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ERGONOMIC STUDY IN DEVELOPING THE ORGANIZATIONAL CULTURE TO IMPROVE SME'S PERFORMANCE

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ABSTRACT
In both large and small-scale industries, organizational performance is a critical indicator of success. A positive and productive corporate culture can significantly enhance performance, while an inappropriate culture may lead to conflicts, discomfort, and decreased morale, ultimately hindering performance. To address this, it is crucial for organizations to develop a culture that considers the human factor. This study explores the role of ergonomics in shaping organizational culture and its subsequent impact on improving worker performance in the SME sector. Using a quantitative approach, the study applies Structural Equation Modeling (SEM) for data analysis. The sample consists of 123 employees and managers from SMEs in Central Java, with data collected through structured interviews and observations. Results reveal that all three dimensions of ergonomics cognitive, organizational, and physical significantly influence organizational culture. The coefficients are as follows: cognitive ergonomics ($\beta = 0.278$, $p = 0.009$), organizational ergonomics ($\beta = 1.050$, $p = 0.000$), and physical ergonomics ($\beta = 0.312$, $p = 0.004$). Moreover, organizational culture positively affects SME performance ($\beta = 0.401$, $p = 0.000$). Key ergonomic aspects include workload, environmental conditions, tool design (physical), logical reasoning (cognitive), and work systems and organizational structures (organizational). These findings emphasize that an integrated ergonomic approach can foster a healthier, adaptive work culture and continuously improve SME performance.
Keyword: *Ergonomics, Organizational Culture, Performance, Small and Medium Industries, Structural Equation Modeling*

I. Introduction

Small and Medium Enterprises (SMEs) are critical in supporting national economic growth, particularly through job creation and improving public welfare (Okobia Eguriase Caleb & Eunice Adotane Ugoh, 2023). However, SMEs face significant challenges in today's globalized and competitive market. To remain competitive, SMEs must continuously enhance their performance, which is influenced not only by production and technological factors but also by the quality of human resources and organizational management (Sarfo et al., 2024). The role of organizational culture in improving SME performance has often been overlooked, despite its potential to foster productivity, efficiency, and collaboration among employees (Amoa-Gyarteng & Dhliwayo, 2024). A strong organizational culture, based on shared values, norms, and behaviors, can mitigate conflicts and enhance morale, while a poor culture can lead to employee dissatisfaction and hinder performance (Kiptulon et al., 2024).

Although the importance of organizational culture has been recognized, many SMEs, particularly in developing countries, still operate with traditional management approaches that lack structured work systems (Kindström et al., 2024). As a result, fostering a positive organizational culture is often not prioritized. Existing studies on the relationship between organizational culture and SME performance have largely focused on developed countries or large industrial sectors, leaving a significant gap in the context of SMEs in developing countries such as Indonesia (Lestari et al., 2024). SMEs in developing countries often face unique challenges, including limited resources, low access to technology, and rigid organizational structures (Lestari et al., 2024). Previous research consistently highlights that existing organizational cultures, although institutionally embedded, often exhibit rigidity, hierarchical control, and low adaptability. Such cultures tend to prioritize stability and compliance over creativity and innovation (Abdellah et al., 2025), discourage knowledge sharing, and reduce employee engagement (Abdellah et al., 2025), rigid, control-oriented, and poorly communicative cultures hinder ambidextrous innovation (AlSaied & McLaughlin, 2024), supports learning and employee engagement reduces performance and long-term commitment (Hasan, 2023).

Based on the above shortcomings, it is necessary to incorporate a new aspect that considers human factors, namely ergonomics. Ergonomics has been implemented in organizations; however, it primarily addresses physical aspects rather than adopting a comprehensive human factors approach, despite its broader potential benefits for organizational performance, in developed nations ergonomics is integral to enhancing productivity and worker welfare (Abdollahpour et al., 2023).

This research seeks to fill this gap by examining how ergonomics principles physical, cognitive, and organizational can be integrated into the formation of a positive organizational culture within SMEs in developing countries. These three dimensions of ergonomics can be applied strategically to improve workplace comfort, enhance decision-making processes, and optimize organizational structures (Hasanain, 2024). The integration of these dimensions aims to create a work environment that supports employee well-being and boosts organizational performance by fostering a positive culture that promotes collaboration and productivity (Ramos-García et al., 2022).

There is a research gap in understanding how these three aspects of ergonomics, when combined, influence both organizational culture and SME performance, especially in developing countries. Prior studies have either focused on large industries or examined the individual aspects of ergonomics without integrating them, such as design (Barinque et al., 2022), musculoskeletal health (Sandoval-Alarcón et al., 2025), perioperative care (Gür, 2025), employee performance (Ghaleb, 2024), according that study we have to highlights the need for studies that examine the combined impact of ergonomics on organizational culture and performance, particularly in developing economies.

This study will investigate the synergistic relationship between ergonomics and organizational culture, aiming to develop a conceptual model that explains how multidimensional ergonomics can enhance performance through the strengthening of work culture. This approach offers a more holistic and human-centered solution to improving work systems in SMEs, which is essential for their sustainable competitiveness. Given the pressures of digital transformation and the need for efficiency, this research will provide both theoretical insights into the interplay between ergonomics, organizational culture, and performance, as well as practical guidance for SMEs in creating productive, healthy, and sustainable work environments. By addressing this gap, the research aims to provide a clear framework for integrating ergonomics into SME management practices in developing countries, contributing to their long-term growth and competitiveness.

