Extended Abstract


The environmental issue and human welfare have become an increasingly challenging goal for today's society, as the scarcity of natural resources has overcharged the rulers as they search for renewable energy and consumption alternatives. Great reflections related of the life quality in Brazil have appeared in relation to welfare, especially in the case of the poor classes, such as recyclable waste collectors, who often face a subhuman working hour striving to obtain the basic survival conditions, leaving the comfort and welfare in their lives behind them. These factors were the motivation by the choice of this line of study — especially because the researcher is graduated in production and safety engineering, acting on issues related to labour welfare in order to provide work environments that allow the execution of professional activities in harmony with the physical and psychological welfare of workers.

I’m currently an employee of the multinational General Electric, a private institution that has different business segments on a global scale. I work in the aviation industry and I have the experience of working in an environment that aims, firstly, at the welfare of your employees — a factor that undoubtedly gave me even more background, theoretical and practical knowledge, as well as technical capacity to act in the present work. This study is not part of a joint initiative of the company mentioned above with this author; it is only an individualized academic study, conducted with the advice and guidance of a thesis supervisor, as a requirement for obtaining a master's degree in Urban and Environmental Engineering by PUC-Rio.

Although several investors believe the recyclable market to be a business opportunity to reduce raw material costs — or even as a pretext to obtain tax incentives — it is possible to realize that the sector lacks of attention from the
government, especially in regards to the working conditions in the cooperative (places where waste is separated for recycling). It is possible to perceive in these institutions a great devaluation of dignified working conditions; in most these places, the working conditions are unhealthy, dangerous, painful, besides having a negative social outcome for those who perform these activities.

In this case, it is important to reflect that this work environment can bring irreversible damage to these employees considered so historically relevant in the scenario of solid waste management in Brazil. The importance of this element served as inspiration for this study to be developed, with the aim of improving the working environment of this labour class. The present study will have, as a practical object for the application of some ergonomic techniques, the Recycling Pole of Jardim Gramacho, in the municipality of Duque de Caxias-RJ. This is a place that has already been the target of several artistic productions very widespread in the national and even international scope, such as Vik Muniz's documentary "Lixo Extraordinário" — which showed the reality of the place when the Metropolitan Landfill of Jardim Gramacho (commonly known as the Gramacho Landing), the largest uncontrolled landfill in Latin America, still operated. Its extension area and its location near the Bay of Guanabara gave the place this title. The lack of public authorities over the years, since its implementation in 1976, gave visibility to the site; however, it turns out to be a negative visibility because it is one of the places with the largest accumulation of waste in the world.

When the Gramacho unregulated Landfill was still operating, there was a 9000 ton per day waste handling at the site, which originated from several cities in the state of Rio de Janeiro. Of this amount, approximately 2.5% was separated as recyclable material by COMLURB (Rio de Janeiro Urban Cleaning Company). Although it seems a small number, studies about the region indicate that around 15 thousand people were involved in this activity, thus the closing of the site removed their livelihood and paused the economy movement.

A recent study by Magalhães (2015) identified that after the closure of the activities of, the then Metropolitan Unregulated Landfill of Jardim Gramacho, a large part of these people who obtained their livelihood from it had their lives affected. Although those people worked among numerous piles of exposed waste
in an unhealthy, dangerous and painful space — the ending of the activities in the landfill caused several discussions between that working class and the public power, in order to find ways to reduce these social and economic impacts.

To obtain a theoretical basis for this study, we carried out a bibliographical research, with a theoretical reference based on the activities performed in the Recycling Pole, to identify the improvements in the place, reducing the losses of the activity to the workers who still work in a scenario such as that. The basis for this study was found in literatures from several authors, as well as in the valid legislation in Brazil. Some applied studies and publications in periodicals and books related to the subject also gave basis to this work, which proposed, a practical application in the case study, besides a presentation of theoretical arguments — where the use of ergonomic tools was tested to mitigate the impacts of the exhausting work on the lives of these collaborators.

Field studies were started on July 19, 2016 and happened until November 19, 2016 (4 months), where it was possible to know the reality of the recyclable materials collectors working conditions in the Recycling Pole of Jardim Gramacho. In this period, some exploratory visits were carried out, with audio-visual recordings which allowed — in addition to a visual analysis of the tasks, the environment and the structure offered to perform the work — an interaction between the researcher and the advisor with the target audience of this study, henceforth called collectors of recyclable materials.

Conversations with the collectors and members of the cooperative administration, visual observations and semi-structured interviews were the basis for this work. However, we have the contribution of the manager of the institution that was the target of the study, Mrs. Glória Santos, of the Cooperativa Mais Verde — which among the cooperatives in the polo is the largest in number of employees and workload.

With the closure of the Metropolitan Unregulated Landfill, the State Secretariat of the Environment (SEA) allowed the activities of the collectors to continue in the area where the old structure was located. Although there are still some bureaucratic obstacles regarding the space concession, we consider the Jardim Gramacho Recycling Pole, in the present location, as the central and
official area of the study. The subjects that were involved in this research were cooperative collectors of the Mais Verde Cooperative, located in the pole.

To better understand the target audience and the application of some techniques of ergonomic improvement in work environment, a research instrument was elaborated, which is available in appendix A, at the end of the present study.

Aiming at a better direction of the present study, we elaborated some central questions to be worked at and answered throughout the work:

- What are the working conditions of the Jardim Gramacho recyclable materials collectors?
- What are the impacts of this activity on the health of these professionals?
- Based on the ergonomic aspects, where are there opportunities for improvement?
- What are the possibilities and ergonomic limits for the collectors’ work?
- What are the main challenges for ergonomic risk mitigations in recycling cooperatives?

