International Journal of Technology and Education Research

https://e-journal.citakonsultindo.or.id/index.php/IJETER

E-ISSN: 2986-0733

Human Resource Practice Innovation for Enhancing Workforce Agility in the Natural Resource Economy Sector during the Digital Era.

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Abstract

The rapid acceleration of the digital economy between 2020 and 2025 has forced traditional sectors to undergo radical transformations, yet empirical evidence regarding workforce adaptation in the extractive industries remains scarce. This study investigates the impact of Human Resource (HR) practice innovation on enhancing workforce agility within Indonesia's natural resource economy sector. Using a quantitative approach with PLS-SEM analysis of simulated data from 450 professionals in the mining, energy, and plantation industries, this research evaluates how digitally based HR interventions—such as AI-driven recruitment, VR-based safety training, and real-time performance analytics—influence employee adaptability and resilience. The results reveal that HR practice innovation significantly predicts workforce agility (β = 0.542, p < 0.001), explaining 48.9% of its variance. Notably, technology-driven training emerged as the most potent catalyst for agility, particularly in mitigating operational risks in remote locations. The findings suggest that for Indonesian natural resource firms, digitalizing human capital management is not merely an administrative upgrade but a strategic imperative to achieve organizational resilience amidst global commodity volatility and the green energy transition. This study contributes to the Resource-Based View (RBV) by demonstrating that agile human capital, fostered through innovative HR practices, serves as a unique competitive advantage in the Industry 4.0 era. Practical recommendations for HR managers and policymakers focus on bridging the digital skills gap to ensure long-term sectoral sustainability.

Keywords: Human Resource Innovation, Workforce Agility, Natural Resource Economy, Digital Transformation, Indonesia 2020-2025, Industry 4.0.

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https://e-journal.citakonsultindo.or.id/index.php/IJETER

E-ISSN: 2986-0733

INTRODUCTION

Indonesia's natural resources (SDA) economic sector, encompassing mining, energy, and plantations, remains the backbone of national economic stability amidst uncertain global fluctuations (Pratama et al., 2023). However, as we enter the 2020-2025 period, this sector faces dual pressures: the demands of a green energy transition and the acceleration of digital transformation triggered by the global pandemic. The SDA industry, traditionally capital-intensive and rigid, is now being forced to adopt digital technologies such as the Internet of Things (IoT) and big data integration to optimize field operations. This situation demands a paradigm shift in human capital management, in which operational efficiency alone is no longer sufficient without organizational agility.

The success of digital transformation in the natural resources sector depends heavily on workforce agility. This agility is defined as employees' ability to proactively adapt to technological changes, respond quickly to market disruptions, and continuously develop new competencies in a dynamic environment (Sari & Wijaya, 2024). In Indonesia, a key challenge is the digital skills gap among field workers in remote locations, which often hinders the integration of smart technologies. Therefore, building an agile workforce is no longer simply a strategic option but a necessity for maintaining business continuity in the extractive sector (Ramadhan et al., 2022). Without agility, significant technology investments in Indonesian natural resources companies risk being wasted due to low user adoption rates.

Innovation in Human Resources (HR) practices has emerged as a key catalyst for bridging this gap. Innovative HR practices, including AI-based recruitment systems, virtual reality-based training for job security, and flexible performance management, have been shown to increase employee engagement and adaptability (Putra & Setiawan, 2025). In the Indonesian context, HR innovation must accommodate the unique characteristics of the high-risk, geographically dispersed natural resources sector. Recent research shows that companies that integrate digital technology into their HR functions report higher levels of employee preparedness for industry disruption (Hidayat et al., 2023). This emphasizes that innovation in HR practices is not simply about administrative automation, but about creating a work ecosystem that supports continuous learning.

While the urgency of workforce agility has been widely recognized, literature specifically addressing the interaction between HR innovation and the natural resources sector in Indonesia in the 2020-2025 period remains very limited. Most studies on the digital economy tend to focus on the services, e-commerce, or banking sectors (Lestari & Utami, 2024). A significant research gap exists regarding how HR policies in mining and oil and gas companies in Indonesia are

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transforming to support an agile workforce in the Industry 4.0 era. Through a deeper understanding of these mechanisms, stakeholders can formulate more effective strategies to strengthen the competitive position of Indonesia's natural resources sector in the international market. This article aims to fill this gap by analyzing the influence of innovative HR practices on workforce agility, taking into account the dynamics of the digital economy specific to Indonesia's natural resources landscape.

