

DR 07015

COUPLING PERFORMANCE MEASUREMENT AND COLLECTIVE ACTIVITY: THE SEMIOTIC FUNCTION OF MANAGEMENT SYSTEMS. A CASE STUDY

PHILIPPE LORINO
INGMAR GEHRKE

MAY 2007

ESSEC

CENTRE
DE RECHERCHE

Coupling Performance Measurement and Collective Activity: The Semiotic Function of Management Systems. A Case Study

Philippe LORINO

Ingmar GEHRKE

Abstract:

Theories about management instruments often enter dualistic debates between structure and agency: do instruments determine the forms of collective activity (CA), or do actors shape instruments to their requirements, or are instruments and concrete activity decoupled, as some trends of new institutionalist theory assume? Attempts to overcome the dualistic opposition between structure and activity stem from diverse sources: actors' networks theory, structuration theory, pragmatism, theory of activity, semiotics. Performance measurement and management systems can be defined as structural instruments engaged in CA. As such they constrain the activity, but they do not determine it. Reciprocally, they are modified by the way CA uses them and makes sense of them.

The central thesis of this paper will be that it is impossible to study the role of performance measurement as a common language in organizations independently from the design of the CA in which it is engaged. There is a not deterministic coupling between structure (i.e. management technical tools) and CA (i.e. business processes). The transformation of CA entails a transformation in the meaning of the "performance" concept, in the type of measurement required and in the performance management practices.

The relationship between performance measurement and CA is studied here in the production division of a large electricity utility in France. The research extended over several years and took place when two new management systems were simultaneously implemented: a new management accounting system and an integrated management information system (ERP), both in the purchasing process. The new management accounting system was designed by the purchasing department; the new management information system was designed by the operational departments. Whereas the coherence between both projects could have been given by their common subordination to the rebuilding of CA (the purchasing process), their disconnection from concrete CA opened the possibility of serious dissonances between them.

Both the new performance management system and the new ERP met difficulties to provide common languages, since the dimension of CA was taken for granted and consequently partly ignored in the engineering of both systems. When CA incurs radical transformations, actors' direct discursive exchanges about it, "collective activity about collective activity", become necessary to ensure a flexible and not deterministic coupling between CA and new management systems. This reflexive and collective analysis of the process by actors themselves requires the establishment of "communities of process", which can jointly redesign the CA and its performance measurement system.

We conclude that performance measurement can be a common language as far as there is a clear and shared understanding of how CA should concretely take place and should be assigned to the different categories of actors.

Keywords: Business Process, Collective Activity, Community of Process, Management Instruments, Performance Measurement, Semiotics, Theory of Activity

Résumé :

Les théories sur les instruments de gestion donnent souvent lieu à débat entre structure et agence : les instruments déterminent-ils les formes de l'activité collective (AC), ou les acteurs impriment-ils aux instruments les formes dont ils ont besoin, ou les instruments et l'activité concrète sont-ils découplés, comme certains courants néo-institutionnalistes le supposent? Théories des réseaux d'acteurs, de la structuration, de l'activité, pragmatisme, sémiotique tentent de surmonter l'opposition dualiste entre structure and activité. Les systèmes de gestion et de pilotage de la performance peuvent être définis comme des instruments structurels engagés dans l'AC, qui la contraignent sans la déterminer. Réciproquement, ils sont modifiés par la manière dont l'AC les utilise et leur donne sens. La thèse centrale de ce papier est l'impossibilité de considérer l'évaluation de la performance comme un langage commun de l'organisation et d'en étudier le rôle indépendamment de la conception de l'AC dans laquelle cette évaluation est engagée. Il y a un couplage non déterministe entre structure (outils de mesure de la performance) et AC (processus). La transformation de l'AC entraîne une transformation de la signification du concept de « performance », du type de mesure requis et des pratiques de pilotage.

La relation entre mesure de performance et AC est étudiée ici dans le cas de la division production d'Electricité de France. La recherche a duré plusieurs années, au cours desquelles deux nouveaux systèmes de gestion furent mis en œuvre simultanément: un système de comptabilité de gestion et un système d'information de gestion intégré (ERP), tous deux appliqués au processus d'achat. Le système de comptabilité de gestion a été conçu par la direction des achats ; l'ERP par les directions opérationnelles. Alors que la cohérence entre les deux projets aurait pu être assurée par leur commune subordination à la reconstruction de l'AC (le processus d'achat), leur découplage de fait de l'activité concrète a ouvert la possibilité de dissonances sérieuses entre eux.

Les deux nouveaux systèmes ont eu des difficultés à fournir des langages communs, car la dimension de l'AC a été largement ignorée dans leur développement. Lorsque l'AC encourt des transformations radicales, les échanges discursifs directs entre les acteurs au sujet de leur propre AC, « activité collective sur l'activité collective », deviennent nécessaires pour assurer un couplage flexible et non déterministe entre AC et nouveaux systèmes de gestion. Cette analyse réflexive et collective du processus par ses acteurs eux-mêmes exige la constitution de « communautés de processus », qui peuvent conjointement reconcevoir l'AC et les systèmes de pilotage de la performance.

L'article conclut que le système de pilotage de la performance ne peut constituer un langage commun que s'il y a une compréhension claire et partagée de l'AC, de ses transformations et des rôles impartis aux différentes catégories d'acteurs.

Mots-clés : Activité collective, Communauté de processus, Instruments de gestion, Pilotage de la performance, Processus, Sémiotique, Théorie de l'activité

JEL Classification: Z00

Coupling performance measurement and collective activity: the semiotic function of management systems. A case study

Philippe Lorino

Ingmar Gehrke

1. Introduction: collective activity and performance measurement

As long as hierarchical and functional coordination proves to be effective, there is no strong need for common languages within the organization, at least at the operational level: each actor does what he is supposed to do in the functional division of work; direct supervision controls the respect of predetermined tasks, roles and coordinating links. But this type of organization requires fairly simple and stable processes, which exclude improvisation and generate neither too dense flows of information nor too diverse information contents. The issues of coherence and coordination within firms are made more difficult by complexity and uncertainty: complexity increases the number of interdependences and potential interactions to regulate; uncertainty limits the effectiveness of predetermined and planned coordination schemes; both increase the risks of mutual misunderstanding and loss of sense. Globalization, as a factor of complexity, interculturality and uncertainty, therefore raises difficult questions for organizational coherence and cooperation. With the globalization of markets and firms, the multicultural settings and the geographical dispersion of organizations obviously limit the effectiveness of hierarchical and functional coordination, which have a limited capacity to tackle complexity and uncertainty. Unplanned complex situations question the efficiency of planned coordination, requiring partially improvised responses and dense and complex flows of information. If each actor does what he is supposed to do according to the functional division of work, in his local setting, without any ongoing exchange with other actors, the actions locally triggered by new situations in multiple sites and units do not necessarily combine into a new coherent collective action. In such contexts, it is necessary that actors adjust to each other in the course of action and continuously rebuild the sense of their mutual interactions to be able to reassure the coherence of collective activity. This gives a renewed importance to the issues of common languages within the organization.

Complex and uncertain situations related with globalization then entail two major consequences:

- the *collective dimension of activity* appears as a cornerstone of organizing and managing: the collective dimension of activity could be “forgotten” in rational / hierarchical types of coordination, because, when operating on the field, the coordination issues were supposed to have been centrally and previously identified and solved; concrete activity could then be organized along individual standards of action and be focused upon the individual work position; but, when facing complex and uncertain situations, calling for improvisation, creativity and sensemaking, the collective activity is a continuously rebuilt compromise and meaning;
- mutual intelligibility requires *systems of signs* to communicate, interact and try to make sense of the situations together, in such a way that collective activity remains feasible: those systems of signs can have very diverse forms and natures, from technical vocabularies to management procedures, rites and customs, a shared narrative fund, integrated information systems, plans and objectives: any object, be it material or informational, which is interpreted by actors and therefore becomes a sign (Eco, 1973); amongst those systems of signs, performance measurements play a key role, since they are asked to interpret actual activities from the point of view of strategic objectives: they should provide a common reading method to evaluate action as pursuing strategic targets; the ambiguity of the word “performance”, which can be understood 1/ as the complete achievement of action (“performing”) as well as 2/ the

evaluation of the action result from the point of view of final objectives (“good or bad performance”), illustrates this key position of performance measurements: reading the activity (“performance 1”) from the point of view of strategic achievement (“performance 2”).

The link between collective activity and performance measurements is of paramount importance: as any system of signs, performance measurements are interpreted by subjects, in this case by the actors of the firm, and they are interpreted, not in some abstract and serene situation, in a suspended time and a non-situated space, but in the course of situated and dated *action*. This interpretation by actors is not a regrettable bias, to be limited and hunted, as sometimes rationalistic theories view performance measurement (looking for “*objective* measurements which are *not interpretable*”). On the contrary interpretation is the very condition for performance measurements to work as “*performance* measurements”. As long as they are not interpreted by actors 1/ to make sense of the situation they face, 2/ to exchange about this situation, 3/ and consequently to go on acting together in the situation, figures, scorecards, indicators and diagrams are only “things”, objective artefacts without meaning, ink on paper, figures on curves. They become *instruments*, engaged in and transforming action, as soon as they are interpreted by actors in the course of their action. Then and only then can they play a key role as a common language to support coherence in sensemaking for action. The performance measurements can provide an extremely useful common language as long as they are engaged in a collective activity which they allow to interpret and to translate into some economic and strategic repertory of meanings. When they are interpreted they can transform collective activity into a common object to debate within more or less vast communities of actors.

By stressing the importance of actors’ interpretation, we wish to highlight the double nature of instruments such as performance measurement: on one side, they are objective artifacts¹ (computer code, calculation formulas, mathematical models), which can be considered as structural; on the other side, they trigger subjective interpretive schemes (schemes of utilization) which translate them into action (instrument utilization). Therefore we define instruments as combinations of 1/ objective artifacts (structure) and 2/ interpretive schemes of utilization, categories of meaning, engaged in human work. In that way, instruments provide a link between structure and actors’ agency, a “modality”, in Giddens terms (Giddens, 1984), by providing interpretive schemes of a particular kind: *utilization schemes*, which organize the “grammar” of possible, thinkable and desirable actions. In our mind, those interpretive schemes are not of a purely cognitive nature: as most interpretive schemes, they convey ethical (legitimacy), political (domination) and aesthetic (emotion) values. Hence the key role of instruments such as management accounting or performance measurement in the fabric of legitimacy, domination and meaning dimensions of organizations (MacIntosh & Scapens, 1991); but also in the fabric of the emotion and seduction dimensions.

This observation can be compared to the status of language for common conversation: of course, a language, for instance English, plays a key role to make conversation possible, as long as it is used by people who meet and converse; by itself, language does not make people meet and converse. A common language is only useful for mutual intelligibility in collective action, for instance in some sensemaking conversation. It does not create the situation of interaction by itself. The instrument – here, performance measurement – and the collective activity are linked by a mutual interdependence relation: there can be no collective activity without common languages, but there is no common language if it is not engaged in a collective activity. A piece of language is instrumental to conversation if it uses words (artefacts) associated with interpretive schemes, which convey meanings, emotions, ethical and aesthetic values. In the same way, an artefact is instrumental to collective activity if it is

¹ By artifact, we mean some (material or informational) object which has been designed and produced by humans with some intent (for instance, to be engaged in activity, or to be interpreted).

associated with interpretive schemes which convey meanings, emotions and ethical or aesthetic values, to trigger possibilities and desires of action. The central issue of this paper will be, therefore, the *relation between instruments, particularly performance measurements, and collective activity*.

