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Social construction as a means of ergonomic intervention

A construção social como meio da intervenção ergonômica

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Abstract: Although Ergonomic Workplace Analysis (EWA) practice is common in Brazil, some critics have asserted that it is not sufficient to bring about an effective change of the workplace. Although this criticism may be partly admissible in regard to Brazilian ergonomics, it cannot be considered to apply to France, where Activity-Centered Ergonomics was born. At the same time, it is important to not confuse EWA with the broader field of Activity-Centered Ergonomics. Against this background, this article seeks to analyze the elements that characterize contemporary ergonomics practices in Brazil so as to compare them to the modes of intervention developed in France. We also seek to investigate models, concepts and methods so as to expand the possibilities of ergonomic interventions in Brazil. To do so, we will start from a theoretical examination of the development of EWA in Brazil from its origins in France, presenting an intervention conducted at a French electricity company. Next, we will discuss the losses suffered by EWA during the transfer of EWA methodology from France to Brazil, as well as the need to cultivate social construction at all stages of these interventions. We conclude by showing the importance of developing this debate in the field of ergonomics and the need to continue it.

Keywords: Ergonomic Workplace Analysis; Intervention; Social construction; Activity-centered ergonomics.

Resumo: A Análise Ergonômica do Trabalho (EWA), embora muito utilizada no Brasil, tem sido alvo de críticas por uma suposta insuficiência em promover a transformação efetiva do trabalho. Embora essa crítica possa ser em parte considerada no caso da ergonomia brasileira, ela não se aplica à ergonomia da atividade desenvolvida na França, seu país de origem. Ao mesmo tempo, a EWA não pode ser confundida com todo o campo da Ergonomia da Atividade. Sob esse cenário, este artigo objetiva analisar os fatores que explicam a prática atual da ergonomia no Brasil para compará-la aos modos de intervenção desenvolvidos na França. Objetivamos, também, aprofundar a reflexão sobre modelos, conceitos e métodos, a fim de expandir a possibilidade da intervenção ergonômica brasileira. Para isso, partimos de uma reflexão teórica

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do desenvolvimento da EWA no Brasil a partir da sua origem na França e apresentamos uma intervenção realizada em uma empresa francesa de eletricidade. Em seguida, discutimos as perdas sofridas pela EWA em sua transferência tecnológica da França para o Brasil, bem como a necessidade de desenvolvimento da construção social em todas as fases da intervenção. Concluímos mostrando a importância do desenvolvimento deste debate no campo da ergonomia e a necessidade de continuá-lo.

Palavras-chave: Análise Ergonômica do Trabalho; Intervenção; Construção social; Ergonomia da atividade.

1 Introduction

Ergonomic Work Analysis (EWA) is one of the best-known methods within the field of Activity-Centered Ergonomics, especially in Brazil. Such analysis is performed quite often by ergonomists, called upon to help address issues associated with workers' health and working conditions or to solve problems related to industrial production and services, and to participate in workplace design or to transform existing work systems (Guérin et al., 1997).

EWA as well as other types of ergonomics interventions are sometimes subject to criticism asserting that they are inadequate to promote an effective change of work systems. These criticisms consider the underlying model, developed to produce ergonomic diagnoses and recommendations that emphasize the centrality of ergonomist as a specialist in the intervention process, as the primary factor limiting this change (Vilela et al., 2014, 2020; Lémonie & Grosstephan, 2021).

In this essay we argue that although this criticism may be partly admissible in regard to the ergonomics state of art in Brazil, it cannot be generalized since it does not apply to the ergonomics practiced today in France – where Activity-Centered Ergonomics was born – since their intervention practices overcame these issues many years ago. Moreover, EWA should not be confused with Activity-Centered Ergonomics as a whole, since it is just one approach among others, and itself may or may not be considered an intervention - i.e., a form of engagement intended to change and develop workplace systems and increase worker autonomy (Guérin et al., 2021). In any case, we believe it is important to seek to understand the reasons for this critique of the practice of Ergonomics in Brazil in order to reflect on the developments needed to adapt it to better suit Brazilian reality based on a comparison with Ergonomics development in France.

What, then, are the real goals of EWA? What are its limits? How can it go beyond diagnosis towards change? What are the determinants of an ergonomic intervention? What can be done to allow for actually worker participation in the intervention process to promote change?

Starting from these questions, this article pursues a dual objective: first, we will seek to analyse the factors that account for ergonomics as it is currently practiced in Brazil so as to compare it to the modes of intervention being practiced in France; next, we will investigate models, concepts and methods so as to expand the possibilities of ergonomic interventions in Brazil.

To this end, the text takes the following organizational approach: firstly, in point 2, we propose an analysis of the development of EWA in Brazil starting from its origins in France, and present a sketch of the evolution of ways of thinking about the practice, and the various constructs regarding ergonomic intervention. To provide some illustration for this discourse, in point 3 we present and discuss an intervention conducted at an electricity company in France. In point 4, based on the discussion

about the factors that explain the success of the intervention in question, we reflect on the need to develop social construction at all stages of the intervention and on which ergonomic intervention we carry out in Brazil. We then present the article's conclusion in point 5, emphasizing the importance of this debate and the need to pursue it further.

2 Theoretical approach

2.1 The evolution of activity-centered ergonomics in Brazil

In Vilela et al. (2020, p. 45, free translation) it is asserted that activity-centered ergonomics interventions do not themselves generate transformation, and involve no effective worker participation, since the workers "remain primarily a source of information or suggestions" rather than being "actors with real power in the decision-making process," and furthermore that the lessons learned from these interventions "tend to be limited to the analysts themselves".

Based on these assertions, we pose the question: why are criticisms still being voiced challenging the fundamental purpose of Activity-Centered Ergonomics, even 25 years after the 1997 publication in Brazil of the Portuguese translation of the book "Comprendre le travail pour le transformer" [Understanding Work to Transform It] and more than 30 years after the 1990 publication of the Brazilian Regulatory Standard about ergonomics at the workplace – Norma regulamentadora 17 (NR-17)? What could explain the fact that in Brazil EWA often does not actually constitute an intervention, since it does not itself bring about any transformation and does not aim to ensure worker leadership?

Here we will offer a few hypotheses that may help elucidate these issues, and then proceed to present some elements of comparison to help contrast the approaches taken in Brazil and in France.

Firstly, we must give due credit to the legacy left by Alain Wisner and his school in Brazil. The elaboration and formulation of EWA is closely linked to Wisner's research and educational programmes at the Ergonomics Laboratory at the *Conservatoire National des Arts et Métiers* (CNAM), which in the 1970s commissioned a group of researchers to develop an intervention method that for several years was used as part of a practice based course on EWA. Although after Wisner's retirement in 1991 the course was transformed and instead took an approach focused on change via design methods, several Brazilian researchers trained in the CNAM's laboratory eventually began to implement the original French training in Brazil, especially in the late 1990s, aiming to conduct in-depth analyses of work systems. Multiple studies were published as a result (see, for example, the 2004 special issue in the *Revista Brasileira de Saúde Ocupacional* [Brazilian Journal of Occupational Health]).