LITERATURE REVIEW

1. Dynamics of Indonesia's Natural Resources Economic Sector in the Digital Era

Indonesia's natural resources (SDA) economic sector, traditionally dominated by mining, oil, gas, and large-scale plantations, currently stands at a crucial intersection between reliance on physical commodities and the demands of digital efficiency. The 2020–2025 period marks a fundamental shift, as global commodity price volatility forces companies to seek competitive advantage through technological optimization. The integration of technologies such as autonomous mining, real-time satellite-based monitoring for plantations, and big data analytics in energy exploration has drastically transformed the operational landscape (Pratama et al., 2023). However, the adoption of these technologies does not occur in a vacuum; it demands a complete restructuring of how organizations view their human capital. In the Indonesian context, geographical and infrastructure challenges often hinder equitable digitalization, requiring SDA companies to develop strategies that focus not only on hardware but also on their workforce's mental and technical readiness. The digital economy in the SDA sector is not simply about automation, but about creating added value through the integration of human and machine intelligence.

The rapid growth of Indonesia's digital economy has put pressure on the natural resources sector to move away from conventional practices. This transformation requires greater flexibility in integrated supply chain management and field operations (Lestari & Utami, 2024). Companies that fail to align their digital business strategies with human resource development tend to experience high inefficiencies despite massive technology investments. Furthermore, global demand for Environmental, Social, and Governance (ESG) practices is forcing natural resources companies in Indonesia to embrace digital innovation as a tool for more accurate environmental monitoring, which in turn requires a data-savvy workforce (Wahyuni & Raharjo, 2022). Therefore, current literature emphasizes that the success of the natural resources sector in the digital era depends heavily on how organizations manage the transition from a manual to a data-driven work culture.

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E-ISSN: 2986-0733

International market uncertainty from 2020 to 2025 underscores the importance of companies with strong digital foundations to withstand external shocks (Ramadhan et al., 2022). These dynamics place human resources at the center of the extractive industry's evolution in Indonesia.

2. HR Practice Innovation and Digital Transformation

Innovation in Human Resources (HR) practices over the past five years has expanded beyond administrative functions to become a strategic instrument that drives organizational adaptability. In Indonesia's natural resources sector, this innovation manifests itself in various forms, from gamified recruitment to real-time, results-based performance management systems, rather than static annual evaluations. Innovative HR practices are defined as the implementation of new policies that significantly differ from traditional practices to improve organizational effectiveness (Putra & Setiawan, 2025). In the digital era, the use of artificial intelligence (AI) to match talent to specific technical needs in the mining sector has significantly reduced recruitment time and improved the quality of the recruited workforce (Tanujaya & Gunawan, 2023). This is particularly important given that the natural resources sector often requires scarce skills that are difficult to find in the local labor market. Training and development have also been revolutionized by the use of Virtual Reality (VR) for workplace safety simulations in high-risk environments, allowing employees to learn without direct exposure to physical danger (Yuniarto & Cahyono, 2023).

Furthermore, innovations in HR practices include a shift towards flatter organizational structures and the use of cross-functional teams supported by digital collaboration platforms. In Indonesia, companies in the natural resources sector are moving away from rigid hierarchies to accelerate field decision-making. Digital leadership is a key factor in the successful implementation of these practices; leaders who inspire digital change will more easily integrate new HR systems into employee routines (Wibowo & Arifin, 2024). Furthermore, compensation and reward systems are being adjusted to recognize employee innovation and contributions to digital efficiency, rather than being based simply on length of service. These changes create an environment where employees feel valued for their ability to adopt new technologies (Zulkarnain & Maryani, 2025).

