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EMPLOYEE ENGAGEMENT AS A STRATEGIC MECHANISM LINKING SAFETY CULTURE AND DIGITAL TRANSFORMATION TO SUSTAINABLE PERFORMANCE IN INDONESIAN COAL MINING

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Abstract

Purpose - This study examines how safety culture and digital transformation shape employee engagement and sustainable performance in a high-risk coal mining context. It also investigates whether employee engagement mediates the effects of safety culture and digital transformation on sustainable performance. Design/methodology/approach - A quantitative explanatory design was used. Survey data were collected from 204 employees of PT Indominco Mandiri Bontang, Indonesia, selected from a population of 422 employees using proportionate stratified random sampling. The research model was tested with partial least squares structural equation modelling (PLS-SEM) using SmartPLS 4.0. The measurement model was assessed through outer loadings, Cronbach's alpha, composite reliability, average variance extracted, and Fornell-Larcker discriminant validity. The structural model was evaluated through R-square, f-square, path coefficients, and bootstrapped indirect effects. Findings - Safety culture has significant positive effects on employee engagement and sustainable performance. Digital transformation also has significant positive effects on employee engagement and sustainable performance. Employee engagement significantly improves sustainable performance and partially mediates both the safety culture-sustainable performance and digital transformation-sustainable performance relationships. The model explains 53.1% of the variance in employee engagement and 65.0% of the variance in sustainable performance. Originality/value - The study contributes to human resource management, safety management, and digital transformation literature by showing that sustainable performance in mining is not generated solely by safety systems or digital technologies, but by the ability of organizations to convert those resources into employee engagement. The findings extend the job demands-resources, social exchange, and resource-based perspectives to an under-researched Indonesian coal mining setting.

Keywords: safety culture; digital transformation; employee engagement; sustainable performance; coal mining; PLS-SEM; Indonesia

1. Introduction

Coal mining organizations operate under intense pressure to maintain productivity, protect workers, comply with safety regulations, and adapt to increasingly digitalized operations (Arzahan et al., 2022). In this environment, sustainable performance is not merely a question of output volume; it also concerns whether employees can maintain stable productivity, consistent work quality, resilience, adaptability, and proactive behavior over time (Christian et al., 2009). This issue is especially important in coal mining because operational risks, safety requirements, and technological changes are embedded in daily work routines (Clarke, 2013). Two organizational forces are particularly salient in this context: safety culture and digital transformation. Safety culture shapes shared assumptions, routines, and behavioral expectations regarding safe work (Bautista-Bernal et al., 2024). It also provides the social and managerial conditions that encourage employees to comply with procedures, communicate hazards, and participate in safety improvement activities (Arzahan et al., 2022). A mature safety culture can therefore become a strategic resource that supports both safety

outcomes and longer-term organizational performance (Christian et al., 2009). Digital transformation represents a second strategic force. Mining companies increasingly use digital safety reporting, equipment monitoring, data platforms, drone-based inspection, and integrated operational systems. These technologies can improve coordination and decision quality when they are embedded into organizational routines rather than treated as isolated technical tools (Vial, 2019). Digital transformation also requires changes in strategy, structure, culture, and employee capabilities, because technology creates value only when it is accepted and used meaningfully by organizational members (Verhoef et al., 2021). Recent work further shows that a clear transformation canvas can help organizations translate digital initiatives into coherent socio-technical change (Elia et al., 2024).

Employee engagement therefore becomes a critical explanatory mechanism. Engagement reflects the energy, dedication, focus, and perseverance that employees invest in their work (Bakker & Albrecht, 2018). The concept is rooted in the idea that people bring physical, cognitive, and emotional selves into role performance when work conditions are meaningful and supportive (Kahn, 1990). In operational settings, engagement is also reflected in vigor, dedication, and absorption, which help explain why some employees sustain performance despite pressure and change (Schaufeli et al., 2002). Despite growing interest in safety culture, digital transformation, and work engagement, the literature remains fragmented. Safety studies often emphasize accident prevention or compliance, while digital transformation studies often focus on technological capability, business process redesign, or organizational renewal (Carroll, 2023). Engagement research, meanwhile, typically explains work motivation and performance without always connecting safety and digitalization in one integrated model (Saks, 2006). This fragmentation limits understanding of how human, safety, and digital resources jointly support sustainable performance in high-risk industries (Fu et al., 2023).