However, due to the duration of the training, deeper explorations of design actions for work systems after the ergonomic diagnosis itself have often ended up treated as a secondary matter. As a consequence, it is common for students of the discipline in Brazil to formulate only general recommendations with no direct relationship to the observations actually made, such as "set up a workplace exercise program" or "replace all the chairs in the department," even when all the work stations had not even actually been subject to analysis. Although the use of ergonomics recommendations in Brazilian courses where EWA is taught is now falling into disuse, it does serve, pedagogically, as a means of validating the quality of the diagnoses made and the interventions

performed and of verifying the coherence between what was actually observed and what modifications are sought (Ferreira, 2015).

It should be pointed out that in spite of the original influence of activity-centered ergonomics, the development of EWA in Brazil was greatly influenced by Human Factors Engineering, which aims to apply existing knowledge about human factors to work systems design (Dul et al., 2012). This is an approach based on technical rationality, i.e., a mode of engineering in which practice is based on clearly defined specializations – cognitive ergonomics, biomechanics, macroergonomics, etc. – without any apparent concern for the social dimension of professional practice (Jackson et al., 2021). This background ultimately contributed to the technocratic and reductionist aspect of EWA as it has developed in Brazil.

At the same time, it is necessary to note the influence of NR-17, published in 1990, which was formulated by inspectors educated at the CNAM school. The provisions of the original text of this standard made the application of EWA mandatory at all companies and required that ergonomists be trained in reference to that methodology; this lasted until 2022, when the standard was updated and this obligation was withdrawn (Brasil, 2022). Thus, the NR-17 was established on solid theoretical foundations, and was very important in the evolution of EWA and ergonomics itself in Brazil, strongly influencing consultants, auditors and managers (Jackson & Lima, 2015). However, with EWA training limited in Brazil, this standard alone is often used as the sole reference for actions; this can lead to decontextualized practices that fail to guarantee effective participation or the real transformation of work systems (Ferreira, 2015).

Lastly, the publication of the book "Understanding Work to Transform It" (Guérin et al., 1997), a translation of the 1991 original work in French, "Comprendre le travail pour le transformer," reinforced the centrality of EWA in Brazil and has become something of a manual of Activity-Centered Ergonomics. As we will see below, by the time the book was translated into Portuguese, ergonomics practice in France had become more advanced, quickly leading to inconsistencies between the practices applied in the two countries. This context distanced Brazilian ergonomics from the important developments that had taken place in French ergonomics, particularly with regard to service relationships, computer system interfaces, and all the experimentation directly focused on the design of equipment, systems and work stations that had been done based on diagnoses developed from workplace analysis. This context of the evolution of ergonomics in France has been clearly explained and detailed in a more recent work by Guérin et al. (2021).

In addition to these issues, difficulties have been encountered in establishing intervention practices in Brazil, for certain specific reasons: 1) the teachers are almost always researchers, who promote ideal applications of the method in an educational context; 2) technology transfer for EWA between France and Brazil faces numerous stumbling blocks, with failures to address the differences in existing social relations, and particularly those within companies; 3) the diversity of ergonomics approaches (not just activity-centered) is not considered, which impedes the development of a common theoretical-practical foundation and the formation of a community of practice aiming to perform interventions within companies.

The development of this context does not however imply that no successful interventions have occurred in Brazil (see, for example, Duarte et al., 2012; Abrahão et al., 2015). However, even where they have focused on ergonomic design process, projects conducted in laboratories at public universities (in particular, at

UFSCAR, UFRJ or USP) have clearly dominated, unlike in France, where a substantial community of professionals and consultants was simultaneously established.

2.2 Research on practice

The end of Alain Wisner's directorship of the Ergonomics laboratory at CNAM led to the departure of several researchers to other research laboratories; among them was François Daniellou, who after having developed methods for project intervention eventually came to propose the development of methods for knowledge production in ergonomics practice, a perspective that came to be called "research on practice" (Daniellou, 1999). This perspective was profoundly influenced by the work of Schön (1983) on "the reflective practitioner," which held that a professional's actions can never be described as a pure and simple application of the fundamental knowledge acquired during training, but are always subject to contextual adaptations. The ergonomist's work itself thus came under the microscope, and ergonomic interventions were modeled with the objective of understanding the required engagement focused on the transformation of work. Thus, the author argues that:

"Our role is not only to describe and alert others. These are respectable positions... but ergonomists are there to influence workplace situations. Our work is always focused on the future, that is, on forms of analysis that help us become more advanced in our knowledge than we were before, in order to be able to transform workplace situations. The analyses we make must not only be useful, but must also serve to promote transformative actions." (Daniellou, 2008, p. 17-18, free translation).

Thus, the evolution of thinking on practice began in the late 1980s, "very shortly before the appearance of 'Understanding Work to Transform It'" (Guérin et al., 2021, p. 25, free translation). This allowed the active participation of ergonomists in large-scale industrial projects. Early interventions conducted in the printing plants of the Parisian newspapers "*Le Monde*" and "*Figaro*" at the time allowed for a consolidation of the methodological basis, later referred to as the Future Activity Approach (FAA), as well as providing experience with the social construction model in view of ensuring participation by workers and their union representatives in the planning processes (Garrigou, 1992).

From then on, FAA began to be applied in other industrial contexts, practiced by researchers and consultants. However, with the economic and productive restructuring underway at the time - characterized by a re-organization of production chains, increasing financialization of companies, automation and robotization, all combined with the weakening of unions - ergonomists have participated in design process in situations that are more difficult in social terms, with little or no union involvement. Given these new conditions of intervention, researchers are called upon to support the work of ergonomists, as Daniellou (1992) points out when describing the interest and emergence of the research on ergonomics practice.

The workplace analysis, therefore, is not applied, but grows from the analyst's work (Lapeyriere, 1995). In order to transform work situations, the ergonomist must be able to influence existing social relations from the perspective of workplace activity in order to influence the representations of technicians and managers (Daniellou, 1992). In regard to design process, the ergonomist leaves exteriority, which is the foundation of activity-centered analysis, and focuses more on the interior aspects of project organization, which becomes its own work environment (Jackson, 1998).

Ultimately, research on practice evolves by having as its object the modeling of ergonomists' transformational activity. Its objectives are to understand the intervention mechanisms implemented, to encourage collective debate about the difficulties and strategies used, and to provide material for professional training (Petit et al., 2007). The models "are not made to be applied, but are tools intended to serve practitioners, as they provide a starting point for interventions"; and "they have no statute of limitations," but contain "ways of organizing the intervention, shortcuts, overlooked steps," and are thus able to "predict the effects of a certain action" (Daniellou, 2008, p. 20, free translation).

2.3 The social dimension in ergonomic interventions

Developments in the action of ergonomists show that interventions in design process have required them to explain the dimension of social organization as implemented in practice. There is no ergonomic intervention without participation, so the social dimension inherent in the intervention will always be present in projects.