2. Literature Review

OC is a set of norms, values, beliefs, and attitudes that guide the actions of all organization members and have a significant impact on employee behavior (Coghlan, 2024). Supporting Schein's definition, Denison define OC as the underlying values, protocols, beliefs, and assumptions that organizational members hold, and it is strongly supported by the organizational structure and fundamental principles (Christopher & Edwinah, 2022). OC includes sociocultural activities (Nzuva, 2022), sets of myths and symbols (Bogale & Debela, 2024). OC encompasses deeper values and serves as a foundation for developing shared norms (Paais & Pattiruhu, 2020).

Past research concur that OC encompasses a common set of values, behaviors, conventions, attitudes, assumption, and beliefs among organizational members (Yip et al., 2020). As articulated by Hardcopf et.al (2021), OC is a group attitude that evolves over time and proves resistant to modification once established (Hardcopf et al., 2021). The study of OC has garnered significant attention in academic literature due to its profound implications for organizational success and performance (Carvalho et al., 2023). Existing systematic reviews have contributed to our understanding of various aspects of OC, such as its relationship with competitive advantage, job satisfaction, innovation, sustainability, and digitalization. For instance, Bogale and Debela (2024) provided a theoretical review of OC's role in competitive advantage (Bogale & Debela, 2024).

Ergonomic interventions such as workspace design, workload regulation, and human machine compatibility are empirically linked to reduced fatigue, higher motivation, and improved job satisfaction (Ramos-García et al., 2022). Proper ergonomic implementation has been shown to reduce fatigue, improve work efficiency, and enhance employee satisfaction and productivity (Gür, 2025). However, much of the existing research remains focused on the physical and technical aspects of ergonomics, while social and cultural dimensions affecting ergonomic adoption are often overlooked. Although ergonomics and organizational culture have been extensively discussed, their relationship with performance has not been thoroughly explained either theoretically or empirically. In the context of small and medium-sized enterprises (SMEs), ergonomics plays a crucial role in enhancing work efficiency, reducing fatigue, and creating a safe and comfortable work environment, ultimately fostering individual productivity (Marková & Škurková, 2023). Meanwhile, organizational culture shapes behavioral patterns, values, and norms that govern how individuals interact, innovate, and respond to change (Aboramadan et al., 2020).

The connection between ergonomics and organizational culture in influencing performance is grounded in strong theoretical foundations. Organizational Culture Theory posits that shared values, beliefs, and assumptions shape how individuals behave and interpret their work experiences, thereby influencing the acceptance of ergonomic practices (Coghlan, 2024). Socio-Technical Systems Theory emphasizes that optimal performance can be achieved when technical aspects (such as ergonomic design) and social aspects (such as work culture) are harmoniously integrated (Ang et al., 2025). Meanwhile, Human Factors Theory provides a framework to understand how human-centered work system design can enhance efficiency, safety, and psychological well-being (Hasanain, 2024). Integrating these three theoretical perspectives offers a comprehensive understanding: ergonomics functions as a technical intervention that improves working conditions, while organizational culture acts as a social mechanism that determines the extent to which these interventions are accepted, internalized, and translated into motivation and performance outcomes. This theory-based approach strengthens the conceptual argument regarding the synergistic relationship between ergonomics and organizational culture in driving organizational performance improvement.

Most previous studies remain descriptive in nature and lack critical analysis of the relationship between ergonomics, organizational culture, and performance. For instance, many emphasize the benefits of ergonomics in enhancing safety and productivity but focus primarily on physical and technical aspects, neglecting the social and cultural dimensions of work (Hasanain, 2024). Conversely, studies that emphasize organizational culture highlight the importance of collaborative and learning-oriented values for performance but often overlook the contribution of ergonomic work design (Sopiah et al., 2024). These divergent approaches indicate that previous literature tends to separate the two concepts, resulting in an incomplete understanding of how the interaction between human factors and social systems influences organizational outcomes. Moreover, most prior research relies on descriptive designs or small-scale case studies, which limit the ability to identify causal mechanisms and the mediating roles of variables such as motivation and job satisfaction.

3. Research Method

3.1. Research Approach

This study adopts a quantitative approach to explore the relationships between ergonomics, organizational culture, and SME performance. The primary reason for selecting this approach is its ability to test hypotheses and validate theoretical concepts through statistical methods, providing precise, reliable, and generalizable results (Lim, 2024). Specifically, Structural Equation Modeling (SEM) is employed to analyze the relationships between the variables, as SEM is well-suited for evaluating complex models with multiple latent variables, as it allows for the simultaneous assessment of direct and indirect effects (Sarstedt & Moisescu, 2024). This method was chosen because it can clarify the multidimensional nature of ergonomics and organizational culture and assess their impact on SME performance. Furthermore, SEM is ideal for testing causal relationships and latent constructs, which are fundamental to understanding how ergonomics and organizational culture interact to influence performance. The research is cross-sectional in nature, providing insights into the relationships between variables at a single point in time, and is therefore more suitable for hypothesis testing rather than establishing causality over time

3.2. Survey

The data collection process is conducted in several systematic stages. The first stage involves a thorough literature review to identify the key dimensions and indicators for each research variable. Following this, a closed-ended questionnaire was developed using a 5-point Likert scale (1 = strongly disagree, 5 = strongly agree). The questionnaire underwent validation through expert judgment, with feedback from a panel of 5 experts in the fields of ergonomics, organizational behavior, and SME management. The experts evaluated the content validity using a content validity index (CVI) of at least 0.8 to ensure that the instrument was both relevant and comprehensive. A pilot test was also conducted with a small sample of 30 respondents from the SME sector to test the clarity and relevance of the questions. After the validation process, the final version of the questionnaire was distributed to respondents either via hardcopy or online using Google Forms. The target respondents include owners, managers, and workers from SMEs in the manufacturing sector.