This study addresses the gap by testing an integrated model of safety culture, digital transformation, employee engagement, and sustainable performance among employees of PT Indominco Mandiri Bontang, a coal mining company in East Kalimantan, Indonesia. The study asks whether safety culture and digital transformation influence employee engagement and sustainable performance, and whether employee engagement mediates these relationships. By doing so, the article offers three contributions. First, it links safety management and digital transformation in a single empirical model. Second, it positions employee engagement as a strategic mechanism through which organizational resources become sustainable performance, consistent with resource-based and JD-R reasoning (Bakker et al., 2023). Third, it provides evidence from an Indonesian coal mining setting, where empirical research remains limited compared with manufacturing, construction, services, and information technology contexts.

2. Literature Review and Hypothesis Development

2.1 Safety culture and employee engagement

Safety culture refers to shared values, norms, communication patterns, leadership commitments, and behavioral expectations that prioritize safety in daily work. In high-risk organizations, safety culture functions as a social control system that guides risk perception, hazard communication, and safe behavior (Clarke, 2013). Prior evidence shows that safety culture and safety climate are closely related to safety performance, particularly when leadership commitment and employee participation are visible in daily routines (Arzahan et al., 2022). Classical safety culture reviews also emphasize that safety culture integrates psychological, behavioral, and organizational dimensions (Guldenmund, 2000; Cooper, 2000). The job demands-resources perspective suggests that organizational resources such as management commitment, effective safety communication, participation in safety activities, and procedural compliance increase work engagement by reducing uncertainty and strengthening psychological security (Bakker et al., 2023). When employees interpret safety systems as evidence that the organization values their well-being, they are more likely to reciprocate through higher involvement and dedication (Saks, 2006). Safety culture can therefore operate as an engagement-generating resource rather than merely a compliance system (Kahn, 1990).

H1. Safety culture has a positive effect on employee engagement.

2.2 Digital transformation and employee engagement

Digital transformation involves the integration of digital technologies into work processes, organizational routines, decision systems, and cultural mindsets. In this study, it includes the use of digital technology in work, organizational adaptation to new technologies, employee digital capability, and the development of a digital mindset. Digital transformation is commonly understood as a multidimensional organizational change process, not simply a technology adoption project (Vial, 2019). This process requires alignment among digital strategy, organizational

capabilities, and employee behavior (Verhoef et al., 2021). However, digitalization can also create stress when employees lack training or perceive digital systems as imposed controls. This study argues that, when implemented with organizational support, digital transformation acts as a job resource by improving access to information, reducing manual burdens, increasing transparency, and strengthening employee learning (Fu et al., 2023). Digital transformation also shapes how employees experience work because digital tools alter collaboration, decision-making, and performance feedback processes (Carroll, 2023). Broader digitalization scholarship also warns that emerging technologies reshape organizational practices and require multidisciplinary attention to human and managerial consequences (Dwivedi et al., 2022).

H2. Digital transformation has a positive effect on employee engagement.

2.3 Safety culture and sustainable performance

Sustainable performance at the employee level reflects stable productivity, consistent work quality, resilience under work pressure, adaptability, and proactive behavior. Safety culture can support these outcomes by reducing preventable disruptions, increasing confidence in work systems, and encouraging responsible behavior (Bautista-Bernal et al., 2024). Meta-analytic evidence also indicates that safety climate and safety practices are linked to safer behavior and fewer adverse outcomes, which are prerequisites for sustained performance (Christian et al., 2009). When employees work in an environment where safety procedures are clear, leaders consistently communicate safety priorities, and workers participate in safety programs, they are more likely to maintain performance without sacrificing well-being. Safety leadership is especially relevant because leaders translate formal safety policies into daily expectations and behavior (Clarke, 2013). These conditions make safety culture a practical pathway for strengthening sustainable performance in operational work settings (Bautista-Bernal et al., 2024).

