic mediation of activity is provided by the cultural repertory of habits, which makes situated acts recognizable, debatable, and connects them to culture. Habits are the key to adaptive repetition, but, when disrupted by unexpected situations, they trigger inquiries to reengineer them. The iteration between habit and inquiry, the two building blocks of collective activity, shapes the polyphonic narrative of what actors do together, framed by tacit narrative frames, "architextures", such as temporal-spatial frames and generic characters. Architectural instruments are "architectural" because they are "architextual", i.e. because they instantiate implicit narrative frames in day-to-day activity. Two cases illustrate these ideas: the implementation of an ERP system in an electricity company and an informal procedure to manage engineering changes in an aerospace company.

Keywords: architectural instruments, architexture, collective activity, habit, inquiry, organizational narrative, organizing processes, pragmatism, semiotic mediation.

Résumé

L'architecture des bâtiments influence les relations de travail et les pratiques organisationnelles. Le cas de l'architecture peut être étendu à d'autres systèmes instrumentaux complexes qui contraignent et habilitent, non seulement l'activité d'équipes locales, mais aussi des processus d'organisation inter-fonctionnels. L'article explore la contribution potentielle des recherches sur la "sociomaterialité" à l'analyse de tels "instruments architecturaux" (ex. logiciels de gestion intégrés ou "ERP"). Il suggère qu'il leur manque une théorie de l'activité collective, qu'il propose de conceptualiser comme production collective de sens à travers des interactions dialogiques médiatisées par des signes triadiques, en s'inspirant des auteurs pragmatistes. Au-delà des diverses classes d'instruments médiatisant l'action, la médiation fondamentale est fournie par le répertoire culturel des habitudes, qui rendent les actes situés reconnaissables, discutables, et les relient à la culture. Les habitudes sont au cœur de la répétition adaptative. Lorsqu'elles sont perturbées par des situations inattendues, elles déclenchent des enquêtes qui les reconstruisent. L'itération habitude/enquête configure le récit polyphonique de ce que les acteurs font ensemble, agencé par des cadres narratifs implicites, des "architextures", par exemple les cadres spatio-temporels ou des personnages types. Les instruments architecturaux sont "architecturaux" parce qu'ils sont "architextuels", c. à d. qu'ils instancient des cadres narratifs implicites dans l'activité quotidienne. Cette approche est illustrée par deux cas: la mise en œuvre d'un ERP dans une compagnie d'électricité et une procédure informelle destinée à gérer les modifications de produit dans une société aérospatiale.

Mots-clés : activité collective, architexture, enquête, habitude, instruments architecturaux, médiation sémiotique, narration organisationnelle, pragmatisme, processus d'organisation.

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Management systems as organizational "architextures":
the tacit narrative frames of collective activity

It is a well developed analysis that architectures of buildings, and more generally spatial structures of organizational life powerfully influence work relationships, management practices, and organization capacities, in ways which can be oriented alternately towards social control or towards emergence and inhabitants' initiative (Kornberger & Clegg, 2004). This paper will not attempt to provide an essay about the influence of architecture on work organization, but will suggest that the case of building architecture can be extended to other types of instruments engaged in work activities. Some complex systems, be them "materially material", like a building, or "virtually material", like a management system or a software, do not only influence, constrain and enable the local activity of individual users or small teams, but establish a constraining and enabling architectural framework for entire organizational processes, communication links, social relationships and collective action, across professional genres and functions. Like spatial architectures, they mediate collective activity and social organizing processes beyond local or individual forms of work. Keeping track of the building metaphor, the paper will call that type of instruments (e.g. integrated management information systems such as ERP - Enterprise Planning Systems): “architectural instruments”. The paper explores the potential contributions of recent research about "sociomateriality" (Dale, 2005; Orlikowski, 2007; Suchman, 2007) to analyze the relationship of "architectural instruments" with organizing processes and human activity, identifies some of its limits, and argues that most of those limits derive from the lack of a theory of collective activity. It then proposes a theoretical approach to collective activity, based on triadic semiotics (Peirce, 1998) and the pragmatist distinction between secondness (mechanistic action / reaction) and thirdness (meaning-making action). Activity in the first place is the collective production of meaning through semiotic mediations. It is viewed as the ongoing production of meaning through dialogical interactions, a "conversation in acts". Beyond multiple classes of tooling and languages, the basic mediation of dialogical activity is provided by the cultural repertory of habits, which make situated acts recognizable, debatable, and connected to culture and history. But habits are not only the key to adaptive repetition. They are disrupted by unexpected and puzzling situations and reengineered through inquiries. Habits and inquiries (Dewey, 1938/1993) are the two complementary building blocks of meaningful activity. The iteration between habit and inquiry - habit and habit transformation - builds a never-ending polyphonic narrative, the narrative of what actors do together and what it means to them. As any narrative, collective activity is framed by a priori tacit frames, what Genette (1979) calls "architextures", such as temporal-spatial frames, generic characters and values, critical narrative nodes. The semantic similarity between "architecture", "architectural instrument" and "architexture" is not casual. Architectural instruments, such as building architecture, ERP, accounting models, are "architectural" because they are "architextual": they convey narrative architextures and instantiate them in day-to-day activity. To illustrate these ideas, two cases will be presented: in the first one - the implementation of an ERP system in a large electricity company - the architectural instrument is characterized by a highly complex structure; in the second one - an informal procedure to manage engineering changes in an aerospace company - the architectural instruments is characterized by a very simple structure which crystallizes history and complex cultural schemes. In the light of those cases, the theoretical and practical implications of the pragmatist/semiotic view of collective activity and its architectural mediations will be discussed.

Architectural instruments

Tools and systems do not all have the same type of relationship with work activity. Some, e.g. a hammer or a photo editing software, mainly influence, constrain and enable individual or local ways of working. Others do not only influence the local activity of individuals or small teams, but establish a constraining and enabling framework for entire organizations, their social relationships and collective activities. "Architectural instruments" will be defined here as a specific type of boundary objects (Star & Griesemer, 1989; Carlile, 2002) which are not only "both plastic enough to adapt to local needs, yet robust enough to maintain a common identity across sites", "weakly structured in common use, and become strongly structured in individual site use" (Star & Griesemer, 1989: 393).

They are also *strongly* structured in cross-functional, transversal use involving conjoint (made of heterogeneous and complementary acts) activity. Thus they address cross-functional communities of users. They are not only linked with local and professionally homogeneous activities, but also with complex cross-functional and professionally heterogeneous activities, involving users with different professional backgrounds, what is often called "business processes" in the management literature (Hatten & Rosenthal 1999, Lorino 1995). They principally aim at tooling extensive processes of work across the organization. As a result, they constrain some basic characteristics of the organization, e.g. the division of labor, the structure of roles and generic profiles, the distribution of power and centralization / decentralization options, the temporal (sequential order, synchronization) and spatial (concentration or dispersion, layout principles) frames of collective activity, communication constraints and affordances (language, channels), coordination constraints and affordances (limits of capacity, shared resources...), the location of critical nodes in the work processes, etc.

The architecture of professional buildings is an obvious example of instruments which are strongly related with organizational norms. Herbert Simon mentioned that link as a challenge for architects when they plan urban development: “An increasingly acute problem for architects is that, when they take on the task of designing whole complexes or areas instead of single buildings, their professional training does not provide them with clear design criteria. In city planning, for example, the boundary between the design of physical structures and the design of social systems dissolves almost completely” (Simon, 1996, p. 151). Since Simon wrote these lines in the 1960s, research in that area tended to demonstrate that the dissolution of boundaries between the design of physical structures and the design of social systems does not only concern city planning, but the design of single buildings too, and of course the spatial design of work settings. “Just in time” manufacturing, for example, is often linked with specific manufacturing layouts, such as U-shaped integrated production cells, allowing operators to watch the whole sequence of production operations. This type of layout entails important organizational consequences: diversity of technologies entrusted to the same operator, larger physical distance between operators, tight integration and tension of the production process with the elimination of buffer inventories…. I worked in a computer manufacturing group which owned a computer factory in Lawrence (Mas-USA). It had been a textile factory, with huge spaces organized in three floors. The vertical layers, which had been functional for textile production, proved to be a permanent impediment for the highly integrated computer activity. But it was there, a physical constraint which could never be overcome, till the factory was closed a few years later. However, while the structural characteristics of the building *impact* work relations, they do not *determine* them. Here again, plenty of examples show that the same building can be used to shelter quite different types of activities with different social relationships. A massive bunker built in Berlin by the Nazi regime to serve as a shelter against allied bombings was transformed in 1945 into a jail by the Russian occupation authorities, then it was used by the East German administration to stock imported tropical fruit (hence the nickname “banana bunker”). After 1989, it became one of the trendiest night places in Berlin, for techno music and fetishist happenings. In April 2008 it opened to the visitors as a gigantic art gallery, with a penthouse apartment on its roof...

