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DEVELOPING ERGONOMICS, DEVELOPING PEOPLE

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Developing ergonomics, developing people

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Abstract

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1. Introduction

In 2000, the IEA Council, composed of delegates from all ergonomics societies federated in the IEA, adopted a new definition of ergonomics. Several aspects of this definition are innovative. The first two paragraphs of the definition state :

Ergonomics (or human factors) is the scientific discipline concerned with the understanding of the interactions among humans and other elements of a system, and the profession that applies theoretical principles, data and methods to design in order to optimize human well being and overall system performance.

Practitioners of ergonomics, ergonomists, contribute to the planning, design and evaluation of tasks, jobs, products, organizations, environments and systems in order to make them compatible with the needs, abilities and limitations of people.

In these two paragraphs, two points are worth noticing. First, it defines the discipline, of course, but also the practitioners of the discipline and what these practitioners do. Indeed, the profession now exists, as demonstrated by the development of ergonomic societies, of training programs, of certification processes and of professional bodies. Second, it mentions the two fundamental goals of ergonomics, on one hand performance-centered goals –which can be translated in efficiency, productivity, reliability, quality, etc.- and person-centered goals – which translate into health, safety, stress and workload, comfort, ease, satisfaction, interest of work, etc.

Ergonomics practice, now as before, thus puts forward a fundamental bet : the bet to satisfy simultaneously performance-centered goals and person-centered goals, as far as possible. The question that arises today is : considering on one hand the world-wide dissemination of ergonomics, on another hand the evolution and diversity of social and economic conditions, how does this view apply to today's work ? Is such a bet still a credible one ?

A second issue is related to the differential approach of ergonomics. A number of authors have advocated the idea that ergonomics needed to take into account the economic, social and cultural differences between peoples of the world, notably when transferring technology from one region to another. This trend appeared quite early in the history of ergonomics. For instance, the book "Ethnic variables in human factors design" was published by A. Chapanis in 1975, that is 30 years ago, following a workshop held on this subject. A. Wisner's concept of 'anthropotechnology' (Wisner,

1997) and the recent book edited by M. Kaplan (2004), entitled “Cultural ergonomics”, are contributions to this differential approach.

I would like here to follow a different slant, which to me is not contradictory. I believe that, whatever the variations in culture, economy, social organization, there are goals which are shared by all ergonomists, crossing borders of countries and cultures. However, these common goals can be perceived only if we adjust properly our view on the end results of ergonomic actions.

What makes ergonomic actions international and borderless is the idea of development, applied both to individuals and to organizations. This is the subject of this text.

2. Ergonomic approaches of health

2.1. The IEA initial statement

In 1957, a seminar was organized in Leyden, Netherlands, funded by the European Productivity Agency. Its title was “Fitting the job to the worker”. 70 participants, from Europe and the USA, gathered and discussed the creation of an international body, which was later named the “International Ergonomics Association”. An initial statement was written by a committee, which is interesting to quote in part here :

[...] There are already international organization dealing with some aspects of ergonomics or human engineering, but there is no such body specifically and exclusively taking care on an international basis of all the sciences which are involved. The Committee therefore came to the conclusion that the creation of an international body is highly desirable and necessary for the further development of this field of applied science.

[...] The changing demands of modern industry, the increasing application of mechanization and automation and the concept of constructive medicine aiming not only at the prevention of disease and accidents, but also at the realization of health all focus attention on man as necessarily the central object of interest in the study of industrial performance.

It is more specifically the concept of “constructive medicine” which will be developed here. What does “constructive medicine” mean ? Does this constructive view of ergonomics apply only to physical activities ? And how does it relate to the global objectives of ergonomics ? What does it entail in terms of evaluation criteria of ergonomic action ?

2.2. Health : a state or a process ?

Health can be conceived either as a state or as a process. When considered as a state, health is generally defined negatively, as the absence of pathologies or deficiencies, of restrictions of social or working life, of economic misery. But health can be seen also as a process. Of course, with time, individual abilities are modified, until death occurs. But :

- this ageing process is sensitive to living and working conditions. Operators who suffer from bad working conditions are more exposed to accidents and diseases, and age differently ;
- this process also has positive outcomes. With practice, operators gain experience, become skilled, build new knowledge and know-how.
- among these new pieces of knowledge, there are adaptation or compensation strategies which allow the experienced worker to proceed differently and use

procedures that are less demanding in terms of efforts and more efficient. Many instances of such phenomena have been described by ergonomic research on ageing at work (Marquié, Paumès & Volkoff, 1998).