In the early projects, the social construction was more clearly defined, based on steering groups and workplace groups, which had been previously negotiated and were linked to intervention methods such as reference situation analyses and future activity simulations (Garrigou, 1992; Jackson, 1998). With the weakening of unions, the social dimension of intervention design became more flexible. In general, the steering groups came to be given less space, though worker participation remained ensured via the organization and facilitation of the workplace groups (Jackson, 1998). This was the social construction essential for implementing future activity simulation sessions. In a way, in order to ensure the team's power to act, ergonomists are led to influence their own context, i.e., project organization. Ergonomics project approach was, therefore, gradually structured in view of addressing two distinct challenges: changing work organization, and involving company actors in the intervention, under differentiated and appropriate conditions (Coutarel & Petit, 2009).

Although the centrality of work analysis is a matter of consensus among activity-centered ergonomists, other equally fundamental elements such as the social conditions for the intervention need to be better addressed. The quality of the social dimension, which involves the development of relationships between the ergonomist and the other actors in the process, can expand the manoeuvring room associated with work systems design, and thus can help cultivate the capacity of operators to act in such systems (Coutarel et al., 2015). Thus, interventions would focus not only on the determinants of the activity of operational workers, but also on a social construction ensuring greater scope of action for the technical, supervisory and management staff, which takes place through possibilities for debate regarding standards and practices, with the explanation of workers' values and decisions, and for increased competence and improved working conditions for individuals. Hence the importance of the analysis of the request, the initial stage of the intervention, which aims to reformulate the problem, defines the methods to be applied and negotiate the terms of the intervention (Petit et al., 2007).

In order to change the workplaces analysed, the development of a social construction is, therefore, fundamental. To achieve this, the ergonomist himself needs a certain margin of action to ensure the effectiveness of the intervention, that depends on the capacity to act of the ergonomists' interlocutors. This is now considered one of the central subjects of ergonomic interventions, which must "equip individuals and

groups to enable them to act on the conditions that impact their work and that of others" (Guérin et al., 2021, p. 85, free translation).

3 Social construction in interventions aimed at preventing accidents at work: the case of EDF/GDF

To illustrate this discussion, we will refer to the research performed by Rocha (2014) between 2010 and 2014 at EDF/GDF, companies providing electricity and gas distribution in France. The companies' initial request had to do with the development of a "culture of safety" at their facilities in western France.

Grounding itself in the field of Activity-Centered Ergonomics, the research team, made up of 2 senior research ergonomists and a field research ergonomist, performed an ethnographic study during the first year of its research work seeking to understand the activity underway in real workplace situations at the company. From this stage, taking a qualitative and participatory approach, and in collaboration with the workers at the company, the researchers developed a feedback-based organizational system based on discussion spaces and the comparison of real situations (Rocha et al., 2015). Such situations were discussed at different hierarchical levels of the organization, leading to concrete escalations, and concomitantly generating lessons regarding the workplace at the different hierarchical levels involved. Lastly, this feedback system took on new aspects insofar as the central approach went beyond simply addressing the cases discussed and the consequent lessons learned, and turned to primarily focus on increasing workers' autonomy at the lower hierarchical levels of the organization in resolving risk situations. Thus, "local workers gain autonomy and power to act to develop their actions against similar situations in the future" (Rocha et al., 2019, p. 198).

The objective here will not be to summarize the contributions made by the aforementioned research, which has already been discussed at other times (Rocha, 2014; Rocha et al., 2015, 2019). Our intention is to reflect on how these stages were reached, what relationships were established, what agreements were made and what interlocutors were needed. In other words, we will bring under the microscope the social construction established during the research activity, which is normally made invisible by the traditional academic format, but is an essential part of the construction of new knowledge, as supported by the research on the practice of Activity-Centered Ergonomics.

To facilitate our examination of the social construction developed amongst the researchers and the other interlocutors involved in the research, we divided it into 3 major phases: an initial negotiation phase, in which the terms for the intervention were established between the team and the organization's decision-makers; a work analysis phase, corresponding to the time the research group would access and remain in the work area and perform its analysis of the activity there and of the interactions among the social groups involved in the research; and a workplace transformation or project phase, when effective changes could be made in workplace situations.

3.1 Negotiation phase

The negotiation phase was conducted during the 8 months preceding the start of research; participants included 2 of the company's Regional Directors - one from the electricity company and the other from the gas company - and the 2 senior researchers.

In addition to the objectives, deadlines and schedule, certain premises and conditions were agreed in this phase among the directors and researchers to ensure

that the ergonomic intervention would be able to get started and continue in the following years. Based on the company's absenteeism and accident data, 6 pilot facilities (3 from each of the companies) were assigned by the Directors for inclusion in the initial phase, i.e., the workplace analysis phase. Based on this, an agenda was prepared for presenting the research and the researchers to each of the managers responsible for these units. Likewise, a project was put together in collaboration with the company's mid-level managers to help introduce them to the research work and ensure that they would be able to help contribute to its execution to the extent possible.

This work - carrying out the presentation and making the initial contact between the team of researchers and the mid-level managers and the local managers at the pilot facilities - was extremely important for the continuation of the research into the following years, as it reduced the initial distance between the team and the actors in the organization, and allowed relationships of trust to begin to develop.

In the same phase, the bureaucratic and financial conditions of the work were agreed, such as the creation of badges for access to company facilities and dining facilities, and the presentation of the researchers to the department handling hotel reservations, train ticket purchases and vehicle rentals.

Also at this stage, protective guarantees were negotiated for workers participating in the research, especially those who would be voluntarily participating in interviews or workshops, who would be providing authorization to film them or who would be recording their own activity (with photos or videos) for later discussion. The protective guarantees offered at that juncture entailed agreements with the Directors that no disciplinary measure, direct or indirect, would be taken against workers who had agreed to participate in the research. This agreement, first established in the negotiation phase, was later reinforced again at various moments, during meetings between the researchers and the Directors.

Finally, the negotiation phase was a moment when certain methodological tools to be used in the work analysis and transformation phases could be previously defined and planned. At this time it was agreed and planned that a Steering and Workplace Groups Committee would be created, both for the work analysis phase and for the research transformation phase. The Steering Committee was to consist of the 3 researchers and the 2 Directors present at this stage, as well as by 6 middle managers from different hierarchical levels (3 from each company) and 6 worker representatives (3 from each company), in addition to the prevention specialist (an employee with substantial working experience, and with specific training in the security area, and in direct communication with the company's Management) for each of the companies. This committee was to meet every 3 months; its objective would be to follow up on the research, validate the empirical data, adjust the conditions established during the negotiation phase, and build the continuity of the intervention. The workplace groups, which focused on operationalizing the research objectives, were composed of the field ergonomist, the managers of the facilities being worked on, and representatives of the workers, and operated primarily during the transformation phase. In this format, 6 workplace groups were established, 3 for each of the companies (or 1 group per company facility being researched), which would meet when needed.