3.3. Population and Sample

The population in this study consists of actors and workers in Small and Medium Industries (SMI) that have a formal organizational structure and have been operating for at least two years. The sample includes managers, supervisors, and operators, selected using purposive sampling. This technique was chosen because it allows for the selection of participants who meet specific criteria: having at least five permanent employees, implementing a formal work system, and being willing to participate in observations and interviews. A total of 123 respondents were selected, which is consistent with SEM sample size recommendations. The estimation method used is Maximum Likelihood (ML), which involves finding parameter values that most likely produce the highest covariance or correlation from the existing data. Several researchers recommend different sample sizes based on varying rules, so there is no standardized sample size for SEM analysis. According Jung, the sample size for Maximum Likelihood (ML) estimation ranges from 100 to 200 (Jung, 2013), while Dillon et al. (1987) recommends a sample size ranging from 100 to 150 (Dillon et al., 1987).

3.4. Research Location

The study was conducted in SMEs located in Tegal Regency, Brebes Regency, and Tegal City in Indonesia. These areas were selected because they represent key growth centers for SMEs, particularly in the metal sector, and are known for their diverse characteristics in terms of subsectors and organizational structures. These regions also benefit from strong industrial infrastructure and government support that enables the implementation of formal work systems and ergonomic approaches. Despite the study's focus on this region, it is expected that the findings will have broader applicability to SMEs in other regions of Indonesia with similar characteristics, such as a formal organizational structure, business size, and industry sector.

3.5. Ergonomics Variables

This research focuses on identifying and analyzing three key dimensions of ergonomics: physical ergonomics, cognitive ergonomics, and organizational ergonomics, and their impact on the formation of organizational culture. Organizational culture is positioned as a mediating variable that bridges the relationship between ergonomics and the performance of SMEs. The research not only maps the direct relationships between these variables but also explains the transformation of work culture as a result of ergonomic interventions. A causal relationship model is shown in Figure 1 below:

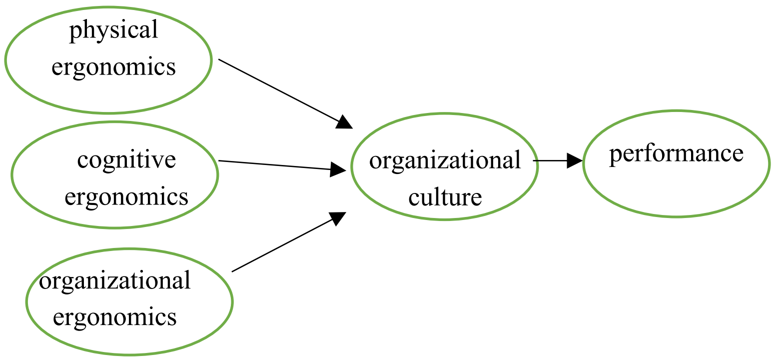

Fig. 1. Causal Relationship Model

The study employs five main variables: physical ergonomics, cognitive ergonomics, organizational ergonomics, organizational culture, and performance. Physical ergonomics is measured through indicators such as workload, work environment (temperature, humidity, lighting, and noise), and equipment or tools. Cognitive ergonomics is assessed through perception, logical reasoning, and work relationship indicators. Organizational ergonomics focuses on work system design, including communication, task variation, and organizational structure. Organizational culture is evaluated based on shared values, open communication, trust, teamwork orientation, innovation, leadership support, and work norms, adapted from Denison's organizational culture model. Lastly, performance is measured through productivity, work quality, time efficiency, job satisfaction, work engagement, attendance, and target accuracy using indicators derived from Key Performance Indicators (KPI) commonly applied in SME performance management.

Each instrument was adapted to the unique characteristics of Indonesian SMEs, considering factors such as space limitations, tool availability, and environmental conditions. The questionnaire's validity and reliability were confirmed through expert judgment, pilot testing, and statistical analysis prior to the full-scale survey.

3.4. Data Collection

Data was collected using two methods:

a. Survey**:** The primary data collection method was a self-administered questionnaire, distributed either in hardcopy or via Google Forms (online survey platform). The survey was distributed to the selected SMEs, ensuring that it reached the managers**,** supervisors**,** and operators who met the sampling criteria.
b. Interviews**:** In addition to the survey, semi-structured interviews were conducted with a subset of 20 managers from the selected SMEs to gain deeper insights into organizational culture and the application of ergonomics in their work systems.

The survey was designed to be anonymous, and informed consent was obtained from all participants. Ethical guidelines were strictly followed, including ensuring that participants' privacy and confidentiality were maintained throughout the research process. The study was approved by the university's ethics committee.

