



Research Article

An Integrated Framework for Ergonomic Performance Assessment in Food Manufacturing: A Case Study Using Ergo-VSM, AHP, and TLS

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ABSTRACT

In food processing industries, particularly nut-based production that relies heavily on manual labor, ergonomic challenges related to repetitive motion, prolonged static postures, and thermal stress are increasingly prominent due to rising production demands. These issues are often concentrated at specific workstations and tend to be overlooked in conventional performance evaluations. To address this gap, this study proposes an integrated Ergonomic Performance Assessment (EPA) framework designed to evaluate ergonomic performance comprehensively across the entire production line. The framework integrates Ergonomic Value Stream Mapping (Ergo-VSM) for process visualization, the Analytical Hierarchy Process (AHP) for assigning weights to ergonomic criteria, and the Traffic Light System (TLS) for intuitive performance classification. A case study was conducted in a peanut processing facility, involving 8 workstations. Data were gathered through direct observations, detailed task analyses, and expert input from three expert via Focus Group Discussions (FGDs). Ergonomic indicators were derived from literature and expert consensus, weighted using AHP based on pairwise comparisons, and assessed using structured observational metrics. The results were visualized within the Ergo-VSM framework using TLS. Ergonomic performance was quantified through the Manufacturing Ergonomic Score (MES), which reached 69.15%. Based on a three-tier classification system low (<60%), moderate (60–90%), and high (>90%) this score falls within the moderate category, indicating several areas require improvement. Musculoskeletal disorder risks and high working temperatures were identified as the most critical concerns, particularly at thermally intensive and physically demanding workstations. The EPA framework enabled the visualization of ergonomic variation between workstations, allowing for systematic identification of priority areas for improvement. This research contributes to ergonomic evaluation literature by offering a structured, data-driven approach and provides practical insights for enhancing worker well-being and operational productivity.

Keywords: ergonomic performance assessment, manufacturing ergonomic score, Ergo-VSM, AHP, lean manufacturing

INTRODUCTION

The manufacturing sector plays a vital role in technological advancement and meeting market demands. However, production systems often face hidden challenges that affect efficiency and sustainability—one of which is ergonomics-related issues [1]. The implementation of ergonomic principles is essential to maintaining a balance

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