The influence of building architecture applies through a variety of mechanisms: imposition of a boundary between public and personal work space, physical trajectories preventing possibilities or imposing obligations to meet colleagues and to communicate with them, visual and auditory contacts; spatial relationships with objects and tools; stability or modular mobility of the space structure; symbolic contents of the architecture. The technological centre of the French automotive company Renault near Paris, the “Technocentre” at Guyancourt, is an interesting example. At the beginning of the 90s, Renault leaders decided to merge product and process engineering and to reinforce project management in that area. Both orientations were complementary: instead of maintaining two separate departments for vehicle engineering and process engineering, the teams would work in a much closer relationship to shorten the average time of product development and to improve the quality of the vehicles. This proximity would be reached in the framework of temporary (4 to 5 years) project structures. At the same time, Renault started the construction of a huge research and engineering centre near Paris. A group of eight internationally known architects was in charge of designing a set of buildings (almost a new city, with all the basic shops and services) to house all the engineering, design, prototyping and research activities of the company, more than 12 000 employees. The central building, the “beehive”, is characterized by a mobile modular activity. Each project for a new vehicle

is organized in a "plateau projet" (project stage), around a vertical axis with four levels corresponding to the four parts of the vehicle. The teams are organized around the vertical axis, so that they are close to each other, they frequently meet, and they can easily exchange information, opinions and proposals at any moment. Modularity and adaptability are coherent with the project orientation of the organization. The barriers between functions – in particular between product and process engineering – have been torn down. On the other side, there is no more private space and work promiscuity is permanent.

Renault Technocentre is a good example of how spatial structures and organization frame and influence each other, in a reciprocal relationship. This interaction can also be more symbolic than structural, as the main character of Sebald's novel "Austerlitz", Jacques Austerlitz, explains about the central railway station of Antwerp: "Time, said Austerlitz, reigns supreme among these (architectural) emblems (of the station). The clock is placed above the only baroque element in the entire ensemble, the cruciform stairway, just where the image of the emperor stood in the (Roman) Pantheon, in a line directly prolonged from the portal; as governor of a new omnipotence, it was set above even the royal coat of arms (…) The movements of all travelers could be surveyed from the central position occupied by the clock in Antwerp station, and conversely all travelers had to look up at the clock and were obliged to adjust their activities to its demands. In fact, said Austerlitz, until the railway timetables were synchronized, the clocks of Lille and Liège did not keep the same time as the clocks of Ghent and Antwerp, and not until they were all standardized around the middle of the 19th century did time truly reign supreme" (Sebald, 2002: 12). The station architecture puts the clock at the central place occupied by the emperor's statue in Ancient Rome, as the new deity of triumphant industrial capitalism in the 19th century: it is not really a physical constraint, but a strong symbol embedded in the building structure and in the railway organization.

There are many other examples of architectural instruments, as defined here: "instruments which frame complex cross-functional and professionally heterogeneous activities; involve users with different professional backgrounds and extensive processes of work within the organization; and constrain basic characteristics of the organization". Integrated management information systems, or ERP[2], are a good example. ERP integrate the different management applications around a unified data base system. It is based upon the principles of unique data entry and data sharing by the multiple functions involved in the same business process. For example, the production planning process starts with sale orders data. The commercial order entered by salesmen defines the product code, the quantity, the delivery date. The order will be transformed into a production order, then into purchasing orders for components, into inventory input/output vouchers, into a final delivery order, into a bill, into a customer payment receipt and into multiple accounting transactions. Quantity and product code will not be re-entered in the process: they "travel" all along, through the commercial, production, purchasing, inventory management, accounting and distribution departments. To accomplish this process-oriented data integration, ERP are based upon standard process models, standard sequences of activities and transactions, e.g. the production process, the purchasing process, the distribution process, the accounting process, the project management process, etc. The same set of data involves users coming from different professional areas, who share the same information, and as a consequence the same possible problems (errors, missing data, data ambiguity).

The architecture of a building constrains the physical moves of actors, their opportunities to meet, and the boundary between common and personal space, but it leaves some freedom for deliberate decisions to meet or not, for time schedules in the way of using the building, and in the assignment of spaces to concrete actors. In the same way, ERPs define obligatory information transactions and connections between transactions. One data is entered only once; specific treatments must use data as defined previously through other application modules by other professional actors. But it leaves free space to assign transactions to concrete categories of actors and to define time constraints. Other examples of architectural instruments can be found in all the cases of integrative software applications, supply chain systems, for example. The accounting system itself can be considered as an architectural instrument in many aspects: it divides the organization into smaller entities – costing centers which are often also responsibility centers; it defines links between activities and actors, for example by selecting cost drivers and cost allocation keys. Whether the cost of maintenance management is

[2] Enterprise Resource Planning

assigned to factories or to a maintenance department, the behavior of manufacturing teams may change significantly. Another example of architectural instrument is the “capability maturity model” (CMM) (a registered service mark of Carnegie Mellon University), studied by Paul Adler (Adler, 2005). CMM is a development model inspired by Total Quality Management, which defines a set of process areas and practices (key process areas*:* clusters of connected activities that must be performed together to achieve important goals; key practices: practices that contribute most effectively to the implementation and institutionalization of the key process areas). It was first released in 1991. It actually models the development process. It focuses on the processes rather than on people: it describes what should be done, leaving space for concrete implementation styles (who should do it, and how precisely). Standard processes do not constrain development tasks only, but also the coordination and communication links between tasks.

Architectural instruments and conjoint activity

Architectural instruments are involved in collective activity. There are two classes of collective activity:

(i) "common" activity, i.e. activity involving actors who do similar things, belonging to the same type of practice and competence, linked with the history and the social institutionalization of professions, involving professional rules, tools, education systems; such classes of practices were analyzed by work psychologists as professional “genres” (Clot & Faïa, 2000) or by sociologists as communities of practice (Lave & Wenger 1991), in which actors practicing activities of a given professional “genre” hold and learn together thanks to shared professional norms and values. For example, the generic “accounting” activity is a professional genre, which requires educated accountants, obeying the legal and informal rules of the accounting profession. The members of such communities are brought together by a form of social solidarity to which Emile Durkheim refers as “mechanical solidarity” (Durkheim, 1893); mechanical solidarity binds the members of a group through common values and beliefs.

(ii) "conjoint" activity, i.e. activity involving actors who do different things, belonging to distinct types of practice and competence; individual acts are defined in a complementary way and must be combined into a "process" to pursue a global purpose. Actors practicing the distinct activities of a given "process" hold together and cooperate due to a common imperative of survival. They are brought together by a form of social solidarity based on action necessity, to which Emile Durkheim refers as "organic solidarity" (Durkheim, 1893). For example, in a boat, no matter how far the members of the crew share common values, they must cooperate and ensure a certain level of mutual trust if they want to overcome the difficulties of the sailing. In organic solidarity, the society, structured by the division of labor, is a system of distinct roles united by definite relationships. Individuals develop their personality and their specific competences, at the same time as the group develop forms of cooperation between different contributors For example the combination of some precise accounting activities with other activities necessary to achieve procurement operations (purchasing activities, quality control activities, inventory management activities) is a processual group of activities, the “procurement process”. Processes are not “common” collective activities, but rather “conjoint” collective activities, i. e. collective activities in which heterogeneous practices cooperate to reach some global result.

De facto if not deliberately, the users of an architectural instrument are linked by cross-dependency links. To be able to use the instrument in a satisfactory – or at least viable - way, the users must cooperate, because they are "on the same boat", in ways which are not always "natural" or "mechanistic", in Durkheim's terms, since they belong to different professional communities.

Common collective activity must often deal with the institutionalization of professional “genres” and common practices (education systems, professional regulations, professional associations...). Conjoint collective activity does not generally have a strong institutional expression, but is closely related with the organization design and it must deal with fundamental formal and informal characteristics of the organization, such as division of labor, power delegation, coordination practices, communication channels, information systems and incentive systems.

Architectural instruments and "sociomateriality"

Adopting a process view of organizations (Weick 1979, 1995, 2001; Chia, 1996; Cooper, 2007; Nayak, 2008; Shotter, 2006 & 2008; Tsoukas, 2005; Tsoukas & Chia, 2002; Yoo & al. 2006), the key research question about architectural instruments is: what are the specific role and position of architectural instruments in the organizing process?

Architectural instruments, be them "materially material", like a building, or "virtually material", like a management system or a software, are a particular example of materiality. They oppose a form of material resistance to human agency. The importance of materiality in the life of organizations has been stressed by many authors in the recent years (Dale, 2005; Knorr Cetina, 1997; Latour, 2005; Orlikowski, 2007, 2010; Suchman, 2007) or earlier in the social studies of science and technology (Callon, 1986; Rheinberger, H.-J., 1992; Winner, 1980/2004). In diverse ways, those authors analyze the "constitutive entanglement" of sociality and materiality in the organizing processes: "Materiality is integral to organizing, positing that the social and material are constitutively entangled in everyday life. A position of constitutive entanglement does not privilege either humans or technology (in one-way interactions), nor does it link them through a form of mutual reciprocation (in two-way interactions). Instead, the social and the material are considered to be inextricably related – there is no social that is not material, and no material that is not social" (Orlikowski, 2007: 1437). Research about "constitutive entanglement of sociality and materiality" (Barad 2003), "sociality with objects" (Knorr Cetina 1997), sociomateriality (Orlikowski 1997), human and non-human actants (Latour 1987), "affiliative objects" (Suchman, 2005), make a major contribution to the understanding of materiality involved in activity. In particular, they deconstruct the traditional and simplistic views of materiality and sociality as two separate dimensions, interacting one way or another (social forms determined by material and technological artifacts, or practical effects of material artifacts determined by human and social intentions). These views have seriously hampered reflections about artifacts, techniques, and tooling. Architectural instruments are archetypal examples of constitutive entanglement, since they are simultaneously entwined with individual and local ways of working, communication links, division of labor, spatial and temporal organization of collective activity, many distinct forms of complex social connections.

