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Strategic Role of Human Resource Quality in Construction Management Effectiveness: A Literature Review

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ABSTRAK: *Efektivitas manajemen proyek konstruksi semakin bergantung tidak hanya pada sumber daya teknis dan finansial, tetapi juga pada kualitas strategis modal manusia. Tinjauan pustaka ini mengadopsi pendekatan naratif tematik untuk menelaah faktor-faktor utama sumber daya manusia (SDM) yang memengaruhi hasil proyek di sektor konstruksi. Berdasarkan seleksi sistematis terhadap studi empiris yang diterbitkan antara tahun 2015 hingga 2025, enam tema sentral berhasil diidentifikasi: kompetensi teknis, perilaku kepemimpinan, pelatihan berkelanjutan, kesiapan digital, motivasi karyawan, serta kesehatan dan keselamatan kerja (K3). Temuan menunjukkan bahwa keahlian teknis dan personel berpengalaman berkontribusi signifikan terhadap efisiensi proyek dan kinerja waktu. Gaya kepemimpinan dan komitmen organisasi meningkatkan kohesi tim serta kualitas pengambilan keputusan. Program pelatihan—khususnya yang melibatkan simulasi digital—memperkuat pengembangan keterampilan dan mengurangi kesalahan operasional. Selain itu, literasi digital dan lingkungan kerja yang inklusif memperkuat kolaborasi serta inovasi. Kepatuhan terhadap standar K3 terbukti mampu menurunkan risiko dan mendukung stabilitas tenaga kerja, sehingga mendorong keberlanjutan proyek jangka panjang. Tinjauan ini menegaskan pentingnya strategi SDM yang terintegrasi, selaras dengan kemajuan teknologi dan tuntutan lingkungan. Hasilnya memberikan wawasan praktis bagi perusahaan konstruksi, pembuat kebijakan, dan institusi akademik yang berupaya memperkuat kapasitas tenaga kerja serta meningkatkan kinerja proyek dalam lanskap industri yang semakin kompleks.*

Kata kunci: *Manajemen Sumber Daya Manusia, Kinerja Konstruksi, Kompetensi Teknis, Literasi Digital, Kesehatan dan Keselamatan Kerja (K3)*

ABSTRACT: The effectiveness of construction project management increasingly depends not only on technical and financial resources but also on the strategic quality of human capital. This literature review adopts a thematic narrative approach to examine key human resource (HR) factors influencing project outcomes in the construction sector. Based on a systematic selection of empirical studies published between 2015 and 2025, six central themes are identified: technical competence, leadership behavior, continuous training, digital readiness, employee motivation, and occupational health and safety (OHS). The findings indicate that technical expertise and experienced personnel contribute significantly to project efficiency and time performance. Leadership styles and organizational commitment enhance team cohesion and decision-making. Training initiatives—particularly those involving digital simulations—improve skill development and reduce operational errors. Furthermore, digital literacy and inclusive work environments strengthen collaboration and innovation. Compliance with OHS standards is shown to reduce risks and support workforce stability, promoting long-term project sustainability. This review highlights the necessity of integrated HR strategies that align with technological advancements and environmental demands. The results offer practical insights for construction firms, policymakers, and academic institutions aiming to strengthen workforce capabilities and improve project delivery in an increasingly complex industry landscape.

Keywords: Human Resource Management, Construction Performance, Technical Competence, Digital Literacy, Occupational Health and Safety

1. INTRODUCTION

The global construction industry plays a critical role in national development by delivering large-scale infrastructure projects that support economic growth and social welfare. In this context, effective project management is essential for ensuring cost-efficiency, timely completion, and high-quality outcomes. Although construction technologies and management tools have advanced significantly, the quality of human resources (HR) remains a decisive factor in project success. Recent studies report that cost overruns, delays, and safety incidents in construction projects are frequently linked to deficiencies in workforce planning, skills development, and employee motivation [1, 2].

The increasing complexity of construction projects has intensified the demand for a workforce that is not only technically skilled but also equipped with soft skills such as leadership, teamwork, and adaptability. As the industry becomes more reliant on technology, digital literacy is also becoming a fundamental requirement. In this regard, the strategic development of HR has emerged as a key enabler of project performance, where successful scheduling, budgeting, and quality assurance largely depend on the capabilities of the workforce [3].

Despite its importance, the integration of HR strategies into construction management remains uneven across organizations and regions. A persistent issue is the lack of a unified understanding of which HR dimensions most significantly affect project outcomes. Questions remain about how to identify, nurture, and retain talent in a labor-intensive and volatile sector. Moreover, the rapid pace of digital transformation and ongoing labor shortages demand adaptive and forward-looking HR strategies.