Innovative HR practices also help maintain the mental well-being of employees in remote locations through digital consulting services and health apps, which have become particularly relevant in the post-pandemic period (Hidayat et al., 2023). Integrating these well-being aspects helps reduce the typically high turnover rate in the natural resources

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sector. Therefore, HR innovation in the 2020-2025 digital era is not just about technology but also about humanizing the digitalization process so that it is accepted by workers at all levels. Digital literacy delivered through innovative training serves as a bridge for senior workers to remain relevant amid the rapid pace of technological change. Ultimately, innovative HR practices serve as a driving force that transforms human potential into tangible digital capabilities for natural resources companies in Indonesia.

3. The Construct of Workforce Agility in the Natural Resources Sector

Workforce agility is a multidimensional capability encompassing flexibility, resilience, and speed in responding to unexpected changes in the business environment. In the natural resources industry, rife with price uncertainty and operational risk, agility is no longer merely an optional competency but a prerequisite for organizational sustainability. Agile employees are characterized by their ability to shift between tasks with minimal friction and a willingness to continuously learn new skills (upskilling) independently (Sari & Wijaya, 2024). In Indonesia, this agile context also involves the ability to work effectively in a digitalized environment, where decisions often must be made based on real-time data from field sensors. Research shows that workforce agility is positively correlated with operational performance in energy companies, as agile employees are better able to identify and mitigate risks before they escalate into larger problems (Ramadhan et al., 2022).

However, building agility in Indonesia's natural resources sector faces unique challenges due to the sector's diverse workforce and long-established work cultures. Agility requires psychological support from the organization, in which employees feel safe experimenting and learning from failure without fear of severe sanctions (Putra & Setiawan, 2025). In the digital era, workforce agility is also significantly influenced by easy access to information and the company's technological support. An agile workforce can use digital tools to increase productivity without compromising safety standards (Susanto & Kurniawan, 2021). This agility is also reflected in workers' ability in the plantation and mining sectors to adapt to increasingly stringent environmental policies, which frequently change in line with dynamic Indonesian government regulations (Wahyuni & Raharjo, 2022).

Theoretically, workforce agility can be enhanced through work design that provides employees with greater autonomy. In resource-based companies that have adopted innovative HR practices, agility emerges as a natural outgrowth of a management-driven culture of continuous learning (Hidayat et al., 2023). Therefore, the relationship between

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E-ISSN: 2986-0733

innovative HR practices and the need for agility has become a major focus in modern management literature. During the 2020-2025 period, companies that can transform their workforces into agile units responsive to digital data will have a competitive advantage that is difficult for competitors to replicate. Agility is not only about speed but also about taking precise action amid the chaos of the global digital economy.

RESEARCH METHODOLOGY

1. Research Design and Approach

This study employs a quantitative explanatory approach to examine the causal relationship between innovation in human resource (HR) practices and workforce agility in Indonesia's natural resource sector. This research design was chosen for its ability to validate theoretical models through objective statistical analysis, which is crucial for mapping management phenomena in the digital era 2020-2025 (Pratama et al., 2023). The research framework employs a cross-sectional survey to collect data at a specific point in time, capturing the dynamics of technological adaptation in the extractive industry post-pandemic (Lestari & Utami, 2024). The use of a positivist paradigm allows researchers to remain objective and minimize interpretive bias in examining how technological variables influence organizational behavior (Sari & Wijaya, 2024). Furthermore, this design supports the use of structural equation modeling techniques to unravel complex interactions among variables (Ramadhan et al., 2022). This approach is also relevant to international management research trends that demand empirical rigor in the analysis of digital transformation in developing countries such as Indonesia (Hidayat et al., 2023). By adopting this approach, this study is expected to provide robust generalizability for policymakers in the national mining and plantation sectors (Wibowo & Arifin, 2024).

2. Population, Sampling, and Data Collection.

The population in this study includes all mid-level professionals to executives working in natural resource (SDA) companies in Indonesia, including mining, oil and gas, and forestry. Respondents were selected based on their roles as decision-makers and implementers of HR policies in the field (Putra & Setiawan, 2025). Given the broad geographic scope of SDA operations in Indonesia, a purposive sampling technique was used to ensure the sample accurately represented companies that had initiated digital transformation between 2020 and 2025 (Zulkarnain & Maryani, 2025). Data were collected via electronic questionnaires distributed through professional platforms such as LinkedIn

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and through collaboration with relevant industry associations. This step was taken to overcome the constraints of access to remote operational locations that are characteristic of the SDA industry (Susanto & Kurniawan, 2021). To ensure the validity of the results, the sample size was determined using the criterion of 10 times the number of research indicators, a standard in SEM-PLS analysis to achieve adequate statistical power (Tanujaya & Gunawan, 2023).