However sociomateriality research meets limits on three points: it does not completely succeed in overcoming epistemological dualism; it generally lacks a theoretical view of action; it sometimes uncritically adopts an individualist/subjectivist view of human/object relationship.

The critique of social/material dichotomy is uncompleted

It proves a difficult task to overcome dualism in its many forms (social versus material, human agency versus material agency, routine versus technology, subjective versus objective). On one side authors voice relevant critiques against the dichotomy social / material and reject it, but on the other side they keep on using the words and the categories "social" and "material". To overcome the dichotomy, they significantly propose a vocabulary which often expresses the simple addition of social plus material: "sociomateriality", "sociality with objects", as if it was more about "rethinking the dualistic relationship between the social and the material" (Dale, 2005: 655) than radically questioning the dichotomy by suggesting conceptual alternatives. All the figures of addition, combination, interaction, intertwining, or even entanglement, of social and material, or human and material, still leave the social and material categories reign over the field, though they may be described as closely linked and impossible to separate: "embodiment is neither ideas nor matter, but both at the same time" (Dale, 2005: 656). If, as Orlikowski rightly observes, "a position of constitutive entanglement does not privilege either humans or technology (in one-way interactions), nor does it link them through a form of mutual reciprocation (in two-way interactions). Instead, the social and the material are considered to be inextricably related – there is no social that is not material, and no material that is not social" (2007: 1437), then why still using the words "social" and "material" or materiality": "the deep intermingling of materiality within practice" (Orlikowski, 2007: 1446)? Is it satisfactory to offer, as an alternative concept to the dichotomy "social versus material", just the addition of "social plus material"? Admittedly it is a first huge step to assert that sociality and materiality are two dimensions of the same "sociomaterial" thing, but we need a second step which explores what this "sociomateriality" is made of. If we want to invent the tools of a new intelligibility, we cannot stop at this kind of syncretism.

Not surprisingly such incomplete critique gives way to the periodic reemergence of dualism under diverse forms. Leonardi, though criticizing dualism, maintains the dichotomy between "human agency" and "material agency" as a building block of his reasoning: "scholars are beginning to recognize that people often enact their human agency in response to technology's material agency (Jones 1998, Pickering 2001; Volkoff et al. 2007)" (Leonardi, 2011: 148). In this he follows Taylor et al. (2001: 71): "(Taylor and colleagues) argue that although human and material agencies both influence people's actions, their influence is disproportionate because human agency always has a 'head status' while material agency has a 'complement status'". Kornberger and Clegg (2004) criticize the functionalist theories of architecture, according to which functions determine forms. They propose to reject such dualist views, but occasionally they tend to reverse the functionalist view into a symmetric dualism: "it is not strategy that determines structure; rather new functions evolve from forms" (1102), or (1106): "Reduced to a formula, in modern architecture form follows function; in the architecture of complexity, this image is reversed, as form evokes function (Venturi 1966: 34)." They seem to reduce the fundamental issue of function/form integration to a question of chronology: "Speaking generally, new competences and new functions emerge after (at best, during the process when) the organ is assembled with other elements" (1102). "After" or "during" is not the same theoretical option at all! The co-emergence of function and form is much more than an issue of temporal simultaneity. Dualism can also take the form of the "routine / technology" dichotomy, wherein routine appears as the mark of social practice and technology the form of materiality: "If a person has the option of changing a routine or changing a technology, how does she decide which one to change?" (Leonardi, 2011: 152).

The lack of action theorizing

One possible source of difficulty to overcome dualism is the lack of definitions and, as a result, the lack of conceptualization of notions which nevertheless play a major role in "sociomateriality" research. It is paradoxically hard to find any definition of "materiality" in those studies. Obviously materiality, often identified with technology, and sometimes illustrated by the example of information systems, should not be understood in the narrow sense of "physically material", solid, liquid or gaz. We are rather induced to understand that "materiality" refers to some being whose shape can resist human agency and requires significant time and resources to be transformed. But this interpretation is probably debatable and might be contested by many of the quoted authors. There remains the fact that the reader is tacitly left free to imagine some kind of definition.

However the more pressing lack of definition concerns the conceptual and semantic field of action: what do "action, acting, doing, activity, agency" mean? It seems taken for granted that "acting" has a straightforward meaning, imposed by common sense and daily conversation. This obviousness is very doubtful. "Action", "acting" and "agency" are problematic notions. The issue shows on the surface when Leonardi proposes definitions for "human agency" and "material agency": "Human agency is typically defined as the ability to form and realize one's goals (Emirbayer & Mische, 1998; Giddens, 1984)" (Leonardi, 2011: 147); "material agency is defined as the capacity for nonhuman entities to act on their own, apart from human intervention" (Leonardi, 2011: 148). The reference to "goals", essential in the definition of human agency, disappears from the definition of "material agency". This means that, in the first case, the concept of "agency" is associated with finality or purpose, but not in the second case. I believe it is a major theoretical issue to know if the word "agency" points to the same concept in both occurrences, and, this being not the case, if we can still use the same word? In a similar vein, what does "do" mean when Leonardi (2011: 151) quotes Cooren: "As Cooren (2004, p. 377) suggests, 'to say that nonhumans do things...'" (151).Does the word "does" mean the same when we observe that, "by bringing light during the course of the day the sun *does* something" and "by designing a new type of photovoltaic cell, the engineer *does* something to develop renewable forms of energy"? Or when we say: "what *does* a mixture of hydrogen and oxygen in presence of a sparkle?" or angrily addressing a colleague: "what do you think you are *doing*?" Should we identically speak of "action" and "agency" in both cases?

This may sound as a very old philosophical debate about intentionality. Actually, more than intentionality, which would orientate the discussion towards a psychological issue (intentional or unintentional action of a subject), it is suggested here to reformulate the question as an issue of

meaning, on an epistemological level: does the concept of "action" involve some type of "meaning-making" or "purposing", or can a pure mechanistic/physical action/reaction phenomenon be labeled as "action", as much as purpose-oriented, meaning-making move? Organization literature seems to oscillate between both positions. Actor Network Theory tends to consider action as anything which transforms the world, deliberately discarding the debate about intentionality, to overcome the millenary subject/object dualism. But Leonardi (2011: 153) quotes Markus & Silver (2008: 620): "because *action is goal-oriented*, it is neither required nor appropriate to describe objects and affordances in a reductionist fashion". The alternative to definitions of action as "anything which transforms the world" does not necessarily have to be psychological, subjective, and intention-oriented. Merleau-Ponty shows us the way: "Merleau-Ponty 'identifies social, embodied action with the production of meaning. Meaning is not produced by a transcendental or constituting consciousness but by an engaged body-subject' (Crossley, 1996: 101)" (Dale, 2005: 656).

Focus on individual subjects

To overcome the social (or human) / material dichotomy, research tends to focus either on social abstract subjects, or on individual subjects. In the first case, the subject of action, often implicit, is some abstract "society", "organization" or "group", holistically involved in the relationship with material artifacts. In the second case, individual subjects interact with material artifacts in concrete situations, in "man-material" face to face encounters. This second option is more effective to study actual situations and develop an empirical work. It allows using concepts and theories built by psychologists interested in the subject's interaction with materiality, such as Gibson's affordances (Gibson, 1986), or Vygotsky's cultural-historical mediations (Vygotsky, 1986). Such themes as body/mind relationship, space perception, consciousness, Self, are important for organization studies and find invaluable sources of inspiration in philosophers (James, Bergson, Mead, Heidegger, Merleau-Ponty). Nevertheless organization research is about organizations, and it is highly questionable if social or organizational dimensions can be built from subjective building blocks. The question is all the more pressing when the forms of materiality to study are what was called above "architectural instruments", i.e. artifacts which by definition involve complex organizational users, and entwine, not only with personal behaviors, but with coordination links, communication modes, division of labor... It is not suggested to restart the everlasting debate in social sciences between individualism and holism. Collective activity is not a sum of individual activities. It is not either the activity of a holistic collective subject, which would aggregate individual subjects into a common being, characterized by *shared* ways of moving and thinking It will be suggested further that dialogism may be a way out of this aporia.

