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Design projects as opportunities for the development of activities

Flore Barcellini, Laurent Van Belleghem, and François Daniellou

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Activity ergonomics has developed, over the past thirty years or so, an approach to supporting design projects that combines ergonomic work analysis, a participatory approach, and the simulation of work (Daniellou & Rabardel, 2005). It can be reported that this approach, when specific conditions are present, contributes to the development of activities, and not just to designing the solutions that are expected in the project. It thus allows the workers to take ownership of these solutions and to implement them, but also their control by other stakeholders in the company. This contributes to strengthening the sociotechnical system, and the social relations as a whole.

This constructive dimension is not just a positive effect induced by this approach: it should be considered as a driving force of the ability of men and women to cope with changes in their work situation, when they can actively contribute to designing this situation. The simulation of work plays a key part in this process.

The constructive dimension that is considered here focuses notably on:

- The development of activity and skills in workers throughout project management, allowing these workers to partially control these situations before they are even deployed.
- The development of designers' activity, through an anticipated confrontation between their proposals and the on-going work in the real world, in the course of the design process itself.
- The development of the decision-making function, which is often made up of a set of stakeholders (company management, project management, human resources...). These stakeholders must take on both a hierarchical role with respect to the populations involved in the project, and the role of a contracting authority with respect to the designers.
- The development of the activity of staff representative institutions, who may find in the simulation of work a means to shift and restructure social relations.

This development does not operate in the same way for each of the agents taken individually. It is created in the meeting of “worlds” (Béguin, 2003; Béguin, this volume) which this approach proposes, and which provides input for mutual learning between these stakeholders.

We propose here that this constructive dimension should become a clearly stated goal for ergonomic interventions in project management.

We will first remind the reader of some perils of projects conducted with little reference to work in the real world. Following this, we will describe the principles of an ergonomic approach to the conduct of design projects that has been developed in activity-centered ergonomics since the 1980s. Finally, we will present:

- The known effects of simulations on the development of the activity of each of the stakeholders and on their relations with one another.
- An argument in favor of a position emphasizing an ergonomic approach of conducting projects as a constructive process.
- The need to pursue the evolution of the initial project of ergonomics, which focused on fitting the job to the human being, broadening this goal to the development of activities.

1 The perils of a poor integration of real-world work in project management

Numerous investment or reorganization projects lead to disappointing results, whose usual symptoms are delays in implementation and failure to complete the project within the budget because of the subsequent need for adjustments or the difficulties of workers to master the new system, an insufficient rate of operation (Wisner & Daniellou, 1984), long delays before achieving the target mode of operation in terms of quantity and quality, and sometimes, serious accidents.

An analysis of these malfunctions often reveals dual failures on the part of project management:

- On the one hand, the structure of the project itself is often at fault: a weakness in the political management of the project and in the definition of project goals; a weak presence of operations managers in the projects; supervision of the projects by engineering approaches that focus on the technical dimensions of work and underestimate the importance of aspects related to the population of workers, to the organization of work, and to training; a lack of regular interactions between the definition of the will behind the project (contracting authority) and the search for solutions (main contractor) (Martin, 2000). The partial and late nature of information and of the consultation of the staff representative institutions; and a very late discovery of the project by the people who will ultimately have to act in the new system.
- On the other hand, ergonomists have highlighted the ineffectiveness with which human work is taken into account in design decisions. The work that takes place in the organizations that predate the project is often approached only as a set of prescribed tasks. The regulations which male and female workers implement to cope with variability are left out, which may for example lead to designing overly simplistic automation schemes that are incapable of dealing with situations of variability (Daniellou, 1987). The future work, which will take place in the new system, is also approached through a set of prescribed procedures, with the assumption that work will merely involve the execution of these procedures. The constraints and

leeway related to work activity, the consequences on health and on the quality of production, are poorly addressed.