There are then two complementary ergonomic approaches of health. One is corrective and preventive. Its goal is to compensate individual deficiencies and avoid detrimental situations. The second one is constructive. The goal is then to promote health construction. To quote Laville and Volkoff (1993) : the goal is to “*allow everyone to build up their own health, their own ageing, in the best possible way*” (my translation).

2.3. Cognitive health

Ergonomics, originally, has considered health in its physical sense. Cognitive aspects are often considered, more or less implicitly, as related mostly to the second objective of ergonomics : improving performance and efficiency. It is only recently that the extension of health to cognition has been attempted. M. de Montmollin wrote one of the rare texts published on this subject. He states that “[Cognitive health] means being competent, that is to say possessing competencies that allow one to be employed, to be successful, to improve. Ignorance, partial or inappropriate knowledge may lead to a ‘cognitive misery’, that in turn may result in social misery” (M. de Montmollin, 1993 ; my translation). For the author, the goal is then to devise “a work organization that allows workers the highest efficiency, that is to say the full use of their competencies” (ibid.). To fulfill this objective, the ergonomist has to analyze professional knowledge, improve training programs and define appropriate assistance tools, in order to maintain the human-system couple in a non-pathological balance.

The same author then criticizes an assumption that often underlies studies of workload, which tends to equate workload and overload. According to this more or less implicit assumption, any workload is detrimental. The goal of the ergonomist should then be to eliminate sources of difficulties and limit or eliminate physical or cognitive workload. The ideal worker is ... the worker at rest.

This is of course erroneous. Any activity provokes some mental activity (because there is no such thing as a purely physical activity) and consequently some mental workload. And mental workload does not have only negative effects. It may have very positive effects in terms of pleasure, satisfaction, learning and personal accomplishment. Thus the goal is not to suppress all difficulties, but to propose *manageable and interesting difficulties*. What does that mean ?

‘Manageable difficulties’ mean on one hand having access to appropriate social, cognitive or physical resources, on another hand being faced to an adequate level of task demands. Stress is provoked by some unbalance between resources and demands : very demanding tasks and insufficient resources.

‘Interesting difficulties’ mean the pleasure of coping with demanding situations, of overcoming task difficulties, and, while doing so, of developing competencies. A task with no challenge is of little interest for the one who fulfills it. This last point is often neglected. Human beings have a natural appetite for building new knowledge. For any ergonomist, that is a commonplace observation : operators develop know-how, procedures, techniques during work and because they work. This natural tendency to learn and discover should be considered as a positive aspect of human activity and encouraged as much as possible, since it contributes both to the quality of the work for the operator and to the progress of the organization.

In M. de Montmollin’s approach, mentioned above, the fundamental ergonomic question is : how to design a work system that allows the person a successful use of

thought ? Within a developmental framework _for cognitive health, the question would rather be : how to design a work system that encourages the development of knowledge and competencies ?

3. Developing people : the capability approach

3.1. Amartya Sen's model of development

The following paragraphs are devoted to a brief presentation of Amartya Sen's approach of social and economic development. Amartya Sen was awarded the Nobel Prize in Economics in 1998. He has developed a theory of social choice which is quite useful for ergonomists in order to better understand their goals and methods.

A fundamental aspect of Sen's model is the idea of "capabilities" (1999). Capability is defined as the set of human functionings available to an individual, whatever their actual use. For Sen, the real possibilities one has cannot be conceived only in terms of access to primary goods or in terms of formal rights. Let us consider for instance the "right to vote" of democratic countries. To Sen, the concept is fairly empty. He would rather ask whether the necessary conditions are met that transform the right to vote in a capability to vote. A capability to vote means many things, ranging from a sufficient level of education to the effective and fair dissemination of political information and to an efficient organization of election processes. So, in a given country, there may be a formal right to vote for everyone with very unequal capability to vote according to different individuals. The objective of public authorities should be to make people equal in capabilities, not only in rights or in financial resources.

According to this model, what matters is the effective capabilities of each individual, in order to ensure a real freedom of choice at all stages of life, thus guaranteeing the possibility of personal development. Welfare and freedom are the result not of the availability of different options (among which one would choose the best), but of the existence of the choice.

The capability approach has two important features :

- it is not limited to developing countries. It applies equally well to all countries, whatever the economic level of development. In a recent book, Salais and Villeneuve (2005) state : "Capability-based policy principles fit well with the transformation of work that accompanies the emergence of a knowledge-based European economy. To be competitive and innovative, standards for employment require responsibility, initiative, autonomy and relational skills. The deployment of these qualities requires workers to possess initiative and the reflexive freedom of action that has no technological substitute".
- it provides a general framework for understanding the trade-offs made by people in their lives. Any action can be judged according to the capabilities it allows one to use or build. For instance, a law was passed (in France) in the late 90s reducing the maximum duration of work from 39h to 35h a week. An assessment of this law was undertaken some years later. Results showed a negative effect on work conditions, in terms of work intensity (the same amount of work had to be completed in less time). However, results also showed that workers were not interested to switch back to the previous working time. They considered that the benefits of having more time off (for leisure, family, etc.) were superior to the loss of quality of work conditions.