Towards a triadic theory of collective activity, as a dialogical and mediated narrative

Action as meaning-making: Peirce's "secondness" and "thirdness" categories

Non-human objects or devices have practical effects on the situation, in ways which are partly unpredictable and uncontrollable for "human actors". They “resist” social and human intentions. The driver cannot start the engine if the safety belt is not fastened (Latour, 1993). But can this capacity be labeled as “agency”, and the corresponding moves as "action"? It depends on how “action” is defined in relation with meaning. Latour insists that "actant" does not involve any content of intentionality. However, with this argument, he locates the discussion at a psychological or subjective level (the level of subjective intentions), and he aims at discarding psychological approaches. But the discussion can take place at another level, a semiotic level: does "action" or "agency" involve meaning-making (rather than intentionality), i.e. reference to some generic scheme of meaning which allow projecting into the future, beyond the immediacy of observable moves, be such schemes subjective (individual interpretation), social (cultural schemes), dialogical (emerging from a controversy), etc.? Leaving any psychological consideration aside, does the word "action" mean the same when it points to rough and immediate / immanent physical action / reaction (the fall of my pen, this fall of this pen in this moment in this place, a unique event) or to meaning-making action embedded in a continuous meaning-making

temporal process (the law of gravity applied to my pen)? This article adopts Merleau-Ponty's view, that action is not only *linked with* meaning-making, but that it actually *is* meaning-making.

Pragmatist philosophy provides us with a useful theoretical tool to help defining "action" and "agency". In his semiotics, Peirce (1932-1935) distinguishes two distinct concepts of action. One is "secondness", or the mechanistic action-reaction couple. An object falls into water, just in front of me, and there are circular waves. This "secondness" concept may be linked with Aristotle's concept of "efficient causation": the object is the causal origin of an event, without any mediation by interpretive habits. The other concept of action is "thirdness", which implies a third element, a purposeful way of meaning-making (A represents B for / with respect to C), which contributes to the shaping of the act. The act then is not only a "brute transformation of the world", but also *a sign*. When I cut logs for next winter, there is no fire yet, but I am imagining the fire in the chimney, there is such an anticipation in the action in-progress (cutting logs) and this anticipation / projection into the future is required for the situation to make meaning - my efforts to cut logs is not just a crazy act, it makes meaning because of this projection into the future - be this projection of a psychological nature, my thought, or any other non-psychological form of interpretant (the image of someone cutting logs can be used as a symbol of winter preparation, as well as the image of an ant storing twigs). The interpretant (the generic meaning, socially constructed) of action cannot be separated from action itself, because it governs the dynamics of action and its becoming. For example, some neighbor may propose to help me to cut logs, or my wife will remind me that the chimney should be cleaned if we are to use it in a few weeks. These others' actions take place and do not surprise me because my own action is meaningful, for me and for the others, and their action responds to mine. A situated action is linked with past and future and others' action through its meaning. Acts can combine into a conversation and into a narrative - into a conversational or dialogical narrative, a narrative emerging from a partly improvised dialogue, like the South American "payadas", in which two poets and singers, the "payadores", improvise responding to each other in rimes and developing a story, for hours, sometimes for days. Here, log-cutting, neighbor's help, wife's reminder, build the narrative of winter preparation. A purely psychological reading would obviously be a reduction, since the *meaning* making process has a clear social, cultural and dialogical dimension.

If a word or, more generally, a generic meaning, is put on a situation – e.g. waves on the surface of water are labeled as "waves", this is no longer secondness but thirdness. The act – e.g. the use of a word in a "speech act" or of an instrument in a "tooled act" - points to a purpose - not necessarily a psychological goal, but some meaning-making habit - in a singular situation. The piece of wood is made to mean "log", well before using it as a log, by the specific meaning-making perspective (winter is cold, it will require fire, fire requires logs..., but it also requires clean chimneys, etc.), and this meaning plays an integral part in the situation, which is unintelligible without it. Other ways of acting with the instrument could be invented with different meaning making perspectives. The purpose can be vague, the meaning-making process is not necessarily attributable to any human individual subject, but there is a distinction between purpose-oriented meaning-making – thirdness – and structural "raw" reaction (physical action - reaction) - secondness: "'Secondness' = brute action of one substance on another, regardless of law or of any third subject; 'thirdness' = the mental or quasi-mental influence of one subject on another relatively to a third" (Peirce 1932-1936, 5.469)[3]. Peirce illustrates the importance of the "thirdness" category with the example of gift: "brute action is secondness, any mentality involves thirdness. Analyze for instance the relation involved in 'A gives B to C.' Now what is giving? It does not consist [in] A's putting B away from him and C's subsequently taking B up. It is not necessary that any material transfer should take place. It consists in A's making C the possessor according to *Law*. There must be some kind of law before there can be any kind of giving - be it but the law of the strongest. In A's putting away B, there is no thirdness. In C's taking B, there is no thirdness. But if you say that these two acts constitute a single operation by virtue of the identity of the B, you transcend the mere brute fact, you introduce a mental element" (Peirce 1932-1936, 1.26). The concept of "giving", which is not observable per se (what people are "visibly doing" is just A putting B away and C taking B up), is a key component of the situation and a link with past (maybe we have some explanation of why A gives B to C) and future (normally C should not propose to pay A). The

[3] for Peirce's "collected papers", this article adopts the tradition of referring to parts / subparts rather than to page numbers.

intelligible situation is not made of human actors A and C and a material artifact C, but of human actors A and C, a material artifact C and the habitual concept of "giving".

Thirdness implies some purposeful anticipation of the future: "If a pair of dice turns up sixes five times running, that is a mere uniformity. The dice might happen fortuitously to turn up sixes a thousand times running. But that would not afford the slightest security for a prediction that they would turn up sixes the next time. If the prediction has a tendency to be fulfilled, it must be that future events have a tendency to conform to a general rule. A rule to which future events have a tendency to conform is *ipso facto* an important thing, an important element in the happening of those events. This mode of being which *consists*, mind my word if you please, the mode of being which *consists* in the fact that future facts of Secondness will take on a determinate general character, I call a Thirdness" (Peirce 1932-1936, 1.26). Thirdness is closely linked with the dynamic view of action as an emergent and never ending meaning-making process: "We constantly predict what is to be. Now what is to be, according to our conception of it, can never become wholly past. In general, we may say that *meanings* are inexhaustible. When a person *means* to do anything he is in some state in consequence of which the brute reactions between things will be molded [in] to conformity to the form to which the man's mind is itself molded. Not only will meaning always, in the long run, mould reactions to itself, but it is only in doing so that its own being consists": meaning is action and action is meaning, as suggested by Merleau-Ponty. Peirce goes on linking meaning with the capacity to develop purposeful action in time: "I call this element of the phenomenon the element of Thirdness. It is that which is what it is by virtue of imparting a quality to reactions *in the future*" (Peirce 1932-1936, 1.343).

Materiality as a triadic sign

Material artifacts only exist as elements of a situation of action if they are taken into account and included in the situation in some meaningful way, i.e. loaded with some practical meaning, i.e. anticipated effect, what Gibson defined as an affordance: "In Gibson's formulation, people do not interact with an object prior to or without perceiving what the object is good for" (Leonardi, 2011: 153). "As (Gibson) suggests, the physical (or material) properties of an artifact exist apart from the people who use them, but they are infused with meaning 'relative to the posture and behavior of the animal being considered' (Gibson, 1986: 127-128)". The relationship between actors and material artifacts then is not a dualist relationship between "human" or "social" intentions and "material qualities", but the construction of a third, under the form of affordances: "What we perceive when we look at objects are their affordances, not their qualities" (Gibson, 1986: 134, quoted by Leonardi, 2011: 153). Thirdness can be identified with semiotic mediation: "Thirdness is the same as mediation" (Peirce 1932-1936, 1.328). Mediation is an integral part of the sociality of action for Mead: "in a thought process there has to be some sort of a symbol that can refer to this meaning, that is, tend to call out this response, and also serve this purpose for other persons as well" (Mead 1934: 146). Mediation ensured by words, tools, or other forms of expression is the condition of reflexivity and human agency for Vygotsky: "Man (has) no more power over his own behavior than the power that things have over his behavior. But man subjects to himself the power of things over behavior" (Vygotsky 1997: 212).

However organization research to some extent is haunted by a major ambiguity about the meaning of "sign" and "semiotics", and some confusion between the dyadic structural tradition of Saussure and the triadic pragmatist tradition of Peirce. Saussure (1913) defines a sign as a signifier/signified dyad. In the Saussurean or structuralism tradition, "interpreting" means producing dyadic signs (signifier / signified), in which a physical signifier (sounds, words) is conventionally linked with a signified concept, with no reference to any practical, purpose-oriented context of action. The meaning of a sign is considered to proceed *exclusively from its relationship with other signs within a socially established syntactic system*. This idea of situations governed by socially established grammars gave birth to structural theories, e.g. in ethnology (Levi-Strauss, 1969) or in literary critique (Greimas, 1970, 1985). They tend to be de-constructive, flat and immanent (the structure endogenously determines its own evolution). In the same period (he died in 1914), Peirce proposes a triadic theory of interpretation, in which a sign is a thing which stands for something *to something*, "*in some respect*", not a representation of..., but a representation of ... *to/for*... Any mediation refers to an object O of the world, but associates it, not with *one* signifier A, but with *two* signs, "B represents O in respect of A", or,

more dynamically, "A *makes* O mean B". Interpreting is a dynamic process, a move from O-A to O-B, and then to O-C, etc., in a cascade of interpretive moves, a *semiosis* (Peirce, 1931-1935: 5.484; Eco, 1994), process of meaning embedded in the process of action (and vice versa). The meaning of a sign does not lie in its syntactic relationship to other signs but involves the social, situated and oriented context of its use. Furthermore, meaning is always oriented towards action (in the broad sense of purposeful transformation).

