Ergonomic Activity, theory and Methodology

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1. Coupling our understanding of "work activity" and the change process

One challenge of this talk, as I understand it, is to provide some background on *the french ergonomics approach*. To introduce this tradition, I think it is necessary to point two main ideas.

The first idea is that "French-speaking ergonomics" considers the concept of activity to be central. The use of the concept of "*work activity*" is far to be new in this tradition. It appeared in 1923, in a text written by J.M. Lahy. The text introduced the creation of a new journal (which still exist) whose the name is "*le Travail Humain*" (in English "the human labour"). To speak about an "*activity*" is, above all, to define a unit of analysis in order to grasp, to define and to understand human work.

But since, this concept of activity has received numerous inputs. The concept of activity as it has been developed in French-speaking countries (and thereafter in others countries, like Brazil) combined different influences, mainly:

- From Psychology, through the work J.M. Faverge or J. Leplat. The work of Leontiev has been introduced there is 40 years in the French approach, particularly by Alain Savoyant (who was a student of J. Leplat).
- From physician, and particularly through the works of A. Wisner and A. Laville
- From Engineers, and particularly through the works of F. Daniellou, but also Leonardo Pinsky or J. Theureau
- By philosophers, such as George Canguilhem, Ignace Meyerson or Yves Schwarz, who play also an important role,

Through these works, the concept of activity appears as a theoretical minefield. And I will not give a definition of work activity in this introduction. I can only invite you to have a gaze on a special issue published by the journal TIES, in 2005 (*Daniellou & Rabardel (eds), TIES, Vol.6, n°5, 2005*).

Second idea, Ergonomics is a discipline of action. The official definition of ergonomics (which has been adopted by the IEA Council in August 2000), asserts that Ergonomics is a profession "*that applies theory, principles, data and methods to design in order to optimize human well-being and overall system performance*». I disagree with the idea that an ergonomist "applies" theories. We never *applied*. Theories and methods are resources or cognitive tools one can use in a singular situation. In all the case we have to take into account the context (in its technical, but also social and cultural dimensions), and the singularity of one situation. However, I share the idea that the main objective of ergonomics is not to understand, but to design or to change. As ergonomist, my aim in not to understand the

difficulties that workers encounter in working on a line work for example, but to change the line work in order to optimize human well-being and overall system performance.

Well … my communication will be centered on the relationship between the *"workers' activities"* and our understanding of what to do as a practitioner in order to contribute positively to healthcare and safety of the workers. My main point in that talk is that there is a strong coupling between the understanding of our own action as practitioners on the one hand and our conceptualization of work activity on the other hand. I will proceed in three steps:

In a first step of my presentation, I will have an historical gaze. The conceptualization of working as a "work activity" has moved during time. And I will suggest we should distinguished three approaches, namely *"crystallization"*, *"plasticity"*, and *"development"*. In a second step, I will focus on "*development*". I will call for a need to discuss the concept of *development*. There is different ways to understand and to grasp this question of development. I will discuss particularly that point in the context of prevention. Based on that (short) discussion, I will argue that there is a need to develop methods for conducting or for managing what I will name *"project of prevention"*; And I would suggest three principles for managing such projects.

2. Taking activity into account during action

This part of my talk is based on a paper previously published in the open access journal named *@ctivités*[1].

Over time, there has been an evolution of our understanding of what is "work activity". Gradually, our understanding of action has evolved. We should distinguished three approaches, namely *"crystallization"*, *"plasticity"*, and *"development"*. For each approach, I will give a principle, then I will give some remarks on the model of work activity which is associated to the principle.

2.1. Crystallization

In this first approach, the oldest, the main idea is that any technical system, any device, crystallizes a knowledge, a representation, or a model of the workers and their activity.
Once this representation or that model crystallized or embedded in an artifact or a device, the representation will be conveyed in the work setting. However these representations will be sources of serious difficulties for the persons if they are false or insufficient.
For example designing a staircase to reach upper floors in a building rests on the representation of a valid worker. But once that representation is crystallized in the artifact, it is imposed to everyone. With the consequence to exclude a person in a wheel chair: that person will not be able to reach upper floors. Crystallization is a general characteristic of an artifact. A computer crystallizes a model of a user. Liam Bannon postulates that more often, these models rest on a *"stupid user"*. So he calls these models KISS (keep it simple stupid). But it is sometimes the reverse: one expects exceptional skills from workers. And a simple table crystallizes a certain representation of the way people are together. In Japan, the height