H3. Safety culture has a positive effect on sustainable performance.

2.4 Digital transformation and sustainable performance

Digital transformation can improve sustainable performance by enabling faster communication, better monitoring, more accurate data, and more efficient coordination. In mining, digital reporting systems and operational platforms can help employees identify problems earlier and respond more consistently. Digital transformation research emphasizes that such benefits emerge when technology is integrated with organizational routines and strategic decision processes (Vial, 2019). Digital innovation management also highlights the importance of combining digital tools with new organizational capabilities (Nambisan et al., 2017). From a resource-based view, digital capability is an organizational resource that creates value when embedded into routines and employee competences. Therefore, digital transformation is expected to enhance sustainable performance by improving learning, adaptability, and the quality of work execution (Fu et al., 2023). At the same time, digital transformation requires careful change management because technological renewal may reshape work roles and employee expectations (Verhoef et al., 2021).

H4. Digital transformation has a positive effect on sustainable performance.

2.5 Employee engagement and sustainable performance

Employee engagement reflects vigor, dedication, absorption, and perseverance. Engaged employees are more willing to invest discretionary effort, remain focused despite obstacles, and maintain high standards. The foundational engagement literature conceptualizes engagement as the harnessing of personal selves to work roles (Kahn, 1990), while later measurement work operationalizes engagement through vigor, dedication, and absorption (Schaufeli et al., 2002). In high-risk and changing environments, employees who are energetic, dedicated, focused, and persistent are better able to adapt to new procedures, sustain productivity, and act proactively. Engagement is therefore expected to support sustainable performance because it provides motivational energy and persistence over time (Bakker & Albrecht, 2018). This logic is also consistent with job demands-resources theory, which positions engagement as a central motivational pathway linking work resources to performance (Bakker et al., 2023).

H5. Employee engagement has a positive effect on sustainable performance.

2.6 The mediating role of employee engagement

This study further proposes that employee engagement explains how safety culture and digital transformation translate into sustainable performance. Safety culture provides psychological security, trust, and procedural clarity, while

digital transformation provides informational and technological resources. These resources can activate engagement, which then supports stable and adaptive performance (Kahn, 1990). Prior studies on digital capability similarly suggest that learning and engagement-related mechanisms help explain how digitalization contributes to sustainable employee outcomes (Fu et al., 2023). Because safety culture and digital transformation may also directly affect work systems and performance processes, engagement is expected to function as a partial mediator rather than a purely indirect mechanism. This logic aligns with PLS-SEM research practice, where direct and indirect effects are interpreted jointly to understand the theoretical mechanism of a model (Benitez et al., 2020). The mediation model also reflects the job demands-resources assumption that organizational resources can influence performance both directly and through motivational states (Bakker et al., 2023).

H6. Employee engagement mediates the relationship between safety culture and sustainable performance.

H7. Employee engagement mediates the relationship between digital transformation and sustainable performance.

3. Methodology

3.1 Research design and context

The study used a quantitative explanatory design to test causal relationships among latent variables. The empirical setting was PT Indominco Mandiri Bontang, a coal mining company operating in East Kalimantan, Indonesia. This setting is appropriate because coal mining combines high safety risk, operational complexity, and increasing digitalization. The explanatory design is suitable for testing theoretically specified relationships among safety culture, digital transformation, engagement, and sustainable performance, particularly when the model aims to explain and predict latent constructs (Hair et al., 2022). The research design was cross-sectional. Data were collected using a structured questionnaire measuring safety culture, digital transformation, employee engagement, and sustainable performance. The use of PLS-SEM was appropriate because the study tested a prediction-oriented model involving multiple latent constructs and mediation relationships (Hair et al., 2022). PLS-SEM is also suitable when the objective is to estimate complex explanatory models and evaluate measurement and structural quality simultaneously (Benitez et al., 2020).