To organize the study, we chose to divide it into five chapters — plus the final considerations — and, in the first chapter, we make an introduction about what will be worked at during the study, as a summary.

The second chapter, entitled "Solid urban waste in Brazil and the work of recyclable waste collectors", brings a general overview of solid waste management in Brazil, with some historical and current data, as well as a reflection about the National Solid Waste Policy. Within the contextualization of waste management, we seek to locate the collector of recyclable materials, and then explore the work in the form of cooperative — its legal prerogatives and obligations to the health and safety of the collaborators who work in this type of establishment.

Next, we began the third chapter entitled "The Ergonomic Question Regarding Working Conditions in Brazil", outlining some definitions about the term work, to seek to historically situate the labour relations in Brazil. We
emphasize some developments in labour legislation over the years, and we identify in the legal framework the health and safety requirements that must be followed by all companies in the national scope, reinforcing in this context those that concern the ergonomic requirements. We continue conceptualizing ergonomics and outlining a methodology that proposes the use of two tools that will help the understanding of the study scenario, regarding the existing ergonomic problems. We conclude the chapter conceptually introducing these two tools that will support the development of the case study.

In the fourth chapter, entitled "Case Study: The Jardim Gramacho Polo and the Ergonomic Implications of the Work Performed in the Life of Recyclable Waste Collectors," we present a study focused on the ergonomic implications on workers' lives. We begin the chapter exploring the physical structure where the work of the collectors is performed, trying to draw a panorama of the work environment, taking the local ergonomic risks into consideration. Then, we seek to identify the possibilities and ergonomic limits for the work of the collectors and, finally, we make some closing considerations about the case study and the results obtained.

In relation to the questions previously raised, we could verify how the work conditions of the collectors, understanding that their work is performed in a poor environment, ergonomically measures and that became the subject of several analyses to propose possible improvements.

We also found, through interviews, that there are significant impacts on the health of these workers due to the task performed by them at the pole. Especially because they signalled some aches and discomforts at strategic points of the body, experienced by them in and out of their labour activities. These impacts have led us to believe that they may be linked to the inadvertent lifting and transporting of loads.

Several points were raised as having an opportunity for improvement, such as the acquisition of machines (which require a certain investment), the creation of simple procedures and the adoption of some rules that will allow for a less aggressive environment, from an ergonomic point of view.
When dealing with the possibilities and ergonomic limits of the work of the collectors, we seek to recommend simple actions, but that will have great impact in the improvement of the work environment, especially without affecting the productivity in the pole — since we know that it is what keeps them with minimal conditions of subsistence. We believe that these are the great challenges of this type of institution when going through analyses as we did because, in the end, recommendations are made and some points are clarified (such as the legal requirements needed). We could also identify the responsibilities assigned to the organization's managers.

To make it easier to understand the study and the questions we raise, Table 1 was elaborated, summarizing the risks identified and the actions proposed:

<table>
<thead>
<tr>
<th>RISK</th>
<th>PROPOSAL</th>
<th>DIFFICULT TO IMPLEMENT</th>
<th>PRIORITY</th>
</tr>
</thead>
<tbody>
<tr>
<td>Benches do not allow adjustment</td>
<td>Establish breaks for postural recovery (5 to 10 min / h)</td>
<td>Easy</td>
<td>Low</td>
</tr>
<tr>
<td>Lifting and manual handling of loads</td>
<td>Limit operation to 23 or 25Kg (NIOSH / CE)</td>
<td>Easy</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Elevation higher than the minimum stipulated only with device use (pallet truck, forklift and the like)</td>
<td>Medium</td>
<td>High</td>
</tr>
<tr>
<td></td>
<td>Acquisition of machinery with conveyor belt</td>
<td>Difficult</td>
<td></td>
</tr>
<tr>
<td>High visual stress to separate similar materials</td>
<td>Establish pauses for visual acuity recovery (5 to 10 min / h)</td>
<td>Easy</td>
<td>Low</td>
</tr>
<tr>
<td>Thermal comfort and direct solar incidence</td>
<td>Establish hydration points with drinking water</td>
<td>Medium</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Install barriers to the sun's rays</td>
<td>Medium</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Acquisition of fans</td>
<td>Difficult</td>
<td></td>
</tr>
<tr>
<td>Contact with sharp-cutting materials</td>
<td>Acquisition and use of PPE</td>
<td>Easy</td>
<td>High</td>
</tr>
<tr>
<td>Contact with chemical substances and biological agents</td>
<td>Acquisition and use of PPE</td>
<td>Easy</td>
<td>High</td>
</tr>
<tr>
<td>There was no ideal place for food consumption</td>
<td>Segregate area for food with satisfactory hygiene conditions</td>
<td>Easy</td>
<td>High</td>
</tr>
</tbody>
</table>
Concluding the present study, we leave, as a proposal for future studies, a more detailed work safety analysis. It is focused not only on ergonomic risks, but also on all the issues that are foreseen in the Brazilian law — such as questions related to Emergency plans, machinery safety and the Internal Committee for the Prevention of Accidents — among many other aspects that have opportunities to be explored in this institution, related to the safety conditions. Just as this study was rewarding, as it contributed a great deal to our professional growth, it may well be again in future studies, whether they are drawn by us or by other professionals.

**Keywords**

Cooperatives; collectors; ergonomics; Jardim Gramacho