

ROLE OF HR PRACTICES IN ENHANCING WORKERS PRODUCTIVITY IN HIGH-HEAT MANUFACTURING ENVIRONMENTS: A CONCEPTUAL FRAMEWORK

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Abstract

High-heat manufacturing environments, such as foundries, metal processing, welding, and the glass industry, will negatively impact workers productivity. Existing literature has emphasised that cooling, ventilation systems and personal protective equipment will improve the productivity of employees. However, the role of human resources practices in these engineering solutions and workers' well-being has not studied. So, the existing paper conceptualises an integrated framework to be applied in high heat manufacturing environments that improves workers' productivity by linking engineering solutions and HR Practices to employee well-being. Using job demands resources theory and socio-technical systems theory, the current study states that training, job design and safety culture as HR initiatives are important for increasing workers' productivity. By adopting a holistic approach, the proposed framework offers sustainable solutions to heat-related workplace challenges, contributing not only to improved employee well-being and productivity but also to long-term organisational sustainability and responsible industrial practices.

Keywords: High-heat manufacturing environments; well-being; Productivity; Job demands resources theory; socio-technical systems theory.

1. Introduction

Extreme heat is inherent in sectors such as glass manufacturing and metalworking industries that involve casting, welding, and forging (Singh, Bhardwaj, & Deepak, 2010). Workers in these sectors are likely to be impacted by heat stress as well as heat discomfort, dehydration, and fatigue. These effects may also affect their ability to concentrate, which may further contribute to accidents (Venugopal et al., 2016). Global warming and climate change have increased the challenges created by heat stress and have thereby created obstacles to operating at high temperatures (Pogačar et al., 2018).

In many organisations, they typically implement engineering controls like ventilation, personal protective gear and heat-resistant technology. But workers' productivity will not only lie in these controls, but also they need organisational support by implementing proper HR Practices (Gilbreath & Montesino, 2006).

Human Resources (HR) practices play an important role in changing the experiences of their work environment (Savanevičienė et al., 2025). HR policies will guide the employees by providing information regarding how to be trained regarding safety in work place and how health is important in the work place environment (Hymel et al., 2011). By adopting a holistic approach, the proposed framework offers sustainable solutions to heat-related workplace challenges, contributing not only to enhanced employee well-being and productivity but also to long-term organizational sustainability and responsible industrial practices.

2. Literature Review

2.1 Workers' Well-Being in High-Heat Manufacturing Environments

Workers' well-being is made up of the physical, social and psychological experiences of an employee's work environment and milk production can be one such example. Emotional well-being is mainly due to the thermal conditions of the employee's work environment (Carrington & McIntosh, 2013). In addition to the thermal conditions of a production facility, the worker may also face other obstacles to optimal performance such as fatigue, work load, safety expectations and organizational support. Studies have shown that prolonged exposure to high temperatures makes it difficult for a worker to think clearly or to continue performing at a normal level of physical exertion (Cheung, Lee, & Oksa, 2016). In addition to mental fatigue, experiencing dizziness, muscle fatigue and dehydration, all of which affect the probability of an individual making an error and having an accident in a production environment will also have an impact on the worker's emotional well-being. Furthermore, the working environment can negatively impact the worker's emotional well-being (Kirschenbaum et al., 2000); as a result, an employee may have a sense of fear of getting injured in addition to a lack of supervisory, co-worker or peer support (Sloan, 2012). Employee well-being should be understood as a holistic construct encompassing physical health, psychological state, and social and organizational experiences, rather than being limited to physical health (Kiefer, 2008). While these states are of importance in understanding how worker feels while on the job, they also need to take into consideration the role of organizational practices and HR policies play in shaping workers' experience on a day-to-day basis. Therefore, employee well-being should be understood as a dynamic outcome emerging from the interaction between physical working conditions and managerially driven organizational systems (Kowalski & Loretto, 2017).

2.2. Engineering Controls for Workers' well-being

The engineering controls are the most commonly used to prevent heat exposure in the workplace (Jay & Kenny, 2010). Engineering controls include the use of ventilation systems, cooling systems, insulating heat sources, automating hazardous jobs, and providing personal protective equipment or PPE. Engineering controls were created to not only decrease the ambient temperature of an environment but also to limit an individual's exposure to heat. There have been many studies conducted in engineering that have shown that good design of a work site can significantly decrease heat stress and injury rates (Chan & Yi, 2016). However, the effectiveness of an engineering control is dependent on the compliance of the employee using it, how it has been maintained, and the commitment of the organization in supporting it (Tyler, Dienhart, & Thomas, 2008). Employees may choose to not wear PPE because they perceive it to be uncomfortable, cooling systems may not be used because there is no knowledge of them, and safety policies may not be followed because the production rate is a priority. Therefore, it cannot be assumed that an engineering control will ensure that there are ongoing improvements in the well-being of a worker. The success of engineering controls depends on the extent to which they have been integrated into an organization's systems and supported by human resources policies and management policy decisions.

2.3. HR Practices and Workers Well-Being

The way work is designed, how workers are supported in the workplace and how health and safety are addressed is greatly impacted by human resources (HR) practices (Obeidat et al., 2023). Studies in human resources and how organizations work show that things like helping employees grow, designing good jobs, taking care of their health, and having strong leadership help keep employees healthy and happy at work (Albrecht et al., 2015). In a manufacturing workplace, HR practices typically have a focus on compliance with safety regulations as opposed to promoting a proactive approach concerning wellbeing of an employee (Sorensen et al., 2018). Training on how to use equipment usually contains more of a focus on developing job-specific skills than on how to manage heat stress and the associated self-care. Schedule requirements often have greater focus on producing results versus allowing enough time for recovery, and reward structure is based more on output than on safety and comfort. There are HR practices that are specifically applicable to high-heat work environments:

- Training and awareness programs on heat stress and equipment operation.