The capability approach has had a very strong influence on international programs for development. It is well captured in the following statement of the late Mahbub ul Haq, creator of the World Report on Human Development (<http://hdr.undp.org>) : "The basic

purpose of development is to enlarge people's choices. In principle, these choices can be infinite and can change over time. People often value achievements that do not show up at all, or not immediately, in income or growth figures: greater access to knowledge, better nutrition and health services, more secure livelihoods, security against crime and physical violence, satisfying leisure hours, political and cultural freedoms and sense of participation in community activities. The objective of development is to create an enabling environment for people to enjoy long, healthy and creative lives.” (Mahbub ul Haq)

To quote further the United Nations Program for Development (UNPD), “Human development is about much more than the rise or fall of national incomes. It is about creating an environment in which people can develop their full potential and lead productive, creative lives in accord with their needs and interests.” (www.undp.org)

3.2. Capabilities and ergonomics

The capability approach has strong relationships with the ergonomics approach. As a matter of fact, effects of ergonomic interventions can also be thought of as empowering people, giving them additional tools for progressing further. Competence acquisition can be seen as the development of capabilities, i.e. increasing the number of options, of operating procedures one has access to. Similarly, allowing workers some freedom on task goals or criteria increases capabilities (by increasing the set of options). Lastly, allowing teams to define their own collective activity increases team capabilities.

4. The effects of ergonomic interventions

Ergonomic interventions have two types of effects, tangible or intangible. Tangible effects are those that come to mind more easily. Ergonomists prescribe solutions, provide recommendations, contribute to the design of artefacts or work situations. These ergonomic productions (when implemented) have visible effects. However, these tangible productions may also have intangible effects, due to the actions themselves or to the process of their production.

Tangible productions may have intangible effects. The philosopher Jean-Paul Sartre once wrote : “Situations get unbearable when one realizes that they can change.” In other words, as long as one believes things cannot change, one sees them as a fate, something to be dealt with, even though they are painful or detrimental to health or well-being. When one recognizes that things can be changed, then situations get unbearable.

A good example of such an effect has been reported after an ergonomic intervention in a saw-mill. The intervention was motivated by very bad working conditions : high exposure to cold and wind. The ergonomist proposed a number of adaptations of the building, which were implemented, and came back some months later. He then asked the operators whether the work conditions had been improved, and he was answered : “Oh yes, but the noise is impossible”. As a matter of fact, the place was not noisier than before, but the mere fact that workers had seen that changes were possible had made them aware of other difficulties.

Ergonomic actions have thus two effects. In the short term, they improve work conditions and performance. But, doing so, they also demonstrate that positive changes are indeed possible, that situations can indeed change. So, a second, long term, intangible effect is the will to improve situations, a feeling of grasp on one’s own life.

Work analysis have intangible effects. Interactions with operators yield side effects. By verbalizing its own activity (explaining constraints, criteria of work quality, difficulties, procedures that are used, painful activities and factors of stress, etc.), work is reified, i.e.

externalized from the operator. Factors of fatigue, of stress, of failures are identified and become independent of the operator. This externalization process allows operators to understand the causes that affect their behavior.

Similarly, requesting explanations force the worker to make explicit what was before implicit, to decipher the hidden knowledge that guide their own actions. Very often, operators are unaware of the competence acquired through practice. In this respect, the ergonomist performs as a maieutician, helping operators to gain a better understanding of themselves, and notably of their own knowledge and know-how. Operators are not the same before and after the interventions.

This process of knowledge externalization can have even stronger effects when performed in a group. A very efficient way of doing this is through collective allo-confrontation (Mollo & Falzon, 2004). Collective allo-confrontation proceeds in the following way. A video recording is made of an operator (or a group of operators) performing an usual task. This recording is then presented to the team of workers (including those who have been filmed). The goal is then for the group to discuss the way the action is performed : why does the operator proceeds in this way ? what other methods could be used ? what are the benefits and difficulties of the various methods ? etc. The method yields several results. First, by being faced to the activity of others, each one is driven to further explain and justify their own activity. Second, the group discussion encourages the sharing of experience and the transfer of knowledge. And lastly, the whole process does not result only in the elicitation of knowledge and know-how : it produces new pieces of knowledge, at an individual or collective level. Operators are led to build up new methods, or to better tune the methods they already possess, or to better define the conditions under which a given method is to be used.