In other words, everything happens as if the prescribers ignored, in their reflection about the upcoming evolutions, those evolutions that are related to the activity. Figure 1 summarizes the course of project management with and without consideration of real-world work, and the hindrance this may cause for the development of activities. The initial situation is characterized by a kind of articulation between a prescription system and work activities, which mutually influence one another (Rabardel & Béguin, 2005; Guerin et al., 2006). By ignoring this connection, designers define a new system of prescriptions that, once it is implemented, is supposed to be mechanically “executed”. The perils we have noted above quickly emerge. Two failures of design projects may then explain the emergence of tensions related to these perils:

- The inadequacy of the prescribed system: the new system of prescriptions (tools, spaces, rules of organization...) does not take enough into account the rules structuring activity and its variability. The result is regulations that are costly to workers.
- A lack of development: the activities that are useful to operating the new system are not well-developed enough at the time of system implementation. It is often expected that this development will occur “when experimenting with the new system”, but the possibilities of such a development are often hindered by the mismatch of the new system that has been designed with the logic underlying the activity. Tensions become long-lasting.

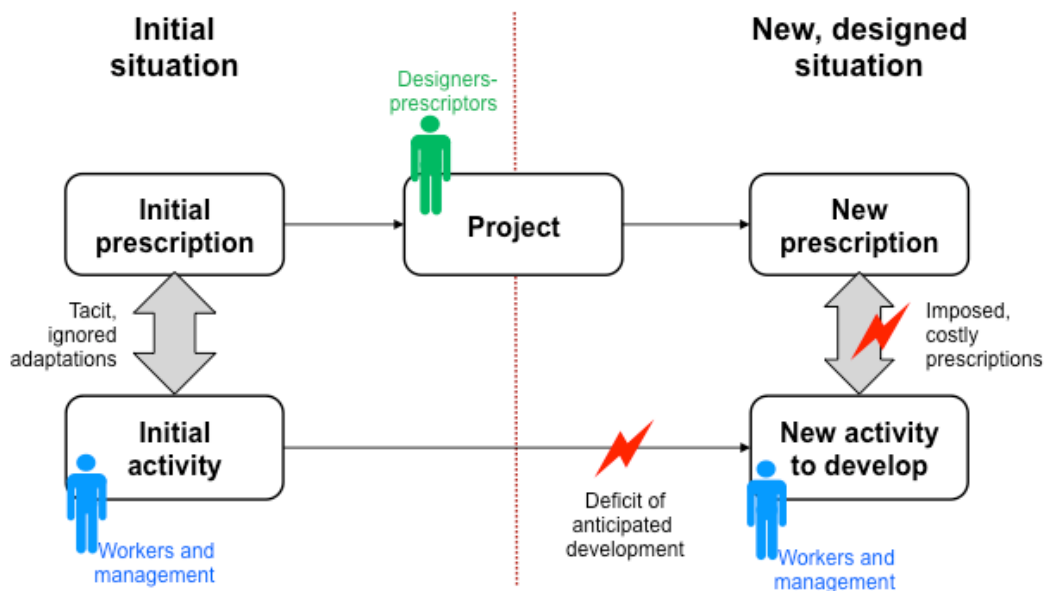


Figure 1 –Failures in the development of activities in a mode of project management with no inclusion of real-world work.

In the face of the inadequacy of prescribed systems, activity ergonomics (Garrigou et al., 1995; Theureau 2003; Daniellou & Rabardel, 2005) has developed since the 1980s approaches to design, followed by approaches to project management, that aimed to foster better interactions between project

stakeholders, a better integration of existing work, and an anticipation of future work. The section below will present an actualized summary of this work.

2 Project management in ergonomics: an approach aiming to enrich the project by taking into account real-world work

In activity ergonomics, design projects are concerned less with defining the characteristics of artefacts (products, tools, spaces, workstations, etc.) and more with defining the features of the work situations in which these artefacts will be present. Indeed, in a work situation, activity is deployed within a space that is framed by a set of prescriptions: tasks to be carried out, work spaces, hardware and software, organizational structure (numbers of workers, types of contracts, formal allocation of tasks, schedules, rules...), the training programs that are made available... The design of the *work situation* then focuses on defining these various components and the relations between them, in order to allow the deployment of an activity that is effective and protective of the health of workers.