3.6. Structural Equation Modeling (SEM)

Data analysis in this study was conducted using the Structural Equation Modeling (SEM) approach, implemented through AMOS software (Holte, 2025). SEM is a powerful statistical technique that allows for the simultaneous testing of multiple relationships between observed and latent variables, making it suitable for examining complex models involving multiple interrelationships among ergonomics, organizational culture, and performance.

The analysis process begins with testing the validity and reliability of the measurement instruments**.** Confirmatory Factor Analysis (CFA) is conducted to assess the validity of the constructs, which helps determine if the data adequately represents the theoretical model. The reliability of the instrument is measured using Cronbach's Alpha, with a threshold value of ≥ 0.70 indicating acceptable reliability (Azadeh et al., 2017).

To assess the measurement model further, two key validity tests are conducted: convergent validity and discriminant validity. Convergent validity is evaluated using the Average Variance Extracted (AVE), where values equal to or greater than 0.50 indicate that the construct explains at least 50% of the variance in its indicators. Additionally, factor loadings for each indicator should meet or exceed 0.50, confirming that each item significantly contributes to its corresponding construct. Discriminant validity is assessed by comparing the square root of AVE for each construct with the inter-construct correlations. If the square root of AVE for a construct is greater than its correlation with any other construct, discriminant validity is established, indicating that the constructs are empirically distinct. These validity criteria are consistent with methodological standards in structural equation modeling

After validating the measurement model, the structural model is evaluated to test the relationships between the constructs and the mediating role of organizational culture. The following hypotheses are tested in the model: H1: Physical ergonomics has a positive effect on organizational culture, H2: Cognitive ergonomics has a positive effect on organizational culture, H3**:** Organizational ergonomics has a positive effect on organizational culture, H4**:** Organizational culture has a positive effect on performance.

Finally, the goodness-of-fit of the model is assessed to determine how well the data fits the proposed model. Several fit indices are commonly used to evaluate model adequacy. The chi-square/df ratio is considered acceptable when it is less than 3, indicating a good model fit. The Comparative Fit Index (CFI) and Tucker-Lewis Index (TLI) are both recommended to be equal to or greater than 0.90, reflecting an acceptable to good fit level. The Root Mean Square Error of Approximation (RMSEA) should be equal to or below 0.08, with lower values indicating a better fit between the model and the data. Additionally, the Goodness of Fit Index (GFI) is typically considered acceptable when it is equal to or greater than 0.90. These cutoff values are consistent with recent methodological recommendations in structural equation modeling (Khademi et al., 2023).

These criteria are used to ensure that the proposed model adequately represents the data and can be used to test the hypotheses concerning the relationships between ergonomics, organizational culture, and performance.

4. Results and Discussion

Validity and Reliability Tests

Validity Test with Confirmatory Factor Analysis (CFA)

This study used Confirmatory Factor Analysis (CFA) to validate five constructs: physical ergonomics, cognitive ergonomics, organizational ergonomics, organizational culture, and performance. CFA confirmed that most indicators had strong factor loadings (≥ 0.50), with AVE ≥ 0.50 and CR ≥ 0.70, ensuring good convergent validity. Model fit was supported by acceptable goodness-of-fit indices (CFI, TLI, RMSEA, χ^2/df).

For physical ergonomics, indicators EF3 (0.713), EF4 (0.692), EF1 (0.691), EF8 (0.688), EF6 (0.672), and EF5 (0.640) showed good validity, while EF7 (0.355) was removed. Similar eliminations were applied to BO2 (0.122) in organizational culture and KJ3 (0.448) in performance due to low loadings. These removals followed theoretical and empirical justifications to improve reliability and model fit (Hair J et al., 2014). For cognitive ergonomics, all indicators were valid, with EKG2 (0.967) being the strongest. Organizational ergonomics showed EO4 (0.823) as the strongest, with EO5 (0.625) and EO3 (0.564) acceptable. Organizational culture retained BO1 (0.794) and BO3 (0.575), while performance kept KJ4 (0.847), KJ1 (0.732), and KJ7 (0.621). Table 1 summarizes the CFA results.

Table 1 - Loading factor value

Construct	Indicator	Estimate	Validities
EF (Physical Ergonomics)	EF1	0.691	Valid
EF (Physical Ergonomics)	EF3	0.713	Valid
EF (Physical Ergonomics)	EF4	0.692	Valid
EF (Physical Ergonomics)	EF5	0.640	Valid
EF (Physical Ergonomics)	EF6	0.672	Valid
EF (Physical Ergonomics)	EF7	0.355	Invalid
EF (Physical Ergonomics)	EF8	0.688	Valid
EKG (Cognitive Ergonomics)	EKG1	0.700	Valid
EKG (Cognitive Ergonomics)	EKG2	0.967	Very valid
EKG (Cognitive Ergonomics)	EKG4	0.733	Valid
EORG (Organizational Ergonomics)	EO3	0.564	Quite valid
EORG (Organizational Ergonomics)	EO4	0.823	Valid
EORG (Organizational Ergonomics)	EO5	0.625	Valid
Organizational culture	BO1	0.794	Valid
Organizational culture	BO2	0.122	Invalid
Organizational culture	BO3	0.575	Quite valid
Performance	KJ1	0.732	Valid
Performance	KJ3	0.448	Invalid
Performance	KJ4	0.847	Very valid
Performance	KJ7	0.621	Valid