In response, researchers and industry practitioners have recommended various HR management practices. These include rigorous recruitment, continuous training, performance evaluations, and motivational strategies designed to enhance job satisfaction and employee engagement [1]. While these strategies have shown promise in improving project efficiency and safety, their implementation varies widely depending on organizational leadership, culture, and resource availability.

Digital transformation adds both urgency and complexity to HR planning. Tools such as Building Information Modeling (BIM), the Internet of Things (IoT), and artificial intelligence require a workforce that is adaptable, technologically competent, and open to change. However, digital readiness remains a major challenge. Many firms struggle with low levels of digital literacy among workers and resistance to new systems [4, 5]. Strategic human resource management (SHRM) must therefore evolve to cultivate digital skills, resilience, and leadership capacity to support this transition [6].

In parallel, motivation remains a cornerstone of HR effectiveness. Motivated workers are more productive, committed, and capable of problem-solving—traits that are particularly critical in dynamic construction environments. Recognition programs and performance-based incentives have proven effective in enhancing motivation [7]. Additional research emphasizes the role of psychological well-being and social support in improving individual performance and organizational outcomes [8].

The COVID-19 pandemic further revealed the fragility of existing HR systems. It exposed structural weaknesses, including overdependence on migrant labor, limited workforce diversity, and outdated training approaches [9, 10]. At the same time, it accelerated the urgency for reskilling and upskilling in line with Construction 4.0 needs [11]. These developments point to the necessity of embedding workforce development into broader organizational strategies.

From an organizational standpoint, leadership behavior plays a critical role in shaping HR effectiveness. Transformational and transactional leadership styles have been shown to improve team cohesion, innovation, and decision-making in high-pressure environments [12, 13]. A supportive organizational culture that promotes trust and shared goals also contributes to conflict reduction and operational efficiency [14]. Conversely, toxic leadership and poor communication hinder knowledge-sharing and lower team morale [15].

Current literature further links leadership to broader strategic outcomes. Leadership style is increasingly viewed as a determinant of organizational agility and innovation capacity [16]. Moreover, integrating HR with financial and strategic planning enhances decision-making, resource allocation, and competitive advantage [17, 18]. Organizational socialization and affective commitment also emerge as critical to sustaining employee identity and engagement in project-based environments [19].

In the Indonesian context, the alignment of HR strategies with safety culture is particularly important. This integration not only improves compliance and productivity but also reflects a growing recognition of human capital as central to sustainable construction [20]. Therefore, a holistic HR approach that balances motivation, leadership, digital readiness, and safety is essential to advancing project management practices.

Given these challenges and opportunities, this study aims to conduct a thematic literature review

to systematically identify, categorize, and evaluate strategic HR factors that influence construction management effectiveness. Addressing a critical gap in the literature, the study offers a consolidated framework that integrates conventional HR elements with emerging priorities such as digital transformation and workforce resilience. Its findings contribute to the development of evidence-based HR strategies and offer practical guidance for construction firms, policymakers, and educators striving to improve project delivery and workforce performance.

2. METHODOLOGY

This study employed a thematic narrative literature review methodology to synthesize and evaluate the strategic role of human resource (HR) quality in enhancing construction management effectiveness. This approach allows for a flexible yet rigorous examination of both quantitative and qualitative findings, emphasizing conceptual clarity and thematic depth. The methodology was developed with reference to best practices in narrative review design, ensuring transparency, reproducibility, and analytical validity throughout the research process [21].

2.1. Type and Approach of Study

The review followed a narrative, descriptive, and thematic approach, suitable for capturing multidimensional insights across diverse empirical studies. This design integrates both inductive and deductive reasoning: inductive analysis was used to extract emergent patterns from the data, while deductive strategies helped validate these findings against established theoretical frameworks. Such integration allows for both descriptive exploration and analytical synthesis, thereby generating robust interpretations of how HR quality affects project performance in construction [22].

2.2. Literature Sources and Selection Criteria

The literature was sourced from reputable academic databases including Scopus and Google Scholar. The inclusion criteria were defined to ensure the relevance, credibility, and timeliness of the reviewed studies. Only peer-reviewed empirical articles published between 2015 and 2025 were considered. Articles were selected based on their direct relevance to human resource practices in construction management, with specific focus on project performance indicators such as cost, time, quality, safety, and digital readiness.

The initial search employed a combination of Boolean operators and keyword strategies—such as ”human resource management,” “construction performance,” “training,” “digital transformation,” and “leadership”—to identify relevant studies. The screening process involved multiple phases: title and abstract screening, full-text review, and application of inclusion/exclusion criteria. Only studies with substantial empirical evidence and clear methodological reporting were retained, providing a solid basis for subsequent analysis [21].