Project management aims to frame this design project within the company¹, and relies on an approach that is:

- defined at the start of the project;
- guided by the will to design or transform one or several work situation(s);
- socially situated, since it involves a collective of stakeholders, each bearing different perspectives;
- structured by an organization and a constrained temporal and financial framework.

This approach suggests carrying out a reversal in the classical relationship between ergonomists and designers. Ergonomists should not focus just on providing input, in the form of recommendations, to processes for designing artefacts that are mastered by the designers alone. They should instead contribute to the implementation of a global structuring approach (see Theureau, 2003 for a synthesis) within the company, in order to move from a project that is managed based on technical criteria, to one that is managed based on existing and future work. This approach makes it possible, not only to contribute to the design of a “high quality” work system, but also to enrich the very goals of the project. Design decisions are then informed by trade-offs between the various dimensions of performance (human, technical, economic...) the connection between them, and the stakes related to health.

This approach must rely on an analysis of the project and of work activities (carried out by ergonomists), on the implementation of a structured, participatory, joint approach (fostered by ergonomists), and on the conduct of simulations of work – supported by ergonomists -that allow make it possible to project oneself in the probable future activity., the formalization of the results of the simulations, directed towards the project stakeholders (carried out by ergonomists, collaborating with the project stakeholders) and support for the project (performed by ergonomists) until it starts.

¹ The term « company » will refer here to any employing institution (industry, hospital, administration...

The stakeholders that must absolutely be involved in this approach of participatory design are:

- *Decision-makers*, including a range of stakeholders (company managers, project managers, human resources). These are the bearers of the intention behind the project and often exert a twofold function. They are part of a functional relationship with prescribers (for example, as a contracting authority) as well as a hierarchical relationship with their employees, whose situation they elect to change. Because of this, they play a crucial role in defining the trade-offs between the expected goals of the project and the effects of that project on the “real-world” work.
- *Workers*, whose activity will be transformed in the situations covered by the project (including middle management);
- *Designers*, but also, more broadly, any function, whether internal or external to the company, that is involved in prescribing work (engineering departments and companies, organizational consultancy firms...) which we will name prescribers.
- *Staff representative institutions*, which must find a genuine place in the system being implemented.

This approach is modelled in Figure 2. It comprises three main stages (analysing, simulating, and supporting) that we will describe below. The simulation of future activity is the heart of this approach.