The results of the Average Variance Extracted (AVE) and Composite Reliability (CR**)** calculations indicate that all constructs in the model meet the criteria for good convergent validity and reliability. The *Physical Ergonomics (EF)* construct has an AVE value of 0.567 and a CR of 0.840, indicating that its indicators can explain more than 50% of the construct variance and demonstrate strong internal consistency. Similarly, the Cognitive Ergonomics *(EKG)* construct shows an AVE of 0.654 and a CR of 0.847, while Organizational Ergonomics *(EORG)* records an AVE of 0.562 and a CR of 0.715 — all of which meet the recommended minimum thresholds (AVE ≥ 0.50 and CR ≥ 0.70). The Organizational Culture *(BO)* construct also exhibits good results, with an AVE of 0.581 and a CR of 0.743, indicating that its indicators adequately represent the underlying construct. Meanwhile, the Performance *(KJ)* construct, with an AVE of 0.546 and a CR of 0.781, also meets validity and reliability criteria. Overall, these findings confirm that all constructs in the measurement model possess adequate measurement quality, making them suitable for subsequent structural analysis.

Reliability Test with Cronbach's Alpha

To ensure the consistency and reliability of the measurement instruments used in this study, a Cronbach's Alpha reliability test was conducted for each construct. A Cronbach's Alpha value of 0.70 or higher is generally considered acceptable, while values above 0.80 indicate excellent reliability. As shown in Table 2, the Cronbach's Alpha values for all variables exceed 0.80. Specifically, Physical Ergonomics has a reliability coefficient of 0.89, Cognitive Ergonomics 0.85, and Organizational Ergonomics 0.87. These results indicate that all measurement instruments used in this study demonstrate excellent internal consistency and can be considered reliable for further analysis.

Table 2 - Cronbach's Alpha Reliability Test Results

No	Variable	Cronbach's Alpha	Interpretation
1	Physical Ergonomics (EF)	0.89	Excellent Reliability
2	Cognitive Ergonomics (EKG)	0.85	Excellent Reliability
3	Organizational Ergonomics (EORG)	0.87	Excellent Reliability

Structural Model Testing

Structural model testing is carried out after the measurement model is confirmed to be valid through the Confirmatory Factor Analysis (CFA) test. The aim of this stage is to test the relationships between latent constructs in the model based on the hypotheses that have been proposed. The test model was constructed by mapping the relationship between independent variables (physical ergonomics, cognitive ergonomics, organizational ergonomics), mediating variables (organizational culture), and bound variables (performance). Based on the results of the SEM analysis with AMOS software, it was obtained that all variables in the model showed a statistically significant influence, both directly and indirectly. The following figure 2 is the structure of the initial model:

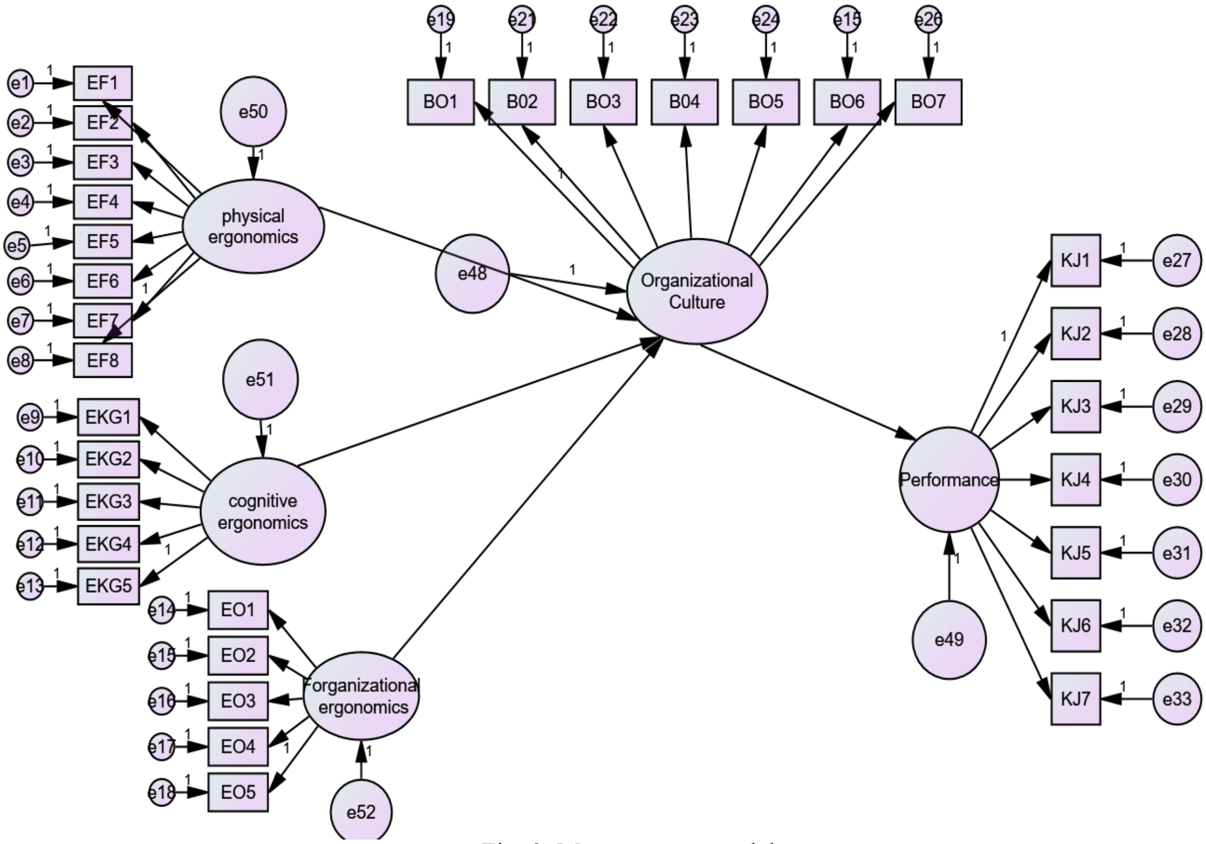

Fig. 2. Measurement model

After initial testing, the model was modified to achieve a better level of fit. The test results of the modified structural model are shown in Figure 3 below.

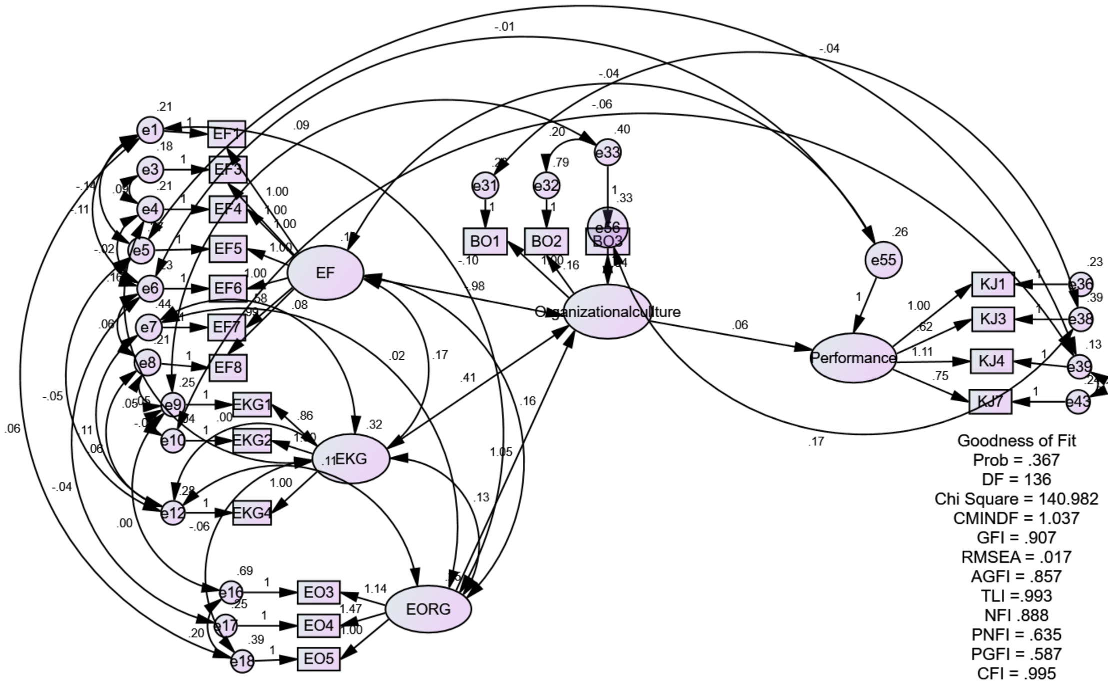

Fig. 3. Model Structure

Estimated Path Coefficient

The estimation results of the structural model show that all hypothesized relationships between constructs are statistically significant. SEM path coefficients indicate the strength and direction of influence between variables, revealing the relative contribution of each ergonomics dimension to organizational culture and its impact on performance.

As shown in Table 3, physical ergonomics significantly affects organizational culture (β = 0.312, p = 0.006), indicating a moderate influence. Key indicators include workload (especially work duration), work environment (temperature, humidity, lighting, noise), and equipment design, emphasizing the role of physical conditions in shaping work values and norms in SMEs. Cognitive ergonomics also has a moderate positive effect (β = 0.278, p = 0.009), driven by task perception, logical reasoning, and work relationships, showing that cognitive aspects help create an adaptive work culture. Organizational ergonomics is the most influential factor (β = 1.050, p = 0.000), with main components such as work system design, internal communication, and organizational structure, indicating that structured coordination fosters a productive work culture.

Finally, organizational culture significantly affects performance (β = 0.401, p = 0.000), with innovation, results orientation, and people-orientation as dominant indicators. This shows that a culture supporting creativity and individual growth enhances performance in SMEs.

Table 3 - Regression weighting results

No.	Variable	Path Coefficient	Probabilities
1	Organizational Culture 🡐 Physical ergonomic	0,312	0,006
2	Organizational Culture 🡐 Cognitive Ergonomic	0,278	0,009
3	Organizational Culture 🡐 Organizational Ergonomic	1,050	0,000
4	Performance 🡐 Organizational Culture	0,401	0,000

The results of this study show that all dimensions of physical, cognitive, and organizational ergonomics have a significant influence on the formation of organizational culture in Small and Medium Industries (SMEs). The results based on the p-value are used to measure the statistical significance of the relationship being tested. In the context of SEM, if the p-value is less than 0.05, then the relationship is considered statistically significant.