3.2 Workplace analysis phase

The workplace analysis phase, carried out during the first year of the research, included both observations of the activities of workers in the field, as well as individual and group interviews with workers and managers. The following agenda was created

by the research team and later validated by the Steering Committee: during this phase, every week the field researcher would spend 3 days in the field monitoring activities among the workers, and would spend the other 2 days on the transcription and processing of data, alongside interviews with workers and managers. As this phase was to cover 6 facilities, it was agreed that the field researcher would stay 1.5 months in each of them. It was possible to keep to this schedule completely for two primary reasons. First, because of the previous work done by the 2 Directors, who had introduced the researchers and the research to the facilities, and who had collaborated with managers to schedule the field researcher's visits. This made it possible for the field researcher himself to contact the managers of the facilities (via email or telephone) to confirm the visits and prevent scheduling conflicts. Aside from this, the presence of the field researcher for long periods in each of the facilities allowed the establishment of bonds of trust with the workers and managers present.

Data collected in the field were transcribed and processed both for discussions internal to the research team and for discussions with company representatives. Physical and telephone meetings were generally held among research team members on a fortnightly or monthly basis, in which field data were discussed, questioned, refined and processed. At the same time, these meetings allowed for the discussion of other issues concerning research, such as strategic project decisions, scientific data analysis, integration with the theoretical basis, etc. Concomitantly, sporadic meetings were held (as needed) between the field researcher, the directors, and the prevention specialists, which also served as an opportunity to validate the data being worked on. On this basis, the Steering Committee would meet once every 3 months to validate the data presented by the field researcher.

Beyond the interlocutors planned for during the negotiation phase, others emerged, more organically and spontaneously, who were also able to make considerable contributions to constructing the workplace analysis. These interlocutors were sometimes persons internal to the company, who were found in informal conversations or were suggested by some interlocutor associated with the research work, and sometimes persons external to the company, such as persons associated with research institutions.

Below are two examples that serve to illustrate the spontaneous interlocutors internal to the company. The first appeared in an informal conversation around the dining table, just after lunch. The field researcher was talking to some gas network workers from the Working Group involved in the research, discussing stories he had heard about how certain work standards had been put in place by the company that were nevertheless incompatible with real conditions in the workplace. Although the group involved in the conversation felt that this was true, no one had expressly come forward with any real examples. But then one worker, who was not part of the Working Group and just happened to be there at the table, turned to the field researcher and said:

I'm assigned to a job right now that's just like that. There's a work standard in place that says we have to use a particular tool (aligner) to align the distributor, but the tool doesn't fit at the job site because the trench is too narrow. So I just use a wrench instead to do what that tool was supposed to do. Come with me this afternoon and I'll show you.

In a second example, a formal interlocutor from the electricity company proposed a meeting between the field ergonomist and an electrician from another facility. Knowing that the researcher was seeking to understand the logic underlying the disciplinary

practices instituted at the company in recent years, a manager in charge of one of the work units suggested:

Talk to Jean-Paul from the southern facility about this. He's been an electrician with the company for about 20 years, and once he had to go through an accident investigation process that really traumatized him. The accident itself wasn't even that serious, but the way the investigative committee went after him trying to blame him for it was really hard on him. I'll call him here and set up a meeting for you.

In addition to the internal interlocutors, others external to the company also contributed significantly to the Workplace Analysis phase. These interlocutors were mainly linked to other educational institutions, such as the *École Nationale Supérieure de Cognitique* (ENSC) ergonomics laboratory at the University of Bordeaux, led by François Daniellou; the *Centre d'Étude et de Recherche Travail, Organisation, Pouvoir* (CERTOP) sociology laboratory at the University of Toulouse, led by Vanina Mollo; and the *Conservatoire National des Arts et Métiers* (CNAM) ergonomics laboratory, directed by Pierre Falzon.

These laboratories were the scene of numerous discussions about the research, both formal and informal, involving various different researchers and colleagues who always contributed essential reflections to guide the continued pursuit of the work and were decisive in achieving a better understanding of the work being done by the workers involved in the research.

3.3 Transformation phase

The transformation phase or workplace planning phase continued for 2 years after the Workplace Analysis phase, and was divided into two subphases: development of local feedback systems, with the participation of 4 pilot facilities; and development of a systematic feedback process with the participation of only one of the facilities, selected in advance.

Of the 6 pilot facilities participating in the Work Analysis phase, 4 continued their participation into the transformation phase (two were from the electricity company and two from the gas company). The criteria for the selection of these facilities were based on the engagement and voluntarism among both the manager in charge and the workers themselves in creating a feedback system able to gather and process real risk situations. Thus, the research project Steering Committee selected the 4 facilities whose managers and workers were the most motivated to develop such a system.

Each of the 4 facilities participating in this phase was associated with a Working Group, which was made up of the field researcher, the manager in charge of the facility, and 3 or 4 volunteer workers, whose objective was to implement feedback systems locally. The idea of these groups was to gather real experience from the field likely to generate lessons for other workers at the facility. For this purpose, they would need to set aside regular discussion spaces during facility meetings, encourage other workers to bring in photos or videos from the field, discuss these situations and collectively think about courses of action to solve any problems that may appear during the discussions. This system took on different forms in each of the 4 participating facilities so that the frequency of meetings and equipment for collecting information from the field could be adjusted among them to suit the needs and wishes of each of the groups.

An agenda was prepared among the Steering Committee and the Work Groups of the pilot facilities so that the field researcher could be periodically present at all units to monitor the progress of the system. Thus, during the year, the agenda was divided as

follows: for each active month, the field researcher would spend two weeks in the field and the other two weeks working on data and research production. One these two weeks in the field would be devoted to the electricity company's 2 facilities, and the other to the gas company's 2 facilities. Thus, the researcher would be able to spend one week a month monitoring the progress of the system at each of the companies.

The relationships that grew during the year of the Workplace Analysis phase allowed the established agenda to be fulfilled without major unforeseen events. During the period not involving visits, the field researcher would periodically talk with each of the managers in charge of the Workplace Groups and with their members about how the local system was working, the group's level of engagement and the motivation of the other workers to participate in the system that had been set up.

The proximity and direct contact of the field researcher with the managers at the facilities and with some members of the Workplace Groups were crucial factors in their understanding of the benefits and limits of the system in that stage. In terms of research results, it was observed that the local feedback system worked better at the electricity company facilities than at the gas company facilities. Both this finding and the reasons for it were provided by the managers at the 4 facilities, as can be seen in the statements below.

The system is working well here. The Working Group remains motivated, organizing the agenda and bringing colleagues to discuss risk situations in the discussion spaces. We are resolving a lot of concrete situations, and I'd say it's thanks to the people participating in the group. Overall, we all feel that discussing actual cases helps move us forward. Besides, I'm a manager who rose through the ranks [which not all the managers have done], so I know how important it is to be closely attentive to the actual work. Manager at electrical company facility 1.

We are doing well here. Sometimes I need to give a boost to the Working Group, to keep things rolling [bringing in situations from in the field, discussing them and processing them], but in general, everyone is participating. Of course, sometimes we get urgent work requirements so we have to put the system on hold for a while, but overall it's been very good. Manager at electrical company facility 2.