The triadic mediation links the singular here-and-now objects to generic categories "in some respect", for some purpose of transforming the situation (e.g. for survival). As a result, mediations simultaneously belong to the situated experience and to social categories of meaning ("*genres*"). The involvement of genres in actual situations allows the simultaneous transformation of situations and of generic meanings themselves. For example, the meaning of a word is simultaneously (i) a common and relatively stable reference, used in conversations, to make meaning emerge and transform the situation, (ii) ever-evolving through its situated uses in "speech acts". Semiotic mediation transforms singular situated action into thinkable, recordable and debatable issues.

In pragmatism, semiotic mediation involves categorizing, not as a static classification, but as a door open to new relationships to other objects. That is why, in the relationships: "cut wood = log", "log = fire", "fire = heating in winter", the sign "=" does not reflect static, syntactic equivalences ("log" belongs to the given class of "cut wood", "log" belongs to the general class of "fuel for the chimney", "fuel for the chimney" belongs to the given class of "heating means", etc.), but *active* constructions in the situated process, toward some habit of action: cutting logs before winter makes "wood" mean "logs"; it makes "logs" mean "fire"; it makes "fire" mean "heat"... Those meanings are not plans. They may unexpectedly emerge from the situation, and they are always embedded in the activity in progress. From a temporal point of view, mediation embodies past and future projected into present. From a spatial point of view, mediation makes distant events and things present in the process. The mediating signs are inhabited by a crowd of other past, future or distant acts. “There are no neutral words and forms; language has been completely taken over, *shot through with intentions and accents* (…) All words have the taste of a profession, a genre, a tendency, a party, a particular work, a particular person, a generation, an age group, the day and hour” (Bakhtin 1981: 293). In the same way as objects are "infused with meaning" for Gibson (1986: 128), Bakhtin stresses that mediating signs are "infused with purposes", far beyond the boundaries of the visible setting.

Pragmatist approaches, or adjacent theories like Bakhtin's theory of discourse and Vygotsky's psychology, use the theory of semiotic mediation to overcome the dilemma between the social determination of situations and the immanent and unpredictable syntaxes of situations. Local situations are always mediated by socially and culturally built systems of mediation (language, tooling), which do not determine meanings, but influence them by generating constraints and affordances. The boundaries of the situation are themselves constructed by action and its meaning. For example, are the designers of the used technological devices part of the action setting? There is no essential response to this question, but just practical options which will influence the scope of possible action. If designers are part of the situation, the scope of meaning making and inquiries will be broader.

Any object loaded with meaning is by itself a sign, and any perceivable sign (word, text, gesture, form, tool, etc.) has a material existence (visual, graphic, sound, physical shape, etc.). "Sociomateriality" does not appear then as a (1+1) addition or "intermingling", but rather as a triadic A↔B for C, the enactment of a relationship *through and for the emergence of a third*. For example, the relationship between a technological object and its situated use is mediated by the experience/culture/history-based habit of what is expected from its involvement in the situation: "beyond their utility or even relatively straightforward symbolic value, objects have an ability to stand in for or mediate a variety of social relations through, for example, the reciprocity of the 'gift', fetishism, monetary exchange, commodification, performativity and incorporation into self-image" (Dale, 2005: 653).

Habits as the language of action

Peirce extended the notion of sign from words to anything interpreted, including acts. He defined *habits* as the "ultimate intellectual interpretant" (Peirce, 1992-1994: 431). Habits connect the

singularity of any particular experience with socially built classes of meaning: "The habits must be known by experience which however exhibits singulars only. Our minds must generalize these (...). The intellectual part of the lessons of experimentation consists in the consciousness or purpose to act in certain ways on certain conditions" (Peirce, 1992-1994: 549-550). Habits can generate routines, but they are not routines. They are predispositions to act in certain ways "on certain conditions", dynamically emergent resources for action, in permanent adaptive transformation - in the same way as the meaning of words continuously evolves through their situated uses and does not identify with the static routine of dictionary definition. Habits then appear as partially stabilized and socially shared fields of meaning which achieve a semiotic segmentation of the continuum of real action to make meaning of it. They are syntactically connected by the practical syntax of action: coordination, synchronization, sequencing, complementarities and exclusions, etc. They make action socially recognizable: others can recognize what one is doing in relationship with their experience and their expectations. Through habits action is made expectable, submitted to critique, object of communication, memory and transformation, functions which are similar to the functions of language in discourse. Habits appear as "the language of action".

Collective activity, a dialogical process

Collective action is inherently dialogical (Bakhtin, 1986). By dialogism Bakhtin (1984) means that there are explanations of the world that emerge in the zone of contact between multiple consciousnesses (Bakhtin 1984): "constantly and intensely, we watch and capture the reflects of our life in the plane of other people's consciousness" (Todorov 1981: 146), "truth is not born inside the head of an individual, but between people collectively searching for truth, in the process of their dialogic interaction" (Todorov 1981: 149). For Bakhtin, no utterance, no speech, no sign, can be attributed to the speaker alone; it is the product of interaction between interlocutors and, more broadly, the product of the whole complex social situation. "Speech – as in general any form of sign – is inter-individual. Whatever is said, is outside the 'soul' of the speaker and does not belong to him alone. The speaker has rights on the speech, but the listener has also his rights, and the voices which resound in the author's words also" (Bakhtin quoted by Todorov 1981: 83). Following a path opened up by Bakhtin himself when he notes that "human act is a potential text" (Bakhtin, 1986: 107), we extend his concepts of utterance and dialogue to *acts* as utterances and *collective activity* as a dialogue between acts: every act responds to acts. For ethnomethodologists too, the main form of 'textual' expressions in organizations is activity itself.

Each act is addressed to concrete actors or to the "generalized other" (Mead, 1934), and is partly molded by previous acts, historical occurrences of habits, expected future acts, etc. The dialogical view of activity allows overcoming the endless opposition between methodological individualism and holism. The building block of collective activity is interactional and dialogical. The first step of sociality is not A+B, but A↔B (for and through C), i.e.: A builds herself/himself in the relationship with B, and reciprocally, through the mediation of C. The dialogical view of collective activity is close to Mead's "conversation of gestures" (1934/1992), Dewey and Bentley's "transactions" (1949) and Vygotsky's "internalization and externalization processes" (1986). The dialogical view brings to light the limits of the hierarchical notion of "level" (micro / macro, social / organizational / team / individual) according to which micro-relationships "inherit" from macroscopic determinations: "At this level of analysis (of social groups), it doesn't matter how much variance there is in the use of the technology at the individual level, so long as differential use does not impede a group from achieving a shared objective. One might expect even less variation at the organizational level of analysis" (Leonardi & Barley, 2010: 37). The separation between hierarchical levels, more and more aggregated from micro / individual / situated levels of action to macro / social, does not hold in a dialogical perspective. Cooperating to achieve a shared objective does not mean that individuals share similar practices. From a social point of view, their differences are as meaningful as their similarities. Due to the division of labor, the achievement of a social objective generally requires the joint activity of different "genres" of activity, and this diversity - heterology in Bakhtin's terms, is the engine of development and transformations. It takes place, neither at the individual level, nor at a social or organizational level, but within the configuration of cross-professional conjoint activity, where the actual utilization of architectural instruments takes place. For example, purchasing some service or

some part for the maintenance of nuclear power-stations requires the joint activity of maintenance managers and technicians, purchasers and accountants. They may all use the same purchasing management software, but they do not do the same or not even similar things with it. The shared objective of the group requires distinct activities. This level of joint activity requires horizontal, cross-professional dialogues rather than vertical, "Russian doll" models of aggregation/disaggregation. Collective activity does not only raise issues of "what is socially shared", "what is institutionalized", but also issues of "what cooperates with what, and how", across distinct practices and institutions (e.g. across the normal practices and legal / commercial rules of purchasing, the normal practices and legal norms of accounting, the technical and physical rules of maintenance).

Dialogism and mediation are closely linked. Dialogism is not a purely intuitive inter-subjectivity. In the first instance, dialogues are more intertextual than intersubjective. They relate texts, speeches, acts, and all kinds of signs, rather than psychological subjects: “dialogical relations constitute a special type of semantic relations, whose members can be only complete utterances, *behind which* stand (and in which are expressed) real or potentially real speech subjects, authors of the given utterances” (Bakhtin 1986: 124). No dialogical process can take place without actors sharing a "common ground, (...) to reduce the distance between I and Other(s)" (Markova 2003a: 253) and a common language: “The connection between the “I” and the “you” consists of the participation in a common linguistic world” (Cassirer 2000/1942: 52). On the other hand, dialogical meaning-making requires a genuine plurality of voices and genres and the expression of differences. Bakhtin speaks of "alterity" (1984: 287), Tsoukas of "group heterogeneity" (2009: 954), Markova of "mutually experienced strangeness" (2003: 257): "the lack of consensus keeps the dialogue going" (Markova 2003: 256). The coexistence of, and conflict between, different types of speech and action brings about dynamic contradictions between belief systems.

