

## Chapter 31

# Ergonomic Bench to Decrease Postural Risk Level on the Task of Changing Forklift's Brake Pads: A Design Approach

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### ABSTRACT

*Development of musculoskeletal disorders caused by awkward postures are present in tasks performed in small companies. Consequently, this chapter evaluates the postural risk level associated to the task of changing brake pads of a forklift, and proposes the design and the implementation of an ergonomic bench that helps to reduce this level of postural risk. As methods, postural risk level corresponding to the task was determined using REBA, whereas anthropometric analysis was developed, and axiomatic design and TRIZ methodologies were used to develop the proposed design. Results showed a REBA score of 8 (high-risk level). The final design is done of nylamid, and it contains some TRIZ principle, such as copying, extraction, and dynamicity. Respect axiomatic design, the bench meets some functional requirements, such as support the user's weight, avoid unsafety conditions, and be adjustable. With the TRIZ principles and functional requirements, this bench will help diminish postural risk level.*

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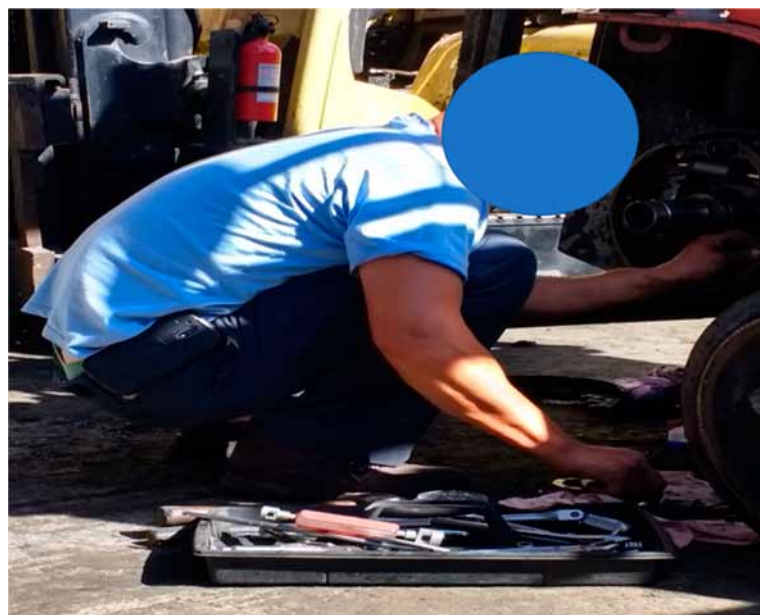
## **INTRODUCTION**

Most of the ergonomic assessment methodologies adopted in the manufacturing industry are implemented to assess ergonomic hazards in the production area (Tompas, Dolinschi, de Oliveira, Amick, & Irvin, 2010), yet other processes, such as machinery maintenance/repairs, material transportation, and/or plant cleaning, require similar ergonomic evaluations to ensure employee safety. To address this gap, this research takes place in a company that repairs and sells industrial machinery.

It is well known that maintenance and repairing tasks force employees to adopt awkward postures (Barros, Marçal, & Soares, 2015; Teymourian, Seneviratne, & Galar, 2016) and apply excessive force. In this sense, the maintenance technicians of the company wherein this study was conducted have claimed to experience discomfort when they change forklift brake pads. This task takes approximately one hour per brake, and to complete it, the technicians usually adopt awkward and long-lasting postures. According to the employees, the main musculoskeletal complaints experienced are in the back, the ankles, and the knees. Even though knee pads are worn, the employees claim these are not an effective solution to pain and discomfort. Figure 1 depicts the typical posture adopted by the employees as they change forklift brake pads.

According to the literature, awkward postures have a negative effect on employee health and performance. They can cause soft tissue injuries that favor the accumulation of metabolites and accelerate disc degeneration, which can ultimately lead to disc herniation (Roffey, Wai, Bishop, Kwon, & Dagenais, 2010). Also, awkward workplace postures can increase the risk of suffering from musculoskeletal disorders (MSDs) – such as osteoarthritis (da Costa & Ramos-Vieira, 2009; Gallagher, Pollard, & Porter, 2011) and fibromyalgia (da Costa & Ramos-Vieira, 2009) – and are strongly associated with low back pain (LBP) and whole-body vibration (Vandergrift, Gold, Hanlon, & Punnett, 2012).

*Figure 1. Posture adopted by employees during the task of changing forklift's brake pads*  
*Source: Prepared by the authors (2017).*



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