



6th International Conference on Applied Human Factors and Ergonomics (AHFE 2015) and the  
Affiliated Conferences, AHFE 2015

## Activities triggered by waste generated in steel production: A study from the ergonomics standpoint

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### Abstract

The treatment of waste in industrial production creates a sector apart from the production process in which activities are developed with varied ergonomic risks, either in treatment, transportation or disposal of material generated. Using Ergonomic Work Analysis (EWA) methodology, questions were raised about the influence of waste generated in the production of steel and its implications at work. The determining factors for ergonomic risk in a work activity are related to various aspects of the production process, the industry's physical characteristics, the layout of the work area, the types of tools used and work organization. These elements may influence the operating mode a worker adopts. Understanding the variability of activity may allow for taking corrective actions or for design in the workplace, providing better interaction with humans, reduced physical and cognitive overloads which directly influence worker productivity. Therefore, this study highlights the determinants for ergonomic risks, recommending improvements in the work process that are related to adequacy and sustainability in the production process.

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Peer-review under responsibility of AHFE Conference

*Keywords:* Ergonomic risk; Steel production; Waste; Labor organization; Ergonomic work analysis; Sustainability

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### 1. Introduction

In recent decades, the steel industry has begun working on sustainability in its processes, adopting cleaner technologies, striving for greater energy efficiency, reducing disposal in the environment and managing its waste with normative and procedural directives. These approaches were considered a point of departure for understanding

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the impact on operational work within this waste-generating sector and, subsequently, in the proposition to create ergonomic analysis of that work.

The official definition, approved by the International Ergonomics Association board (IEA) in August 2000, states that ergonomics is a systems-oriented discipline - now extending into all aspects of human activity and professions - that applies theory, principles, data, and methods to design in order to optimize human well-being and overall system performance [1].

Based on the context of facets of the production process and on the organization of work in the steel industry, this article's objective is to focus on ergonomic analysis of work and its possible contributions to understanding and transforming the work of this specific industrial sector.

## 2. Methodology

The Ergonomic Work Analysis- EWA is well-structured in its general and operational aspects. Its fundamental principle consists of identifying the "real work", as compared to the formal organizational, highlighting the practical knowledge (know-how, tacit skills) of the actors in a given situation, the criteria that guide their actions, and the conflicting aims that shape their behavior at work. This information instructs the design process, reinforcing the positive ergonomic conditions and avoiding inadequacies. According to Guérin[2], EWA is a tool that deals with the business's systemic reality, from the optic of work activity. To produce representations of current work, the ergonomist should, therefore, use work analysis approaches.

The activity analysis method elaborated by Yves Clot [3] and his team with the goal of proportioning a transformation in work situations, with workers themselves being protagonists of that transformation. The idea is to move the subjects from the position of being observed to that of observers, coauthors in the production of the data collected.

Using this context, direct observation of active workers was undertaken with semi-structured individual interviews, as well as taking photographs and filming focused on workers' activities, their work stations, with consecutive auto-confrontation aiding in the collection of data and the respective analysis of the real task confronting the prescribed one.

The distinctive characteristic of good ergonomics is not its data collection tools in the field, but in detailing, the depth and the view of the work. Work is the privileged element, and it is not something impersonal: good ergonomics deals with work and the worker inseparably. If treatment is objectified with little detail, there is not much difference from the methods-time analyst who takes a sampling of work (a technique described in all the pertinent manuals) and manages to quantify various details of activity, including some variability. Without returning to and discussing with the worker the objects and purpose for ergonomic analysis (which is known as "auto-confrontation"), this becomes impoverished, as imposition of the analyst's criteria prevails on the object, with no effective possibility of methodological control – the analysis tends to become sophisticated "methods-times", resulting in a new prescription defined in an externalized manner for the executor, despite having good intentions[4].

## 3. Results and discussion

EWA gave evidence regarding the layout of areas where the production process occurs, limiting the worker during execution of his or her activity and waste removal. According to Iida [5], incorrect projects for products and improper work stations can provoke adverse musculoskeletal conditions.

The determinants of ergonomic risk evidenced in the activities:

- Accessibility and the respective accumulation in the removal of waste for disposal;
- Manual movements using a shovel in the removal of waste for disposal
- Postural and lifting/holding demands of the load being moved.

Therefore, the study gave evidence of the determinants of ergonomic risk, recommending improvements in the work process related to making the productive process adequate. Ergonomic adequations of the processes consist of

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