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The Effect of Workload and Technostress on Safety Performance with Safety Climate as a Moderating Variable in Construction Companies

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Abstract. *This study aims to analyze the effect of workload and technostress on the safety performance of construction workers, as well as to examine the moderating role of safety climate. The background of this study is based on the high risk of occupational accidents in the construction sector, which is influenced not only by technical factors but also by psychosocial factors such as excessive workload and stress arising from the use of digital technology. The rapid development of technology in the construction industry, including digital systems and project-based applications, enhances efficiency but also creates technostress that may negatively affect workers' safety performance. This research employs a quantitative approach using an explanatory research method. The population consists of construction company employees, with samples selected through purposive sampling based on specific criteria, such as a minimum of six months of work experience and direct involvement in construction projects. Data were collected through questionnaires using a Likert scale. The variables examined include workload as an independent variable, technostress as a mediating variable, safety performance as the dependent variable, and safety climate as a moderating variable. Data analysis was conducted using Partial Least Square-Structural Equation Modeling (PLS-SEM) to simultaneously test the relationships among variables. The results indicate that workload has a negative effect on safety performance, meaning that higher workload leads to lower safety behavior among workers. Technostress also has a negative effect on safety performance, suggesting that stress caused by technology usage reduces both safety compliance and participation. Additionally, workload has a positive effect on technostress, indicating that increased job demands intensify psychological pressure related to technology use. Furthermore, safety climate is proven to moderate the relationship by weakening the negative effects of workload and technostress on safety performance. This finding suggests that a strong safety climate, reflected in organizational commitment to safety, can act as a protective factor in maintaining safe behavior even under high work pressure. This study contributes theoretically to the development of occupational safety research based on psychosocial factors and provides practical implications for construction companies in managing workload,*

minimizing technostress, and strengthening safety climate to improve safety performance sustainably.

Keywords: *Construction; Performance; Safety; Technostress; Workload.*

1. Introduction

The construction sector is a highly promising sector, but it also faces intense competition and complex work challenges. Success in construction projects is closely linked to worker performance, including work quality, timely completion, safety, and the ability to work collaboratively in groups. However, excessive workload and technostress are often major barriers that hinder workers' abilities. When facing a high workload, individuals typically experience difficulty concentrating, an increased number of errors, and decreased efficiency. Furthermore, fatigue both physical and mental can reduce cognitive abilities, motivation, and emotional resilience, thus impacting productivity and work quality. The construction industry is one of the sectors with the highest levels of occupational safety and health (OHS) risks compared to other industrial sectors. The characteristics of construction work, which involve heavy physical activity, the use of heavy equipment and high-risk machinery, a constantly changing work environment, and the involvement of many parties with diverse competency backgrounds, make this sector highly vulnerable to workplace accidents. The International Labour Organization (ILO) reports that the construction sector consistently contributes a significant proportion of fatal workplace accidents globally, despite employing only around 7–10 percent of the world's total workforce.

In developing countries, including Indonesia, construction safety challenges tend to be more complex. Rapid national infrastructure development, demands for accelerated project completion, and intense industrial competition often push companies to maximize workforce productivity. These conditions have the potential to compromise safety if not balanced with a robust occupational safety and health management system. Various reports and studies indicate that occupational accidents in construction projects are caused not only by technical failures but also by human and organizational factors, such as fatigue, work pressure, poor decision-making, and weak supervision and safety culture (Reason, 1997; Hinze, 2006). One of the most influential human factors in this context is workload. Workload is defined as the difference between job demands and an individual's physical and mental abilities to complete the work (Tarwaka, 2015). On construction projects, workers often face high physical workloads due to manual activities, exposure to extreme work environments, and long working hours. Furthermore, mental stress arises from project completion deadlines, cross-team coordination, and responsibility for work quality and safety.

Numerous studies have shown that excessive workloads can cause physical and mental fatigue, reduce alertness, and increase the likelihood of work errors and unsafe behaviors (Leung et al., 2015; Li et al., 2021). In the long term, these conditions not only increase the risk of workplace accidents but also reduce the overall quality of safety performance. Along with technological advancements and digital transformation, the construction industry is also experiencing significant changes in work systems. The implementation of technologies such as Building Information Modeling (BIM), digital-based project management systems, safety reporting applications, mobile devices for field coordination, and Internet of Things (IoT)-based monitoring systems aims to improve project efficiency, accuracy, and transparency. However, despite these benefits, the intense use of digital technology also presents new challenges for construction workers.