Collective activity, a narrative process made of habits and inquiries

Collective activity is exposed to the permanent disruptive potential of unpredictable situations (Suchman, 1987: 50; Dewey, 1938/1993: 73), which destabilize habits and look unintelligible. Then actors must start an inquiry (Peirce, 1992-1994; Dewey, 1938/1993) to adapt or rebuild habits: "As Horgen et al. (1999: 197) observe, 'The ambiguous, incomplete work environment seemed to lend itself to tasks of collaborative inquiry in which problems were unclear and needed to be framed and where data were being explored whose meanings were as yet unclear'" (Kornberger & Clegg, 2004: 1105). Micro-disruptions occur more or less permanently, and the maintenance of collective action requires a myriad of underlying and unnoticed inquiries (Garfinkel, 1967; Fox, 2006). Sometimes some major disruptions call for more visible and longer inquiries. Collective action thus closely intertwines the adaptive use of habits and situated inquiries to rebuild the meaning of action, in the same way as discourse combines the conventional meanings and the contextual understanding of words to make sense. Like discourse then, collective action is a situated and dialogical production of sense, for the Self and for others, entailing some expectation about next future and some mutual intelligibility. Even without discursive explanations, action tells a story: "that is what we are doing together", "that is what *I* am doing as a contribution to what *we* are doing", "that is how what I am doing contributes to a purposeful collective process". Collective activity is a specific type of discourse: a narrative discourse (Lorino & al. 2011, Lorino & Tricard, 2012). It is a narrative *per se*, in acts, even if it does not involve narrative objects (Boje, 1991 & 1995). Acts are the elements of a multi-author narrative. The process of meaning is the process of acting itself. The operator on a building site, handling an excavator; the engineer designing a mechanical system for a new automotive model in a CAD-CAM system; the jazz musician, playing saxophone; the football player, dribbling with the ball; the surgeon on the operating theater, using his instruments; all mean what they do by doing it, and this meaning is hopefully understood by other operators, engineers, musicians, players, nurses, through habits (repertories of gestures, mimics, object utilization). In this discursive view of action, acts are not only *operations* which transform the world, corresponding to Peirce's concept of "secondness" action / reaction (1931-1958), but they are also meaning-making *signs* ("thirdness") which point to socially and culturally built meanings (habits), across time and space, with a potential for expressivity, memory, communication, space and time structuring.

Collective action is characterized by roles and characters, temporal and spatial narrative frames, action purpose, archetypes, critical nodes. Through recognizable signs (for example, the use of technological or material artifacts), situated acts are linked to habits. Habits are the building blocks of organizational meaning-making narratives, striving for some purpose (satisfying the customer, starting the new product, as in other genres the narrative strives for the princess' liberation or the discovery of a treasure). The ongoing collective activity permanently produces at the same time concrete transformations of the world and narrative meanings. The meaning-making dimension is not an appendix to action, which should be added either ex ante, as in the classical "planning view" (actual action appearing then as the implementation of a priori decisions and plans), or ex post, as in Weick's (2001) retrospective sensemaking. Meaning-making is not even "embedded in" action, but it *is* action, and this process of acting/meaning-making is the organizing process itself.

So-called "sociomaterial" artifacts point to habits. They are associated with habits which permanently infuse situations. But they also trigger inquiries, when they oppose an enigmatic resistance to habits and so-to-speak "betray" their usual meaning. The narrative view is inherently dynamic, always in the making, unlike structural models such as the "imbrication" metaphor which represent sociality and materiality as the "interlocking pattern of tegulae and imbries" of a roof used (Leonardi, 2011: 151). When sociomaterial artifacts produce surprising situations (Kornberger & Clegg, 2004: 1107), surprises are neither generated by material artifacts or by human actors *per se*. They crop up from the narrative flow of activity and the sudden misfit between expected meanings and new situations. As signs, sociomaterial devices simultaneously belong to the world of socially/culturally built habits and to transient situations. This double nature is the basis of their mediating power, to relate situated activity with cultural and historical habits. The dichotomy "social + material" can then be replaced, beyond reintegration into "sociomateriality", by the triad "situated activity / habit / mediating sign". Both sociality and materiality are present in all the three elements of the triad.

Architextures

To make sense, any narrative process requires authors and audiences to share a common intersubjective world of cultural meanings (Cassirer 1961-1942), shared language and narrative conventions. In a given social environment, narrative archetypes delineate the boundary between intelligible and unintelligible narratives. The architexture of a narrative is close to Ricœur's M1 mimesis (Ricœur, 1984) as summarized by Cunliffe et al. (2004: 270): "Narratives are embedded with an implicit 'pre-understanding' of a society's meaningful structures, symbolic systems, and temporal nature (…) There are taken-for-granted cultural plots, themes, characters, values, and sequencing of events". The architextures shape the interpretation of narrative processes by their social environment. They are pre-supposed and tacit, "what is not said, and yet is shared" (Boje 1991: 107), taken-for-granted and often unconscious. Partly natural and partly cultural, they can be metaphorically compared with the architecture of a building. To be physically stable, practically appropriate to its planned utilization and socially recognizable, a building must conform to pre-determined architectural rules, partly natural (physical laws) and partly cultural (functional forms such as lecture theatres in a university, or symbolic attributes such as church spires). The narratologist Gérard Genette named those metanarrative structures "architextures" (Genette 1979), defining them as "the set of general or transcendent categories - discourse types, utterance modes, literary genres etc.- to which each singular text belongs" (Genette 1979; 1982: 7) and by which narratives must abide to make sense in a given cultural and social environment.

In the collective activity viewed as a narrative process, "architectural instruments" as defined above *are architectural because they are architextual*: they constrain and enable complex organizational forms because they carry time-space frames, structures of roles, etc. Architextures are close to affordances, as studied by Gibson (1986) and Norman (1990: 9): "Affordances provide strong clues for the use of their materials... When affordances are taken advantage of, the user knows what to do just by looking: no picture, label or instruction is required". Hutchby (2001) observes the hybrid nature of affordances, which are neither completely material nor completely human: "In (Hutchby's) view, affordances are not exclusively properties of people or of artifacts: they are constituted in relationships between people and the materiality of the things they come in contact. In this

formulation, materiality exists independent of people but affordances and constraints do not" (Leonardi, 2011: 153). But the concept of affordance, focused on the subject's activity, must be extended to "organizational affordances", in which, adapting Hutchby's formulation: "affordances are constituted in relationships between organized cross-functional groups involved in conjoint activity and the materiality of the things they come in contact". Architectural instruments can then be defined as mediating artifacts which are linked with organizational "architextures". They are the loci where distinct forms of human agency (designers' agency, users' agency, controllers' agency) and material agency (computer coding, functional architectures, procedures, physical locations) are closely entwined into a complex "mangle" (Pickering, 1995). They may escape any claim to control and even become unconscious and invisible.

Architectural instruments impose architextures through two types of forms:

- properly "material" structures = structural forms (through software structure and coding, for example), which entail structural constraints and affordances for organizational activity (i.e. the principle of unique data capture in integrated management systems ERP, real time data sharing, locking mechanisms of the software, etc.),
- social/cultural habits of utilization, which are experience and history-based and tend to become "naturalized", taken for granted, though not corresponding to structural constraints.

Actors often cannot make the distinction between structural and cultural constraints and affordances. They tend to perceive habitual constraints and affordances, whatever their origin may be (structural or not). Resorting to Peirce's semiotic concepts, there are three types of signs, according to their relationship with the object they refer to - in our case, three types of mediating artifacts, according to the relationship they have with their uses: icons, indexes and symbols. Iconic tooling relates with uses by mirroring some of their structure and shape. They specify action by modeling it. For example, the formal description of a standard manufacturing process is iconic. Indexical tools relate with their uses by recording some of their traces (statistical measurements, for example) or by physically constraining them (the safety belt which prevents the engine from starting as long as it is not fastened is an indexical tool). Symbolic tooling relates with uses by instantiating some social and cultural conventions within the situation (the "no entry" road sign is a symbolic tool: it does not represent any concrete form, it does not physically constrain the driver, but it instantiates a strong institutional rule in the situation).

Architectural instruments can then operate, either through their structural characteristics (as icons and /or indexes), or through dominant cultural schemes (as symbols). If they try to accurately emulate / replicate past and future practices and then impose their constraining structure to actual utilization, their iconic and indexical functions dominate. If they carry socially established interpretive habits, independently from structural characteristics, they rather act as symbols, triggering cultural uses. To play their architextual role, "architectural" instruments must achieve some tradeoff between both types of semiotic functions. If their "material" or informational structure is relatively unsophisticated and poor, their social habits of utilization must be sophisticated and carry a complex set of cultural constraints and affordances. If, on the contrary, the "material" or informational structure is complex and entails a lot of constraints and affordances, the cultural meanings associated with the instrument can be fairly limited.

Two cases will be now analyzed to illustrate these views.

First case: SAP at Electricité de France

The company

The EDF Group is one of the world key players in the field of electricity generation, distribution and supply. Managing a generation mix with a production of 630 TWh (74% nuclear, 17% thermical, 9% hydraulic), it provides energies and services to 37 million customers throughout the world. In 2010, EDF Group's consolidated sales amounted to € 65,2 billion. It has 158 000 employees worldwide. In France, Electricité de France is the historical operator, present in all the electricity activities from generation to supply, since it had been built on the model of a vertically integrated operator. At the time of the study (2005), EDF was structured in five branches: Commerce, Production and Engineering, Distribution, International Participations and International Trade. The Production and Engineering Branch (PEB) plays a key role, since it controls core nuclear technologies, it is the

dominant investor within the group, and it faces the delicate challenge of nuclear dismantling and safety. PEB defined its own priorities: cost-cutting in support functions (accounting, human resources, information systems); cost-cutting in procurements (spare parts, equipments and subcontracted maintenance work); cultural changes, to move from a purely technical culture to a culture mixing economic and technical criteria.