This relation was analyzed by researchers in organization science with different theoretical frames, which we would classify into three major categories:

1. According to rationalistic theories such as taylorism, contingency theory, control theories (e. g. agency theory) or cognitivism, management systems such as standard times, contractual objectives, performance measurements or integrated management systems (ERP) determine the forms of collective action, i.e. determine organizational processes, through their technical characteristics, either in a way which would be fairly independent from actors' will, as "invisible technologies" (Berry, 1983), or in a deliberate way, according to the plans of a dominating group which uses instruments to maintain control (critical theories inspired by Foucault's political philosophy: Foucault, 1965; Dillard & Yuthas, 2006; Dechow N. & Mouritsen J., 2005; Quattrone P. & Hopper T., 2005).
2. According to subjectivist theories, individual and collective users of management systems would appropriate them and interpret them in their own way, the final scheme of utilization resulting from their "strategic" project (in the sense of personal, subjective or local strategy) rather than from the intrinsic and structural characteristics of systems (Crozier & Friedberg, 1981).
3. According to « decoupling » theories, such as some new institutionalist trends, the introduction of a new management system would obey external legitimacy requirements (conformance to regulations or customers' requirements, conformance to norms, mimetic imitation of successful organizations, managerial fashions) (Carruthers, 1995), and would hardly have any impact upon actual internal activities, protected from external constraints by some level of decoupling.

In many of those cases, authors enter a dualist debate between structure and agency: do instruments determine the forms of collective activity, or do activity and actors shape instruments to their requirements, or are instruments and concrete activity decoupled? We believe it is necessary to recur to more integrative theoretical frames, which avoid those dichotomies. To overcome the dualistic opposition between structural instruments and human activity, we need "coupling" theories, which analyze the dynamics of instruments *engaged in* collective activity, such as Giddens-inspired structuration theory (MacIntosh & Scapens, 1991; Orlikowski & Robey, 1991), pragmatism (Dewey, 1938; Lorino, 2006), the theory of activity (Vygotsky, 1986; Leont'ev, 1981; Engeström, 1987; Clot, 1999). The semiotic theory (Peirce, 1958; Eco, 1983) can be applied to management instruments as signs (Lorino, 2005 & 2006). We shall try to explain how organizational transformations and management systems relate, and how the constraints that systems impose to users and the space of freedom that they leave to users' interpretation are articulated:

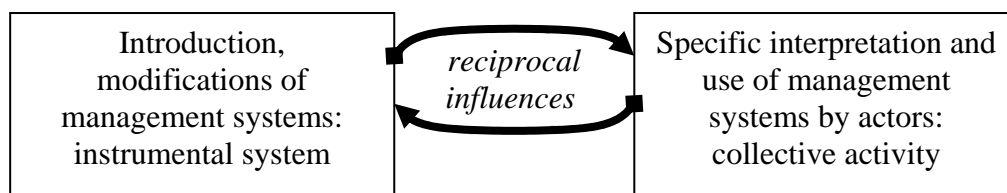


figure 1 : a *coupling* theory: how instrumental systems and activity relate to each other

2. The conceptual framework

2.1. The dynamics of “organizing” is collective activity

Our starting hypothesis is that organizations only exist in and through actors' activities. We observe that organization dynamics appears in the form of transformations of collective activity: of what actors *do* together and how they do it. In this pragmaticist view, organization itself can be characterized as a set of socially legitimated collective activities: designing products, producing and selling them, making material or information flows circulate... Those collective activities are not the simple addition of individual activities. Interactions between actors are assured through coordination and cooperation mechanisms, so that individual activities can together accomplish some global sensemaking transactions with the world (selling to customers, getting purchased goods delivered, proposing new products, producing services, transferring financial resources...). They roughly correspond to what management literature calls “business processes” (Lorino & Tarondeau, 2002) (Hatten & Rosenthal, 1999). Work is always “performed in conditions of joint, collective activity (...) Only through a relation with other people does man relate to nature itself, which means that labour appears from the very beginning as a process mediated by tools (in the broad sense) and at the same time mediated socially” (Leont'ev, 1981). To summarize, collective activity is:

- *interactional* (it links different people, different actors who interact in many distinct ways),
- *transactional* (it relates to nature, by achieving some type of transaction with the world to transform it),
- *mediated* (it is always mediated by some systems of signs, tools and languages, which enable actors to collectively make sense of it).

2.2 The role and the sense of performance measurement

Collective activity is analyzed here as an ongoing dialogical construction by actors, who must interact to make sense of their actions. Actors' actions must be complementary to combine and to tend towards global results. By “dialogical”, we mean that each actor's activity is *addressed* to other subjects, be them physically present or not, and the sense emerges from this exchange, in the same way as the sense of a conversation emerges from the conversation itself, not from individual speeches considered separately. A dialogical interaction is not simply the coordination of individual actions: strictly speaking, *there is no individual action*, since actors' activities are intrinsically addressed to “others” and cannot be understood if this dialogical dimension is not taken into account. Collective activity is no more the coordination of individual activities than conversation is the coordination of monologues.

Collective activity does not necessarily need discursive communication between agents to ensure collective sensemaking, as MacIntosh and Scapens observe: “a lot of what agents know about what and why they interact in a certain way is contained in what Giddens labels practical consciousness” (MacIntosh & Scapens, 1991), and those authors quote Giddens' definition of “practical consciousness”: “all the things which actors know tacitly about how to *go on* in the contexts of social life without being able to give them direct discursive expression” (Giddens, 1984). We would modify Giddens' definition slightly, by proposing “without *needing to* give them direct discursive expression” rather than “without *being able to*”: there is no reason why the use of direct discursive expression should be considered as the normal situation and its absence as the sign of some impossibility. “Acts speak to acts”, and discursive resources are used when required.

Activities are always semiotically mediated by signs, if not necessarily by linguistic signs. As soon as human activity goes beyond reflexes to enter the sphere of awareness, it is thought by human actors through semiotic mediations (Vygotsky, 1986), languages and tools, which allow to abstract it from the uniqueness of situations. The concrete collective activity, which takes place here and now, is always unique. But it is represented and interpreted by actors through signs, i. e. through generic semiotic descriptions, labels or attributes, amongst which we find performance measurements: *instruments* in a broader sense (discursive or not discursive languages, tools).

However, direct discursive exchanges start being required when collective activity undergoes important transformations, for instance when introducing a radically new management system. This is what Giddens calls “critical situations”, defining them as “...where the established modes of accustomed daily life are drastically undermined or shattered” (Giddens, 1984), when “agency does not simply reproduce old structures” (MacIntosh & Scapens, 1991). Beyond the usual dialogical exchange in which actors are always involved when they act together, in the critical situations when collective activity must be redesigned, a *reflexive* dialogical exchange between actors becomes necessary. While acting together, actors must “comment” together – with words or other types of languages – their own collective activity, to maintain and rebuild its sense. So we find two levels of collective activity: the primary activity (business processes) is collective and dialogical (activities “speak to” activities), but its reflexive interpretation is also a collective and dialogical construction (a “collective activity about collective activity”), of a basically discursive nature. This *collective reflexivity* is made feasible by the permanent “inscription” (Latour, 1999; Quattrone & Hopper, 2005; Robson, 1992) of business processes in systems of signs: speeches or texts in natural or technical languages, gestures, graphical representations, and again instruments (accounting, performance measurements, standards, procedures...). But the function of signs in the reflexive collective activity is significantly different from their function in the primary collective activity: whereas in the primary activity they mainly refer to a repertory of generic situations and generic activities, in the reflexive activity their main function is to try to rebuild the sense of non generic situations and to build a new repertory of activities.

This is particularly so when collective activity takes place in a complex and uncertain environment, as globalization most often generates. As long as collective activity is simple and repetitive, its dialogical and sensemaking quality can be forgotten: everything takes place “as if” stable norms and standards ensured sense and coherence, whatever the individual awareness of the global sense. In Charlie Chaplin’s film “Modern Times”, the worker does not know much either about the global production process in which he is involved or the sense of his own activity. He does not communicate with fellow workers, he does not conceptualize the business process in appropriated forms of signs. But, as we saw before, growing complexity and uncertainty make the need for collective sensemaking more obvious. Activity loses its “obviousness” to become an issue for collective sensemaking (Weick, 2001).

2.3. Performance measurement and collective activity

Amongst the instruments engaged in collective activity, we find performance measurements (including management accounting and cost control). Performance measurement can be defined as a structural artifact engaged in collective activity through interpretive schemes. As such it constrains the activity, but it does not determine it. For instance, if local productivity, measured by the yield of machines, is considered as the key performance measurement, it will be difficult to transform the activity towards smaller lots and “just in time” methods, since such an evolution generally deteriorates local productivity.

It will be all the more so if such indicators as inventory turn over, production lead time, delivery time or final customer satisfaction are not available. Then reducing the size of lots diminishes productivity, but no positive effect can be noted on other measurements, since they are not available. Reciprocally, the practical meaning of measurement is modified by the way the actors involved in collective activity use it and make sense of it. If the factory manager decides to develop a “just in time” policy, he may implement the measurement of inventory turn over and consider it as a priority. Then he may look at productivity as an indirect sign of stockpiling: if machine yields increase, it might be due to more production for inventory – in that case productivity becomes a negative sign. But if he presents the results of his factory in a monthly business review to his colleagues from other factories who still use productivity as the key performance indicator, he might have some difficulty to make himself clear and understood. The decrease in his local productivity might be interpreted as a bad performance (Goldratt & Cox, 1984). The same performance measurement, engaged in differently designed collective activities (in one case, just in time production; in the other case, fordian mass production), far from providing a common language, provides misunderstanding. *It is therefore impossible to study the role and the sense of performance measurement as a common language independently from the construction and the design of the collective activity (business processes) in which it is engaged.* In this example, we clearly see that the proper meaning of the word “performance” is activity- and context-dependent. In one case, “local productivity” is performance, in the other case, “local productivity” (i.e. order- and lot-grouping) is *counter*-performance. The meaning of words and concepts is contingent to the design of situated collective activity.

We can summarize by observing that:

- the semiotic mediations of collective activity, in particular performance measurements, effectively work as sense-supporting mediations if and only if they are engaged and interpreted by actors in sensemaking collective activities and interactions,
- the actual meaning of those semiotic mediations is contingent to the design of the collective activity in which they are engaged,
- reciprocally, collective activity is made feasible by the use of semiotic mediations which allow actors to interact and to build the sense of their situated collective activity in a dialogical way; business processes such as “producing”, “designing new products”, “selling”, “purchasing”, are viable only if they are supported by common and interpretable mediations.

Therefore there is a flexible and not deterministic coupling between structure – in particular instrumental artifacts (e.g. performance measurement artifacts) - and collective activity. This is particularly visible in the situations in which collective activity incurs deep transformations, for instance when implementing ERPs: the transformation of collective activity (e.g. business process re-engineering) related with ERP implementation and the redesign of performance measurement systems must be seen as mutually dependent, but not determining each other in a rigid way. In other words one cannot design a relevant performance measurement system without designing the collective activity which will use it at the same time and jointly: *the very definition of what “performance” is depends upon the design of collective activity.*

Instruments such as performance measurements simultaneously constrain and enable activity:

- They constrain it by attaching it to generic classes of meaning, generic “schemes of utilization of the instrument”. Constraints derive from both the objective characteristics of the instrument and the social habits which prevail in their interpretation and use. For instance, if the performance measurement system only includes productivity measurements, it will be difficult to steer the collective activity with inventory turn over and delivery lead time in view, since those

indicators are not available, and this situation changes the way activity can be performed. But, even if the performance measurement system provides lead times and inventory turn over, it can happen that a long Fordian and productivist tradition naturally orientates the actors' interpretation towards local productivity as the key performance.

- Instruments also enable collective activity: they allow to do things which would have been impossible without them. In our case, performance measurements allow to assign performance objectives, to compare the performance of one activity in different periods of time, to compare the performance of different activities, to make quantified trade offs between productivity and just in time... Potential constraints are not unique, there are many possible ways of interpreting and using the measurement. Human agency plays a key role in enacting some of those possibilities, "shaping either the design or the use of technologies" (Orlikowski & Barley, 2001).