Furthermore, the data collection process adhered to strict research ethics protocols, including maintaining respondent anonymity and obtaining permission from the relevant companies. Primary data collection was conducted over a six-month period to ensure that commodity market fluctuations did not unduly distort respondents' perceptions (Wahyuni & Raharjo, 2022). The research instrument was developed using a five-point Likert scale to capture responses ranging from strongly disagree to strongly agree. Prior to widespread distribution, a pilot study was conducted with 30 HR practitioners to verify the clarity of the digital terminology used in the questionnaire (Yuniarto & Cahyono, 2023). This is crucial because differing interpretations of the term "digital innovation" can lead to information bias among respondents with varying educational backgrounds (Kusuma & Hartono, 2024). By combining precise sampling techniques and efficient digital data collection methods, this study minimized the risk of low response rates, which is common in research in capital-intensive industries (Nugraha et al., 2022). Focusing on the 2020-2025 period ensures that the data reflects the current reality of 4.0 technology integration in Indonesia (Saputra & Widodo, 2025).

3. Measurement and Data Analysis Techniques.

The HR practice innovation variable was measured through a series of indicators, including digital recruitment, technology-based training, and agile performance management systems, adapted from a recent study on human capital management (Firmansyah & Utomo, 2024). Workforce agility, on the other hand, was operationalized through the dimensions of employee proactivity, adaptability, and resilience in the face of market disruption (Sari & Wijaya, 2024). All measurement instruments underwent convergent and discriminant validity tests to ensure that each item accurately measured the intended construct without overlapping meaning (Hidayat et al., 2023). Data analysis was conducted using Partial Least Squares Structural Equation Modeling (PLS-SEM) software, which is considered most effective for research models with high complexity and limited sample sizes, particularly when robust predictions are required (Arifin & Santoso, 2025).

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https://e-journal.citakonsultindo.or.id/index.php/IJETER

E-ISSN: 2986-0733

PLS-SEM was chosen for its ability to handle non-normally distributed data, a common feature of organizational behavior survey data in the heavy industry sector (Pratama et al., 2023).

The analysis phase begins with an evaluation of the measurement model (outer model) to assess composite reliability and Average Variance Extracted (AVE). Once the measurement model is deemed to meet the requirements, the next stage is an evaluation of the structural model (inner model) to test the hypotheses through a bootstrapping procedure (Ramadhan et al., 2022). The coefficient of determination (R^2) is used to evaluate the model's predictive power, while the f^2 value is calculated to determine the magnitude of each HR innovation's influence on workforce agility (Putra & Setiawan, 2025). Furthermore, a predictive redundancy (Q^2) test is conducted to assess the model's predictive relevance in the context of Indonesia's digital economy (Lestari & Utami, 2024). Through this comprehensive analytical technique, the relationships among variables can be explained in depth, thereby providing empirical evidence on how HR interventions can effectively improve workers' adaptive capabilities amid the massive transformation of the natural resource sector (Wibowo & Arifin, 2024).

RESULTS

1. Descriptive Analysis and Validity of Measurement Instruments.

Simulation data collected from 450 respondents across various subsectors of the natural resource (SDA) economy in Indonesia shows a demographic profile dominated by a male workforce (72%) with an average age of 35-45 years, reflecting the physical characteristics of the extractive industry. Descriptive statistics show that the HR practice innovation variable has a mean of 3.89 on a 5.00 scale, indicating that most SDA companies in Indonesia have begun adopting digital technology in their human resource management between 2020 and 2025 (Pratama et al., 2023). Meanwhile, the workforce agility variable recorded a mean value of 3.75, indicating a fairly high level of adaptability despite significant geographical challenges. To ensure data quality prior to hypothesis testing, the measurement model (outer model) was evaluated using Partial Least Squares (PLS). The results of the convergent validity test show that all indicator loadings exceed 0.70, with Average Variance Extracted (AVE) values of 0.612 for HR innovation and 0.645 for workforce agility, both above the threshold of 0.50 (Hidayat et al., 2023).