3.2 Population, sample, and data collection

The population consisted of 422 employees involved in operational activities, safety implementation, and digital transformation-related work processes. Using the Cochran formula and finite population adjustment, the minimum representative sample was set at 204 respondents. The sampling method was proportionate stratified random sampling to ensure that employees from relevant divisions were proportionally represented. This sampling logic supports the interpretation of PLS-SEM results because adequate sample size and relevant respondent coverage are central to model estimation quality (Hair et al., 2022). The final sample included employees from administration, digital and system performance management, external affairs, health, safety, environment and community development, mine head, operations, and port, utilities and maintenance. The survey used a five-point Likert scale ranging from strongly disagree to strongly agree.

3.3 Measures

Safety culture was measured through four indicators: management commitment to safety, effective safety communication, employee involvement in safety activities, and compliance with safety procedures. These indicators reflect core safety culture and safety climate dimensions emphasized in prior safety research (Arzahan et al., 2022). Digital transformation was measured using technology use, organizational adaptation, employee digital capability, and digital mindset, consistent with the view of digital transformation as a strategic and cultural change process (Vial, 2019). Employee engagement was measured through vigor, dedication, absorption, and perseverance, drawing on the dominant engagement tradition (Schaufeli et al., 2002). Sustainable performance was measured through stable productivity, consistent quality, resilience, adaptability, and proactive behavior, consistent with research linking digital capability to sustainable employee outcomes (Fu et al., 2023). All constructs were modeled reflectively because the indicators were treated as manifestations of the underlying latent variables. Higher scores indicated stronger perceptions of the respective construct. This reflective specification is consistent with PLS-SEM guidance when indicators are expected to covary as

expressions of a common latent construct (Hair et al., 2022). Discriminant validity was later assessed using both the Fornell-Larcker logic and the HTMT tradition in PLS-SEM reporting (Fornell & Larcker, 1981; Henseler et al., 2015).

3.4 Data analysis

Data were analyzed with PLS-SEM using SmartPLS 4.0. The measurement model was evaluated through outer loadings, Cronbach's alpha, composite reliability, average variance extracted, and discriminant validity. The structural model was evaluated through R-square, f-square, bootstrapped path coefficients, and mediation effects, following established PLS-SEM reporting guidelines (Hair et al., 2022). Minimum sample size and model evaluation were also considered in light of contemporary PLS-SEM recommendations for applied management research (Kock & Hadaya, 2018; Sarstedt et al., 2021).

4. Results

4.1 Respondent profile

The study included 204 respondents. The majority were male (81.9%), reflecting the operational characteristics of the mining sector. Most respondents were in productive age groups, particularly 26-35 years (36.3%) and 36-45 years (30.9%). Regarding education, the largest groups held undergraduate degrees (38.2%) and senior high school qualifications (35.3%). The largest divisional representation came from operations (38.2%), followed by HSEC (15.7%) and port, utilities and maintenance (14.2%). By position, the largest groups were foremen (21.6%), supervisors (19.1%), and operators (18.6%).

4.2 Descriptive statistics

The descriptive results show that all constructs were perceived at a moderate level. Safety culture obtained the highest mean score (3.25), followed by employee engagement and sustainable performance (both 3.23), while digital transformation obtained the lowest mean score (3.20). These findings indicate that although the company has established safety and digital practices, there remains room to strengthen employee participation, digital mindset, perseverance, and resilience under pressure. This pattern is theoretically meaningful because safety, digital capability, and engagement are expected to function as organizational and motivational resources (Bakker et al., 2023).

Table 1. Descriptive statistics of construct indicators.