2.4. The key influence of the structure of roles

One important element of collective activity design is the structure of roles (Weick, 2001): who does what? According to circumstances, the structure of roles can adapt and the roles can be redistributed, as Weick shows when he analyzes crisis situations: a football team surviving a plane crash in the Andes redistributes roles according to the actual competences of actors in the new situation. The coach might be a good hunter to provide animals for food but a bad organizer in high mountain environments, etc.

The structure of roles is not only fundamental for the collective activity itself, but also for the design of performance measurements. A given business process will require different performance measurement systems according to the structure of roles adopted. In the case we present further, for instance, if the purchaser's role is strictly defined as a price-bargaining negotiator, the key performance measurement for him will be the negotiated price (compared with the average market price, for instance). But if his role is widened to control the global economic performance of purchased goods – their impact upon the bottom line of the company –, he will have to take into account the utilization cost of purchased machines, including future maintenance, life cycle duration, reliability... In the engineering departments of Hewlett-Packard, for a long time a key performance measurement was "time to market": how long did it take to design and engineer a new product till its production and sale could start up? This performance measurement was coherent with a structure of roles in which engineers were seen primarily as product and process designers. But the company realized that product engineers had to play an important role as technical supports for production and after sale service in the first months of the product commercial life. The structure of roles was transformed, and so had to be the performance measurement: "time to market" was replaced by "time to break even", i.e. the time it takes to ensure the economic balance of the new product, to take into account the contribution of engineers to the economic success of the first commercial phase.

2.5. Three levels of interaction

To make a thorough analysis of the sensemaking role of performance measurements as an organizational language, it is necessary to situate performance measurements in the context of actors' interactions and dialogical sensemaking. For that purpose, we shall use the theoretical frame of instrumented / mediated collective activity. There are three levels of interactions to consider:

- level 1: actors act together to produce collective transactions with the world: it is the level of concrete, here and now business processes – producing together, maintaining together, purchasing together...
- level 2: actors are engaged in a critical and reflexive reassessment of the business processes in which they are engaged, to face new situations, to adapt their individual actions, the structure of roles, the coordination schemes: for this reflexive reassessment they use instruments such as ERPs and performance measurements as common languages and semiotic mediations;
- level 3: the redesign of collective practices (level 1) can entail deep transformations in the way to define, measure and control performance (level 2), and in the corresponding instrument design and structure of roles– but here, not the roles to act together, but the “reflexive roles” to define, measure and interpret performance: who adapts performance measurement, who produces indicators, who reads and interpret them, who presents measurement to whom...? Therefore a third level of interaction is necessary to reassess the design of instruments, their adaptation to operating and controlling practices, the transformation of actors’ roles and competences in the process of performance control.

Those three levels are rather close to what Argyris and Schön (Argyris & Schön, 1978) call “single loop learning”, “double loop learning”, “deutero-learning” (learning to learn).

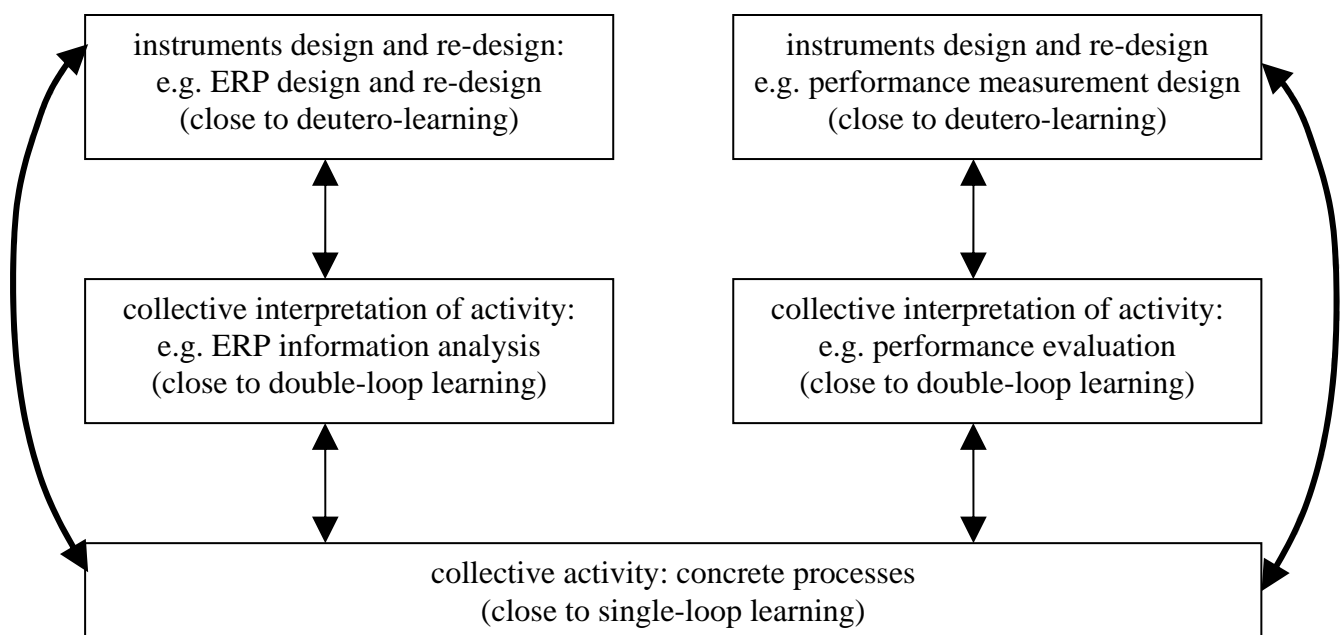


figure 2: three levels of sensemaking interactions between actors

Therefore there is a strong relation between the design / redesign of collective activity and the design / redesign of instruments, including performance measurements. The objective of building a “common language”, an effective medium to serve collective sensemaking, can only be attained if *instrument design and activity design are achieved in an integrated way: involving the same actors, with coherent objectives, with a general interpretive frame of what collective activity is and means.*

3. A case study: the changes of the procurement process linked with an ERP and a new management accounting system implementation

3.1. The company

The EDF Group is one of the key players in the field of electricity generation, distribution and supply in Europe. Managing a generation mix with a capacity of 125.4 GWe (74% nuclear, 17% thermal, 9% hydraulic), it provides energies and services to 42.1 million customers throughout the world, including 36.2 million in Europe. The EDF Group is made up of *Electricité de France*, parent company (EDF SA), and a network of 75 affiliates and investments established in Europe and around the world. In 2004, EDF Group's consolidated sales amounted to €46.9 billion. It has 161,310 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. Electricity is a very particular product. It is crucial for the economy and as such has always got attention from the public authority. It cannot be stocked and the production must immediately satisfy the demand, that is highly variable.

In France the company, state owned since 1946 with a mission of public service, had the monopoly of electricity transportation and distribution and a “quasi”-monopoly on production (87%). Ambitious profit objectives or cost reduction targets were not priorities. Traditionally EDF culture was based upon the notion of general interest. Following the opening of energy markets decided by the European Union in 1997, European countries are subject to diverse regulatory regimes. To cope with the new challenge of deregulated markets, the French state decided to transform EDF in a public company in 2005 and to sell a minority of shares on the financial markets. Due to the progressive opening of the French electricity market to free competition (30% on July 1, 2002, 70% on July 1, 2004 and 100% on July 1 2007), EDF must look for growth opportunities abroad. It cannot grow in France, which is a mature market. Therefore funding the international development becomes a priority, and profit objectives and cost reduction targets become vital priorities.

EDF is structured in 5 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; more flexible and reactive management practices.

3.2. Research methodology and design

The research described in this paper has arisen out of two distinct studies. Our field work approach in both cases was based on participative observation.

First study: the transformation of the cost measurement system for purchased goods and services

First we studied the change in performance measurement practices, more precisely in the management accounting and cost performance measurement system, in the corporate purchasing department (CPD) of EDF over three years, from 2001 to 2004. The CPD chief controller asked us to play a role of participating observers, following the “PMC”

(“Purchasing Management Control”) project. This project tried to redefine the management accounting system of EDF purchases to give more direct responsibilities to the operational branches and to the CPD in cost-cutting and bottom line improvement. We were asked to give information about common practices in other companies and to give advice about the planned new system. We systematically attended the PMC project weekly meetings, specific review sessions, coordination meetings with operational branches (production, distribution, commerce), meetings with purchase managers, meetings with information systems managers. We had periodic (more or less monthly) 1 to 2 hour work meetings with the CPD chief controller and the PMC project manager. We had access to all the PMC documents. We repeatedly interviewed the main project contributors (around 12 persons). Beyond interviews, our involvement in the field was continuous, and we established a familiar presence in the project.

Second study: the organizational impact of an ERP implementation in the purchase and procurement domain of PEB (Production and Engineering) Branch

Second we conducted a field study concerning the organizational impact of an ERP (SAP) implementation in the purchase and procurement domain at EDF – PEB from January to September 2005. We had access to the researched organization (PEB) during the post implementation phase. Due to the size of the company, we decided to limit the research 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*”). We had no operational mission, but the company expected some feedback from us to adjust future PGI implementation methods in other branches. We followed an iterative process of research: 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: we selected and analyzed some 100 documents (minutes of meetings, reports, instructions, procedures, training supports, methodological tools, action plans...).

The research project involved two entities:

- a project team in which we cooperated with two EDF managers (one representative of the corporate purchasing department, one representative of the Production and Engineering Branch); we were accompanied by at least one of them in all the interviews we made;
- a steering committee, in which we reported the progress of our study 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 further limit the scope of our 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.

We alternately interviewed EDF employees on their working sites (nuclear plant, hydraulic units, offices in Lyon) and central managers at Paris corporate headquarters. We met maintenance technicians, maintenance managers, regional and corporate accountants, unit procurement managers, regional and national purchasers, PGI project team members.

In September 2005, we presented the final conclusions of our study to the steering committee.

3.3. From the semiotic theoretical frame to EDF case study

In this case study, we try to analyze the relation between the implementation of new instruments at EDF (two parallel projects: PMC – Purchasing Management Control – and PGI – SAP introduction) and the evolution of collective activity (the Purchasing Business Process). Therefore the theoretical frame presented in part 2 here applies to:

- the Purchasing Business Process as it concretely operates in day to day operations as *collective activity*,
- PMC and PGI systems as *instrumental artifacts* (software, calculation formulas, fromal written procedures), giving raise to *actual utilization practices* through their interpretation by actors,
- *actors* mainly involved in the purchasing process and the use of PMC and PGI; here, for the sake of simplicity, we shall focus our analysis upon two key categories of actors, the technical agents in charge of maintenance operations on one side, the purchasers on the other side.

We shall study, first, how instruments are interpreted by actors and actually translated into practices, and, beyond that, under which conditions instruments can provide a common language for the global coherence of the corporate work.

3.4. Evolution of performance measurement practices (PMC project)

There were three main phases in the performance measurement practices in the purchasing areas, corresponding to major changes in the company organization.

Phase 1

In the past (90s), the purchasing function was integrated into the operations: each operational branch (nuclear production, hydraulic production, thermical production, engineering, distribution, trade) had its own purchasing department, which involved a specific design of collective activity. Purchasers were considered as functional supports of operational managers and tended to give the first priority to technical specifications, users' convenience and minimization of operating risk. Like accountants or human resource managers, purchasers were considered as mainly clerical supports for operating managers. Most of them were on site and had close relations with technicians. The economic performance of purchases actually appeared as a secondary objective. Economies of scale were limited by the scattered nature of purchases throughout the company. There were only a few exceptions, for heavy pieces of equipment or critical maintenance services in the nuclear power plants. The nuclear plants are fairly standardized, but nevertheless centralized and standardized purchases were exceptions. They did not represent more than 20% of the global purchases of nuclear production units. In other areas, the level of centralization and standardization was much lower.