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[1] Béguin, P. (2007). Taking activity into account during the design process. *@ctivités, 4 (2), pp. 115-121*, http:// www.activites.org/v4n2/v4n2.pdf

of a table in not 70 cm, because people sit on the floor, having a different sociality from the west one. We have to generalize: a technical system embeds and conveys numerous representations of human, and particularly of human work activity. In work setting, these choices are not only cognitive, but also social and political. Freyssenet, a French sociologist, has shown for example that automation is based on a model where the machine is considered as been more reliable than a worker. This is a political representation of the workers. However, these choices are most often made through lack of knowledge regarding work activity, and how work gets accomplished.

Let me highlight two ideas on this basis.

The first idea is about work activity. What is required in such an approach is to understand the "coupling" between the human and a device. Work initially developed by L.S. Vygotski and others in Soviet psychology supplies a rich and fertile approach to apprehend activities with artefacts. As an activity consists in acting "through" an instrument (Bødker, 89), artifacts must not only be analyzed as things but in the manner in which they mediate usage. We have Vygotski to thank for emphasizing the importance of mediation, which he considers as the central fact of psychology. And as highlighted by J. Leplat, activity is a way to conceptualize not only a coupling between a subject and an artifact, but also a coupling between a subject, a human and a task.

<div align="center">Activity = Function (Subject X Task)</div>

The second idea is that an important issue is the process of *visibilization of work* (Engeström, 1999 ; Rasmussen, 2000). From my point of view, there are two issues in this process of visibilization of work:

- A first issue is that it helps to modifying or transforming the representation of the designers. For ergonomists, it is often frightening to see the poverty of the representations used by the engineers and the policiy makers about work and the workers.
  For example …
- Secondly, visibilizate invisible work is an important process during design and change, because it helps to define the problem to solve (Wisner, 1995), i.e. to make a "diagnosis". As highlited by Reijo Miettinen, defining a problem is a key question, every bit as essential as the search for a solution (Miettinen, 2000).
  For example : it is not the same to say "*the workers have packaging activities*" and that "*in packaging, the worker make quality control*." Quality control needs lighting, which is not necessary when packaging. In ergonomics, making a diagnosis, is to define, from the point of view of the workers, the relevant field to consider for acting and thinking a work environment.

2.2. Plasticity

The preceding approach rests on well-established data: because an insufficient knowledge of work activity causes disappointment, one needs to better represent and model activity. However, a range of empirical and theoretical arguments leads to thinking that it is not possible to fully represent or model activity, because an anticipation of a future activity is impossible.

There is a gap between prescribed work and real work On the one hand a prescription (i.e. what is planed to be done), and on the other hand, what is really done. There is an

unbridgeable gap between an activity represented and anticipated during design on the one hand, and an activity actually carried out in a situation on the other hand.

Activity is driven by the concrete situations that exist at any moment and is constantly changed. In work situations, the workers encounter unforeseen situations and oppositions linked to "industrial variability" – i.e. for example by systematic deregulation of tools, instability of the matter to be transformed, etc. –, and to the fluctuation of their own state of the worker, for example due to tiredness – (Daniellou, Laville, & Teiger, 1983). Tasks and peoples fluctuate with time, and these fluctuations must be taken into account.

Activity is "situated", in the sense of Suchman who used the term "situated *action*". Whatever the effort put into planning (i.e. anticipate during design), activity is neverbe the mere execution of a plan. One must adjust to circumstances and address situation contingencies, for instance by acting at the right time and by seizing favorable opportunities. As highlighted by Suchman "rather *than attempting to abstract action away from its circumstances and represent it as a rational plan, the approach is to study how people use their circumstances to achieve intelligent action*" (Suchman, 1984, p. 50). Speaking of activity is to speak about intelligent actions. In the French speaking ergonomics approach, the concept of work activity is almost synonymous with "inventiveness" and "creativity".