Construct	Indicator	Code	Mean
Safety culture	Management commitment to safety	BK1	3.28
Safety culture	Effective safety communication	BK2	3.23
Safety culture	Involvement in safety activities	BK3	3.19
Safety culture	Compliance with safety procedures	BK4	3.31
Digital transformation	Use of digital technology	TD1	3.21
Digital transformation	Adaptation to new technology	TD2	3.23
Digital transformation	Employee digital capability	TD3	3.25
Digital transformation	Digital mindset	TD4	3.13
Employee engagement	Vigor	EE1	3.29
Employee engagement	Dedication	EE2	3.22
Employee engagement	Absorption	EE3	3.23
Employee engagement	Perseverance	EE4	3.16
Sustainable performance	Stable productivity	SP1	3.25
Sustainable performance	Consistent work quality	SP2	3.25
Sustainable performance	Resilience under pressure	SP3	3.11
Sustainable performance	Adaptability	SP4	3.25
Sustainable performance	Proactive behavior	SP5	3.27

4.3 Measurement model

The measurement model met the recommended criteria for reliability and validity. All outer loadings exceeded 0.70. Cronbach's alpha values ranged from 0.898 to 0.928, composite reliability values ranged from 0.929 to 0.946, and AVE

values ranged from 0.765 to 0.790. These results indicate satisfactory convergent validity and internal consistency according to common PLS-SEM criteria (Hair et al., 2022). The reliability and validity evidence also supports the interpretation of subsequent structural paths (Benitez et al., 2020).

Table 2. Measurement model results.

Construct	Outer loading range	Cronbach alpha	Composite reliability	AVE
Safety culture	0.850-0.883	0.898	0.929	0.765
Digital transformation	0.877-0.906	0.912	0.938	0.790
Employee engagement	0.859-0.888	0.899	0.930	0.767
Sustainable performance	0.868-0.901	0.928	0.946	0.777

Discriminant validity was also established using the Fornell-Larcker criterion. The square root of AVE for each construct was higher than its correlations with other constructs. Therefore, the constructs were empirically distinct and suitable for structural model testing (Fornell & Larcker, 1981). This conclusion is also consistent with the broader PLS-SEM emphasis on demonstrating that latent constructs capture conceptually different phenomena (Henseler et al., 2015).

Table 3. Fornell-Larcker discriminant validity.

Construct	Safety culture	Employee engagement	Sustainable performance	Digital transformation
Safety culture	0.875			
Employee engagement	0.569	0.876		
Sustainable performance	0.593	0.754	0.882	
Digital transformation	0.077	0.498	0.494	0.889

4.4 Structural model and hypothesis testing

The structural model demonstrated meaningful explanatory power. Safety culture and digital transformation explained 53.1% of the variance in employee engagement. Safety culture, digital transformation, and employee engagement explained 65.0% of the variance in sustainable performance. The adjusted R-square values were close to the R-square values, indicating stable model estimation. Such explanatory power is consistent with the use of PLS-SEM for prediction-oriented models in organizational research (Hair et al., 2022).

Table 4. Coefficient of determination.

Endogenous construct	R-square	Adjusted R-square
Employee engagement	0.531	0.526
Sustainable performance	0.650	0.644

The f-square results show that safety culture had a large effect on employee engagement (0.603), and digital transformation also had a large effect on employee engagement (0.443). Employee engagement had a medium effect on sustainable performance (0.275). Safety culture had a medium direct effect on sustainable performance (0.177), whereas digital transformation had a small-to-medium direct effect on sustainable performance (0.116). Interpreting these effect sizes alongside path coefficients helps avoid overreliance on statistical significance alone (Benitez et al., 2020).

Table 5. Effect size results.

Relationship	f-square	Interpretation
Safety culture -> Employee engagement	0.603	Large
Digital transformation -> Employee engagement	0.443	Large
Employee engagement -> Sustainable performance	0.275	Medium
Safety culture -> Sustainable performance	0.177	Medium
Digital transformation -> Sustainable performance	0.116	Small to medium

Bootstrapping results supported all direct and indirect hypotheses. Safety culture positively affected employee engagement (beta = 0.533, t = 11.439, $p < 0.001$) and sustainable performance (beta = 0.316, t = 5.820, $p < 0.001$). Digital transformation positively affected employee engagement (beta = 0.457, t = 9.476, $p < 0.001$) and sustainable performance

(beta = 0.243, t = 4.929, p < 0.001). Employee engagement positively affected sustainable performance (beta = 0.454, t = 8.180, p < 0.001). The use of bootstrapping is appropriate for testing the significance of structural paths and mediation effects in PLS-SEM (Hair et al., 2022).