Phase 2

With the new strategic environment of EDF: European de-regulation, privatization, the improvement of economic performances became a priority. The traditional organization of purchases appeared as a waste of resources: no economies of scale, redundancies, over-sophisticated technical specifications... In 2000, to increase the economies of scale and the industrial coherence of technical purchases – particular the purchases of engineering and maintenance services –, it was decided to group the purchasing departments in one corporate department, the CPD (Corporate Purchasing Department), which directly reported to the CEO, with the clear objective of reducing the cost of purchased goods and services. The CPD was responsible for all the purchases excepting fuels (oil, coal, uranium).

This decision entailed a drastic transformation of the purchasing collective activity. The purchasers moved from operating sites to regional or corporate headquarters. The dominating view of the purchasing performance then became the price effectiveness of purchasers' negotiations with suppliers. To measure it, a key performance measurement was used: the "economic gain", i. e. the planned reduction of the purchasing expense for one type of purchased article, thanks to the decrease in the negotiated price. For instance, let us assume that the negotiated price of turbines type X for one three year period was P_n . A new contract is negotiated for the following three-year period at the price P_{n+1} . In the planning cycle, planners made a forecast for the purchasing volume V_{n+1} of this article (number of turbines to purchase in the planned period of the next three years). The economic gain amounts to: $(P_n - P_{n+1}) * V_{n+1}$. This comparison between two planned figures (extrapolated from contracts n and $n+1$) was the basis for the performance evaluation of purchasers and of the purchasing department (CPD).

Here we can see the semiotic function of the performance management system. The economic gain was a sign which replaced the concrete negotiating activity with one monetary figure. It translated the concrete negotiation into the world of economic values and allowed to interpret it as a financial performance. It opened the space of possible actions: by evaluating the purchasing performance in a linear scale, it allowed to compare purchasers, to compare performances in the course of time for one given group of purchasers, and to decide if some corrective actions were required. But to contribute to transform collective activity, economics gains had to be interpreted by actors. The "economic gain" was a semiotic mediator which allowed to make sense of the purchasing action and to trigger new actions.

However, those theoretical gains were not often verifiable in the company's actual accounts, since there was no link with the accounting structure of expenses. Therefore EDF executives could not measure the actual contribution of the purchasing function to financial results. Actually purchase expenses kept on growing as fast as or faster than sales, and this bad performance was often attributed by purchasers to the behavior of operations managers:

- the operational managers did not always use centrally negotiated frame contracts² and sometimes re-negotiated their own purchases on a local basis; the percentage of purchases which was made with frame contracts was less than 50%;
- the purchasers argued that operations managers did not always have a tight control of purchased services and equipments utilization: they claimed that there could be increases in consumed volumes for lack of operational efficiency; of course the operations managers rejected that type of explanation and claimed that price decreases were purely theoretical since the actual operational settings never corresponded to the contractually planned conditions and required some re-negotiation.

In that phase, the main levers to reduce purchase expenses were: increasing the percentage of purchases recurring to frame contracts, standardizing purchased articles and services, reducing the number of suppliers. Those policies required some firm control of actual practices. The purchaser saw himself and was seen by the company executives as a controller of operations managers, with whom the relation was rather antagonic. In particular, he had to control that operations managers actually used the frame contracts that the purchasing department had negotiated. On the other side, operations criticized the purchasing department because many frame contracts were coined "difficult to use" if not, in some cases, altogether irrelevant. They also considered the "gains" figures as fairly arbitrary. There was a complete separation between the operating functions and the purchasing function, even in information systems: the world of operations was "budget versus actual expenses", the world of

2 A "frame contract" is a contract with a supplier which establishes the technical (specifications) and economic (prices) frame for some specific procurement, but which leaves the precise logistic conditions (quantities, dates) open. The frame contracts are generally negotiated by central purchasing services, whereas the logistic conditions are determined by local operations.

purchasers was “contract N versus contract N-1”, with no easy bridge. Each function had its own computer applications, with little integration. Figures were not comparable.

Phase 3

To make the purchasing performance more controllable, it was decided to link it with the actual company P&L: the first target was no longer to compare planned purchases from one period to another, but to compare planned expenses (as they could be calculated from the contracts) or budgeted expenses (as they could be read in the budget) with actual expenses derived from the accounting system. The corporate executives were tired with the “deaf and dumb” dialogue between purchasers and operations managers. They needed a clear view of the actual impact of purchase management upon bottom line. This went along with four big changes:

- the definition of purchasing performance actually changed: it was no longer the reduction in negotiated prices, but the *reduction in actual procurement expenses*;
- so far, the personal performance of the individual purchaser and the functional performance of the purchasing department had been merged; it was decided to differentiate them: the negotiating performance remained important for the individual purchaser, it was no longer considered as relevant for the purchasing function;
- the definition of the purchaser’s mission was also modified: from now on, he had to care about the final purchasing expenses and be able to explain variances between planned expenses and actual expenses; the major technique adopted to fulfill this objective was variance analysis, disaggregating the expense variance into price and quantity variances; for instance, if the budgeted expense for purchased transformers was 200 M€, the actual expense was 210 M€, the -10 M€ variance would have to be disaggregated into quantity variance (for instance in this case a -12 M€ variance due to the fact that more transformers than budgeted were purchased) and price variance (for instance in this case a + 2 M€ variance due to the fact that each transformer was cheaper than budgeted); *the purchasing function would be held responsible for the average unit price of purchases; the operating functions would be held responsible for the volume of goods and services consumed*; in this way, there was a model to explain variances, with a clear-cut separation between operational managers’ (volume) and purchasing managers’ (price) responsibilities;
- the relation between operational managers and purchasing managers evolved from a complete separation in phase 2 towards a limited cooperation in phase 3: the operating and purchasing functions had to cooperate to implement the systems required by variance analysis: budgeted expense versus actual expense, price versus volume variance. This required developing some level of compatibility and integration between systems, some coherence in figures, and the development of new managerial elements. For instance, it was necessary to design commonly agreed volume measurements: e.g. would kilometers be the right volume measurement for cables, at what level of “cable” definition (how many types of cables), would the number of transformers be the right volume measurement for transformers, etc.

Nevertheless, even if the level of cooperation had to be significantly reinforced, it was intended to keep a clear separation between operations and purchasing responsibilities. The world of operations was seen as the world of volumes and the world of purchasers was seen as the world of prices, “global expenses” becoming a bridge between both worlds. As a consequence volume should be forecast by the operations and price should be forecast by the purchasers. This scheme, which can seem simple, actually raised complex technical issues. For instance, the operating functions based their budget upon an activity-segmentation of their business units (*for what* activity do we purchase?), whereas the purchasers based their price analysis upon a contract and purchased article segmentation (*what* do we purchase?). It was

necessary to build specific tools to establish a correspondence between activity volumes and purchased article volumes, a kind of “standard consumption of article A by activity Y” matrix.

The measurement of purchasers’ performance changed: the “gain” notion was abandoned and the budget variance was introduced. The new system was seen as a support for cooperation between purchasers and operations managers, by making them jointly responsible for the expense reduction. It was also seen as a support for the communication between the purchasing function and the rest of the company, by linking the performance measurement of purchases with the budgeting cycle. A new instrument – budget variance – replaced the former one, the economic gain, and the semiotic function of the instrument evolved. It did not translate the purchasers’ activity into a general economic language, as the “gain” did, in a fairly abstract way, but it translated it into something more precise and focused: the specific contribution of purchases to the financial results of the company, as it could be checked in the corporate accounting system. Furthermore, by splitting the budget variance between volume and price variance, the new instrument favoured interpretations based upon the complementary cooperation between technical operations (“volume”) and purchasing (“price”). But the new performance measurement system assumed that collective activity (the purchasing process) was designed in such a way that purchasers were clearly in control of prices and the operations managers clearly in control of quantities.

The key message of the PMC project therefore was: “operations, be in charge of volumes; purchasers, be in charge of prices”

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

The phases 2 and 3 of PMC project previously described were simultaneous and parallel to SAP implementation in the production branch (PEB). 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”³. A strong project team was constituted. PGI is an ambitious project: with several thousands of users, it is one of the biggest SAP platforms in Europe. PGI is implemented as an integrated solution, covering accounting, control, purchasing and procurements, inventory management, time and activity management and sales. It is 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.

Phase 1: operation of the procurement process before the creation of CPD and the implementation of PGI

Before PGI implementation, the purchasing function was integrated into the operations: as mentioned earlier, each operational branch had its own purchasing department. As a consequence the purchasing process was highly fragmented. Figure 3 describes the historic roles of technicians and purchasers in the purchasing and procurement process at EDF PEB

3 PGI = *Progiciel de Gestion Intégré*

divisions (nuclear, hydraulic and thermal production, engineering), in the cases of locally managed procurements, when there was no frame contract (the majority of cases). Hierarchical and functional coordination was then effective, since technicians, controllers and purchasers acted in simple and stable processes. Purchasers executed technical purchase specifications of technicians without much economic constraint (no standardization of articles and suppliers etc.). Purchasing was completely decentralized. The direct supervision of operational and purchase managers assured the respect of predetermined tasks in local units. Collective activity (the purchase and procurement process) was an objective reality (it actually existed) but it was neither seen nor experienced in the daily operations by the actors who accomplished their missions separately.

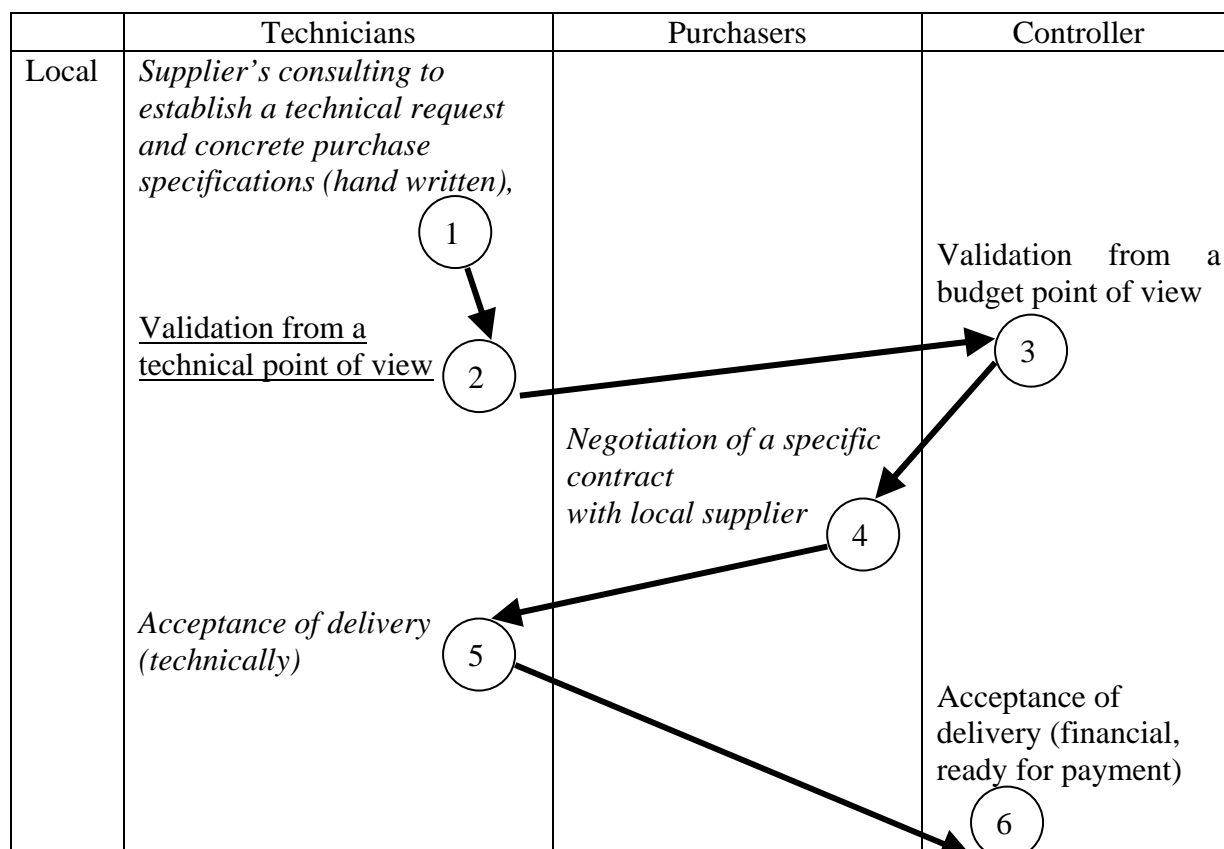


figure 3: the purchase process before PGI and before CPD creation, in the case of local procurements (no frame contract)

N.B. 1 in italic letters, activity of operational agents, in underlined text, activity of manager

N.B. 2 The important activities of accountants are neglected in this diagram.