Here we've managed to keep the system running, but it's been tough sometimes. People don't always understand how important it is to discuss real situations; some would rather just be left alone to do their work and just go home at the end of the day. But even so we have made it work, and we've actually had some very interesting discussions. Manager at gas company facility 1.

It's been something of a challenge here. We've had a lot of urgent work requirements in recent weeks, and that's kept us from really getting the system set up. I tried a few times with the Workplace Group too, but the staff hasn't participated, mainly because of the work requirements we've had. Manager at gas company facility 2.

Interestingly, although all the managers in charge said they were aware of the need to implement the system, some said that they were able to do so more successfully than others. It should be pointed out as well that there was a strategic difference between the electricity and gas companies. Whereas the electricity company favoured facility managers from the operational field, the gas company had more managers with an academic background. It turned out managers who achieved better results were managers with an operational background, i.e., the managers at the electrical company facilities. According to the managers at the electrical company facilities, this was one

of the crucial reasons for their good implementation of the system, since work requirements were very similar across all the facilities involved.

Local feedback system development phase led to another transformation phase, called the "systemic feedback arrangement development" phase. This system was developed over another year, involving only one of the three facilities from the previous phase. The criteria used to select this facility were consistent with the criteria used in the previous phase, that is, the willingness of the manager and of the workers to move from a local arrangement to a more systematic one, escalating situations not handled locally to hierarchical levels capable of resolving them. Thus, in order to meet this criterion, facility 1 of the electricity company was selected by the research Steering Committee to participate in the current phase. In this phase, if any situations reported at the facilities were not processed locally due to a lack of resources or adequate conditions at the participating facility, they could be escalated to higher hierarchical levels, and could even be brought to the attention of the company's national management. Rocha et al. (2019) shows different examples of the functioning of the systematic feedback arrangement.

In practice, the system would continue to function in the same way as in the previous phase. The difference was that, where participants at the facility did not have the resources to resolve a given situation, the responsible manager would bring the matter up at a monthly meeting held between the prevention specialist and all the electricity company's facility managers. If a solution were found at this meeting, the facility manager would return that solution to the group. Otherwise, the prevention specialist would bring the situation up at another monthly meeting, this time of the Regional Board, to have the situation addressed. Likewise at this level, the situation might or might not end up being resolved. If not, the matter would be escalated to other, higher hierarchical levels, and the process would cease only when one of these levels could deal with the situation reported by the facility.

Along with this process of handling situations drawn from the field, the systematic arrangement also allowed an analysis of the workers' degree of autonomy in handling the risks they face. As time went on, the central approach went beyond simply addressing the cases, and turned to primarily focus on increasing workers' autonomy at lower hierarchical levels in resolving risk situations. Thus, for each real case discussed at the higher hierarchical levels, the approach being developed with the managers involved not only the handling of the situation itself, but above all involved how to offer resources (material, human, financial, etc.) at hierarchically lower levels, so that similar future situations could be handled without necessarily being escalated to higher levels.

The work of the field researcher at this phase was to negotiate with the prevention specialist and the director of the electricity company the time intervals for the meetings intended for discussions of situations from the field, and to accompany this activity with an escalation of situations and analysis of worker autonomy. Thus, frequent communication was established with the local manager of electricity company facility 1, to find out the content of situations handled locally or otherwise, in addition to meetings with the Prevention Specialist and with the Director of the electricity company, who at this stage were even more involved in the research than before, as situations from the field were discussed in meetings that they themselves coordinated. The field researcher, then, was present at several of these meetings to supervise the process and furthermore to set forth the various actors the commitments and responsibilities assumed by each in this systematic arrangement. Thus, he was able, for example, to bring up situations that had not yet been put on the agenda, or bring back up others that had already been discussed but had had no measures taken for their resolution.

Research team meetings were held over the entire course of the transformation phase, both during the sub-phases where the local systems were developed, and sub-phases where the systematic arrangements were developed. This close contact between researchers was essential for purposes of data processing and decision-making in the process. For example, it was during these meetings that the decision was made to record and transcribe the meetings in the local systems to ensure that the details could be understood. This completely changed the team's understanding, even influencing the facilities' choices in each of the phases. Likewise, at one of these meetings, it was suggested that in order to ensure greater control of the systematic arrangement, only one unit in the last stage of the transformation phase should be monitored, instead of two, as initially planned. This was also essential to ensuring the proper implementation of this phase.

In addition to the team of researchers and the company's interlocutors, at this stage the field researcher was again able to establish relationships with other external interlocutors, who contributed in different degrees to the construction of the research. The interlocutors from the ENSC, CERTOP and CNAM laboratories were a fundamental part of this phase through formal or informal discussions, as they were in the Workplace Analysis phase. Here, in particular, the participation of the Management Sciences laboratory at the University of Nantes was added, which, through the dialogue undertaken with the team of Mathieu Detchessahar and Benoît Journé, researchers with extensive experience in workplace discussion spaces, made it possible to implement the fundamental notion of subsidiarity in the process of developing feedback systems.

3.4 Modeling the social construction

The field researcher established communications of different types and of differing frequency with each of the interlocutors described above, both in the work analysis phase and in the transformation phase. Though the nature of these communications is more difficult to represent, and therefore has been described in detail above, the frequency of these communications may be more easily modelable. Thus, the following figure seeks to represent the frequency of communications between the field researcher and the other interlocutors, classifying them as "frequent" (meetings held weekly or biweekly on average), "relatively frequent" (meetings held monthly on average) and "infrequent" (meetings held once every 2 or 3 months on average) (Figure 1).

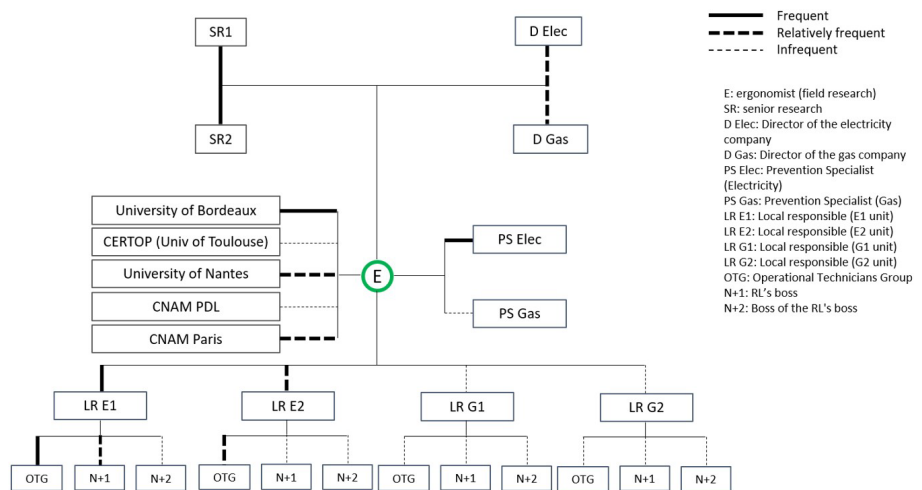


Figure 1. Representation of social relations between the ergonomist and the actors involved in the research transformation phases.