Table 6. Hypothesis testing results.

Hypothesis	Path	Beta	t-statistic	p-value	Decision
H1	Safety culture -> Employee engagement	0.533	11.439	0.000	Supported
H2	Digital transformation -> Employee engagement	0.457	9.476	0.000	Supported
H3	Safety culture -> Sustainable performance	0.316	5.820	0.000	Supported
H4	Digital transformation -> Sustainable performance	0.243	4.929	0.000	Supported
H5	Employee engagement -> Sustainable performance	0.454	8.180	0.000	Supported
H6	Safety culture -> Employee engagement -> Sustainable performance	0.242	6.782	0.000	Supported
H7	Digital transformation -> Employee engagement -> Sustainable performance	0.207	5.745	0.000	Supported

5. Discussion

5.1 Safety culture as an engagement-generating resource

The positive effect of safety culture on employee engagement indicates that safety systems shape more than compliance behavior. In a high-risk mining context, management commitment, safety communication, participation, and compliance create a work environment in which employees feel protected and supported (Arzahan et al., 2022). This finding is consistent with evidence that safety culture and leadership practices are linked to safety behavior and safety performance (Christian et al., 2009). This finding supports the idea that safety culture should be treated as a human resource management issue as well as a safety management issue. Employees do not become engaged simply because rules exist. They become engaged when rules are supported by credible leadership, meaningful communication, and visible concern for employee well-being (Clarke, 2013). The result therefore extends safety culture research by connecting safety management with the motivational logic of work engagement (Bakker et al., 2023).

5.2 Digital transformation as a socio-technical resource

The positive effect of digital transformation on employee engagement shows that digitalization can be experienced as a supportive work resource. In this study, employee digital capability and organizational adaptation to technology helped explain why digital transformation strengthened engagement. This interpretation aligns with research that frames digital transformation as a strategic change process involving people, processes, and technology (Vial, 2019). It also supports the argument that digital transformation creates value when it is translated into employee learning and usable work resources (Fu et al., 2023). This result also cautions against viewing digital transformation as a purely technical project. Digital platforms, reporting systems, and operational technologies contribute to performance only when employees perceive them as useful, manageable, and relevant to their work. Digital transformation therefore requires socio-technical alignment, capability development, and cultural readiness (Verhoef et al., 2021). The digital transformation canvas similarly emphasizes that leaders must coordinate technological, strategic, and organizational dimensions of transformation (Elia et al., 2024).

5.3 Engagement as a driver of sustainable performance

The strong positive effect of employee engagement on sustainable performance demonstrates that sustainable performance depends on the quality of employees' psychological connection with work. Engaged employees are more capable of maintaining effort, concentration, and persistence, especially when work is risky or demanding (Schaufeli et al., 2002). This finding is consistent with the engagement literature showing that engaged employees invest more energy and attention in their roles (Kahn, 1990). The finding also shows that employee engagement should be managed as a strategic performance capability. Sustainable performance cannot be achieved by technology and procedures alone. It requires employees who have the energy, dedication, focus, and perseverance to use systems effectively and maintain

high standards over time (Bakker & Albrecht, 2018). This interpretation reinforces the job demands-resources view that engagement is a key motivational pathway from resources to performance (Bakker et al., 2023).

5.4 The mediating role of engagement

The mediation results show that engagement partially mediates the effects of both safety culture and digital transformation on sustainable performance. This means that safety culture and digital transformation influence performance directly, but they also operate through employee engagement. The safety pathway is consistent with evidence that safety culture is associated with organizational and performance outcomes (Bautista-Bernal et al., 2024). The digital pathway is consistent with evidence that digital capability can improve sustainable employee performance through learning-related mechanisms (Fu et al., 2023). The partial mediation is theoretically important. It suggests that safety culture and digital transformation are not merely background conditions. They are organizational resources that become more powerful when they are translated into employee motivation and involvement. This interpretation aligns with socio-technical digital transformation thinking (Carroll, 2023) and with engagement theory's emphasis on meaningful, safe, and resourceful work conditions (Saks, 2006).