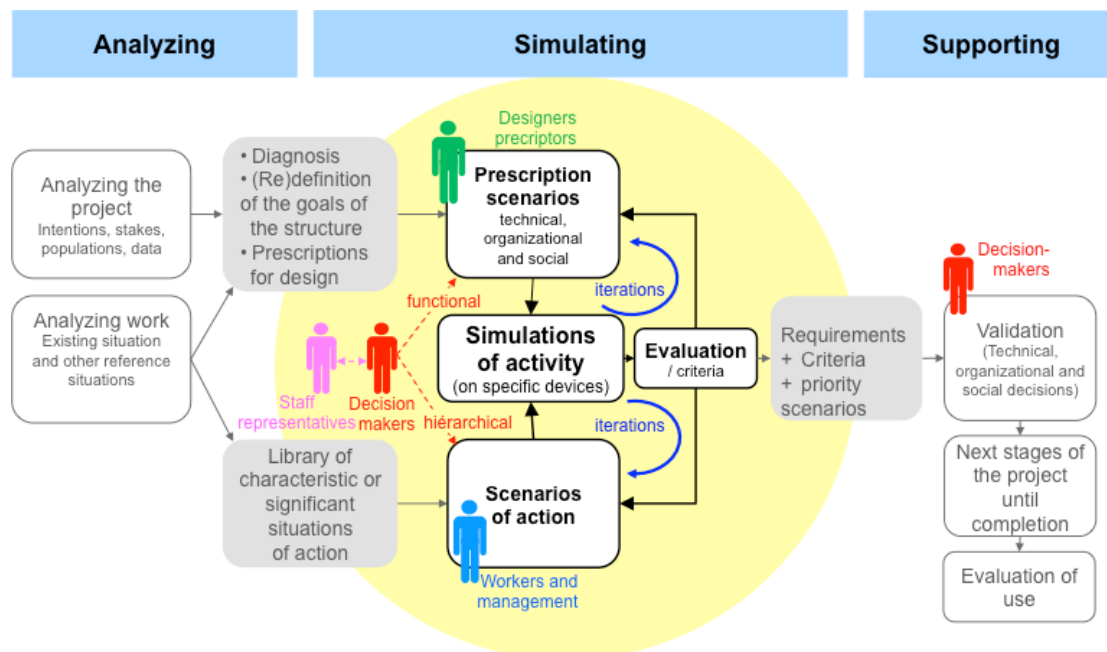


Figure 2 –(Updated) approach to project management, as proposed by activity ergonomics

2.1 Analyzing: constructing knowledge about the project and work in the real world

Project analysis focuses on the prime intentions behind the project, and on its stakes (economic stakes, production stakes, stakes related to work activity)

whether these are made explicit or not, and on the project structure that has been implemented. This project structure ties together a will related to the future, borne by the contracting authority, and the search for solutions, borne by the main contractor, on identifying the population involved in future work situations. Project analysis also covers the data related to health and system performance. This analysis makes it possible to formulate a project diagnosis that is geared towards the decision-makers, and to contribute to structuring and redefining project goals.

Ergonomic work analysis is the first stage in the approach of project management. Its goal is to produce knowledge that is related to work, that will be useful to inform project choices (e.g. helping enrich the goals, the structure, and the early design choices) and to the continuation of the process (handing down key elements to designers and conducting simulations). Work analysis is conducted in any work situation that is said to be a *reference situation*, whose determinants – whether technical, organizational, social – are relevant with respect to the initial situation, or to the future work situation. This analysis may produce many outputs: it contributes to enriching the project, but also aims to generate knowledge about work that is necessary for continuing the process. The formalization of this knowledge is directed:

- towards the decision-makers, who are in a position to make project goals evolve based on the insights of the analysis;
- towards designers and prescribers, by formalizing references to help construct the early design solutions. We will give to these references a status of *prescriptive scenarios*.
- towards the *ergonomist*, through the construction of libraries containing characteristic situations of action (Garrigou et al., 1995; Theureau, 2003). These situations account for the variability of situations encountered by workers, making it possible to identify situations they may have to deal with in the future. They make it possible to construct “*action scenarios*” that will be “played out” during the simulations.

2.2 Simulating: assessing and enriching the proposals of designers

Simulations aim, based on an understanding of the current state of work in the real world, to have the persons involved “play out” the probable future work (based on action scenarios) in the conditions that are imposed by the new prescriptive scenarios suggested by prescribers. Simulating work is a projective method (Daniellou, 2007) that makes it possible to anticipate the conditions in which an activity will be carried out, in a given set of conditions. It makes it possible to assess the proposals made by prescribers, guiding choices towards this or that prescriptive scenario - scenarios being represented by intermediary objects (Boujut & Blanco, 2002) – and fostering their progressive improvement in a series of iterative stages.

Simulations may take place following one of two main modes (Daniellou, 2007). They can either be full scale, for example by using a prototype: workers may then personally experience the improvements that may or may not be brought on by the new solution. This makes it possible, in turn, to bypass the defenses that may lead stakeholders to think that it is impossible to improve upon the situation; either on a small-scale simulation (for example, a mock-up). In this latter case,

the activity may be described verbally (one then uses the term *language-based simulation*). However, this kind of simulation runs the risk of simulating the sequence of tasks rather than the activity. The use of avatars to mediate the activity (Barcellini & Van Belleghem, to appear) may help with the “game” of simulation, by allowing workers to embody the simulated actions, and contribute to realistic descriptions of the activity. The simulation provides some input for the dialog taking place between workers and prescribers, and allows the construction of negotiated design solutions (e.g. Détienne, 2006; Béguin, 2003; Béguin, this volume), and of trade-offs which experience shows may be innovative ones. This dialog takes place at the discretion of decision-makers (connected with the staff representative institutions) who must open up or close down specific orientations to search for solutions, depending on the goals pursued by and the means available for the project.