4 Discussion

4.1 Social construction as an object of intervention and research

The object of any ergonomic intervention must go beyond the scope of technical construction - which consists of grouping the elements that make it possible to identify different aspects of work systems that constitute a problem - and focus on the development of a social construction amongst actors - or on the development of pertinent interactions between the ergonomist and the different key actors at the company, in order to ensure the social and practical conditions for the development of the intervention (Jackson, 1998; Coutarel & Daniellou, 2007). Without this, many ergonomic projects may fail (Martin, 1998).

The intervention conducted by Rocha (2014), as well as several other ergonomic interventions carried out over the last decades, includes the development of negotiation, work analysis (EWA) and change phases, within which social construction could be clearly demonstrated.

The negotiation phase establishes the conditions for conducting the intervention with the request initiators and the company's management. Ergonomics refers to this as strategic analysis of the request. In the research conducted by Rocha (2014), this stage continued for nearly a year, and was conducted by the project's senior researchers in collaboration with the Directors of the companies involved. In this case, the negotiation undertaken had to account for the need for the intervention in the long term, necessarily including the change phase. Furthermore, in that phase it ensured that any disciplinary practices in use at the company would be suspended for the duration the project, thus allowing full access to realities in the workplace and the expression and participation of workers.

Likewise, Ferreira (2015, p. 9, free translation), when conducting a study in the clothing sector, indicates that this phase required many months of negotiation "[...] to have guarantees that the team of researchers would be able to observe work in the field and that workers could be interviewed at the factory without risking disciplinary sanctions, among other things". Thus, this strategic analysis "[...] initiates both the social construction of the demand, the social construction of the intervention, and, in fact, the progressive organization of participation and collective action [...]" (Benchekrone, 2016, p. 44, free translation).

It is observed that concurrent with the strategic analysis of the request and the negotiation phase, there is also a need to create follow-up groups throughout the intervention, able, on the one hand, to verify information obtained in the field with the participants, and, on the other, to ensure that the initially negotiated intervention conditions will be maintained. Thus, both the work analysis and change phases are served by specific tools, such as the Steering Committee and the Workplace Groups, which over the duration of the intervention provide for the effective participation of workers in the change process and the development of the social construction among the various different actors from the research world and the organization being studied. It was these committees that validated the field results and (re)defined Rocha's (2014) research/intervention strategies.

Likewise, at a large French air parcel sorting company, Coutarel & Daniellou (2007) formed project groups involving the production engineer, the human resources director, the manager, the team leader, and the sorting workers themselves, in addition to the occupational physician and safety manager; these groups remained together for the

duration of the research project and were fundamental in assembling its results. In another example, Albert et al. (2016) created monitoring committees at each stage of the intervention, validating the elements brought in by the ergonomist, from the initial request to the change implementation. This committee was formed by "[...] managers and people involved with the problems," and was able to include "[...] persons from top management, occupational health and safety (OSH) or human resources managers, supervisors, specialists, technicians, and workers involved with the problems, as well as their representatives [...]" (Albert et al. (2016, p. 716, free translation).

And lastly, in addition to the committees initially planned or formally constituted during the intervention, other relationships, no less important, also come about in a more organic, spontaneous, less planned manner, with interlocutors both internal and external to the company, as shown by Bucciarelli (1994) in engineering projects and Moisdon (1994) in production management. These kinds of social relations, though often hidden and neglected as a methodological contribution to research, certainly do play a fundamental role in making strategic corrections and in the theoretical and methodological enrichment of interventions. A kind of "engineering of the social spaces" of intervention is called for here (Detchessahar et al., 2015). Thus, in the case of the research conducted by Rocha (2014), more organic relationships developed between the research group itself and, for example, the Detchessahar Management Sciences research group (Detchessahar, 2011), which was also investigating matters of occupational health. Thus, with the different researchers having a common object – in this case the workers' health – social construction concerned not only the technical dimension of practice, but this social dimension as well, supported by dialogue among different disciplines.

The phases of the ergonomic intervention, as well as its objectives and tools, can thus be visualized in the model shown below (Figure 2).

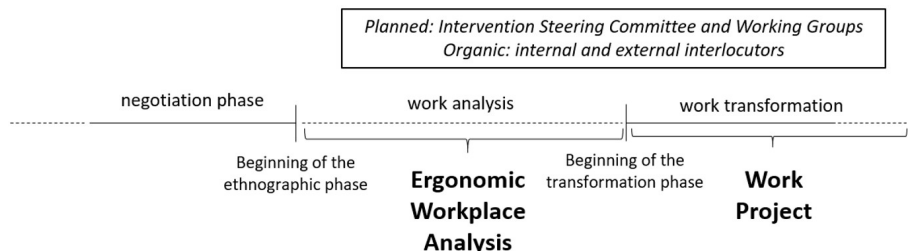


Figure 2. Representation of the phases and tools of the ergonomic intervention.

4.2 Anachronisms of activity-centered ergonomics

When we analyse the entire context of the evolution of ergonomics in Brazil, we observe that criticisms of its limitations with regard to the transformation of the workplace are legitimate, especially in consideration of the market in Brazil for the preparation of technical ergonomics reports simply because they are needed to comply with legislation and meet the requirements imposed by labour inspectors at companies. This situation may change with the publication of the new version of Regulatory Norm 17 (Brasil, 2022), which removed the obligation to perform EWA at companies, limiting it to certain 'trigger' events (pursuant to sub-item 17.3.2 of the norm).

Furthermore, in Brazil EWA is most often practiced within a paradigm requiring a strict application of knowledge and techniques to real situations with little concern for the social

dimensions of the analysis (Jackson et al., 2021). In these cases, the approach remained strongly linked to the diagnostic model and recommendations, with few experiences reported in regard to workplace redesign and even less to the development of social construction amongst the actors. In the process of “transfer” between France and Brazil, EWA became more distanced from social issues, and its results were “at the mercy of managers to decide whether they would end up being either used or shelved” (Jackson & Lima, 2015, p. 15). The EWA was thus instrumentalized, used and taught as a simple set of analysis techniques that may even be used “against workers, against the evolution of work itself” (Jackson & Lima, 2015, p. 15, free translation).

However, the criticisms of the discipline begin to lose relevance when we look more deeply into the knowledge produced and accumulated by Activity-Centered Ergonomics over the years, and even more so when the Brazilian ergonomics context is confused with that of francophone ergonomics, or when EWA is confused with the discipline as a whole. Vilela (2019, p. 88, free translation), for example, states that “one of the obstacles and paradoxes of activity-centered ergonomics is the risk that it may stop merely at making a diagnosis, and not go on to build the kind of internal learning at organizations that can enable/facilitate a change”. While this statement may be valid for a decontextualized EWA, it is not valid for all “activity-centered ergonomics” as a whole. Likewise, while it may apply to a certain approach to ergonomics practiced in Brazil, the same cannot be said about the Activity-Centered Ergonomics as originally developed in France. This distinction must be made clearly in discussions on the topic.