Phase 2: Design and implementation of the procurement process with PGI

In the purchasing process, we found that ERP implementation involved the redesign of collective activity, requiring closer cross functional integration: the principle of a single data base creates tight interdependences between maintenance technicians (the main users of purchased articles) and purchasers at the different levels of the organization (corporate, division, local unit). EDF executives decided to exploit this SAP characteristic to impose their new view of performance and organization. The aforementioned economic constraints in the PEB branch (cost reduction, cash generation etc.) logically entailed the decision to reengineer business processes in a significant way. PGI was seen as a major opportunity for such a change, but PGI did not *determine* change. Other researchers have already observed that SAP opens up certain opportunities and facilitates certain changes which were already taking place within the company (MacIntosh & Scapens, 1991; Scapens & Jazayeri, 2003). EDF managers

interpreted PGI use in their own way, as a vector for major changes in the business process design. They decided to integrate the purchasing and the technical functions and to impose a highly standardised version of SAP in all the divisions. The same procurement process was imposed to nuclear, thermic and hydraulic power stations and engineering units, though the average amount of single purchases (very high for nuclear plants, much lower for hydraulic plants), the geographical scattering of delivery sites and the “service to goods” ratio strongly differ from one division to another, making the standardization of articles, the reduction of suppliers and the mandatory use of frame contracts more or less difficult to implement.

Consequently, the purchase and procurement process suffered important changes:

- with PGI, the maintenance technician must define a purchasing request (PR) without consulting any supplier (only purchasers can have contacts with suppliers), whereas he used to cooperate with potential suppliers to determine technical specifications;
- in the PR, the technician must select the relevant frame contract and the relevant article code; the article code determines an account and a tax regime (VAT); so, by choosing an article code, the technician determines the accounting and the tax characteristics of the procurement; the PR, which was a merely technical document before, now automatically involves budget imputation, accounting imputation and tax regime;
- the acceptance of deliveries (control of the conformity of the delivery to the order), which was before a technical event, has now become an important financial event, since it automatically gives the authorization for supplier’s payment; if the delivery is not formally accepted in PGI by the technician, the supplier cannot be paid.

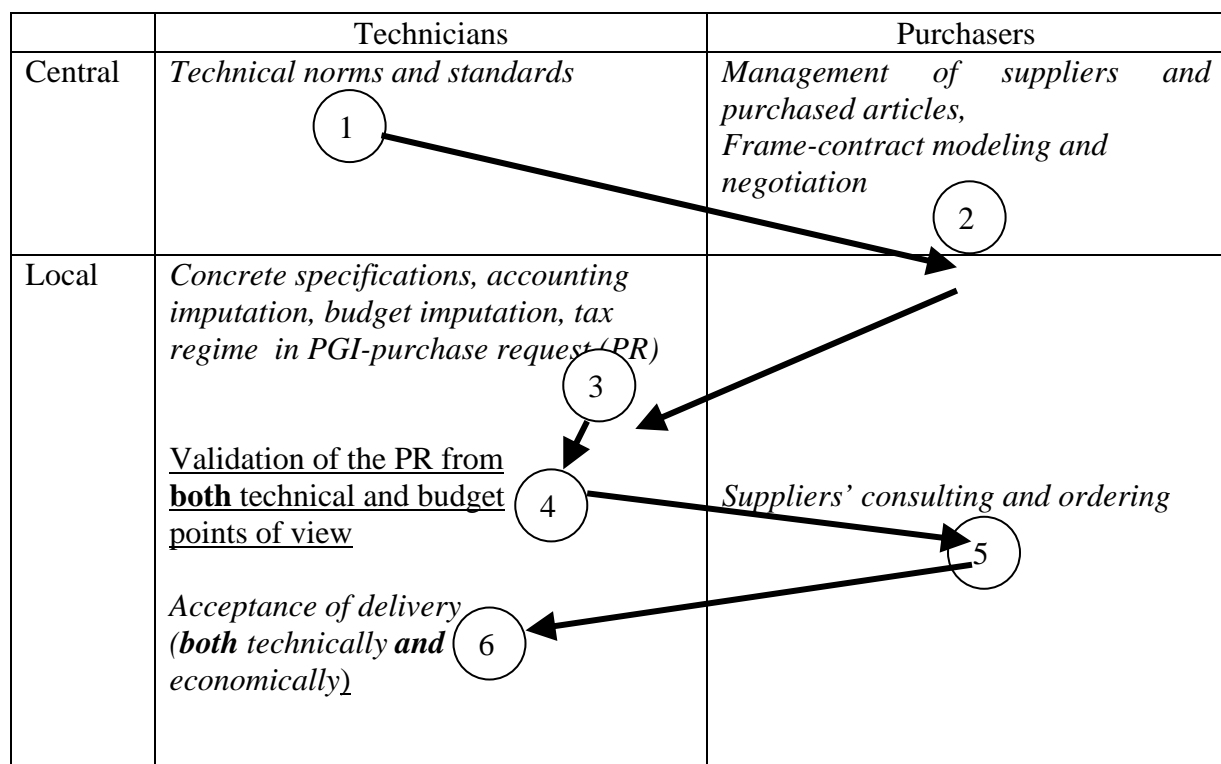


figure 4: the target purchase process after PGI implementation and CPD creation

N.B. 1 in italic letters, activity of operational agents, in underlined text, activity of manager

N.B. 2 The important activities of accountants are neglected in this diagram.

Here we see the semiotic function of the PGI instrument as a sign. For instance the base of article codes in PGI plays the role of a language. The article code links the technical maintenance operation with an accounting code, which in turn gives this particular technical procurement, here and now, generic economic meanings: is it “investment” or “period expense”, is it “current maintenance” or “repair” or “operation to ensure conformity to regulations”, “electronic maintenance” or “mechanical maintenance”, what VAT rate does it

support? Through the article code, interpreted and used by the technician, the technical operation is read as an economic event. The base of frame contracts plays a similar role, by allowing to read a specific technical operation as one particular implementation of a generic industrial policy (choice of potential suppliers, suppliers' portfolio management, technical partnerships). In both cases, to make sense and to generate practical effects, the instrument artifact (the article coding in one case, the frame contract coding in the other case) must be interpreted by the technician.

Since there is a structural separation between the technician's and the purchaser's functions (creation of the Corporate Purchasing Department), this new design of the purchase process, based upon a close integration between technical and purchasing functions, multiplies interfaces between those two distinct functions. It requires intense informal cooperation, ongoing information exchanges and mutual adjustments between purchasers and technicians: the technician must support the purchaser's negotiation by providing the adequate environment information (most purchases concern maintenance services whose precise definition is strongly influenced by technical and human environments); the purchaser must support the technician by coaching him for the utilization of frame contracts in establishing the PR; etc. The traditional hierarchical control becomes more difficult (no common local hierarchy for technicians and purchasers). Since the potential interactions across functional boundaries increase, there is a greater risk of mutual misunderstanding and loss of sense. In this context only an ongoing cross-functional exchange between the actors can assure the necessary coherence of collective action.

For instance the frame contract, whose design becomes the purchasers' critical activity, is a model of its future utilization by technicians. In the frame contracts purchasers define the generic decomposition of an outsourced maintenance service into lots and partial deliveries, which strongly constrain the way the service can be concretely scheduled, achieved and billed. They also mention article codes, which determine the capacity to decompose the service into specific tasks and to measure their accomplishment. To design technically viable frame contracts, purchasers must acquire some technical competence. At the same time contract users (technicians) must be able to communicate their needs to the purchasers in an intelligible and clear way to support their efforts to design relevant frame contracts. The relation between technicians and purchasers evolves from a clear-cut separation in phase 1 towards a close cooperation in phase 2. Collective activity becomes visible to both categories of actors as a day-to-day living requirement.

Phase 3: actual operation of the procurement and purchase process after the implementation of PGI

The actual operation of the procurement process with PGI meets difficulties and does not achieve the expected integration, because the dimension of collective activity was taken for granted and consequently partly ignored in the engineering of the system. Problems of coherence between the ERP and the actual collective activity appeared. The reflexive rebuilding of the process did not take place: the importance of business process reengineering was underestimated by the project managers, partly because many impacts take place in the micropractices and the daily operations of technicians and purchasers (and accountants, but we shall not consider this dimension here), at the level of activity, rather than in the formal organization charts. Thus the strong mutual cooperation planned by the PGI project turned out to be difficult to achieve. Technicians complain about the lack of purchasers' cooperation. They regret the insufficient purchasers' knowledge of technical operations. For instance, hydraulic technicians suffer from specific constraints related with the geographical

peculiarities of their activity: small dams in the mountains, some of them very far from towns down in the valley. The corporate purchasing policy (centralizing the management of the suppliers' panel and reducing the number of suppliers) is a frequent source of problems for them, because they need access to small local suppliers. The policy was applied in a fairly rigid way to avoid permanent renegotiation, but hydraulic technicians conclude that their colleagues in the purchasing function do not understand their job. Engineers in the engineering center for the dismantling of nuclear units have the same type of complaint: from Lyon they must coordinate six or seven dismantling sites all over France, and they face limitations in the use of suppliers which do not take into account the specificity of their activity. Symmetrically, purchasers complain about the low competence of technicians in purchasing procedures: article coding, ordering rules, delivery scheduling... They regret that technicians often make mistakes in their purchase requests: they do not choose the right article code, they do not refer to the right frame contract, and those mistakes entail a heavy work of "undoing" and "redoing" later in the process. Many problems are raised by the decomposition of the supplied services into lots, partial deliveries based upon technical considerations and partial bills based upon financial considerations: how does a partial bill reflect the state of partial deliveries? Difficulties can derive from the supplier (unclear bill), the technician (incorrect timing of deliveries), the accountant (misunderstanding of the technical nature of the delivery), the purchaser (wrong modelling of the frame contract)...

Obviously in the design and preparation phase, it seems that the cross-functional dimension of collective activity (business process) was not fully anticipated (impact studies were only made for "vertical" units, not for business processes; PGI training was strictly organized for homogeneous professional groups, with no cross-participation of other functions). In the actual use of PGI, unprepared cross-functionality remains a sensitive point. To overcome these difficulties actors express their need to establish new forms of reflexive cooperation to redesign their own collective cross-functional activity.

In the procurement process, three upstream activities appear as critical points for this reflexive cooperation between technicians and purchasers:

1. defining technical norms and standards (central technicians),
2. modelling frame contracts (purchasers),
3. designing purchase requests (local technicians).

All of those three activities design instruments (technical norms, frame contracts, purchase requests) which play a key role in constraining later activities, further downstream in the process, with different anticipation ranges: long range anticipation through technical norms (TN), medium range anticipation through frame contracts (FC) and short range anticipation through purchase requests (PR).