It is to be understood that such effects in terms of development of competence may be the focus of the ergonomist's intervention, and not only a side effect of the intervention. The intangible result may be the real one.

Participatory approaches do not only result in better systems and better acceptance of systems. Darses and Reuzeau (2004) advocate that participatory approaches (in a context of technological change) allow operators to develop a better understanding of the way the future production system will operate and thus facilitate transitions between old and new systems. This effect has also been stressed by Haims and Carayon (1996), who indicate that this enhanced understanding will result in further learning and change in operators' behavior. Participatory meetings create situations where hidden knowledge is made explicit, is shared and collectively tuned or adapted. This benefits both the individual worker and the organization as a whole.

In that perspective, the objective is clearly to develop a continuous, permanent, participatory programme with the intent of devising and implementing new solutions and of developing operators' competences.

Participatory methodologies have often been presented as the appropriate way to develop ergonomics in developing countries (Kogi, 1995 ; Kogi, Kawatami, Itani and Batino, 1999 ; Kogi & Sen, 1987 ; Shahnavaz 1983, 2000). Similarly, the IEA/ILO Ergonomic checkpoints strongly advocate the point that the research of solutions to ergonomic problems should be reached through a participatory approach. My guess is that the benefits are not only that these methodologies produce better solutions, but also that they encourage individual and collective development.

Organizations learn. Lasting effects of an intervention can sometimes be spotted in the organization itself. For instance, the action may go on after the ergonomist has departed, because the intervention itself has played the role of a training session. The management and the operators have understood, through the "practical exercise" accomplished with

the ergonomist's help, the gains of improving work conditions through participatory methods. Consequently, the same methods are transferred to other projects, with or without the assistance of an ergonomist. More generally, organizations may become aware of the importance of work as a strategic dimension of management. This may influence decisions, for instance when buying new equipment or building new shops.

That kind of influence can sometimes last a long time. I have conducted an assessment of the effect of an intervention ten years after it was conducted. The effects in the shop itself did not last long. Ten years after, anyway, the workers who took part in the study had all left the shop (because of retirement, promotion or turn-over). However, the management had kept a vivid memory of what had been learnt at that time. Among the lessons learnt, in that particular case, was the role of ergonomics as a resource for knowledge (and personnel) management.

As a matter of fact, in the long run, assessment cannot consider only tangible changes (which often have disappeared, because economic conditions have evolved), but should consider factors like the company's behavior in terms of workers' involvement in decisions, or the degree of consideration paid to work in the decision processes of the management.

5. Conclusion

This conclusion will consider the nature of the activity of the ergonomist, seen as a practitioner providing a service to an organization. Sardas (2002) indicates that the model of relations between the service provider and the client has evolved over time, from a client-provider relation to a relation of partnership.

The client-provider relation is characterized by a "closed and complete" contract between the two sides : what the client wants is stipulated from the beginning in a contract and no discussion is to take place between the order and the provision of the service. This entails that clients need to know precisely what they want and that the service providers are sure of being able to provide the desired services. In this model, there is no way to modify the contract during task completion. No matter if the client has made a mistake, or if the provider finds unexpected difficulties (or new possibilities). Any change to the contract is perceived negatively and not as an unavoidable and positive phenomenon, which allows the partners to learn and achieve a better performance. On the contrary, as Sardas notes, incidental learning is perceived negatively, as provoked by a gap, alas unavoidable, between an ideal model of the client-provider contract and reality.

The partnership model postulates that the client's needs are unstable and may evolve in the course of the interactions with the service provider and because of these interactions. The consequence is that providers have no guarantee that they will possess the competencies allowing them to provide the service : some of these competencies may need to be elaborated in the course of the contract. So the partnership model implies that :

- the provider must accept that clients do not know precisely what they want ;
- the client must accept that providers do not know precisely whether they will be able to complete the task

Consequently, the partnership relation entails the sharing of a common will to jointly elaborate needs, solution, and knowledge. Partners share cooperation rules : each agrees to let the other know their own difficulties and the problems the other may meet, and to contribute as much as possible to solve them. Defining needs is no longer the problem of the client only, defining solutions is no longer the problem of the provider only. The

consequence is mutual learning. Each one learns through interacting with the partner, while solving an ill-defined problem.

The partnership model is closely related to the reflective contract advocated by Schön (1982) for customer-practitioner relations. In such a reflective contract, learning occurs on both sides.

Obviously, this framework fits well ergonomics practice. The ergonomist is a practitioner providing a service. The ergonomist's action is negotiated in situation, through the interaction with service seekers. The contract with the customer generally stipulates a goal, in terms of tangible end results. We may wonder whether these tangible results are not mainly for us an opportunity to produce intangible ones.

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