

Analyzing territorial governance to prevent occupational risks in the sector of waste management

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Abstract. Waste recycling management, in France, depends on numerous decisions made between policy makers acting at different levels. Focusing on research carried out in four waste sorting centers, we analyze the dimensions of the territory that impact on working conditions for operators. System performance in terms of sustainable development raises the essential question of sectors and flows of waste collected. However, it also appears that the latter and the collection process are central issues for prevention (in terms of employee health, safety and welfare). We examine the design process and seek disconnections between the sorting center and its territory that impact work activity. Our goal is therefore to identify margins of maneuver for safeguarding occupational health and preventing risks.

Keywords. Waste management, territorial policy, plasticity, organization

1. Introduction

This research focuses on working conditions and occupational risk prevention in waste sorting centers. Sorting trades, known as “green jobs”, have developed since the beginning of the 1990s with the beginning of recycling in France. The waste sorting sector takes up a large share of *green business*, driven by the challenges of sustainable development and by French and European environmental directives (as French Grenelle round table on the environment). We think that this sector represents a new challenge for ergonomics, due to the economic and social stakes it represents and the questions it raises. More particularly, our objective is to analyze the links between the working conditions of the operators who sort the waste and territorial policies for waste management.

Sorting household waste packages is part of the exploitable waste management chain, which starts from packaging production to the exploitation of waste, and includes household waste collection. Waste sorting centers lie at the central point of this chain and they receive and sort waste as a function of type of material and its recycling potential. After reconditioning and storage, the products recovered are transferred to waste processors for recycling.

In parallel, recycling management is structured by a large number of decision-makers who act at different levels of decision, from global to local. If we limit ourselves to the French national context, three levels of decision-making can be distinguished (Boudra and

Delecroix, 2012). At the macro level, national decision-makers formulate environmental policies that must be implemented at territorial (or meso-level). This second level raises the question of the appropriation of national decisions by territorial actors as a function of the characteristics of a given territory. The actors of the territory at meso-level take numerous decisions liable to impact on the operation of waste sorting centers at micro level (see also Laroche, 1995). This is the case, for example, for the collection perimeter (which local communities send their waste for sorting at the center?), equipment supplied to households collection (collection in bags or bins?). These decisions definitely have repercussions on the design of the site and the operating facilities (what machines are useful in the sorting center? How should the incoming waste reception and storage area be laid out?) and, finally, on the activity of the sorting operatives.

In this communication, we focus on the “links” between the territory and the sorting center, starting from the constraints affecting the activity performed by the operatives of the sorting centers. The ergonomic analysis of their activity in these sorting centers shows that the conditions under which they perform their work mainly depend on the decisions of the territorial actors and the characteristics specific to the territory in which the sorting center is located. We illustrate our analysis with an example stemming from our observations. Then we question the plasticity of work systems from the standpoint of territorial policies.

2. Context of the research: define actions at different levels of decision making to protect health of workers

The French National Institute of Research and Safety (INRS) leads a national project for global improvement of work conditions for sort operators in waste sorting centers. This work is done on factory type production lines on which each worker performs a predefined task: they must remove on average three types of product (recyclable or not). The types depend on their place in the sorting line. Some ergonomics’ studies have characterized work in waste sorting as “*a difficult and extremely repetitive task that demands great effort from the upper limbs and which is carried out in shifts in an unpleasant, noisy, tactile and olfactory environment*” (Beaudoin et al., 2009, p. 381). Besides the considerable biomechanical efforts made by the upper limbs, maintaining often difficult postures (for example, due to the width of the belt) and prolonged standing, the operatives are also subject to continuous visual and cognitive demands.

Furthermore, a large number of studies have highlighted the different risks to which employees in the waste sector are exposed (see for example Kiviranta et al., 1999; Rushton, 2003, Krajewski et al., 2007). Several paths of action and prevention have been proposed for respiratory risks linked to dust (Rapp et al., 2009; Rosenberg, 2007), risks linked to contact with waste such as being picked by needles (Vu-Khan et al., 2011), and elements intended to help the design of sorting centers (INRS, 2011). However, few studies have focused on the impact of all waste on the activity of the operators and the links between decisions taken by territorial actors and constraints of activity in waste sorting centers.