Model Fit Evaluation

The structural model was evaluated using several key fit indices, including Chi-square/df, RMSEA (Root Mean Square Error of Approximation), CFI (Comparative Fit Index), and TLI (Tucker–Lewis Index) [20]. The results show that the Chi-square/df value is 1.037, which falls well within the acceptable range (≤ 3), indicating that the model fits the observed data adequately. The RMSEA value of 0.017, which is below the maximum threshold of 0.05, demonstrates an excellent model fit. Similarly, the GFI value of 0.908 and TLI of 0.993 exceed the minimum recommended value of 0.90, further confirming the robustness of the model fit.

However, achieving this fit required minor model refinements guided by modification indices. Several non-significant error covariances were removed, and a small number of theoretically justified covariance paths were added to improve the model's parsimony and alignment with the data structure. These adjustments were conducted cautiously to maintain theoretical integrity. Figure 3 presents the final structural model with standardized path coefficients, allowing a clearer interpretation of the relationships among latent constructs. Taken together, these fit statistics and targeted model modifications indicate that the final model not only fits the data well but also aligns strongly with the underlying theoretical framework.

Interpretation of Path Coefficients in SEM

The path coefficients in the Structural Equation Modeling (SEM) analysis were interpreted using standardized benchmarks to assess the strength of the relationships between variables. Consistent with common SEM guidelines coefficients between 0.10–0.29 are considered weak, 0.30–0.49 moderate, and ≥0.50 strong. The results show that physical ergonomics has a path coefficient of 0.312 ($p = 0.004$), indicating a moderate effect on organizational culture.

This suggests that aspects such as workload, work environment, and work equipment contribute meaningfully to shaping organizational culture in Small and Medium Enterprises (SMEs). Cognitive ergonomics has a path coefficient of 0.278 ($p = 0.009$), falling within the weak effect range, implying that factors such as perception, logical reasoning, and working relationships influence organizational culture, although less strongly compared to other ergonomic dimensions. In contrast, organizational ergonomics shows the highest effect on organizational culture, with a path coefficient of 0.356 ($p = 0.001$), categorized as moderate. This indicates that structured work systems and effective organizational arrangements play a crucial role in reinforcing organizational values and practices.

Finally, organizational culture has a direct effect on performance with a path coefficient of 0.401 ($p = 0.000$), also classified as moderate, highlighting the strategic importance of cultural factors such as innovation, results orientation, and individual development in improving SME performance.

Discussion

Physical Ergonomics

The findings on the role of physical workload and work environment strongly support the classical ergonomics framework, which emphasizes the alignment between workers' physiological capacity and job demands as a primary determinant of well-being and performance (Heuel et al., 2024). However, the results also reveal a significant contextual gap in applying this theory within micro, small, and medium enterprises (MSMEs). Classical ergonomics was largely developed in the context of large-scale industries with standardized work schedules and well-regulated environments, whereas MSMEs typically operate under informal structures, minimal regulatory oversight, and limited resources. This contextual difference extends classical ergonomic theory by revealing its limited applicability in informal economic settings and highlights the need for a context-sensitive ergonomic framework tailored to MSMEs.

Previous studies were emphasized the protective function of adaptive ergonomic design against chronic fatigue and productivity loss (Behrens et al., 2023). Unlike these studies, the current findings show that work duration interacts with organizational and environmental factors, producing layered and more complex effects (Wahlström et al., 2024). While prior research has linked extended working hours to burnout risks, the lack of formal regulation in MSMEs amplifies these effects (Reich, 2024), showing that ergonomic risks are intensified in unregulated work structures. For instance, in several MSMEs observed during fieldwork, workers often exceeded 10 hours of work per day without formal rest periods or ergonomic equipment, illustrating how informal labor structures magnify physical strain. These findings suggest the necessity of moving beyond traditional ergonomic models toward a systemic approach that integrates human, organizational, and environmental dimensions. Strategic interventions such as periodic ergonomic audits, redesign of work schedules, and provision of ergonomic equipment may significantly improve workplace comfort and operational efficiency (Marková & Škurková, 2023).

Cognitive Ergonomics

Within the framework of human factors theory, cognitive reasoning and perceptual processes are central to maintaining performance stability in complex work systems (Read et al., 2021). This study, however, demonstrates that cognitive load in MSMEs is shaped not only by task complexity but also by informal work structures and high multitasking demands (Kamaliah et al., 2023) (Cunningham et al., 2023). This extends existing human factors theory by integrating socio-cultural dimensions, illustrating that cognitive workload is not solely determined by individual mental capacity but also by the informal social dynamics embedded within MSMEs. Previous literature focused primarily on formal industrial contexts, where structured coordination helps reduce cognitive burden (Morrison & Jaime, 2020). In contrast, in MSMEs, close social ties can facilitate rapid communication but simultaneously increase operational errors due to the absence of formal systems (Tuckey et al., 2024). While earlier research stressed system design as a key factor in managing cognitive load, the present findings reveal a mismatch between task demands and workers' mental capacity in informal work systems (Paas & van Merriënboer, 2020), creating chronic cognitive overload that cannot be mitigated solely through technical interventions. These results challenge the traditional human factors perspective and support the integration of socio-cultural approaches to explain how informal interaction patterns shape cognitive workload. User-centered interface design, simplified decision-making processes, and mental training are strategic interventions to balance cognitive load in MSMEs (Skulmowski & Xu, 2022).