2.3 Supporting: “converting the try” of simulations

Simulations are at the heart of the ergonomic approach of design. However, implementing a simulation is not enough in itself to act on the work situation that is being constructed. The chosen prescription scenarios must also be validated by the project’s decision-making authority. They must also be genuinely implemented and deployed upon project launch. This has several consequences in methodological terms. Approval by the decision-making authority implies that the choices that are made, the trade-offs that are performed in design, should be justified with respect to the stakes of the project. Decision criteria need to be “sketched out” in the simulation sessions. The concrete implementation of the prescription scenarios implies translating the results of simulations in the form of requirements that can be taken over by the designers. These formalized requirements are an essential resource for the work of designers. They make it possible to move forward in the design of the future system, in its concrete realization, until the beginning of the project. The approach supports this development by implementing iterative, increasingly detailed simulations that make it possible to refine the definition of the system to be designed, until it is launched.

The approach we have presented here has been implemented many times since it was first formalized. Today, it focuses not just on the design of technical systems, but also on the design of work organizations (Petit, 2008; Petit, Dugué & Daniellou, 2011; Petit & Dugué, 2012; Barcellini & Van Belleghem, to appear; Coutarel & Petit, this volume). On these various occasions, we were able to notice forms of activity development, notably in the simulation stages. From our point of view, these forms of development compensate for the lack of development that we highlighted in the introduction of this chapter. Whereas until now, this development has been viewed as a side effect of this approach, we suggest this development might be seen as a goal of this approach in itself.

3 Design projects as opportunities for the development of activities

Implementing the approach outlined above produces effects that frequently go beyond the initial goals of the project. In particular, one can observe that

equipping the participation of stakeholders to this approach will contribute both to the design of the future situation and to the development of their own activity, in the course of the approach. It also contributes to the development of the activities of the other stakeholders involved in this approach: decision-makers, designers, staff representatives. Because of this, when the conditions are adequately met, this approach strengthens these functions and the professional relations *between them*, both over the course of the project (cooperation in the project) and following its operational implementation (cooperation in work). One can point out that the success of the project relates to the relevance of the choices made during the project, as much as to the quality of the developmental processes it helped support.

We will describe below in detail the development processes that we have observed, depending on the type of stakeholder.

3.1 Development in the activity of workers

The approach we propose locates a particular activity situation, the *situation of simulation* (Béguin & Pastré, 2002) between the former situation of activity and the new situation that is being designed. This transition situation provides an opportunity for the development of activities of “future users” of the system (in particular, various workers and middle managers) before the project is implemented, whilst contributing to its design. Figure 3 summarizes the progression of this situation of simulation.