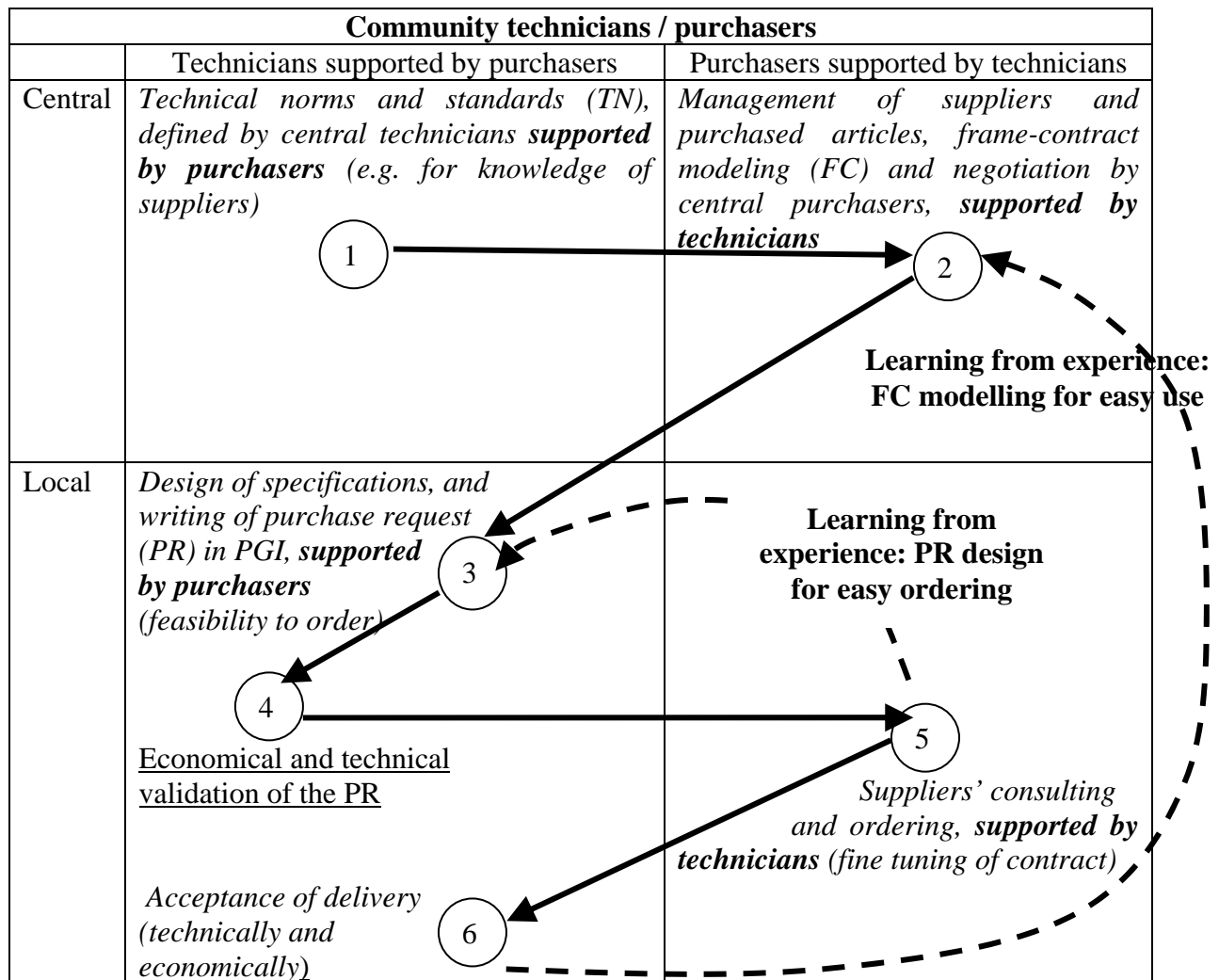


figure 5: the target purchase process after PGI implementation and CPD creation

N.B. 1 in italic letters, activity of operational agents, in underlined text, activity of manager

N.B. 2 The important activities of accountants are neglected in this diagram.

To control the redesign of the business process, there are key interactions, particularly in the design activities (activities 1, 2 and 3):

- to define technical norms, central technicians should consult purchasers about the past performance of suppliers, their technological developments, the evolution of the suppliers' markets and competitiveness;
- to model frame contracts, the purchasers should take into account the technical requirements of maintenance technicians: what kind of decomposition into lots and phases do they need, how do they need to identify different articles within the global subcontracted service;
- when designing their purchase request, local technicians should take into account the information requirements of purchasers to pre-select suppliers, to organize a tender, to answer suppliers' questions.

Interactions between technicians and purchasers are not only important in design activities (activities 1, 2 and 3), but also in the feedback loops (pecked arrows on figure 5) from downstream operating activities (activities 5 and 6) towards design activities; for instance:

- in consulting suppliers and ordering, purchasers can give some quick feedback about the PR: does it bring all the necessary information, is it intelligible, is it easy to interpret by suppliers?

- the final control and acceptance of delivery allow the technicians to give some feedback about the frame contracts: do they correctly take into account the constraints of operational maintenance, are they competitive?

There are so many interactions between technicians and purchasers that it would be more relevant to attribute the whole purchase and procurement process as a joint collective activity to the community “technicians + purchasers” (figure 5) (actually to a more complex community including accountants and maintenance managers, but we limit ourselves here to two categories - technicians and purchasers - for the sake of simplicity).

Finally the key message of the PGI project is: “technical operations and purchasers, work in close integration on a day-to-day basis”

3.6. Summary of the two studies: three levels in the design of the collective activity

To summarize the two studies, we can apply figure 2 to the case of EDF and PGI and PMC projects (figure 6). We find the three levels as shown in figure 2:

1. Level 1: actors are engaged in the concrete, here and now purchasing process,
2. Level 2: actors are engaged in the critical and reflexive reassessment of the purchasing process, through PGI (for instance to position one particular procurement operation in the industrial policy of the company, by selecting a frame contract in PGI base), and through PMC (for instance to characterize the economic meaning of purchasing practices through volume and price variance analysis).
3. Level 3: the reassessment of collective practices entails deep transformations in the design of instruments, to adapt them to evolving operating and controlling practices; here, for instance, the PGI base of frame contracts must be periodically modified to take new experience into account (e. g. extending the list of technical options provided by the contract); the PMC classes of articles used for volume analysis must be periodically reviewed to improve their economic homogeneity.

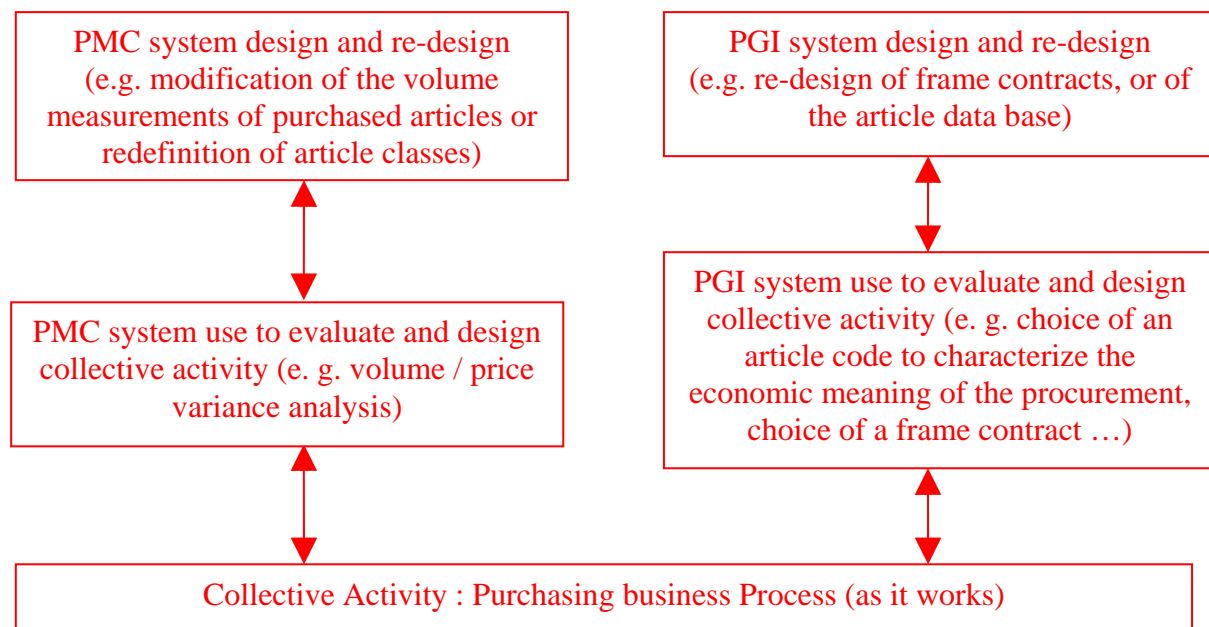


figure 6: the three levels of the instrumental design of collective activity at EDF (PGI and PMC projects)

4. Interpretation of the case in the light of the semiotic theoretical frame

The separation between technicians (“volume” performance) and purchasers (“price” performance) as designed by the new management accounting system proves to be contradictory with the close intertwining of the purchasers’ and the technicians’ activities as required by the business process-based architecture of PGI. Most of the PGI process activities actually have an impact upon both the price and the quantity purchased. This is particularly the case for the three upstream critical activities already mentioned (TN definition by central technicians, FC modeling by central purchasers, PR design by central technicians, FC modeling by central purchasers, PR design by local technicians).

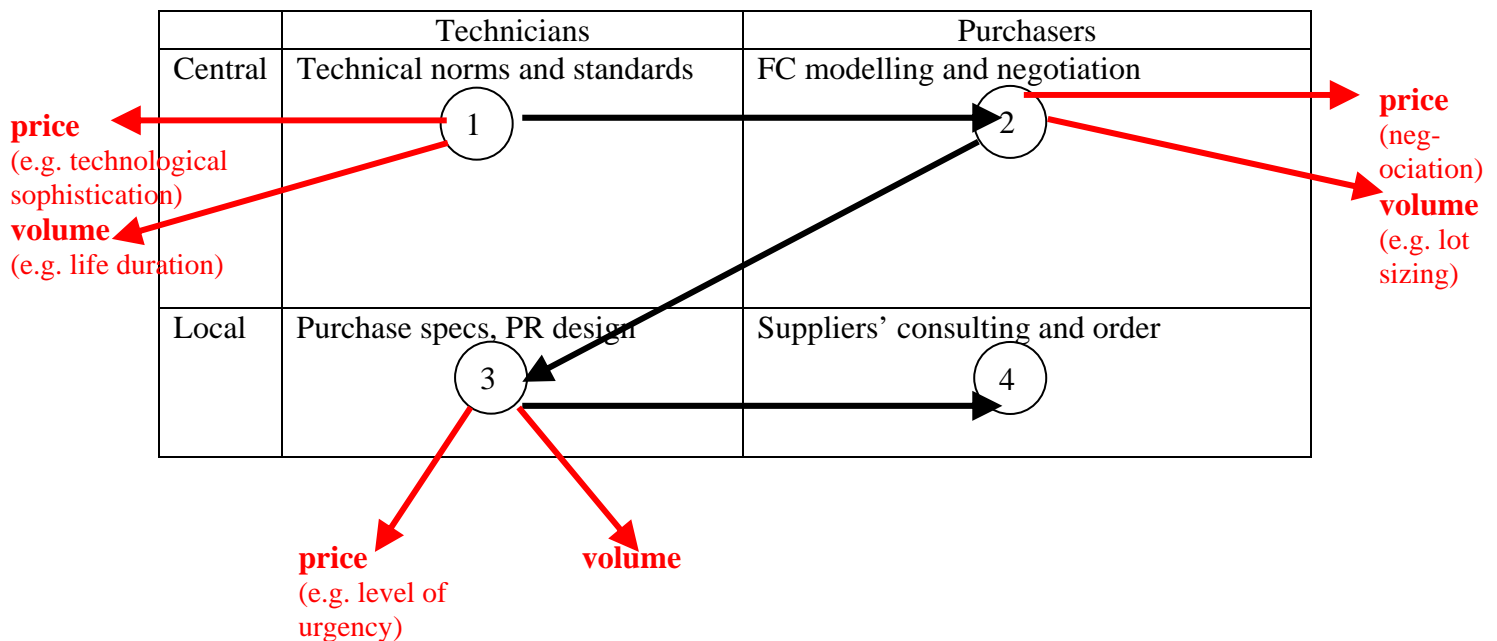


figure 7: the price and volume impacts of critical activities 1, 2 and 3

- TN (technical norms) definition: the technical norms influence the price, for instance through the level of technological performance and sophistication required and the more or less open composition of the suppliers’ panel for the selected technology; they influence the volume, for instance through the maximum life duration of equipments (renewal requirements) or the standard time between two maintenance interventions.
- FC (frame contract) modeling influences price through the commercial effectiveness of tenders and negotiations and the capacity to make competitive comparisons between different frame contracts; it influences volume through lot-sizing or through the perimeter of the defined maintenance service and the “make or buy” trade off it involves.
- PR (purchase request) design influences price, for instance through the level of anticipation of the request (more or less commercial urgency), and it influences volume through the “make or buy” choices which the specifications adopt.