6. Theoretical and Practical Implications

6.1 Theoretical implications

This study contributes to the literature in three ways. First, it integrates safety culture and digital transformation into a single model of sustainable employee performance. This integration is important because safety and digitalization are often examined separately, even though both shape daily work in high-risk organizations (Arzahan et al., 2022). Second, the study extends digital transformation research by showing that employee engagement helps explain how digital resources become performance-relevant in operational work (Vial, 2019). Third, the study extends the job demands-resources perspective by showing that safety culture and digital transformation operate as organizational resources that strengthen engagement. It also extends resource-based and socio-technical approaches by showing that safety and digital resources become more valuable when employees are psychologically connected to their work (Bakker et al., 2023). Methodologically, the study demonstrates a coherent use of PLS-SEM for testing direct and indirect relationships among latent constructs (Benitez et al., 2020).

6.2 Practical implications

For PT Indominco Mandiri and similar mining organizations, the findings imply that safety culture should be strengthened through visible management commitment, two-way safety communication, and stronger employee participation in safety activities. Safety leadership should be enacted consistently at supervisory and operational levels because employees judge safety culture through daily managerial behavior (Clarke, 2013). Strengthening safety culture may also support performance by reducing operational disruption and strengthening employee confidence in work systems (Christian et al., 2009). Digital transformation should be implemented as a socio-technical change process. Training, user-friendly systems, peer support, and clear communication about the purpose of digital tools are necessary to build digital capability and reduce resistance. Organizations should avoid treating digital tools as isolated applications; instead, they should align digital technology with strategy, processes, and culture (Verhoef et al., 2021). A structured digital transformation framework can help managers connect digital initiatives with employee capability and organizational value creation (Elia et al., 2024). Management should also treat engagement as a strategic bridge between safety, technology, and performance. Recognition systems, participatory problem-solving, supervisor coaching, and opportunities for employees to contribute to safety and digital improvement can strengthen vigor, dedication, absorption, and perseverance. Such practices are consistent with engagement theory, which emphasizes meaningfulness, safety, and availability as conditions for investing the self in work roles (Kahn, 1990).

7. Limitations and Future Research

This study has several limitations. First, the cross-sectional design limits strong causal inference. Future studies should use longitudinal designs to examine how safety culture, digital transformation, engagement, and sustainable performance evolve over time. Second, all constructs were measured through self-report questionnaires, which may create common method concerns, a recurring issue in behavioral survey research (Podsakoff et al., 2003). Future research can combine survey data with supervisor ratings, safety records, digital usage data, or objective performance indicators.

Methodologically, future studies can also compare PLS-SEM with covariance-based SEM or longitudinal modeling when theory and data allow stronger causal tests (Hair et al., 2022; Sarstedt et al., 2021).

Third, the study was conducted in one coal mining company in Indonesia. Although the setting is theoretically relevant, future research should compare multiple mining companies or industries to improve generalizability. Researchers may also examine whether digital capability, safety leadership, or organizational learning moderate the relationships tested in this model. Future studies should also consider sample size planning and statistical power more explicitly when extending the model to multigroup or longitudinal designs (Kock & Hadaya, 2018).

8. Conclusion

This study demonstrates that safety culture and digital transformation significantly improve employee engagement and sustainable performance in an Indonesian coal mining context. Employee engagement also significantly improves sustainable performance and partially mediates the effects of safety culture and digital transformation. These findings confirm that sustainable performance in high-risk work is shaped by both protective safety resources and enabling digital resources (Bautista-Bernal et al., 2024; Fu et al., 2023). For high-risk mining organizations, the central managerial lesson is clear: safety and digitalization must be designed around people. A strong safety culture protects employees, digital transformation equips them, and engagement converts these resources into sustained performance. This people-centered interpretation is consistent with digital transformation research that emphasizes organizational renewal (Vial, 2019) and with engagement theory that highlights the importance of meaningful and supportive work conditions (Saks, 2006).

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