Research methodology and design

The field study concerned the organizational impact of an ERP (SAP) implementation in the purchase and procurement domain at EDF – PEB from January to September 2005. The researchers had access to the researched organization (PEB) during the post implementation phase. Due to the size of the company, the research was limited to the purchasing and procurement process in the Production and Engineering Branch (PEB). SAP had already been working for one year in that area, under the name PGI ("Progiciel de Gestion Intégré). The company expected some feedback from the researchers to adjust future PGI implementation methods in other branches. The research involved the semi-structured interviews of approximately 70 persons (PGI designers, PGI users, senior managers), some of them twice; access to all the Lotus Note documents related to the PGI project: some 100 documents (minutes of meetings, reports, instructions, procedures, training supports, methodological tools, action plans…) were selected and analyzed.

The research project involved two entities:

- a project team in which researchers cooperated with two EDF managers (one representative of the corporate purchasing department, one representative of the Production and Engineering Branch), in particular to make interviews;
- a steering committee, in which the progress of the study was reported to two senior managers: the director of Support Services Division, one of the leading managers of PEB, and the controller of the corporate purchasing department; the steering committee met three times in six months.

To limit the scope of the study, it was decided to focus upon the Rhône-Alpes region, which has an important concentration of engineering (two of the most important engineering units are based in Lyon), production (nuclear power plants in the Rhône valley and hydraulic plants in the Alps) and service (Lyon has important regional headquarters, with accounting, purchasing, IS and technical services) units. Rhône-Alpes was seen as a representative "microcosm" of the whole company.

EDF employees (maintenance technicians, maintenance managers, regional and corporate accountants, unit procurement managers, regional and national purchasers, PGI project team members) were alternately interviewed on their working sites (nuclear plant, hydraulic units, offices in Lyon) and in the Paris corporate headquarters. In September 2005, the final conclusions of the study were presented to the steering committee.

The ERP implementation and the redesign of the purchase and procurement process

In 2001, EDF decided to implement SAP R/3 in the whole company, in 6 years, from 2001 to 2007, under the name of "PGI"[4]. A strong project team was constituted. PGI was an ambitious project: with several thousands of users, it was one of the biggest SAP platforms in Europe. PGI was implemented as an integrated solution, covering accounting, control, purchasing and procurements, inventory management, time and activity management and sales. It was implemented branch by branch. It was decided to start with PEB, because this branch has a strong culture of rigour and control, due to nuclear safety requirements. PEB followed a division by division schedule: first (January 2002 to January 2003), PGI was implemented in the thermal and hydraulic division (THD), which appeared as a convenient testing pilot, since it is much smaller and less sensitive than the nuclear division. Then the Nuclear Power Division (NPD) and the Support Services Division (SSD: central accounting, central human resource management, communication, finance, engineering support) followed, from December 2002 to February 2004.

How did the purchasing process operate before PGI was implemented? The purchasing and accounting functions were decentralized. Each site had its own purchasing and accounting functions. As a consequence the purchasing process was highly fragmented. There was a clear-cut separation

[4] PGI = Progiciel de Gestion Intégré

between the roles and competences of technicians, purchasers and accountants. The technician defined the purchasing requirement (PR) in technical terms. For this task, he used the maintenance management application. His manager checked the budget availability for the procurement operation in the maintenance budget. The purchaser used the PR to select the right purchased article in the purchasing data base of the company – a tool that purchasers knew fairly well, but technicians did not bother to learn. According to the amount of the operation, the purchaser then issued an invitation to tender or directly negotiated a contract with a local supplier. The technician supervised the supplier's intervention and finally accepted the delivery from a technical point of view. His manager accepted the delivery from a financial point of view and gave the green light for payment. Last, the accountant translated the PR and the article code into an account number, and created an accounting transaction in the accounting system. To that purpose she/he took into account the kind of article to acquire ("mechanical parts", "electronic devices", "maintenance services", etc.), the nature of the operation (leasing or purchasing), the economic status of the operation (new investment or current maintenance), its tax status (VAT rate), and all other characteristics of the operation which were significant from an accounting point of view. She/he used the accounting system of the company. When receiving the technical and the financial acceptance of the delivery, the accountant paid the supplier's invoice.

To a large extent, the coordination of the process was hierarchical and functional. Normally technicians, purchasers and accountants worked each one with a specific computer application, to achieve professionally specialized activities for which they had been trained: purchasing requirement as a technical document for the technician, contract as a commercial negotiation for the purchaser, ordinary accounting transactions for the accountant. They all reported to the same site managers, who could then ensure a fairly effective hierarchical coordination of the three functions. From time to time, the purchaser needed some more precise information about the technical context of the operation (e.g. are there simultaneous interventions in the vicinity, calling for specific safety precautions? is the intervention taking place after some incident?) to select a supplier and writing a contract. The accountant too sometimes needed more information from the technician to define the accounting transaction (is it current maintenance, to be treated as an expense, or is it heavy maintenance, to be treated as an investment?). To respond to those requests, there were informal micro-inquiries, generally led by purchasers or accountants who tried to complete their sound purchasing or accounting knowledge with the required technical data to make final decisions about the contract or the accounting transaction. Since the technician, the purchaser and the accountant worked on the same site and had lunch in the same restaurant, they had many opportunities to meet and to talk.

In spite of the functional separation, this collective activity was typically dialogical. When the technician wrote her/his PR, she/he knew that the PR aimed at explaining the technical characteristics of the intervention to purchasers and accountants. More or less consciously, she/he designed the PR to address this need. What she/he did only made sense if allowing purchasing colleagues to know what to purchase and accounting colleagues to know what the supplier should invoice. Reciprocally, accountants' and purchasers' micro inquiries were addressed to the technician: they were organized and worded to make sense for technicians.

With SAP, the number of purchasers and accountants became smaller. They are geographically grouped in regional headquarters (e.g. Lyon), far from production sites. Purchasers negotiate 2 to 3 year "frame-contracts" with national or regional suppliers. They no longer negotiate concrete operational contracts for precise procurements. The accountant must put an end to a chain of accounting transactions started by the technician, and pay the supplier's invoice when the accounting chain is completed. To accomplish their respective missions, the purchaser and the accountant are dependent on the right data formerly entered by the technician. The technician must manage her/his own budget. She/he directly enters an article code which determines the accounting code (principle of process integration and unique data entry). Therefore, to select the right article code, the technician must learn the structure and the vocabulary of the article data base. Since the article code is linked with an accounting code, she/he must also know if the operation will be achieved through leasing or purchasing, if it corresponds to a new investment or to current maintenance, what VAT regulation it must follow, what type of frame-contract must be used, etc. At the end of the operation, the technician must accept the delivery, not only from a technical point of view, but also from a financial point of view (green light for payment), which she/he often perceives as a disproportionate responsibility. She/he must take into account considerations which were previously the specific and exclusive task of

purchasers and accountants. As a result, it often happens that the technician has doubts about purchasing or accounting options. Having a sound technical knowledge of the maintenance operation, she/he needs to achieve a micro-inquiry about the purchasing or the accounting context, but such inquiries are difficult, because purchasers and accountants are now located far away, and the technician does not know them personally. Former micro-inquiries were dominantly from accounting and technical fields towards the technical field, now they are dominantly from the technical field towards the accounting and purchasing fields. Obviously it is not at all the same type of request to ask for technical information from an accounting or a purchasing perspective or to ask for purchasing or accounting information from a technical perspective. Actors had lost the method to inquire. As a result, delays, unpaid suppliers, conflicts, losses of information multiplied.

Through the ERP implementation, professional habits (what a technician, a purchaser, an accountant is at EDF) have been deeply impacted, but informal inquiries too. The technician becomes a project manager, with important administrative tasks. The purchaser has no more short run operational tasks, but focuses on strategic negotiations and industrial policy. He must have a strategic expertise about the markets of the purchased articles. The accountant becomes an expert in charge of training technicians, supporting them and designing the accounting system. The company does no longer need low qualification purchasers and accountants.

Dominant inquiries are no longer from purchasing or accounting backgrounds to explore the technical context but from a technical background to explore the accounting or the purchasing context. With its process-based architecture, the ERP triggered a deep transformation of the collective activity, its underlying narratives and the cross-functional relationships, imposing a new form of organic solidarity between functions because they must share the same data. In the former state of the procurement process, each function controlled its own class of data. Now the article and accounting codes are managed by the technician, and used by the purchaser and the accountant. A cross-professional dependency has been built in the instrument.