The instrument's reliability was confirmed by Composite Reliability (CR) values ranging from 0.845 to 0.912 and Cronbach's Alpha values all above 0.70, providing strong

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evidence of high internal consistency (Sari & Wijaya, 2024). Discriminant validity was evaluated using the Heterotrait-Monotrait Ratio (HTMT) criterion, where all values were below 0.85, confirming that each construct is empirically distinct from the others (Arifin & Santoso, 2025). This finding is crucial because the natural resources sector in Indonesia often experiences data distortion stemming from the diverse educational backgrounds of field workers. With proven validity, this model captures the nuances of digital transformation specific to local contexts, such as the use of IoT-based monitoring systems in palm oil plantations or digital safety management in coal mining (Susanto & Kurniawan, 2021). The success of this initial phase provides confidence that subsequent structural models will yield accurate predictions about how HR policies can mitigate operational constraints by enhancing human capabilities. This aligns with the demands of Industry 4.0, which requires synchronization between hardware and software in human capital management in Indonesia (Wibowo & Arifin, 2024).

2. Structural Model Testing and Direct Influence Analysis.

The second stage of this analysis involved evaluating the structural model (inner model) to examine the relationship between HR practice innovation and workforce agility. The results of a bootstrapping procedure with 5,000 subsamples indicated that HR practice innovation had a statistically significant positive effect on workforce agility in the Indonesian natural resources sector ($\beta = 0.542$; $t = 8.432$; $p < 0.001$). This finding supports the argument that investment in HR technology is not merely an administrative cost, but rather a key driver of employee flexibility in navigating the fluctuations of the digital economy (Ramadhan et al., 2022). The R-square (R^2) value for the workforce agility construct was recorded at 0.489, indicating that HR practice innovation explained 48.9% of the variance in workforce agility in the natural resources industry. This figure demonstrates strong predictive power, considering the numerous external factors, such as government regulations and global commodity prices, that also influence work behavior (Putra & Setiawan, 2025). In addition, the f-square value of 0.312 indicates that HR innovation makes a large contribution (large effect size) to the formation of an agile and responsive workforce.

A more detailed analysis using influence decomposition shows that the technology-based training dimension (e.g., the use of AR/VR simulations for field technicians) has the strongest path coefficient relative to the recruitment or compensation system dimensions (Yuniarto & Cahyono, 2023). This indicates that in Indonesia's natural resources sector, digital competency development has the most direct impact on workers' ability to switch

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roles or adapt to operating autonomous heavy equipment. Furthermore, an agile performance management system was found to significantly reduce employee resistance to change, as evidenced by the negative correlation between HR innovation and digital work stress levels (Zulkarnain & Maryani, 2025). Simulation results also show that the effectiveness of this HR innovation remains consistent across subsectors in both mineral mining and renewable energy, thus confirming the generalizability of this model (Tanujaya & Gunawan, 2023). The model's predictive relevance is confirmed by a Q-square value of 0.325, indicating good observational relevance. Overall, this hypothesis test provides undeniable empirical evidence that human resource organizations that actively integrate HR innovation into their operations will have a workforce that is significantly more adaptive to the digital market disruption predicted to occur by the end of 2025 (Saputra & Widodo, 2025). This influence also reflects the shift in work culture from a rigid, hierarchical model to a more collaborative, data-driven ecosystem in Indonesia (Lestari & Utami, 2024).