The limitations of EWA have been debated for many years in France. The book “*Comprendre le travail pour le transformer*” the first French edition of which was published in 1991, is quite cautious when discussing the change process offered by EWA. Guérin et al. (1997, p. 78, free translation) states that “there is no guarantee that the ‘recommendations’ are written in a relevant manner,” and that even the “simplest transformation (...) still requires design work,” and that, “instead of simply leaving after providing his ‘recommendations,’ it is preferable for the ergonomist to remain to *monitor the transformation process*.” Thus, when Vilela et al. (2014) state that “the idea of ‘recommendations’ needs to be questioned” (pg. 3931), it should be pointed out that such questioning of the notion of recommendations was already taking place when they began to be made, as far back as in the basic textbook of ergonomics more than 30 years ago. It is also interesting to note that the quotation marks placed around the word “recommendations” by Vilela et al. (2014) are also used by Guérin et al. (1997), possibly with the same intention, that is, to highlight the limitations faced by the concept.

It is in this sense that the recent book *Concevoir le travail, le défi de l’ergonomie* [Designing Work: The Challenge of Ergonomics] argues that the experiences in the field of ergonomics in the 1980s and 1990s “profoundly challenge the discipline (...) and the central role given to EWA in ‘Understanding Work to Transform It’” (Guérin et al., 2021, p. 25, free translation). Thus, even in those days, the method was considered a reductionist one, as its purpose would only be “to ‘capture’ knowledge in order to support the intervener’s decision-making process” (Guérin et al., 2021, p. 84, free translation), itself having no influence on the capacity of individuals to act or on workplace transformation. In this way, recent statements that try to present this as a new idea are in fact anachronistic, as in, for example, the work of Lémonie & Grosstephan (2021, p. 17, free translation), when they state that EWA “presents the risk of becoming a local approach to problem solving, instead of an approach able to profoundly transform the workplace.”

There is thus an unacceptably anachronistic aspect to the idea that the “methodology [EWA] does not facilitate any expansion of the capacity to act of those potentially

concerned by the transformation" (Vilela, 2019, p. 88, free translation), or even that, in "ergonomics interventions," workers "may not expand their knowledge" and "may remain mere spectators" or just be "sources of consultation" (Vilela et al., 2020, p. 43, free translation). These statements confuse EWA with ergonomic intervention as a whole, that is, with the entire discipline and the other methods it includes. At the same time research such as that conducted by Rocha (2014) has proven that these assertions are unfounded, unless the methodology is practiced within the paradigm of the strict application of knowledge and techniques to reality. When the professional community can establish that the practice of EWA is materialized in an ergonomic intervention and consolidated through both a social and technical construction that provide the real conditions for the intervention, we can confirm an increased the capacity to act among those potentially concerned by the transformation. This has been the prevailing paradigm for the practice of ergonomics in France since the 1990s.

5 Conclusion

This article presents a fundamental discussion underway in the field of ergonomics and worker health involving the validity of approaches developed by activity-centered ergonomics. The transition between diagnosis and the change process is a topical matter not only for the Brazilian community, but remains so for the French-speaking community as well. In addition to the recent French work "Concevoir le travail, le défi de l'ergonomie" referred to in this article, other works such as the Canadian work "L'intervention en ergonomie" ("Intervention in Ergonomics," free translation) (St-Vincent et al., 2011) continue to discuss the objectives of the discipline and show the challenges of social construction as an object of intervention.

It is urgent for this debate to move forward in Brazil. We have tended most often to practice an anachronistic type of ergonomics, based, if not exclusively on ergonomic tools or on legislation, on an ineffective technocracy that disregards the living reality of the workplace. We blend our tools and methods in with the disciplinary field as a whole, leading to projects with a restricted capacity for change.

For all these reasons, the criticisms of Activity-Centered Ergonomics made by certain researchers and presented in various publications by Vilela are quite valuable. They require us to undertake an exercise of basic thinking about our discipline from the historical perspective of its development. They require us to systematically analyze the discussions and studies conducted on the limitations and advancements in the discipline and help us to relocate it within the disciplines included among the Labor Sciences. Such criticisms, coming from highly specialized researchers in the field of work and workers' health, contain all the inestimable value of the search for truth in the data, for honesty in the field, respect for the workplace and for the workers. The result of this debate must be to help advance the quality of research in the field of ergonomics and occupational health. The debate is now open; let's hope it will continue.

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References

- Abrahão, R. F., Tereso, M. J. A., & Gemma, S. F. B. (2015). A análise Ergonômica do Trabalho (AET) aplicada ao trabalho na agricultura: experiências e reflexões. *Revista Brasileira de Saúde Ocupacional, São Paulo*, 40(131), 88-97. <http://dx.doi.org/10.1590/0303-7657000079013>.
- Albert, V., Vézina, N., Bilodeau, H., & Coutarel, F. (2016). Analyse des processus menant à des changements dans une entreprise du secteur aéronautique : vers un modèle d'évaluation des interventions ergonomiques. *Relations industrielles. Industrial Relations*, 71(4), 713-740. <http://dx.doi.org/10.7202/1038529ar>.
- Bencheqroun, T. (2016). Intervenir en ergonomie : analyser le travail pour le comprendre et transformer le travail pour le concevoir. In *51e Congrès International Société d'Ergonomie de Langue Française*. Marseille.
- Brasil. Ministério do Trabalho e Previdência – MTP. (2022). *Norma Regulamentadora 17*. Brasília, DF: MTP. Retrieved in 2022, July 27, from <https://www.gov.br/trabalho-e-previdencia/pt-br/composicao/orgaos-especificos/secretaria-de-trabalho/inspecao/seguranca-e-saude-no-trabalho/ctpp-nrs/norma-regulamentadora-no-17-nr-17>
- Bucciarelli, L. L. (1994). *Designing engineers*. Cambridge: MIT Press.
- Coutarel, F., & Daniellou, F. (2007). Construction sociale du changement en ergonomie et réseaux sociaux : vers une conduite de projet orientée "conception d'organisations capacitantes. In *Colloque Management et Réseaux Sociaux, Capital social et/ou réseau social en actes : quels outils de gestion?* (pp. 85-86). Clermont-Ferrand, France.
- Coutarel, F., & Petit, J. (2009). Le réseau social dans l'intervention ergonomique : enjeux pour la conception organisationnelle. *Management & Avenir*, 27(27), 135-151. <http://dx.doi.org/10.3917/mav.027.0135>.
- Coutarel, F., Caroly, S., Vézina, N., & Daniellou, F. (2015). Marge de Manoeuvre Situationnelle et Pouvoir d'Agir: des concepts à l'intervention ergonomique. *Le Travail Humain*, 78, 2015/1, 9-29. <http://dx.doi.org/10.3917/th.781.0009>.
- Daniellou, F. (1992). *Le statut de la pratique et des connaissances dans l'intervention ergonomique de conception* (Thèse d'habilitation à diriger des recherches). Éditions du Laboratoire d'ergonomie des systèmes, Complexe de l'Université Victor-Segalen, Bordeaux 2.
- Daniellou, F. (1999). The ergonomist is a worker? That is the (epistemological) question. In N. Marmaras (Ed.), *Strengths and Weaknesses Threats and Opportunities of Ergonomics in Front of 2000*. Marmaras Athens: The Hellenic Ergonomics Society.
- Daniellou, F. (2008). Diversité des domaines d'intervention, nouvelles pratiques de l'ergonomie, qu'avons-nous encore en commun? *Actes des Journées de la pratique de l'ergonomie*. Retrieved in 2022, July 27, from <http://jdb-ergonomie.fr/actes.html>
- Detchessahar, M. (2011). Santé au travail. Quand le management n'est pas le problème, mais la solution. *Revue Française de Gestion*, 5(214), 89-105.
- Detchessahar, M., Gentil, S., Grevin, A., & Stimec, A. (2015). Quels modes d'intervention pour soutenir la discussion sur le travail dans les organisations? *@GRH*, 2015/3(16), 63-89. Retrieved in 2022, July 27, from <https://www.cairn.info/revue-agrh1-2015-3-page-63.htm>
- Duarte, F., Jackson, J. M., Fo., Lima, F. P. A., & Maia, N. C. (2012). The application of the ISO 11064 for deep water platform control centre design: benefits and limitations. *International Journal of Computer Applications in Technology*, 43(3), 272-279. <http://dx.doi.org/10.1504/IJCAT.2012.046314>.