2.3. Thematic Analysis Strategy

The thematic analysis followed a structured yet iterative procedure. After extracting and coding key content from the included articles, themes were developed through constant comparison and cross-referencing. The process was supported by a manual matrix method to cluster similar ideas and identify recurring patterns. Expert consultation was conducted to enhance the accuracy and validity of coding decisions, following recommendations to ensure methodological rigor and trustworthiness [23].

Six core themes were identified through the thematic analysis. The first theme, technical competence and skills, reflects the significance of labor expertise, accumulated experience, and job-specific technical training in improving construction project performance. As evidenced in recent studies, workforce proficiency in core construction activities directly correlates with heightened productivity and project efficiency [3]. The second theme, organizational behavior and leadership, underscores the role of leadership styles, communication strategies, and team cohesion in operational success. Effective leadership not only guides project direction but also fosters a collaborative environment that mitigates conflict and enhances decision-making [24].

The third theme is human resource training and development, which highlights how ongoing professional development initiatives contribute to employee skill enhancement and reduced operational errors. Continuous learning fosters adaptability, especially in the face of technological and organizational change. The fourth theme, digital readiness and technological adaptability, addresses the way digital transformation redefines HR roles and necessitates new workforce competencies. The incorporation of tools like BIM and IoT demands digital literacy and proactive adaptation among employees, with HR serving as the facilitator of this transition [25].

The fifth theme involves motivation, job satisfaction, and work culture, focusing on the psychological and environmental drivers of employee performance. Reward systems, recognition, and intrinsic motivators play a pivotal role in fostering a productive and committed workforce. Finally, the

sixth theme, occupational health and safety (OHS), highlights the integration of HRM practices with safety protocols and health awareness measures to ensure long-term workforce welfare and project sustainability. These six themes not only emerged from recurring codes in the data but also align with broader theoretical frameworks and best practices in construction project management.

These themes were not only derived from recurrent codes but also aligned with theoretical constructs and industry frameworks relevant to construction project management. The analysis acknowledged regional variations, such as insights from Egypt and Indonesia, and emphasized the interplay between strategic HR practices and organizational outcomes [3]. To complement the qualitative synthesis, a summary matrix was developed to map each thematic dimension to its key concepts and representative studies. This matrix, presented in Table 1, reinforces the analytical rigor of the thematic coding and illustrates the empirical grounding of each HR dimension identified in the review.

Table 1. This table summarizes the six HR dimensions identified in the thematic analysis, along with their core concepts and representative studies from the selected empirical literature.

Table 1. Matrix of Thematic Dimensions and Supporting Literature

HR Dimension	Key Concepts	Representative Studies
Technical Competence	Skills, local knowledge, execution	[3, 26].
Leadership & Organizational Behavior	Transformational, participatory styles	[24, 27].
Training & Development	VR/AR learning, institutional training	[28, 29].
Digital Readiness	BIM, IoT, digital literacy	[25, 30].
Motivation & Work Culture	Recognition, inclusivity, social capital	[31, 32].
Occupational Health & Safety (OHS)	Risk mitigation, compliance	[33, 34].

By adhering to a clearly documented and cross-validated methodology, this study ensures analytical robustness and contributes meaningful insights into the role of HR in the success of construction management initiatives. The process facilitates an audit trail of analytical decisions, enhancing the credibility and scholarly utility of the findings.

3. RESULTS

Technical competence plays a vital role in improving productivity and efficiency in construction projects by enabling informed decision-making, effective problem-solving, and accurate technical execution. Strong technical capabilities are linked to better time performance through reduced delays and improved implementation accuracy [26]. Local knowledge and specialized technical skills are also essential to meeting quality standards and adhering to strict timelines, thereby significantly contributing to productivity improvements [35]. In sectors characterized by technological intensity, such as oil and gas, technical expertise supports both risk mitigation and cost optimization [36]. Furthermore, when technical proficiency is paired with effective communication, the overall impact on project performance is amplified [37].

Experience among workers further enhances project outcomes by influencing safety awareness, task execution, and operational performance. Experienced personnel are generally more engaged, better prepared to contribute meaningfully to project goals, and more likely to adhere to safety protocols. Their commitment and accumulated knowledge contribute to stronger team dynamics and more reliable project delivery [38].

Leadership style and organizational behavior are also critical in shaping project success. Approaches that combine empowering, transformational, supportive, and democratic leadership characteristics have been found to promote well-being, autonomy, and collaborative engagement among team members [27, 39]. Such leadership enhances cooperation and helps teams meet project targets more effectively. In particular, transformational leadership is associated with improved productivity and a stronger emphasis on sustainable practices. Work discipline and organizational loyalty complement effective leadership by promoting structured workflows, punctuality, and alignment with organizational goals [40]. Loyalty and trust among employees strengthen engagement and ensure long-term consistency in performance [41].