What does it needs for the action of ergonomists? The aim is to design systems that allow or facilitate situated "*intelligent action*". Many proposals have been made in order to support situated action during design. I can quote two different but closed approaches:
- Saying that anticipation (or a plan) will never be applied does not mean that a plan is useless. It guides and helps to find the best positioning, as highlighted by the Canadian ergonomist K. Vicente (1999). Consequently, an anticipation is a resource that helps to find the best position. But because it is impossible to fully anticipate activity, one must therefore leave to the workers the possibility to adapt to local circumstances, "*giving workers the possibility to finish the design*". In this approach, to design is to specify "boundaries" on action.
- A second approach, proposed by Daniellou, is to design a "*space of possible activity*", rather than to specificy the characteristics of a devices or an organization. In such an approach, the aim is to grasp the diversity and the variability of a future setting, in order to evaluate if the "space of possible activity" will leave the worker the possibility for "intelligent action". Working with a computer may serve as an example: to provide a printer will allow the worker to use the screen and a paper printout if necessary. But without a printer, the only possibility is to use the screen. With the printer, there is more space for the possible activity.

Regardless of the difference of these proposals, the aim for ergonomists is to design "*plastic*" or "*flexible*" systems. They are "*plastic*" in the sense that they leave the activity sufficient freedom to maneuver to render technical or organizational aspects more efficient whilst remaining in good health. Identifying the characteristics that contribute to making systems flexible is a strategic direction for ergonomics research.

This idea of plasticity is particularly important regarding to risky work. It highlights that technologies and organization are always imperfects, that rules and procedures are never sufficient for achieving successful. Workers operating *with–in* risky environments, are dealing with imperfect systems, and to a large extent their activity consist to positively act to mitigate risk in everyday work setting.

What does it means to work in imperfect work systems, how do workers contribute to mitigate risks in everyday work setting, and what do they encounter in so doing? We try to provide some answers to those questions in a book written some years ago with C. Owen and G. Waekers (Owen, C., P. Béguin, G. Wackers, 2009). In such an approach, "human error" for example is considered as a impossibility encounter by the workers to migitate risk (and not as a violation, as argued by Reason).

2.3. Development

The third approach can be referred to as developmental. With the first approach (*crystallization*), it retains the idea that it is necessary to apprehend jointly the characteristics of artifacts and their uses. With the second approach (*plasticity*), it retains the idea that the efficiency of work systems does not rest alone on artifacts, but also on creativity and inventiveness of the users. But a developmental approach adds a further dimension: the development of artifacts and the development of activity must be considered jointly during the change process: action is situated in the development of activity as we argue in a paper we wrote with Yves Clot[2].

The introduction of a new artifact, or more generally of a novelty in a given situation, allows old problems to be solved, but it changes the nature of the task and creates new problems requiring new solutions. Along with others (Nardi 1996, Wertsch 1998), I think that this process must be defined as a process of *appropriation*. And one could understand this process of appropriation through three main ideas:
- The first point is that an activity is not only related to the contingencies of the situation, as suggested by situated action. An activity is a historico-culturelle construction, a certain way to understand a situation and to act in a setting, which is set in heritage within a professional community.
- Second idea: if we try to analyze the processes by which an worker appropriate a novelty, we observe that the process take two distinct forms:
  o Either the workers develop new ways of understanding or acting, stemming from those they already disposes,
  o Either the workers modifies, transforms the devices or the novelties to adapt them to his/her own constructions.
  This is one of the main results from work carried out on "instrumental genesis" (Rabardel, & Béguin, 2005). During these processes we can observe either an instrumentation (an evolution in the form of actions or understanding), or an instrumentalization (a process in which the subject enriches or modify the artifact's properties).
- The appropriation of a novelty raises a general dimension of the activity: *its constructive dimension*, i.e. the development, by the workers and in action, of the resources of his or her own action. This development concerns the instruments, but also competences (Pastré, 1999) as well as subjectively organized forms of action within collectives, such as « professional genre » (Clot, 1999).

To understand this developmental process of appropriation, I think it is useful to reference the work of the philosopher Georges Canguilhem. Canguilhem is a philosopher who sustained a

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[2] Béguin, P., & Clot, Y. (2004). Situated action in the development of activity. *@ctivités*, 1 (2), 50-63 (http://www.activites.org/v1n2/beguin.eng.pdf)

PhD in Medicine. The tittle of the dissertation (sustaine in 1947) is '"*the normal and the pathological*". His main question is *what is health* ? And to answer that question, Canguilhem argue that an "healthy person" is one who does not suffer the constraints of the environment, but who is able to change the environnement in a setting, in order to assert his or her standard and his or her own life project (Canguilhem, 1966). If you can not transform a environment in order to ajust it your vital needs, then you get sick. If a worker can not have a "*constructive activity*", when it is forbidden for someone to adapt his/her environment, to align it with his/her projects, his/her needs, his/her understanding, his/her values, then this person get sick.