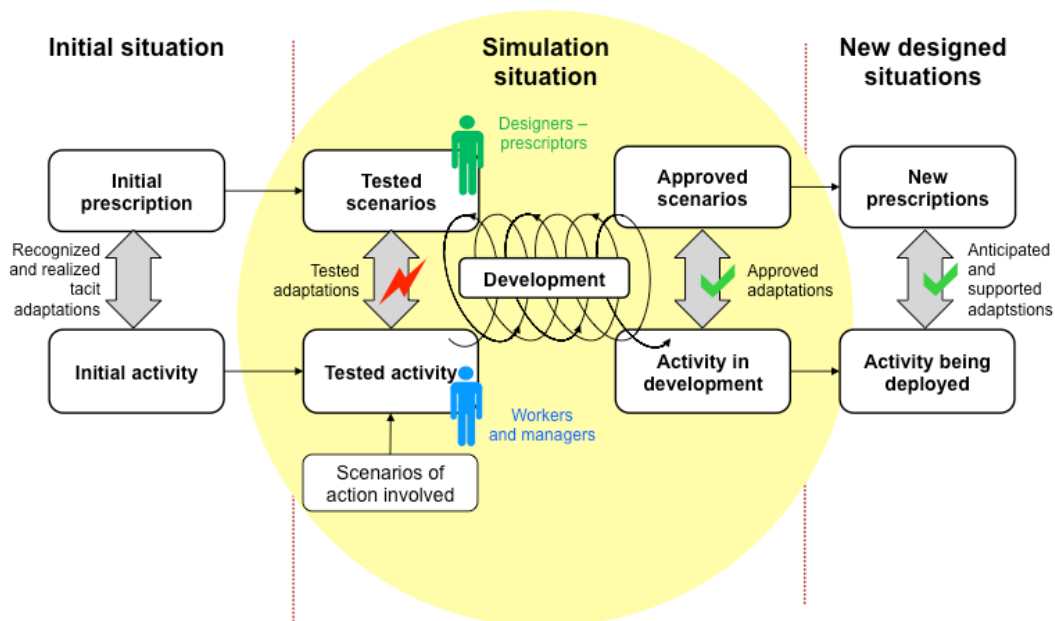


Figure 3 -The situation of simulation, a mould for the development of activities

As we have pointed out, simulations aim to have workers “play out” their probable future work based on the prescription scenarios suggested by designers and on the action scenarios derived from the analysis of existing situations. It is both the prescription scenarios and the activity that are tested. In the first stage, this trial always reveals difficulties, or even dead ends and disagreements (Béguin, this volume) in the realization of the simulated activity. These difficulties do not have any severe consequences, since they emerge

before the solutions are produced (this justifies the use of the term “scenario”, since scenarios allow some evolutions). On the contrary, the early revelation of these difficulties – contrary to what happens all too often in “classical” design processes) reveals some shortcomings that may lead, later on, to difficulties in system operation, that could be avoided by altering the prescription scenarios. However, these difficulties may also reveal a need for the development of activities, so that workers might better take ownership of the principles of prescription that might prove to be relevant. Simulations must here, once again, allow testing of the forms of appropriation. The scenario might be adapted to foster this process of development. When carried out in this way, this approach leads to designing a prescription system based on the level of development that it allows.

This dual motion of development of prescription and development of activity echoes the process of instrumentalization/instrumentation proposed by Rabardel (Rabardel & Bourmaud, 2003; Rabardel & Béguin, 2005; Bourmaud, this volume) that, in turn, draws inspiration from the process of accommodation/assimilation proposed by Piaget.

Iterations in this dual movement, which rest on a wide range of characteristic situations of action, lead to the elaboration of a prescription scenario that has been sufficiently stabilized through successive trials. But they also lead to the elaboration of new forms of activity, which are tried out by workers taking part in the approach even before the process is launched in concrete terms. When this occurs, the activity that has started developing during the simulations may be deployed in the new system, continuing its development. It is quite common, just before implementing a new installation, a new software program, or a new organization, to hear the workers who took part in the approach say they “cannot wait to be there” and express their confidence in the success of the project. This finding is in sharp contrast with numerous forms of project management where forms of resistance and mistrust are often observed. However, the simulation focuses on several prescription scenarios – not just the scenario that will ultimately be selected. Because of this, it covers a broad space of exploration and experimentation, describing ways of doing work, and opening them up for debate or even controversy – not just between workers and prescribers, but also between the workers themselves. Indeed, it is this very kind of debate, which will focus notably on the criteria involved in the quality of work, which Clot (2011) calls for in order to set the foundations for “well-doing” - something without which no “well-being” would be possible.

Thus, simulations contribute to the construction of a rich experience of the various scenarios explored, gradually expanding the range of possible “professional gestures” (Ibid., p.102). Even if the activity developed in simulations will continue to develop in real-world situations, it may sometimes cover a broader range of possibilities than what will be required in the new situation. Indeed, the situation of simulation comprises numerous trials and errors that are subject to collective arbitrage, and that continue to provide input for the activity in development.

To avoid discrepancies between the workers who took part in simulations and the other workers, it is necessary to design a complementary training system which, once again will rely on the implementation of simulations of work, but

focusing only on the scenario that has been tested out and approved. From this training system, one can expect the development of new activities focusing on the “use” of the future system, even before its operational implementation.