Organizational Ergonomics

The findings on the role of work systems, communication, and task variation reinforce the core principle of socio-technical systems theory, which emphasizes joint optimization between social and technical subsystems as a prerequisite for organizational effectiveness (Imaduddin et al., 2025). However, this theoretical framework, which was originally developed for structured and formal organizational contexts, faces clear limitations when applied to micro, small, and medium enterprises (MSMEs). Unlike formal organizations, MSMEs typically exhibit flat, flexible, and non-standardized structures, which often result in role ambiguity, inefficient coordination, and latent conflicts. This structural informality exposes a critical theoretical gap between the assumptions of socio-technical systems theory and the practical realities of MSMEs. While structured internal communication has been highlighted as important for enhancing organizational efficiency, MSMEs rely predominantly on informal interpersonal communication, which lacks formal control mechanisms (Botzen et al., 2020). This reliance increases organizational vulnerability to miscommunication and operational delays, thereby diluting the effectiveness of ergonomic interventions. Similarly, although task variation is often considered a protective factor against burnout, in MSMEs such variation often emerges as a consequence of resource scarcity rather than deliberate job design strategy (Thomas, 2024) (Badri et al., 2025). Consequently, task variation in MSMEs may not yield the motivational benefits predicted by classical socio-technical theory.

These contextual divergences indicate that socio-technical systems theory requires adaptive reformulation to accommodate organizational realities characterized by informality, resource constraints, and multitasking. Instead of assuming structured task and communication systems, ergonomic interventions for MSMEs should balance flexibility with role clarity, communication structure, and task manageability. This theoretical refinement not only bridges the gap between classical ergonomics and MSME contexts but also provides a basis for more context-sensitive models of organizational design.

5. Conclusion

This study confirms that all dimensions of physical, cognitive, and organizational ergonomics significantly influence the formation of organizational culture in Small and Medium Enterprises (SMEs). The findings highlight the critical role of physical ergonomics, particularly through the regulation of work duration, the management of work environment conditions (such as temperature, humidity, lighting, and noise), and the design of tools, machines, and workstations. These elements are essential in ensuring a comfortable and productive workplace, which, in turn, fosters a supportive organizational culture. Cognitive ergonomics contributes to shaping organizational culture through logical reasoning, perception, and working relationships, particularly in roles requiring complex decision-making and communication. Organizational ergonomics, on the other hand, focuses on designing work systems that promote communication and task variation, alongside structuring the organization in a way that enhances efficiency and adaptability.

These ergonomic dimensions collectively form a foundation for a strong organizational culture, which has been shown to significantly impact performance. Specifically, the study found that a commitment to the vision and mission, strong team collaboration, and leadership support for innovation and ergonomic principles are key factors in improving performance in SMEs.

The findings underline the importance of adopting an integrated ergonomic approach as a strategic tool for fostering a positive work culture and enhancing SME performance. This approach emphasizes the need for SMEs to adopt a holistic view that combines physical, cognitive, and organizational ergonomics to optimize work conditions and boost employee well-being and performance.

Practical Implications

For practitioners and SME managers, this study offers several actionable recommendations: Regular ergonomic audits should be conducted to assess and align the working conditions with workers' needs, ensuring that the physical and cognitive demands are within acceptable limits. Organizational policies should focus on two-way communication, role-based training, and work flexibility to foster an environment conducive to employee engagement and innovation. Technologies that support cognitive load reduction and data-driven decision-making should be integrated to optimize work processes and enhance decision-making. SME leaders should be trained in ergonomic leadership styles that emphasize employee participation and innovation, creating a culture where workers feel empowered and motivated.

Theoretical Implications

Theoretically, this research contributes to the development of the socio-technical systems theory by applying it to SMEs, expanding its applicability beyond large industries. It demonstrates how integrating ergonomic principles with organizational culture can lead to improved performance in smaller, resource-constrained organizations. This study provides further evidence that ergonomics is not only a physical issue but also a cognitive and organizational one, requiring a multidisciplinary approach to address both the human and system factors in organizations.

Limitations and Recommendations for Future Research

While this study provides valuable insights, there are several limitations. First, the quantitative approach used in this research does not capture the subjective experiences of workers regarding ergonomics and organizational culture. Future research could adopt a qualitative approach to explore employees' perceptions of ergonomic practices and how they relate to organizational culture. Additionally, this study focused on SMEs in a specific geographic region, limiting the generalizability of the results. Future studies should consider longitudinal research and expand the research scope to different sectors or regions to enhance external validity.

Future research could also investigate the mediating role of organizational culture in greater depth, perhaps using advanced SEM techniques like bootstrapping to explore indirect effects more rigorously. Furthermore, exploring how specific ergonomic interventions impact individual performance and organizational outcomes would add value to the existing literature.

Policy Implications

For policymakers, the findings suggest the need for regulations that support ergonomic standards in SMEs. These could include setting reasonable work hour limits to prevent burnout and ensure employee well-being, providing subsidies or incentives for SMEs to improve their work environment, particularly in resource-constrained sectors, promoting ergonomics training programs for SME owners and workers, emphasizing the importance of ergonomics in improving productivity and reducing workplace injuries.

In conclusion, this study highlights the significant role of ergonomics in shaping organizational culture and improving SME performance. By integrating ergonomic principles into daily work practices, SMEs can not only enhance worker well-being but also foster a culture of innovation and efficiency, ultimately leading to sustainable organizational success.

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