- Dul, J., Bruder, R., Buckle, P., Carayon, P., Falzon, P., Marras, W. S., Wilson, J. R., & Van der Doelen, B. (2012). A strategy for human factors/ergonomics: developing the discipline and profession. *Ergonomics*, 55(4), 377-395. <http://dx.doi.org/10.1080/00140139.2012.661087>. PMID:22332611.
- Ferreira, L. L. (2015). Sobre a Análise Ergonômica do Trabalho ou AET. *Revista Brasileira de Saúde Ocupacional*, 40(131), 8-11. <http://dx.doi.org/10.1590/0303-7657ED0213115>.
- Garrigou, A. (1992). *Les apports des confrontations d'orientations socio-cognitives au sein de processus de conception participatifs: le rôle de l'ergonomie* (Thèse de doctorat). Paris Laboratoire d'Ergonomie et Neurophysiologie du travail du Conservatoire National des Arts et Métiers, Paris.
- Guérin, F., Laville, A., Daniellou, F., Duraffourg, J., & Kerguelen, A. (1997). *Compreender o trabalho para transformá-lo: a prática da ergonomia*. São Paulo: Blucher.
- Guérin, F., Pueyo, V., Béguin, P., Garrigou, A., Hubault, F., Maline, J., & Morlet, T. (2021). *Concevoir le travail, le défi de l'ergonomie*. Toulouse: Octarès Éditions.
- Jackson, J. M. (1998). *Entre situations de gestion et situations de délibération : l'action de l'ergonome dans les projets industriels* (Thèse de doctorat). Cnam, Paris.
- Jackson, J. M., Fo., & Lima, F. P. A. (2015). Análise Ergonômica do Trabalho no Brasil: transferência tecnológica bem-sucedida? *Revista Brasileira de Saúde Ocupacional*, 40(131), 12-17.
- Jackson, J. M., Fo., Lima, F., Donatelli, S., & Simonelli, A. P. (2021). Elementos da história da ergonomia no Brasil. In D. Braatz, R. Rocha & S. Gemma (Orgs.), *Engenharia do trabalho: saúde, segurança, ergonomia e projeto* (pp. 117-134). Campinas: Ex Libris.
- Lapeyriere, S. (1995). *Problématique autour du travail consultant. Performances Humaines & Techniques* (pp. 44-47).
- Lémonie, Y., & Grosstephan, V. (2021). Le laboratoire du changement, Une méthodologie d'intervention au service de la transformation du travail Perspectives méthodologiques pour une ergonomie développementale. *Revue d'anthropologie des connaissances*, 15-2.
- Martin, C. (1998). *La conception architecturale entre volonté politique et faisabilité technique: le positionnement de l'intervention ergonomique*. Bordeaux: Département d'Ergonomie Université Bordeaux 2.
- Moison, J.-C. (1994). Appareil gestionnaire et travail ou de la lacune comme opportunité. *Sociologie du Travail*, 36^e année, hors-série, pp. 11-19. Les énigmes du travail. <http://dx.doi.org/10.3406/sotra.1994.2145>.
- Petit, J., Querelle, L., & Daniellou, F. (2007). Quelles données pour la recherche sur la pratique de l'ergonomie? *Le Travail Humain*, 70(4), 391-411. <http://dx.doi.org/10.3917/th.704.0391>.
- Rocha, R. (2014). *Du silence organisationnel au débat structuré sur le travail: les effets sur la sécurité et sur l'organisation* (Tese de doutorado). Universidade de Bordeaux, Bordeaux.
- Rocha, R., Mollo, V., & Daniellou, F. (2015). Work debate spaces: a tool for developing a participatory safety management. *Applied Ergonomics*, 46(Pt A), 107-114. <http://dx.doi.org/10.1016/j.apergo.2014.07.012>. PMID:25109248.
- Rocha, R., Mollo, V., & Daniellou, F. (2019). Contributions and conditions of structured debates on work on safety construction. *Safety Science*, 113, 192-199. <http://dx.doi.org/10.1016/j.ssci.2018.11.030>.
- Schön, D. A. (1983). *The reflexive practitioner: how professional think in action*. États-Unis: Basic Books.
- St-Vincent, M., Vezina, N., Bellemare, M., Denis, D., Ledoux, E., & Imbeau, D. (2011). *L'intervention en ergonomie*. Quebec: Editions MultiMondes.
- Vilela, R. (2019). Interfaces da ergonomia com o laboratório de Mudança. *Intervozes: Trabalho, Saúde, Cultura*, 4(1), 87-90.
- Vilela, R. A. G., Querol, M. A. P., Almeida, I. M., & Jackson Filho, J. M. (2020). Saúde do trabalhador. Do diagnóstico à intervenção formativa. In R. A. G. Vilela, M. A. P. Querol, S.

Beltrán-Hurtado, G. C. O. Cerveny & M. G. R. Lopes. *desenvolvimento colaborativo para a prevenção de acidentes e doenças relacionadas ao trabalho laboratório de mudança na saúde do trabalhador*. São Paulo: Ex-Libris. p. 37-48.

Vilela, R. A. V., Querol, M. A. P., & Seppänen, L., Lima, F. P. A., Mendes, R. W. B., Lopes, M. G. R., Almeida, I. M., & Jackson Filho, J. M. (2014). Work ergonomic analysis and change laboratory: similarities and complementarities between interventionist methods. In T. Ahram, W. Karwowski & T. Marek (Eds.), *Proceedings of the 5th International Conference on Applied Human Factors and Ergonomics, AHFE 2014* (pp. 19-23). Kraków, Poland.

Authors contribution

All authors worked on the conceptualization and theoretical-methodological approach. The theoretical review was conducted by Raoni Rocha and José Marçal Jackson Filho. Data analysis for the example study was conducted by Raoni Rocha. All authors participated in the writing and final revision of the manuscript.