3. Multidimensional Impacts on the Resilience of the Natural Resources Sector.

The final subsection of this research explores how the combination of HR innovation and workforce agility contributes to overall organizational resilience in the natural resources sector. Simulation data revealed that companies with high workforce agility scores reported a 22% increase in operational efficiency and a 15% reduction in workplace accidents in high-risk locations (Putra & Setiawan, 2025). Workforce agility proved to be a mediating variable that strengthens the relationship between a company's internal digitalization and its competitive position in the international market. Between 2020 and 2025, workers' flexibility in using analytical tools to monitor resource extraction significantly reduced energy waste, directly supporting the Indonesian government's green economy agenda (Wahyuni & Raharjo, 2022). These results demonstrate that agility is not just about speed, but also about accuracy in executing tasks under extreme environmental pressures. Interestingly, data simulations also found that the impact of HR innovation on agility was more pronounced among millennial workers than among Generation X, indicating the need for age-based talent management strategies in the natural resources sector (Yuniarto & Cahyono, 2023).

Furthermore, the integration of a digital, skills-based reward system has sparked intrinsic motivation among field workers to pursue bottom-up innovation, a previously rare phenomenon in Indonesia's heavy industry sector. Companies that adopted more flexible work structures through digital communication platforms reported more stable employee

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engagement levels despite the uncertainty of employment contracts in the post-pandemic era (Hidayat et al., 2023). These findings provide new insights into how workforce agility serves as a psychological defense mechanism for employees, enabling them to remain productive without experiencing burnout amid technological acceleration (Sari & Wijaya, 2024). Statistical trajectory analysis reinforces the conclusion that digital transformation in Indonesia's natural resources sector will succeed only if supported by a robust human resource foundation. By optimizing human adaptive capabilities, the natural resources sector can not only maintain profitability but also transform into a more socially and environmentally sustainable industry. These research findings ultimately validate that innovative human capital development strategies are key to unlocking the full potential of the digital economy in Indonesia's challenging natural resource landscape (Ramadhan et al., 2022).

DISCUSSION

1. Interpretation of Results.

Interpretation of the results of this study reveals that the success of digital innovation in increasing workforce agility in Indonesia's natural resources sector is heavily influenced by technology's ability to mitigate physical and geographical barriers. The use of virtual reality (VR)-based digital training platforms and autonomous simulations not only improves technical skills but also builds employees' mental readiness to face unexpected operational situations in the field (Yuniarto & Cahyono, 2023). In the mining and energy sector, agility emerges when workers have real-time access to operational data, enabling them to make proactive decisions without waiting for rigid hierarchical instructions (Wibowo & Arifin, 2024). Innovations in digital performance management also play a crucial role by providing instant feedback that fosters a culture of continuous improvement, an aspect that has been difficult to achieve with traditional HR practices in Indonesia's extractive industries (Zulkarnain & Maryani, 2025). Fundamentally, digital technology functions as an enabler that expands workers' cognitive capacity, transforming them from routine task performers into agile problem solvers amidst the dynamics of the digital economy in 2020-2025. These findings confirm that the effectiveness of HR innovation depends heavily on how well the technology integrates job security with the need for rapid adaptation in remote locations.

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E-ISSN: 2986-0733

2. Integration with Previous Research.

Compared with research in other sectors, such as banking or e-commerce, HR transformation in the natural resources sector presents a much more challenging resilience challenge due to high operational risks. While in the service sector, workforce agility is often associated with creativity and customer service, in the Indonesian natural resources industry, it is more focused on technical precision and risk management (Ramadhan et al., 2022). These findings align with global studies showing that companies adopting AI-based recruitment systems have an advantage in placing the right talent in crucial positions (Tanujaya & Gunawan, 2023). However, our findings also demonstrate a significant difference, with Indonesian natural resources workers being more responsive to practical-digital training compared to the conventional-theoretical approach often found in the manufacturing sector (Sari & Wijaya, 2024). Integrating this with recent literature on the Resource-Based View strengthens the argument that agility driven by human resource innovation is a unique strategic asset that is difficult for competitors to replicate in the global commodity market (Pratama et al., 2023). This phenomenon shows that while the natural resources sector is often considered slow to adapt, the 2020-2025 period has triggered an acceleration that matches, if not surpasses, that of pure technology sectors in integrating human capital and digital infrastructure for business sustainability.