3. Method of analysis: studying the constraints of the activity by observing work situations

The research was carried out in the framework of a change in the instructions

governing the sorting of plastic packaging (Boudra and Delecroix, 2012). Ergonomic studies were performed at four sorting centers that volunteered to participate. They took place between January 2012 and March 2014. Our work aims at analyzing constraints and working conditions. We study “*the factors determining activity, the characteristics of activity and its effects*” (Daniellou, 2005, p. 412). Traditionally, we base our results on observing operators during their work for analyzing work activity: indeed, « *French-speaking ergonomists who are used to spend long hours analyzing operating strategies, the regulations set up by workers to manage the variations that occur in their workshop and the difficulties that workers come up against, may well say that they are performing « activity analysis* ».” (op. cit. p. 422).

The method implemented was the Ergonomic Analysis of Work (Guérin et al., 1991; Wisner, 1995; Daniellou and Béguin, 2004; Daniellou, 2005). Twenty-two sequences of observation on sites were performed, each lasting an average of two days. For every sequence, three steps were developed:

- The first step was a context analysis dedicated to holding interviews with the actors of the sorting center. It aimed to learn of the current situation, production difficulties and constraints. The operators, production managers, team leaders and sorting operators were questioned.
- Then followed a step consisting in observing the work situations of the sorting operatives. We drew up event tables and performed analyses of occupational movements and different practices, formal and informal work organization and the regulations and constraints for the work activity. Video films were shot with certain voluntary workers.
- Lastly, a third step comprised individual interviews with certain operatives and team leaders outside their workstations. These interviews permitted validating our observations and the verbalization of the unobservable part of work activity.

4. Results of actions in waste sorting centers: disconnection between the waste sorting center and its territory

Our observations highlight that the activity performed by the operators is highly dependent on the quality of incoming waste. For example, work activity is influenced by geographical conditions (sea, mountains, etc.) and by the meteorological conditions of collection. This activity also depends on the composition of the incoming flows of waste, which varies as a function of local authority and collection mode: bags, door to door, and containers used for voluntary deposits. Incoming waste can also contain large numbers of undesirable and non recyclable products that are sources of problems in the sorting centers. There are technical problems consecutive to the “jamming” of machines, and even breakdowns and equipment failure. They can also present a source of risk for the employees, since syringes and gas canisters, for example, are frequently found on the sorting belts. We wonder how to prevent these constraints for sustainable work systems.

The quality and composition of incoming flows of waste in sorting centers relies heavily on the characteristics of the “territory of the sorting center”. This can be defined as a territorial unit composed of different local authorities (for example single communes or groups of communes) that combine to satisfy the regulatory obligation to treat waste. Its characteristics are decisive regarding the waste that the operatives have to sort. Its aspects have a very substantial impact on the type of waste and the activity of the sorting operatives. We can give for examples:

- modes of the consumption and lifestyles of the population (types of waste differ

considerably between urban and rural environments),

- sectors and modes of waste collection: the collection could be done by bags or containers,
- economics particularities: for example, tourism activity modifies the composition of the flow and its quality.

Indeed, work activity in waste sorting centers is in fact dependant of flows and sectors of waste in the territory. Our hypothesis is that, ideally, a connection should be made between the characteristics of each sector of the territory with those of the sorting center. Choices should be made at the meso-level itself to organize collection by taking into account the reality of the sorting center, and the technical choices made concerning it (level of automation, type of technical equipment, etc.) as a function of the territory's characteristics.

Nonetheless, this link is not systematically present in the interactions between the actors of the meso and micro levels when designing the sorting center. And, whatever the case, it is extremely difficult to maintain since the territory changes according to its own economic, social and political evolutions. This leads to a disconnection between the characteristics of the sorting center and the quality of the incoming products and flows. They cause constraints for work activity. "Accomplishing production" therefore demands adapting the work organization and the activity of the operatives (individually and collectively). "Regulations" by work activity are necessary, in the French meaning of this term in ergonomics (Pueyo et Gaudart, 2000; Noulin, 2002; Livian et al., 2004; Leplat, 2006). Work organization is adapted by managers and workers themselves in order to absorb and process the different sectors and flows.