Continuously evolving technology requires workers to constantly adapt to new systems, update their knowledge, and respond to information quickly and in real time. This condition can cause psychological stress known as technostress. Tarafdar et al. (2011) define technostress as a stressful condition experienced by individuals due to the inability or limitations in dealing with the demands of using information technology. Technostress encompasses various dimensions, including techno-overload (technology increases workload), techno-complexity (system complexity), techno-invasion (blurred boundaries between work and personal life), techno-insecurity, and techno-uncertainty.

2. Research Methods

This research uses quantitative approach with the method explanatory research, namely research that aims to explain the causal relationship between research variables through hypothesis testing (Sugiyono, 2019). The quantitative approach was chosen because this study measures the relationship between workload and Technostress on Safety Performance and examines the role of Safety Climate as a moderating variable. This method is also used because the data collected is in the form of numerical measurements using a Likert scale questionnaire and analyzed using statistical methods.

3. Results and Discussion

3.1. Workload has a negative effect on Safety Performance

The test results show that workload has a positive and significant effect on safety performance ($\beta = 0.254$; $p = 0.003$). Therefore, the direction of the effect is inconsistent with the proposed hypothesis, and H1 is rejected. This finding suggests that increasing workload can actually increase worker vigilance and discipline in implementing safety procedures.

These results indicate that increased workload among study respondents is not always accompanied by decreased safety performance. Conversely, under certain conditions, increased job demands can encourage workers to increase their attention, concentration, and vigilance regarding the work being performed. In construction jobs with high job demands and safety risks, workers facing greater job demands can become more focused on completing tasks and pay greater attention to safety procedures to ensure successful completion.

These results are inconsistent with research by Michael Y. Leung et al. (2015), which states that high workloads can reduce safety performance due to work fatigue. However, these results can be explained by the Job Demands-Resources theory by Arnold B. Bakker and Evangelia Demerouti (2007), which states that job demands can improve performance if supported by adequate work resources.

This finding aligns with research by Akalpa et al. (2026), which found that mental workload has a positive and significant effect on safety performance, with a coefficient of $\beta = 0.159$ and $p = 0.001$. This study shows that the relationship between workload and safety performance does not always follow the assumption that a higher workload automatically decreases safety performance. Instead, the relationship can be influenced by job characteristics and how workers respond to the job demands they face.

3.2. Technostress has a negative effect on Safety Performance

The test results show that Technostress has a negative but insignificant effect on Safety Performance ($\beta = -0.136$; $p = 0.070$), so H2 is rejected. This indicates that Technostress has not had a significant impact on worker safety performance.

The insignificant direct effect of technostress on safety performance may indicate that the impact of technostress on worker safety is not always immediate. Workers may have the ability to adapt to technology, experience using digital devices or systems, and receive support from the work environment, so that the stress arising from technology use does not directly reduce safety performance.

These results do not fully align with research by Monideepa Tarafdar et al. (2007), which states that technostress can reduce productivity by increasing role stress. However, these results can be explained by research by Ramakrishna Ayyagari et al. (2011), which states that the impact of technostress depends on an individual's ability to adapt to technology.

These findings are supported by research by Elbir and Mizrak (2026), which examined technostress among workers in an automated manufacturing environment. The results showed that the direct effect of technostress on the various outcomes studied was not

statistically significant, although the direction of the effect was consistent with theoretical expectations. Instead, the study found that job resources, such as supervisory ICT support, recovery opportunities, and digital literacy, can act as factors that mitigate the negative impact of technostress. Furthermore, psychosocial safety climate was also found to be associated with better safety behaviors.

Based on these results, the insignificant direct effect of Technostress on Safety Performance in this study can be understood as the Technostress experienced by workers does not necessarily directly reduce safety performance. Its impact can be influenced by other factors, such as workers' ability to adapt to technology, experience using technology, supervisor support, digital literacy, and work environment conditions. Thus, Technostress is probably more appropriately understood as a factor that can influence Safety Performance through certain mechanisms or conditions, rather than as a factor that automatically reduces Safety Performance directly.

3.3. Workload has a positive effect on Technostress

The test results show that workload has a positive and significant effect on technostress (β = 0.375; p = 0.001), thus H3 is accepted. This means that the higher the workload, the higher the level of stress due to technology use.

This finding aligns with research by Tarafdar et al. (2007), which states that workload is a major cause of technostress. Furthermore, research by La Torre et al. (2020) also confirms that increased technology-based work demands can increase work stress.

3.4. Safety Climate moderates the effect of Workload on Safety Performance (weakens)

The test results show that Safety Climate negatively and significantly moderates the relationship between Workload and Safety Performance (β = -0.286; p = 0.003), so H4 is accepted. This means that Safety Climate is able to weaken the impact of Workload on Safety Performance.