- Job rotation and scheduling practices to minimize the length of time exposed to high heat.
- Provide health and wellness initiatives to promote drinking fluids/hydration;
- Establish performance management systems that include safety and comfort in employee performance reviews.
- Establish a strong safety culture through effective communication and leadership.

HR practices provide the foundation for employees to evaluate how much their employers care about the employee's overall well-being, and will therefore influence the employee's motivation and willingness to comply with engineering controls.

2.4. Workers' Well-Being and Productivity.

In general, healthy workers maintain good mental health; therefore, they have a greater ability to concentrate on tasks associated with their employment, resulting in increased productivity at their job.

2.5. Research Gap

While many researchers have investigated how to reduce heat stress in industrial environments by developing different types of engineering control solutions, few have considered using human resources (HR) practices as an effective way to improve workplace comfort. Most research on heat management tends to approach the problem from either an engineering perspective only or fails to include any management/behavioural components in the analysis. Additionally, there is currently no clear conceptual model that describes how HR practices and engineering controls work together to positively impact workers' well-being and in turn workers' productivity; without this kind of holistic perspective, we cannot properly conceptualise heat stress management as an organisational issue.

6. Theoretical Foundations

This conceptual paper draws upon two major theoretical perspectives.

6.1 Job Demands-Resources (JD-R) Theory

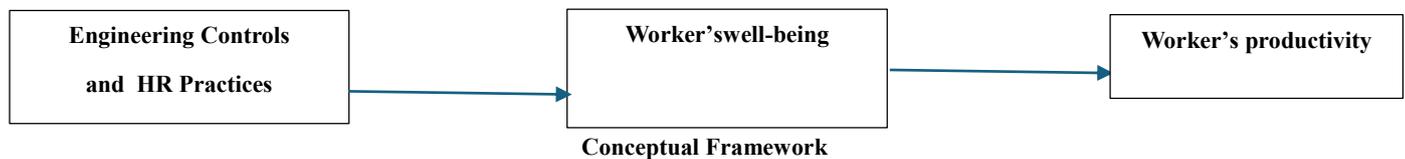
Jobs that require working in high-heat conditions place tremendous demand on an employee's physical and psychological capabilities (stressors) and increase the amount of physical and mental stress an employee may experience. Organisations can use HR practices such as training, rest breaks, and wellness programs to provide job resources that help employees cope with the demands of high-heat work environments, thereby improving overall employee health. (Gilbreath & Montesino, 2006).

6.2 Socio-Technical Systems Theory

This theory emphasizes the interdependence between technical systems and social systems. Engineering controls represent the technical subsystem, while HR practices represent the social subsystem. Worker well-being emerges from the effective alignment of both systems (Cimino et al., 2025).

7. Proposed Conceptual Framework

This paper proposes that Engineering Controls (ventilation, cooling systems, PPE, workplace design) and HR Practices (training, job rotation, work scheduling and safety culture) jointly influence Workers well-being, which in turn increases workers productivity.



9. Theoretical Contributions and Practical Implications

This article has created significant theoretical advancements in several fields of study, including occupational health, human resource management and high-heat manufacturing environments. The primary advancement is a holistic view of worker well-being that merges both Job Demands-Resources (JD-R) theory and Socio-Technical Systems Theory to create an understanding of well-being based on the interaction between environmental job demands and organisational job resources (Pansini et al., 2023). The vast majority of previous studies on heat stress have looked at it solely from physiological or engineering perspectives. To date, the key to this integrated framework is the physical and psychological impact that HR practices contribute towards providing much-needed resources to mitigate the negative impact of the high demand of jobs in high-heat environments, in comparison to the use of technical or engineering measures.

The framework set forth by us provides upside to people responsible for running factories in extremely hot work environments like the foundry industry and welding industry, as well as manufacturing processes that are normally operated under adverse conditions. Our research demonstrated that if you only implement engineering controls (i.e., ventilation systems, cool-off areas and personal protective equipment) without also implementing HR practices, such as formalised break periods, heat-safety education and wellness programs, your effectiveness with respect to heat safety will be limited at best. Therefore, you should consider taking a holistic approach to improving safety in high-heat work environments by combining your technical solutions with HR initiatives that target creating a safety-oriented work culture through employee participation and compliance. With the improvement in the work environment, the workers well-being will be increased, leading to an increase in the workers' productivity.

HR professionals have an active role in providing positive outcomes for employees by redesigning jobs and work schedules to limit heat exposure; using job rotation strategies; and supporting an environment that fosters a strong safety culture that encourages compliance and worker participation (Lovejoy et al., 2021). Another important way that HR professionals can enhance worker productivity, as well as their overall welfare, is through education programs that increase worker knowledge regarding heat exposure and develop workers' coping abilities, thus enhancing the buffering of job resources outlined in the JD-R model (Miller, 1977).

At the organizational level, the framework should also support the development of sustainable and responsible workplace practices that improve the overall welfare of the organization's workforce through alignment of technical systems with social and managerial systems to improve employee welfare (RA et al., 2025); minimize absenteeism and turnover; and maximize long-term productivity. This will result in a more productive workplace.

10. Conclusion

In this conceptual article, we provide an integrated view of engineering control and HR-related activity to achieve improved overall worker well-being and in turn workers' productivity, within high heat manufacturing settings. We use the lenses of socio-technical and job resources to provide a framing of workers well-being, highlighting HR-related activity as an important component for achieving sustainable and human-centred workplace solutions. This framework provides evidence to further conduct empirical research and also supports organisations in developing their strategies for addressing heat-related risks in a more comprehensive, and sustainable way.

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