3. Understanding development

What is the logic of action introduced by this developmental approach? To answer this question, we must deepen our conceptualization of the concept of development. The concept of development is rarely discussed (Y. Engeström does that, and we have to thank him). In this short presentation, it is not possible to exhaustively discuss that concept of development. But I want to point an alternative, on the one hand the possibilities or impossibilities due to the very nature of the things, and on the other hand the normative and political will. I explain myself.

In France, the concept of development appearead to a large extent within the background of child psychology, and particularly within the Piagetian backgroun. There is many point to discuss here, particularly the dialogue between Piagetian and Vygotskian. But an important concept in child psychology is the existence of "stage" (used by Piaget, but also by many others such as Freud, Winicott, Wallon …). Piaget argue the existence of different stages of mental development (sensorimotor, preoperational, etc.). With the idea of stage, it is say that by nature, a child will pass through inevitable stages of development. Obviously, applied to the economic and social transformations this concept of development can easily turns into an ideology of necessary laws societies. For example, the economist Rostow (1963) use this concept stage for explaining economic development. And through his work, development appears inscribed is a deterministic ideology, that interprets the socio-cultural history of the human, as being related to a natural necessity. This is very problematic. However in Rostow approach, the main problem is that the different stages proposed was defined based on an analysis of the economic development which appears in the West. This is why the most famous opponents to this approach argue that there is an "*endogenous development*". What I try to point here, is not a difference between nature and culture, but to say that a given culture (inluding the micro culture of an activity system) has its own possibilities or impossibilities.

Quite different is the understanding that appears when we add an adjective to the word *development*, as for example in speaking of "*sustainable development*". Switch is then clearly the issue of development towards a normative thought, which apprehends the reality in a gap with a more desirable state. In such a context, the word "development" as to be understand as a moral and/or a political process, which aims to take over what constitutes a state of nature, and which aim to extract the society and the human being to its condition.

These two meanings of the concept of developmènt, the "endogenous" one and the political one, are in fact opposite.
- If the development is carried out by an internal logic, at the heart of a reality (as it is the case through the idea of stage) , there is no necessity for a will or for a political project. The developmental process is inscribed in the nature of things, and it will appears.

- On the contrary, if one however there is a necessity to install a developmental process in the order of a normative or a political will, it is because the development doesn't appears as an inevitable movement, inscribed in the order of the things.

But as specialists of working conditions and work prevention, we are led to reconcile these two orders of fact:
- On the one hand, we cannot improve working conditions, or preventing occupational hazards without a political or a normative commitment. The political action is essential, because prevention does not result spontaneously from the existing economic organization.
- But on the other hand if the realization of this development should not respond to a possibility in the economic organisation, it should be only imposed by an external will. And it would be doomed.

This finding have important methodological implications. We have to combine these two different explanation orders: the will of the political action or the desirable order on the one hand, and the possibility or impossibilities of a given reality on the other hand. And to my knowledge, there are *a priori* only two possible solutions to combine these two orders:
- The first one is to consider that the developmental process is "*impeded*" or "*blocked*". The aim of political action is then to release the existing developmental potential, which is block and smothered by a set of obstacles that the political actor have to remove. This is the position of Yves Clot: methods such as cross self-confrontation aims to promote development potential and to release it.
- The second solution is to articulate in the same process both dynamics : those of a political will which define a desirable order on the one hand, and those of the internal dynamics of a given environment or setting on the other end.

It is for pointing out this second solution that I will speak of "*prevention project management*". In this last part of my talk, I want to explore this idea of "prevention project management".

4. Landmarks for "prevention project management"

I wish to make a contribution starting from the concepts of "project" and "project management". These concepts are useful if we consider the making of safe work systems as something that still needs to be done and design.

Designing safe work system may be understood as a project, an objective to be reached, a desired future to construct or a new order to achieve. But this oriented change must be implemented in a real setting. Speaking of "project management" is designing a process through which an initial intention will be turned into an accomplishment, and where the proposal change will be appropriated (see Figure 1).