The design of two new instruments for the purchase process was started at the same time: on one side, a new performance management (management accounting) system, designed by the purchasing department; on the other side, a new integrated management information system (ERP), designed by line management (process reengineering related with PGI project). Whereas the coherence between PGI and PMC projects could have been given by their common subordination to the rebuilding of collective activity, their disconnection from collective activity opened the possibility of serious dissonances between them. Both the new performance management system and the new ERP met difficulties to provide common languages, since the dimension of collective activity was taken for granted and consequently partly ignored in the engineering of both systems. In implementing the new Performance

Measurement System (PMC), managers took for granted that Collective Activity would allow separating the “world of purchased volumes” on the technical operations side and the “world of prices” on the purchasing side. In implementing the ERP system (PGI), managers took for granted that Collective Activity would allow the required day to day cooperation and adjustments between purchasers and technicians, particularly for the upstream design of key instruments (frame contracts, purchase requests). Neither of those two projects made provision for the deliberate and conscious reengineering of the *actual* collective activity, as it takes place every day on the field. It would have required a comprehensive and thorough management of change, involving the actors of the process themselves, in such areas as competence profiles, motivation and incentives, networks of personal relations, team configurations, meeting rites, spatial arrangements...

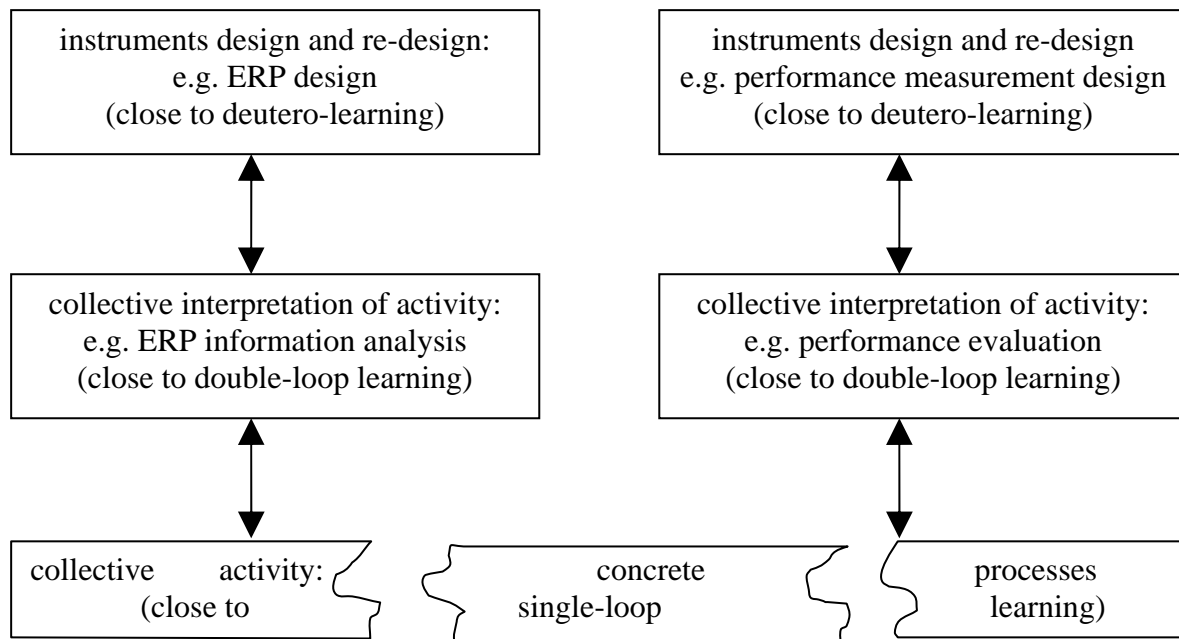


figure 8: since they are fairly disconnected from the reinterpretation of collective activity, projects can diverge (no common sensemaking reference to collective activity)

This situation raised problems of coherence on the three “sides of the triangle” collective activity / ERP / performance measurement: problems of coherence between the management accounting system and the actual collective activity (existing business process), between the ERP (targeted business process) and the actual collective activity, and between the ERP and the management accounting system. The flexible and non deterministic coupling between performance measurement and collective activity was not assured; neither with the existing business process, nor with the PGI based targeted business process.

The ERP proves to be dominant to reengineer collective activity (business processes), because of its cost and the severe constraints it involves for data availability. The PGI project was translated into new organizational models which entailed a deep transformation in the structure of roles and in the competence profiles of actors. Technicians must become project managers with technical, managerial and accounting roles; purchasers are no longer pure negotiators but must manage the global economic performance of purchases. The transformations in the structure of roles involve changes in the meaning of “performance” for the actors concerned:

- The maintenance technician, as a technician, is responsible for the timing and the technical effectiveness of the intervention; this aspect of performance often inclines technicians to minimize their clerical work, to keep time and attention for the technical control of suppliers’ service. But as a project manager, he must optimize the cost /

time / quality trade offs, which requires to optimize the design of the maintenance intervention from an economic point of view, the schedule of intervention, the schedule of supplier's payment and the schedule of accounting transactions, with a fairly heavy clerical and managerial work. In this area of his new activity portfolio, the technician must take into account purchasing procedures, rules, constraints and objectives.

- The purchaser, as a negotiator, is responsible for the negotiated prices. But as the controller of the global economic performance of purchases, he is responsible for the impact of purchases upon operating costs and performances (utilization cost, quality, timeliness). In this area of his new activity portfolio, the purchaser must take into account technical and operational constraints and objectives.

While the PGI project targeted a much closer integration between technicians and purchasers in the day-to-day operations, at the same time, the PMC (Purchasing Management Control) project tried to establish a clear separation between technicians' and purchasers' responsibilities and roles. Both projects delineated two implicit and contradictory images of the collective activity, neither achieved the explicit redesign of concrete collective activity.

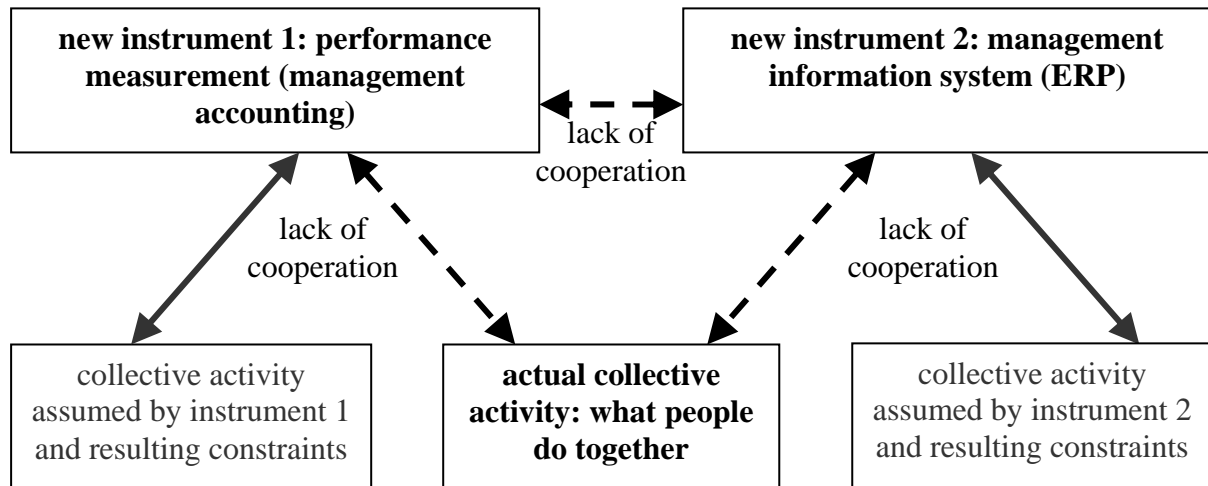


figure 9: the disconnected approaches of instruments (management accounting and ERP) and collective activity (purchase and procurement process)

5. Conclusion

In conclusion, performance measurement can be a common language as far as there is a clear and shared understanding of how collective activity should be organized and assigned to the different categories of actors (and vice versa). When designing performance measurement as a common language, it is necessary to build some shared understanding of (a) collective activity (here, the actual purchasing and procurement process), (b) the structure of roles in this collective activity (here, the roles of technicians, purchasers, accountants, etc.), and (c) the performance measurement required for this new collective activity (here the performance measurement of the business process and of each category of actors). Performance measurement must be based upon the actual process and its transformation. Under such conditions, the process-based performance measurement system can play an important integration role (Beretta).

Performance management is semiotically linked with the setting and the role casting of the collective activity, in the same way as the text of a theater play is linked with the role casting and the setting of the play. There is no way to design a relevant performance

measurement system without coupling it with the design of collective activity, in its cross-functional dimension.

This coupling cannot be exclusively determined by experts in headquarter offices. As mentioned before, it is the *actual* collective activity, i. e. the process as it actually works on the field, that should be deliberately redesigned. This cannot be done without a thorough experience of actual operations, their requirements, their difficulties, their risks, their potentials for improvement and the necessary day to day cooperation links. It requires the adhesion of concerned actors, neither exclusively nor principally to new instruments, but rather *to the new form of collective activity*. So it is of utmost importance to establish the cross-functional groups which can jointly redesign the collective activity and the performance measurements as a language engaged in collective activity. These groups are more than ordinary working groups: they are communities. By this comment, we mean that designing the new profile of collective activity is at the same time a risky and an exciting venture, because activity is more than an ordinary attribute for actors: it is deeply related with their professional identity and their intellectual, emotional and physiological being. The dialogical exchanges between actors to make sense of collective activity and to rebuild it require creativity and commitment. Redesigning collective activity – and related performance measurements as common languages - is an issue for passionate “communities of process”. The exact configuration of those communities and the practical methods to establish them are key issues for future research.