3. Practical Implications for SDA Firms.

The practical implication for HR managers in natural resource companies is the urgent need to design a work ecosystem that supports self-directed learning through an inclusive digital infrastructure. Concrete recommendations include implementing a transparent, data analytics-driven talent management system to identify employee potential and agility early on (Hidayat et al., 2023). Managers should begin shifting the focus from tenure-based performance evaluations to rewards based on innovative contributions and the speed of adaptation to new technologies in the field (Putra & Setiawan, 2025). Furthermore, it is crucial for companies to ensure that HR digitalization encompasses employee well-being, given that the increased cognitive load in the digital economy can lead to burnout if not managed properly (Lestari & Utami, 2024). Adopting a sustainable upskilling strategy tailored to local needs in Indonesia will ensure that the workforce remains relevant and capable of supporting long-term efficiency targets (Saputra & Widodo, 2025). By implementing innovative HR practices, natural resource companies not only increase operational productivity but also build organizational resilience to face the

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challenges of the green energy transition and future market volatility (Wahyuni & Raharjo, 2022).

CONCLUSION AND RECOMMENDATIONS

1. Conclusion

This study concludes that innovation in human resource practices is a crucial determinant of accelerating workforce agility in Indonesia's natural resource (SDA) economy sector during the 2020–2025 digital transformation period. Empirical findings indicate that integrating digital technologies into HR functions, such as Virtual Reality-based training and data analytics-driven performance management, significantly improves employee adaptability and resilience in high-risk work environments (Putra & Setiawan, 2025). Amid global market volatility, an agile workforce has proven capable of mitigating operational disruptions and accelerating the adoption of Industry 4.0 technologies, thereby strengthening the competitive position of national SDA companies (Ramadhan et al., 2022). This study also confirms that workforce agility serves as a bridge between a company's technology investment and sustainable performance, especially when facing the challenges of Indonesia's energy transition (Wahyuni & Raharjo, 2022). The success of HR innovation in this sector depends heavily on digital leadership capable of inspiring a shift in work culture from traditional models to a more flexible and collaborative ecosystem (Wibowo & Arifin, 2024). Overall, modernizing human capital management practices is no longer merely an administrative option but a strategic imperative for the sustainability of the extractive industry in the rapidly evolving digital economy (Pratama et al., 2023).

2. Policy and Practical Recommendations

Based on research findings, it is recommended that company management in Indonesia's natural resources sector prioritize budget allocation to develop inclusive digital HR infrastructure, particularly to reach workers in remote operational locations. Companies need to design sustainable upskilling programs based on real-world needs to close the still-wide digital skills gap among senior workers (Yuniarto & Cahyono, 2023). Furthermore, HR managers are advised to adopt artificial intelligence (AI)-based recruitment systems capable of identifying psychological characteristics related to agility, so that recruited talent is better prepared to face disruption (Tanujaya & Gunawan, 2023). At the macro-policy level, the Indonesian government must strengthen regulations to support digital transformation in the natural resources sector by offering tax incentives to companies investing in technology

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training for the local workforce (Lestari & Utami, 2024). Synchronization between vocational education policies and the needs of the digital natural resources industry is crucial to ensure the availability of a competent workforce in the future (Sari & Wijaya, 2024). Implementing more transparent and flexible performance management should also be a key focus for increasing employee engagement and reducing resistance to technological change (Zulkarnain & Maryani, 2025). By leveraging technological innovation and human empowerment, Indonesia's natural resources sector can achieve greater organizational resilience to global economic shocks (Hidayat et al., 2023).

3. Limitations and Future Research Directions.

Despite its theoretical and practical contributions, this study has several limitations, including its narrow focus on Indonesia's natural resource sector, which may differ from other regions. The study sample, collected during the 2020–2025 period, reflects the unique post-pandemic transition, so generalizing the results outside this context should be done with caution (Saputra & Widodo, 2025). Future researchers are advised to conduct longitudinal studies to more deeply examine the long-term impact of innovative HR practices on firm productivity (Arifin & Santoso, 2025). Furthermore, exploring moderating variables, such as local organizational culture or region-specific leadership styles in Indonesia, could provide a more comprehensive understanding (Susanto & Kurniawan, 2021). Future studies should also consider the ethical implications of AI use in people management in the heavy industry sector to ensure a balance between digital efficiency and worker well-being. Integrating cross-industry perspectives could also enrich the literature on workforce agility amid increasingly complex business environments.

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