The results of the Simple Slope Analysis (Appendix 5) show that at low levels of Safety Climate (-1 SD), the relationship between Workload and Safety Performance has a relatively stronger positive slope. At average levels of Safety Climate, the relationship becomes more gradual, while at high levels of Safety Climate (+1 SD), the relationship between Workload and Safety Performance becomes almost flat. This indicates that the higher the Safety Climate, the weaker the relationship between Workload and Safety Performance.

The findings of this study align with those of Barbaranelli et al. (2020) in the International Journal of Environmental Research and Public Health, published in a study entitled

"Multilevel Job Demands and Resources: Cross-Level Effects of Competing Organizational Facet-Specific Climates on Risky Safety Behaviors." The study showed that workload, as a form of job demand, increases workers' tendency to engage in risky safety behaviors. However, organizational safety climate has been shown to significantly mitigate the effect of workload on risky safety behaviors. Thus, safety climate can serve as an organizational resource that helps workers cope with job demands without sacrificing safety.

This similarity in patterns reinforces the findings of this study, which suggest that Safety Climate can serve as a buffer against workload demands. When Safety Climate is high, workers experience a work environment that places greater emphasis on safety, so high job demands do not necessarily lead to a decline or disruption in work safety.

Theoretically, these findings can be explained through the perspective of the Job Demands–Resources (JD-R) Model. Workload is a job demand that requires workers' physical, cognitive, and psychological energy. Meanwhile, Safety Climate can be viewed as an organizational resource that provides support for workers to face these demands. A strong Safety Climate indicates an organizational priority on safety, good safety communication, and support and appreciation for safe work behaviors. These conditions enable workers to face Workload without increasing the tendency to neglect safety aspects.

3.5. Safety Climate moderates the influence of Technostress on Safety Performance (weakens)

The test results show that Safety Climate significantly moderates the relationship between Technostress and Safety Performance with an interaction coefficient value of $\beta = 0.182$ and $p = 0.023$. A p value <0.05 indicates that the moderating effect of Safety Climate on the relationship between Technostress and Safety Performance is significant.

Although the interaction coefficient indicates a positive direction, the results need to be interpreted by considering the direction of the direct relationship between Technostress and Safety Performance which shows a negative direction ($\beta = -0.136$). Thus, the positive interaction coefficient indicates that an increase in Safety Climate shifts the relationship between Technostress and Safety Performance in a more positive direction, thereby reducing or weakening the negative impact of Technostress on Safety Performance.

These results are supported by a Simple Slope Analysis (Appendix 6). Under low Safety Climate conditions (-1 SD), the relationship between Technostress and Safety Performance shows a relatively strong negative slope. At average Safety Climate levels, the relationship becomes more gradual. Meanwhile, at high Safety Climate levels (+1 SD), the relationship between Technostress and Safety Performance becomes nearly flat. This pattern indicates

that the higher the Safety Climate, the smaller the negative impact of Technostress on Safety Performance.

This finding aligns with research by Zhang et al. (2024), which showed that perceived organizational support can act as a buffering factor that reduces the negative impact of technostress on safety performance. The study also showed that the influence of technostress on safety performance is related to job burnout, making organizational resources crucial in mitigating the negative consequences of technology-related stress.

The results of this study are also in line with Elbir and Mizrak (2026), who used the Job Demands–Resources (JD-R) perspective and showed that job resources can function as a protective factor against the negative impacts of technostress. This study found that technostress does not always have the same impact on workers, as its effects depend on resource availability and work environment conditions. Furthermore, psychosocial safety climate at the group and organizational levels was found to be associated with better worker conditions and safety behaviors.

Theoretically, these findings can be explained through the Job Demands–Resources (JD-R) Model, where Technostress can be viewed as a Job Demand that requires workers' energy and adaptability, while Safety Climate can act as an organizational resource that helps workers cope with these demands. When Safety Climate is high, workers receive support, safety communication, management attention to safety, and a more conducive work environment so that the negative impact of Technostress on Safety Performance can be reduced.

Thus, H5 is accepted, namely that Safety Climate is proven to moderate and weaken the negative influence of Technostress on Safety Performance.

4. Conclusion

This study aims to analyze the influence of workload and technostress on safety performance and examine the role of safety climate as a moderating variable in construction workers. The main research questions are how work pressure and technology use affect safety performance and the extent to which a safety-oriented work environment can strengthen or weaken this relationship. Based on the results of the analysis using SEM-PLS, it was found that organizational factors such as Safety Climate have an important role in maintaining and improving safety performance, while the influence of workload and technostress showed varying results depending on the context and conditions of workers.

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