3.2 Development in the activity of designers

Designers are invited to take an active part in the simulation. They are expected to suggest some initial prescription scenarios (and not just a single solution) based on the reference materials produced by the ergonomic diagnosis; to attend the simulations carried out by the workers; that they discuss and argue their evaluation criteria, and that they help make scenarios evolve towards a better integration of the activity in development. On this occasion, one can observe some development in the activity of designers.

Designers, who are most often involved in a process with a strongly technical view that is focused only on the material or procedural aspects of the system to be designed, are confronted with the activity of the workers and with its possibilities for development. When made visible through simulation, this activity may, at first, appear as an additional constraint to them, which would be difficult to ignore. But it quickly becomes the central issue of design when it emerges as the very condition of system operation.

At this point, a reversal will occur. Whereas they used to be constraints, the increased requirements related to the recognition of work activity in the real world becomes a resource for designers. By providing designers with tools to imagine new solutions to respond better to the debate between criteria that begins between participants (for example, productivity requirements and quality requirements), it constitutes a source of innovation for them (in the sense that an innovation is an appropriation). If the task, as Clot (1999) points out, is a “cooled-down product” of the activity of designers, there is a key stake in testing this activity, as long as it is still “hot” with respect to the activity of the workers which is still in development. It is in this mold, formed by participatory design and made “white hot” by the simulation of future work, that the mutual learning (Béguin, 2003; Béguin, this volume) between designers and workers takes all of its strength... and contribute to the development in the activity of designers.

Initiating this process implies that the activity of design should be distributed and that the designers agree to share part of the design, notably regarding:

- the elaboration of prescription scenarios, for which each participant (workers, managers, decision-makers, staff representatives) can be a source of propositions;
- the elaboration of criteria for the evaluation of the design system. These will no longer refer only to the technical validity of the system, but will be completed by criteria that are related to the development of an efficient and meaningful work activity.

It is quite surprising, from this point of view, to note that the development of the activity of designers seems to be dependent upon being “dispossessed” from one part of that activity. Here, the simulation situation seems to offer an opportunity for designers to reflect upon their own practice (Schön, 1983), helping them guide their activity towards a greater relevance of the designed system, with the possibility of moving them away from their initial models. This may contribute to

the renewal of the profession of engineering, which has fallen prey to the misgivings of project management (Charue-Duboc & Midler, 2002).

3.3 Development in the activity of decision-makers

The approach contributes to the development of the decision-making function. It allows decision-makers to realize the primacy – and therefore, the liability – of the function of contracting authority, which defines the will related to the future, compared with contractors, whose function is to identify solutions to implement this will. Discrepancies between “what is wished for” and “what can be done” require trade-offs, through adjustments of goals and resources. This pre-eminence must apply to all aspects – technical, organizational, training-related – over the entire duration of the project, which implies organizing the decision-making activity with:

- on the one hand, a team of managers, representing various logics that are all vital to the development of the company (finances, marketing, human resources, quality, safety, environment...);
- on the other hand, a permanent representation of this collective by a project manager who deals with the everyday interactions with contractors.

The development of decision-making activity implies, notably, strengthening the acknowledgement of the diversity of logics that need to be taken into account, of the contradictions between these logics, and of the interest in the collective construction of trade-offs within the management team. By confronting technical and organizational prescriptions with simulations of “real-world” work, the ergonomic approach contributes to implementing a restoring force grounded in the real world, and to avoiding the construction of “managerial defences” such as “it’ll work regardless”. It also helps reveal possible hidden expenses and conflicts between criteria. But it may also contribute, sometimes, to opening up new perspectives for organization and management, which would have appeared to be incongruous or inaccessible, had simulations not shown them to be viable solutions.

This point may lead decision-makers to alter their strategy for announcing future projects: rather than waiting for the project to be stabilized before making an announcement, they may consider the early announcement of projects that are still uncertain as a positive opportunity to enrich those projects by debating them in the light of the possibilities available to the activity.