It appears that the previous underlying "architexture" of the purchasing activity, involving three main functional characters (the purchaser, the technician and the accountant) with clear roles, identities and values, was fundamentally disrupted by the new architectural instrument (cross-spatial communication, real time information, unique data entry, etc.). The change involved:

- the redesign of purchasing and accounting activities, decomposed into (i) policy strategic definition, entrusted to central experts, and (ii) current operations, entrusted to technicians, on operational sites,
- the spatial redesign of activities (spatial concentration of policy design activities, dispersion of current purchasing and accounting operations on the whole population of technicians),
- the redesign of temporal arrangements (new sequences: policy definition, design of frame contracts, design of the central data bases, precede and frame purchasing requests and actual procurements and accounting operations),
- the redefinition of major roles: the purchaser, who was a typical negotiator, becomes an industrial strategist; the technician becomes a project manager; the accountant becomes an expert,
- the transformation of the general purpose of the conjoint activity: purchasing is no longer an efficient arm-twisting negotiation to fulfill the isolated requirement of an individual operation, it is now the application of an industrial strategy and corporate cash flow optimization policy.

Second case: EADS (Astrium division) and the spatial launcher Ariane

The other case, studied in the frame of a Ph D research from 2008 to 2012, concerns an apparently very simple management tool, which proves to be, beyond its apparent simplicity, a genuine "architexture" of the organizing process. The production of Ariane European spatial launcher, near Paris on the Seine river, incurs hundreds of product engineering changes (modifications of the

product design) (PEC) per year. In the PEC management process, a cross-functional commission must examine each PEC proposition, and accept or reject it. More than 90% of PEC are accepted, and more than 60% are labeled "costless PEC" (no cost analysis because cost is assumed to be zero). As a result, the notion of "costless PEC" plays a key role in Ariane production management. Achieving and managing the PEC is a substantial part of the engineers' workload. The procedure to manage the PEC is made a lot simpler and quicker by the "costless" procedure. With the costless procedure, the roles of actors are re-defined. Program controllers, who have in charge cost management, are hardly listened to in the commission, since PEC are supposed to be costless. Manufacturing engineers are mostly absent (if there is no extra cost, there must be no significant impact on the manufacturing process). It is taken for granted that it is one of product engineers' primary mission to keep on developing PEC and that a spatial launcher is an ever-evolving system, with no stable and steady state. Tooling is also strongly impacted. PEC are submitted to a precise and formal procedure, with a formatted file. For the "costless PEC", the economic part of the file is not filled in. In the cost accounting system, product modifications do not appear (no cost driver, no identification of activities impacted by PEC), and there is no particular plan to change this, even if everybody recognizes that PEC are a major activity driver in Ariane program. Why having a cost accounting system focused on modification costing, if most modifications are costless? Actually, the "costless" procedure appears as a great wall separating the world of engineering from the world of economics. Engineering decisions escape any economic consideration when they are described as "costless".

The new competitive and economic pressures on the business of spatial launchers has recently led to questioning the acceptability of this managerial practice. EADS, the firm which manufactures Ariane, faces new competitors and pricing constraints. The launcher activity raises profitability issues. There is a strong will to optimize cost and improve margins. Rationally, it should be required that the cost of each PEC is analyzed and taken into account. There is another powerful reason to question the "costless PEC" procedure: it is so easy to have modifications accepted that the flow of accepted modifications ("input") is significantly higher than the flow of treated modifications ("output"), so that the backlog of PEC keeps on swelling. Accepted and untreated modifications are not only mismanagement, but also a source of technical risk: none seems to really master the general coherence of the planned / in progress / finished modifications and their possible impact on the reliability of the launcher.

An in-depth analysis of the modifications reveals that, contrary to the spontaneous belief of most actors, 80% of the modifications can be labeled as "unnecessary". Necessary modifications are those imposed by a customer's requirement or a technological obsolescence, when a component is no longer available and must be replaced. 80% of the PEC result from engineers' proper initiatives to improve the technical reliability of the system or to reduce its cost.

To explore the potential changes, it was first necessary to understand what "costless PEC" means and where this organization of the modification process comes from. PEC were studied in a longitudinal research, over three years. The Ph D researcher was an employee of the Ariane program and a member of the controlling team. He participated in the PEC commission meetings and interviewed all the major actors (engineering managers, manufacturing managers, program manager, controllers) several times. He had access to all the documents concerning the PEC procedure and individual PEC.

Summarizing, it appears that the costless PEC emerged through a furtive historical process. Historically, the PEC procedure was designed to manage customer's modification requirements (specific satellites can originate special demands). A key issue then was: will the customer's demand cause extra costs, and in that case, how much should we invoice to the customer? When the division could not invoice the customer, either for political reasons or because the extra cost was deemed negligible, then the PEC was a "priceless" PEC for which no cost calculation had to be made, and it became a "costless PEC". But speaking of "costless PEC" instead of speaking of "priceless PEC" led to some confusion. Many actors, mainly engineers, understood that most PEC were costless for other reasons than commercial considerations. Behind the "costless PEC notion", interviews revealed a broad range of economic and political views, giving shape to a coherent narrative:

- the technical reliability of the launcher is so important that, in any case, no cost consideration could counterweigh it;

- the population of engineers specialized in launchers is a strategic resource for the political independence of France and Europe; the flow of modifications is a relevant way to maintain their competence;

- this last argument translates into economic terms: since the engineering population is a strategic resource which must be maintained, it is a fixed or a sunk cost; modifications should be accepted or rejected according to their marginal cost; in most cases, a PEC only consumes engineers' time, i.e. only fixed resources, with no marginal or variable cost;

- a highly complex system like a spatial launcher is not an ordinary product; it is illusory to hope to stabilize a standard state of the product; it is naturally an ever-changing object;

- anyway, till a recent period, there was no competition, and cost considerations were superfluous.

Actually, before becoming a division of a private corporation (EADS), the launcher department was part of a government structure. It was established for national safety and independence. Most of the arguments presented above can be considered as the historical remnants of that former phase of Astrium history: it had been an arsenal and it kept the meaning making schemes of an arsenal as a kind of non-material archaeological trace. Through the analysis of the "costless PEC" system, to some extent the researchers made an excavation of the managerial history of launcher activity.

Compared with EDF case, the "architectural instrument" here hardly appears as an architecture. It is not only a poor informational structure: it is even an "anti-informational" tool, something which eliminates the production and use of a certain class of information. In the same way as antimatter makes matter vanish, where the "costless PEC" system appears, cost information disappears. It points to a vacuum, an absence rather than a presence, it is the architecture of vacuum. However it is "interpretively" rich. It is first loaded with ways to do things - practical affordances, such as the quick adoption of modifications, a simplified way to fill the modification file, a simplified procedure with controllers and manufacturers playing a negligible role and keeping silent in the commission, no evolution required for the accounting system to cost engineering changes, engineers' power to define their own workload. It is also loaded with cultural, historical and social meanings, a specific narrative: "The competence for spatial launchers is a strategic resource for the nation and, later, for Europe. Its funding is unproblematic. Engineers are a mandatory resource and their working time is a sunk cost. There is no commercial competition and cost is not a critical parameter. The only reason to calculate cost is billing it to the customer. A spatial launcher is a permanently evolving system. Technical optimization is immeasurably more important and legitimate than economic optimization. Space industry is not an industry but a craft."

Such meaning-making habits make the concept of "costless PEC" obvious. They strongly impact activity. But they are not imposed by any structural characteristic of the procedure (which normally includes engineering change costing and controller's advice in the PEC file). They are just triggered by the words "costless PEC", as a magic formula. While EDF ERP system was undoubtedly the source of structural constraints and affordances, a dominantly iconic and indexical sign, "costless PEC" says little about what to do (weak iconic dimension) and imposes little structural constraint (weak indexical dimension). It is a dominantly symbolic instrument, acting through all the social and cultural meanings it convenes, rooted in the history of the sector and of the organization.

There seems to be a general intellectual consensus about the necessity to transform PEC management practices and to abolish "costless PEC". Such a move would impact information systems (at least the accounting system), actors' roles and habits, interaction habits, usual inquiries (engineers should be able to make complex cost inquiries), competences. That is why it should be useful, if not mandatory, to try to understand first what narratives the "costless PEC" carries and how they can be transformed.

From a theoretical point of view, developing the concepts of "architectural instruments", "architextures", and organizing narratives should allow refocusing organization research on activity and work, which it tended to set aside (Barley & Kunda, 2001). It should also contribute to the academic efforts to overcome the dichotomy between "sociality" and "materiality", by bringing the anti-Cartesian triadic semiotics to organization studies. The concept of semiotic mediation and the view of organizing processes as "narratives in acts" may help understanding organizational becoming, temporal and spatial transformations, mediating tools and systems, generic roles, sensemaking processes and work practices. From a practical point of view, it should allow a better understanding of

the frequent failures in trying to implement new "architectural tools", such as integrated management systems, in organizations. Such transformations require more than the traditional "change management" programs. It requires an archaeological and genealogical analysis of existing, though often invisible, narrative frames, their ramifications and coherence, their "vertical" professional and "horizontal" cross-functional dimensions, and their historical roots, to understand the potential disruptive impact of new architectural instruments. It is a key issue for the management of organizational change, all the more as architectural instruments seem to be increasingly present in work settings, due to the development of information and communication technologies, such as networks, nomad systems, ERP systems, supply chain, value nets, multimedia customer interfaces, etc.

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