In this short text, we limit ourselves to the presentation of a single case essentially for the purposes of illustration. We analyze work situation in a sorting center with little automation built in 1998 that processes about 1 500 tons of waste a year. Eight operators work on a single sorting belt. Their task is to remove all the recyclable products and leave the non recyclable waste on the belt. The sorting center belongs to a "treatment syndicate" that groups eight different local communities. The syndicate is responsible for processing waste whereas the inter-communal authority manages its collection. Different modes of collection are employed in the territory of the sorting center that give different sectors and flows. The first sector represents most of the collection done by container at voluntary waste collection points. The sorting instructions are to separate papers, newspapers, and magazines from packages. The packages are sorted on the belt and the papers and newspapers are stored on the site. For the second sector, some local authorities have opted for collection by bag due to difficulties in setting up voluntary garbage collection points easily accessible for the population. The sorting center receives 700 kg to 1 ton of waste collected in bags per week.

These different collection methods must be taken into account in the technical characteristics of the sorting center in order to prevent them from becoming a constraint for the operatives. However, no specific technical equipment was provided to open the bags. They cannot be sent to the belt directly without causing jams in machines and work overloads for the operatives. They therefore have to be opened, emptied and withdrawn from the stocks of products before the sorting belt. Opening is done manually by an operative assigned to that task during a working day per week. This operation is done in the incoming waste storage area. It is a difficult operation that presents risks. The latter are

linked to joint activity with loading machines (machine/pedestrian collision, crushing, etc.), high biomechanical stress for opening the bags and load carrying: each full bag must be drawn from the stock, carried, torn, shaken and emptied, after which the operative removed the bag from the other products. With the lack of specific equipments, work organization takes in charge bags and regulations are made with activity, to the detriment of workers' health and safety.

5. Discussion: articulating territorial governance and work systems plasticity

Two questions appear to emerge from the standpoint of improving working conditions and preventing the risks encountered by the operatives who work in the sorting centers.

The first question concerns the technical choices in the sorting centers. The issue of coupling between the sorting center and its territory can be perceived from the angle of the technical system's "plasticity". For Béguin (2007), plastic technical systems "*leave the activity sufficient freedom to maneuver to render technical aspects more efficient whilst remaining in good health*". We argued above that the sorting center and its technical equipments are designed on the basis of a certain perception of the territory. However, the territory is a dynamic element (attractiveness, evolution, actors and policy decisions), while sorting centers are technical facilities whose plasticity is very limited. In this framework, work organization and the activity of the operators are adjustment variables that allow compensating for design rigidity and adapting to the evolution of the territory with regard to its diversity. But these adaptations come at a cost for the organization, for the performance of the system and for the individuals themselves.

The second question concerns the interactions between the actors of the meso and micro levels. In this study our main contact was the operator who was in charge of processing the selective garbage collection and thus sorting it. However, many local actors are also involved, as political actors; actors specialized in waste management, economic actors, etc. The meshing of relations between public and private actors impacts on the configuration of the territory. These interdependent actors (Béguin, 2010; Pasquier et al., 2013) have to define a standard. Thus, "*the problems that have to be taken in charge must be defined and identified collectively at local level, and it is also locally that the solutions for responding to them have to be found. It is more than a specific problem, it is in the interest of a territory supposed to gather the actors of territorial development policies*" (Pasquier et al., 2013). Consequently a process of appropriation of this standard by the actors of the territory is emerging. Nonetheless, coordination between them is a complex and difficult process to implement, due to the fact that the competences of each party are compartmentalized. The rigidity of the work systems of sorting centers can also be explained by a lack of interaction and exchange regarding the challenges. In this context, the work done by the sorting operatives is a means of regulating the difficulties of interaction. However, improving these interactions between the different actors could be a means for improving working conditions, provided that it permits sharing challenges and difficulties (including working conditions), and that it results in the implementation of concerted and possibly corrective actions to improve the working conditions of the sorting operatives. The working conditions of the sorting center operatives depend on dimensions that are forged on the scale of the territory. In this context, the perimeter of action of ergonomics must go beyond the specific domain of the production unit, and mobilize more distant actors who are not always aware of the impact of their decisions on working conditions.

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