An ergonomic approach to project management also contributes to reinforce the workers’ and middle managers’ “right to play” as participants in the design process. The discovery, by decision-makers that their contribution has led to avoiding major mistakes may facilitate the implementation of new management practices. This is also the case with the relations with staff representative institutions.

3.4 Development in the activity of staff representative institutions

The ergonomic approach described above also constitutes a trial and an opportunity for staff representative institutions. It is a trial, because it may come in to question a culture of representation by delegation, where staff representatives may think of themselves as the only legitimate bearers of the point of view of employees on the conditions of work. It is also an opportunity,

because the results of activity analysis cast a light on employees not just as being constrained by their work environment, but also as being fully committed to the pursuit of what they consider to be “quality work” (Chassaing et al., 2011; Petit & Dugué, 2012), and as bearers of unsuspected knowledge. In some cases, this reversal has led trade unions to explicitly alter their practices regarding relations with employees, seeking to ground these practices in an understanding of work.

The approach may contribute to the development of the activity of staff representative organizations when there are major organizational stakes at play, by providing two main tools: a detailed understanding of the existing activity, and a reflection on the future in terms of consequences on future work. A structured process of informing choices can thus develop in lieu of previous ritual confrontations (Dugué, 2008; Guerin et al., 2006). “Tracking” design decisions over the course of them being formalized also allows staff representative institutions, if need be, to remind other stakeholders of their importance in case they had been left out of the later stages of project realization.

This development of the activity of staff representative organizations around the issue of “work” does not imply that they should not take into account many other dimensions than those that are taken into account in ergonomic simulations: employment, pay, status, etc. In some cases, it can be noted that this “macro” aspect is nourished by the reflection about work that has been developed in the project. Such is the case, for example, when negotiations regarding the size of the workforce rely on the action scenarios used in the simulations to ensure that the staff will be in sufficient numbers to cope not only with normal situations, but also with incidental ones.

4 Conclusion: from the adaptation of work to human beings to the development of activity

Acknowledging the development of activities as a part of the ergonomic approach to project management (and more generally, as part of any work situation) is one aspect of an evolution of the foundational project of ergonomics, whose goal was “adapting work to human beings”. This view was initially reflected in the original orientations of the Ergonomics Research Society in 1949, under the heading of “fitting the job to the worker”, through the search for a match between work and the psychological and physiological characteristics of the human being. This orientation is also reflected in what Hubault & Bourgeois (2004) have called “the ergonomics of tasks”, with the development of ergonomic guidelines that could be applied directly to the design of work systems².

² This dynamic approach was developed in the United States under the term « Human Factors », and in the United Kingdom under the term « Ergonomics ». The convergence between the two terms was reflected in the change in the name of the Human Factors Society, in 1992, to the Human Factors and Ergonomics

Around the same time, “activity ergonomics” was developed (mainly in French-speaking countries, but also in Scandinavian or South-American ones) which highlighted the active contribution of workers to the completion of tasks, considering the inescapable variability of real-world situations. This activity ergonomics, which was originally focused on the understanding of work, changed its orientation in the 1980s towards taking into account work activity in project management, as described above. The stake of this approach is to spaces for future activity (Daniellou, 2007) that leave some leeway for workers to manage their activity – or even possibilities for the continuation of design in use (Rabardel & Béguin, 2005).

The prospect of “constructive ergonomics”, then, is to broaden the concept of “adaptation” or “fit” to that of the development of activity. The goal of ergonomists is to contribute to the design of work situations that will serve as a starting point for the development of the activity of the men and women who are the stakeholders of the project. To allow this development to start early, in the design of work situations, and in so doing, turning the criterion of the construction of experience (through the simulation of work) a criterion to assess the solutions produced by the -prescriber designers, may prove to be a strategic choice for ergonomists.

This prospect would, no doubt, call for strengthening research programs, concerning both the learning that is involved in the various stakeholders involved in project management (including the ergonomist) and on the practical methods and practices for intervention that may support the development of their activities.

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