References

- Argyris, Chris & Schön, Donald (1978), *Organizational Learning. A theory of Action Perspective*, New York: Addison-Wesley.
- Beretta, Sergio (2004), "Enabling Integration in Complex Contexts: The Role of Process Based Performance Measurement Systems", *Managerial Finance*, vol. 30, N° 8, 69-91.
- Berry, Michel (1983), *Une technologie invisible? Le rôle des instruments de gestion dans l'évolution des systèmes humains*, Paris: Édition Ecole Polytechnique.
- Carruthers B.G. (1995), "Accounting, Ambiguity, and the New Institutionalism", *Accounting, Organizations and Society*, Vol. 20, N° 4, pp. 313-328.
- Clot, Yves (1999), *La fonction psychologique au travail*. Paris: P.U.F.
- Crozier, Michel & Friedberg, Erhard (1981), *"L'acteur et le système : les contraintes de l'action collective"*, Paris: Editions du Seuil.
- Dechow, Niels & Mouritsen, Jan (2005), "Enterprise resource planning systems, management control and the quest for integration", *Accounting, Organizations and Society* 30, 691-733.
- Dewey, John (1938), *Logic: The Theory of Enquiry*. New York: Henry Holt and Co.
- Dillard, Jesse F. & Yuthas, Kristi (2006), "Enterprise Resource Planning Systems and Communicative Action", *Critical Perspectives on Accounting*, N°17, 202-223.
- Eco, Umberto (1973), *Segno*, Milano: Isedi. New edition (1980). Milano: Arnoldo Mondadori.
- Engeström, Yrjö (1987), *Learning by expanding: An activity-theoretical approach to developmental research*, Helsinki: Orienta-Konsultit.
- Foucault, Michel (1965), *Madness and Civilization: A History of Insanity in the Age of Reason*, New York: Pantheon.
- Giddens, Anthony (1984), *The Constitution of Society*, Berkeley: University of California Press.
- Goldratt, Eliyahu & Cox, Jeff (1984), *The Goal*, Great Barrington (MA): North River Press.
- Hatten, Kenneth J. & Rosenthal, Stephen R. (1999), "Managing the Process-centred Enterprise", *Long Range Planning*, Vol. 32, N°3, pp.293 to 310.
- Latour, Bruno (1999), *Pandora's Hope. Essays on the Reality of Science Studies*, Cambridge (Mas): Harvard University Press.
- Leont'ev, Aleksie Nikolaevich (1981), *Problems of the development of the mind*, Moscow: Progress Publishers.
- Lorino, Philippe & Tarondeau, Jean-Claude (2002), "From Resources to Processes in Competence-Based Strategic Management", in *Systems Perspectives on Resources, Capabilities, and Management Processes*, edited by John Morecroft, Ron Sanchez, Aimé Heene - Pergamon, pp. 127-152.
- Lorino, Philippe (2005), "Stylistic creativity in the utilization of management tools", paper for OLKC 6 conference (Organizational Learning, Knowledge and Creativity 6th international conference), Trento, June 2005.
- Lorino, Philippe (2006), "Integrated management tools (ERPs) and organizational learning: an interpretive and pragmaticist analysis. The case of SAP in a large European electricity producer", paper for OLKC 2006 (International Conference on Organizational Learning, Knowledge and Capabilities), Warwick, March 2006, "Best paper award" of the conference.
- MacIntosh, Norman B. & Scapens, Robert W. (1991), "Management accounting and control systems: A structuration theory analysis", *Journal of Management Accounting Research*, Vol. 3, p. 131-158.
- Orlikowski, Wanda J. & Barley, Stephen R. (2001), "Technology and institutions: what can research on information technology and research on organizations learn from each other?" *MIS Quarterly*, 25:2, 145-165.
- Orlikowski, Wanda J. & Robey, D. (1991), "Information technology and the structuring of organizations", *Information Systems Research*, 2:2, 143-169.
- Peirce, Charles Saunders (1958) *Collected Papers*, Cambridge (Mas): Harvard University Press.
- Quattrone, Paolo & Hopper, Trevor (2005b), "'If I don't see it, I cannot manage it!'. SAP, accounting and visibility in a multinational organization", *research document* presented at HEC Business School 15 April 2005.
- Robson, Keith (1992), "Accounting Numbers as "Inscription": Action at a Distance, and the Development of Accounting", *Accounting, Organizations and Society* 17(7): 685-.

Scapens, Robert & Jazayeri Mostafa (2003), "ERP Systems and Management Accounting Change: Opportunities or Impacts? A Research Note", *European Accounting Review* 12(1): 201-233.

Vygotsky, Lev S. (1986) *Thought and Language*. Cambridge (Mas): The MIT Press.

Weick, Karl E. (2001) *Making Sense of the Organization*. Oxford: Blackwell Publishers.

LISTE DES DOCUMENTS DE RECHERCHE DU CENTRE DE RECHERCHE DE L'ESSEC
(Pour se procurer ces documents, s'adresser au CENTRE DE RECHERCHE DE L'ESSEC)

LISTE OF ESSEC RESEARCH CENTER WORKING PAPERS
(Contact the ESSEC RESEARCH CENTER for information on how to obtain copies of these papers)

RESEARCH.CENTER@ESSEC.FR

2004

- 04001 BESANCENOT Damien, VRANCEANU Radu**
Excessive Liability Dollarization in a Simple Signaling Model
- 04002 ALFANDARI Laurent**
Choice Rules Size Constraints for Multiple Criteria Decision Making
- 04003 BOURGUIGNON Annick, JENKINS Alan**
Management Accounting Change and the Construction of Coherence in Organisations: a Case Study
- 04004 CHARLETY Patricia, FAGART Marie-Cécile, SOUAM Saïd**
Real Market Concentration through Partial Acquisitions
- 04005 CHOFFRAY Jean-Marie**
La révolution Internet
- 04006 BARONI Michel, BARTHELEMY Fabrice, MOKRANE Mahdi**
The Paris Residential Market: Driving Factors and Market Behaviour 1973-2001
- 04007 BARONI Michel, BARTHELEMY Fabrice, MOKRANE Mahdi**
Physical Real Estate: A Paris Repeat Sales Residential Index
- 04008 BESANCENOT Damien, VRANCEANU Radu**
The Information Limit to Honest Managerial Behavior
- 04009 BIZET Bernard**
Public Property Privatization in France
- 04010 BIZET Bernard**
Real Estate Taxation and Local Tax Policies in France
- 04011 CONTENSOU François**
Legal Profit-Sharing: Shifting the Tax Burden in a Dual Economy
- 04012 CHAU Minh, CONTENSOU François**
Profit-Sharing as Tax Saving and Incentive Device
- 04013 REZZOUK Med**
Cartels globaux, riposte américaine. L'ère Empagran ?

2005

- 05001 VRANCEANU Radu**
The Ethical Dimension of Economic Choices
- 05002 BARONI Michel, BARTHELEMY Fabrice, MOKRANE Mahdi**
A PCA Factor Repeat Sales Index (1973-2001) to Forecast Apartment Prices in Paris (France)
- 05003 ALFANDARI Laurent**
Improved Approximation of the General Soft-Capacitated Facility Location Problem
- 05004 JENKINS Alan**
Performance Appraisal Research: A Critical Review of Work on "the Social Context and Politics of Appraisal"
- 05005 BESANCENOT Damien, VRANCEANU Radu**
Socially Efficient Managerial Dishonesty
- 05006 BOARI Mircea**
Biology & Political Science. Foundational Issues of Political Biology
- 05007 BIBARD Laurent**
Biologie et politique
- 05008 BESANCENOT Damien, VRANCEANU Radu**
Le financement public du secteur de la défense, une source d'inefficacité ?

2006

- 06001 CAZAVAN-JENY Anne, JEANJEAN Thomas**
Levels of Voluntary Disclosure in IPO prospectuses: An Empirical Analysis
- 06002 BARONI Michel, BARTHELEMY Fabrice, MOKRANE Mahdi**
Monte Carlo Simulations versus DCF in Real Estate Portfolio Valuation
- 06003 BESANCENOT Damien, VRANCEANU Radu**
Can Incentives for Research Harm Research? A Business Schools Tale
- 06004 FOURCANS André, VRANCEANU Radu**
Is the ECB so Special? A Qualitative and Quantitative Analysis
- 06005 NAIDITCH Claire, VRANCEANU Radu**
Transferts des migrants et offre de travail dans un modèle de signalisation
- 06006 MOTTIS Nicolas**
Bologna: Far from a Model, Just a Process for a While...
- 06007 LAMBERT Brice**
Ambiance Factors, Emotions and Web User Behavior: A Model Integrating and Affective and Symbolical Approach
- 06008 BATISTA Catia, POTIN Jacques**
Stages of Diversification and Capital Accumulation in an Heckscher-Ohlin World, 1975-1995
- 06009 TARONDEAU Jean-Claude**
Strategy and Organization Improving Organizational Learning
- 06010 TIXIER Daniel**
Teaching Management of Market Driven Business Units Using Internet Based Business Games
- 06011 COEURDACIER Nicolas**
Do Trade Costs in Goods Market Lead to Home Bias in Equities?

- 06012 AVIAT Antonin, COEURDACIER Nicolas**
The Geography of Trade in Goods and Asset Holdings
- 06013 COEURDACIER Nicolas, GUIBAUD Stéphane**
International Portfolio Diversification Is Better Than You Think
- 06014 COEURDACIER Nicolas, GUIBAUD Stéphane**
A Dynamic Equilibrium Model of Imperfectly Integrated Financial Markets
- 06015 DUAN Jin-Chuan, FULOP Andras**
Estimating the Structural Credit Risk Model When Equity Prices Are Contaminated by Trading Noises
- 06016 FULOP Andras**
Feedback Effects of Rating Downgrades
- 06017 LESCOURRET Laurence, ROBERT Christian Y.**
Preferencing, Internalization and Inventory Position
- 06018 BOURGUIGNON Annick, SAULPIC Olivier, ZARLOWSKI Philippe**
Management Accounting Change in the Public Sector: A French Case Study and a New Institutional Perspective
- 06019 de BEAUFORT Viviane**
One Share – One Vote, le nouveau Saint Graal ?
- 06020 COEURDACIER Nicolas, MARTIN Philippe**
The Geography of Asset Trade and the Euro: Insiders and Outsiders
- 06021 BESANCENOT Damien, HUYNH Kim, VRANCEANU Radu**
The "Read or Write" Dilemma in Academic Production: A European Perspective

2007

- 07001 NAIDITCH Claire, VRANCEANU Radu**
International Remittances and Residents' Labour Supply in a Signaling Model
- 07002 VIENS G., LEVESQUE K., CHAHWAKILIAN P., EL HASNAOUI A., GAUDILLAT A., NICOL G., CROUZIER C.**
Évolution comparée de la consommation de médicaments dans 5 pays européens entre 2000 et 2004 : analyse de 7 classes pharmaco-thérapeutiques
- 07003 de BEAUFORT Viviane**
La création d'entreprise au féminin dans le monde occidental
- 07004 BOARI Mircea**
Rationalizing the Irrational. The Principle of Relative Maximization from Sociobiology to Economics and Its Implications for Ethics
- 07005 BIBARD Laurent**
Sexualités et mondialisation
- 07006 VRANCEANU Radu**
The Moral Layer of Contemporary Economics: A Virtue Ethics Perspective
- 07007 LORINO Philippe**
Stylistic Creativity in the Utilization of Management Tools
- 07008 BARONI Michel, BARTHELEMY Fabrice, MOKRANE Mahdi**
Optimal Holding Period for a Real Estate Portfolio
- 07009 de BEAUFORT Viviane**
One Share - One Vote, the New Holy Graal?
- 07010 DEMEESTERE René**
L'analyse des coûts : public ou privé ?

07011 TIXIER Maud

Appreciation of the Sustainability of the Tourism Industry in Cyprus

07012 LORINO Philippe

Competence-based Competence Management: a Pragmatic and Interpretive Approach. The Case of a Telecommunications Company

07013 LORINO Philippe

Process Based Management and the Central Role of Dialogical Collective Activity in Organizational Learning. The Case of Work Safety in the Building Industry

07014 LORINO Philippe

The Instrumental Genesis of Collective Activity. The Case of an ERP Implementation in a Large Electricity Producer

Pour tous renseignements :

- **Centre de Recherche/Research Center**

Tél. 33 (0)1 34 43 30 91
research.center@essec.fr

- **Visitez notre site**

www.essec.fr

GRUPE ESSEC
CENTRE DE RECHERCHE / RESEARCH CENTER
AVENUE BERNARD HIRSCH
BP 50105 CERGY
95021 CERGY PONTOISE CEDEX
FRANCE
TÉL. 33 (0)1 34 43 30 91
FAX 33 (0)1 34 43 30 01
research.center@essec.fr



ESSEC BUSINESS SCHOOL.
ÉTABLISSEMENTS PRIVÉS D'ENSEIGNEMENT SUPÉRIEUR,
ASSOCIATION LOI 1901.
ACCREDITÉS AACSB INTERNATIONAL - THE ASSOCIATION
TO ADVANCE COLLEGIATE SCHOOLS OF BUSINESS,
ACCREDITÉS EQUIS - THE EUROPEAN QUALITY IMPROVEMENT SYSTEM,
AFFILIÉS À LA CHAMBRE DE COMMERCE ET D'INDUSTRIE
DE VERSAILLES VAL D'OISE - YVELINES.