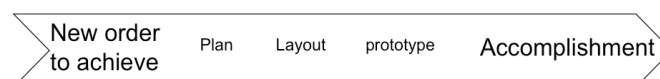New order to achieve | Plan | Layout | prototype | Accomplishment

Figure 1: projects as a transition from a desire in relation to the future towards the change in a concrete setting

But we need to manage such a project. Project management can be understood as a course of action, which must articulate two planes: the "desirable" and the "possibilities" (Béguin,

2010). On the one side a representation of "what is desirable" or "what need to be done". But this representation is "virtual". And on the other side the reality of a situation, with its resistances, its contingencies and its own possibilities or impossibilities, which must be taken into account if we want to implement a change. There is consequently a need to re-examine the desirable through the possibilities or impossibilities of the reality of a setting to transform and develop, and through appropriation process. Therefore project management is a process during which the representation of what is desirable on the one hand, and what is possible on the other hand must be articulated. (see figure 2).
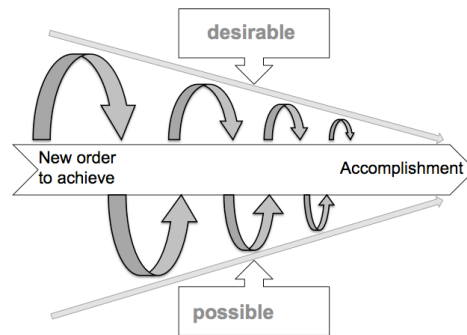

Figure 2: project management as a process of articulation between the
"desirable" and "possibilities"

These two poles, "desirable" and "possibilities", are conceptual minefields. And we could understand them from the perspective of multiple dichotomies: problem solving and problem setting, virtual and real, opportunity of choice and determination of a given setting. However, in all cases, it is necessary to put a purpose and a provisional understanding in tension with its appropriation in singular situations. Donald Schön's famous metaphor of a "*reflective conversation with the situation*" (1983) illustrates this tension: the designer, with an aim in mind designs ideas and knowledge, but the situation "*responds*" and shows unexpected resistance. These serve as a learning basis for the designer, who has to modify his/her initial ideas or aims.

This frame is interesting because it provides three ideas for managing prevention project:
- The first idea suggests that the initial understanding of what is needed cannot and should not be understood as being defined once and for all at the beginning of the design process. There is an initial intention. But due to appropriation in the situation, the project undergoes a morphogenesis. Reorientations and changes will take place. If not, the desirable and the possible will never converge. From this perspective, it is worth mentioning that the aim and intentions are formed by the revelation of what is possible or impossible. A lesson can be learned from this: the direction of the action emerges from its effectuation. As highlighted by Joas (1996) Western philosophies mobilize a "*teleological*" framework, according to which human acts are understood as the quest for preconceived ends that are then implemented in action. This teleological vision of the project is quite problematic in several design management approaches. To say that safe work system is something still to be built and is related to design is to call attention to the fact that we need a non-teleological process. It is not possible to abstract the journey, the path or the construction of experience.
- The second idea is that this non-teleological process is inseparable from the concept of learning. No action can be the pure and simple implementation of prior knowledge. Every action reconstructs the knowledge it needs. This is also the meaning of Schön's

metaphor of a "*dialogue with the situation*" (*op.cit.*). The initial idea and knowledge are questioned when confronted to the situation, which "responds" and "surprised" by its unexpected resistance. These responses are at the base of the learning process. This is why it is so important to establish learning processes based on the real work and on the resistance workers find when they implement the solution provided by the designers. When such a learning process is not possible or when the consequences cannot be extracted, developmental process will not be impossible.

- The third idea is that this learning process should be seen from a collective (and not only individual) perspective, and should therefore take into account power and the social relations between protagonists. The French philosopher, Michel Foucault (2004) suggested a distinction between two type of process: "*normation*" and "*normalization*". The process of " *normation*" is characterized by the fact that some people's knowledge and ideas are transformed into power for others people. The knowledge of some therefore becomes the norm, and those who do not conform are abnormal. In contrast, the concept of "*normalization*" consists, accordingly to Foucault, of constructing development curves of knowledge so as to locally establish normality. Developmental curves of knowledge between the decision makers and those who undertake the actions and actually experience the work conditions are favorable to developmental process. But it means that the knowledge and resistance experienced by the latter will be considering as acceptable ideas and questions for the formers.