Human resource training and development significantly influence on-site quality, safety, and operational performance. Advanced methods, such as virtual and augmented reality training, provide immersive environments that enhance knowledge retention and reduce real-world risk exposure [28]. Site supervisors who undergo targeted training are better at managing tasks and making informed decisions, thereby contributing to productivity and minimizing rework [42]. Well-designed training programs are essential for professionalizing the labor force and enabling the transition of unskilled workers into

skilled roles [29]. Collaboration among employers, vocational institutions, and labor unions ensures that training content remains aligned with industry needs [43, 11]. Moreover, technology-enhanced learning offers safer and more engaging educational experiences, reinforcing both technical standards and safety protocols [44].

Digital readiness and technological adaptability are increasingly vital in construction, yet adoption remains limited due to low digital literacy, resistance to change, and constrained organizational readiness. Many construction workers find it difficult to adapt to digital platforms such as Building Information Modeling (BIM) due to limited training and the disconnect between modern tools and traditional workflows [30]. In some cases, leadership hesitation and financial limitations further delay technology integration. However, enhanced digital literacy is strongly correlated with improved collaboration, communication, and operational efficiency [45]. The COVID-19 pandemic highlighted the value of digital solutions in maintaining productivity during periods of limited physical interaction [46]. Therefore, improving digital competencies is essential to support innovation and resilience in the construction industry [47].

Motivation and work culture are closely linked to employee satisfaction and productivity. A combination of intrinsic and extrinsic motivators—such as fair compensation, recognition, and inclusive leadership—can enhance job satisfaction and improve employee retention [31]. Organizational cultures that promote entrepreneurship and career development tend to foster higher levels of motivation [32]. In addition, strong social capital within teams enhances communication, collaboration, and overall performance [48]. A supportive and inclusive work environment is crucial to sustaining high morale. Organizations that value diversity and provide safe channels for communication are more likely to achieve better workforce outcomes [49]. Such environments also help prevent harassment and discrimination, thereby improving retention and organizational cohesion [50].

Occupational health and safety (OHS) standards are essential for achieving sustainable project performance. Well-established safety protocols reduce accidents, boost productivity, and build stakeholder trust [33]. Adherence to OHS guidelines also facilitates better cost management and efficient resource use throughout the project lifecycle [51]. On the other hand, inadequate OHS implementation can lead to increased accident rates, financial losses, and project delays. Lack of safety awareness, especially among unskilled workers, poses serious risks to project integrity [34]. Ineffective safety management can diminish morale and result in high turnover rates, thereby undermining quality and continuity [52]. These findings reinforce the need for OHS to be integrated into broader HR frameworks to ensure the well-being of workers and the long-term sustainability of construction projects.

4. DISCUSSION

4.1. Conceptual Model of HR Interconnection in Construction Management

This section presents a conceptual model that visualizes the interconnected roles of key human resource (HR) dimensions in enhancing project management effectiveness within the construction sector. Building upon the thematic analysis discussed previously, the model offers a synthesized perspective that captures both the independent and mutual influences of each HR component on construction project outcomes.

As shown in Figure 1, the model places ”Project Management Effectiveness” at its core, symbolizing the ultimate goal of HR-driven strategies. Surrounding this central node are six critical HR dimensions: technical competence, leadership and behavior, training and development, digital readiness, motivation and work culture, and occupational health and safety (OHS). Each of these dimensions is directly connected to the center, indicating its unique and essential contribution to project success, including factors such as cost efficiency, time management, quality standards, and long-term sustainability.

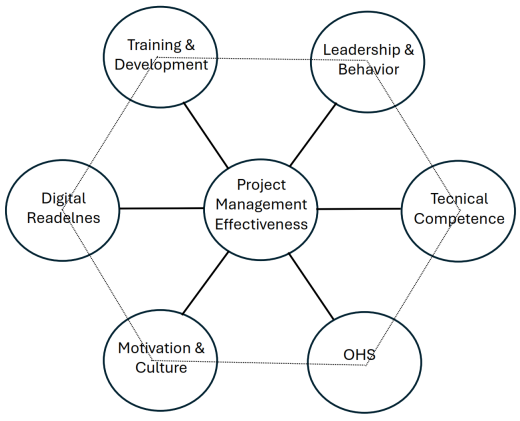

Figure 1. Interconnected HR Dimensions and Their Role in Project Management Effectiveness

The diagram also incorporates interlinking lines among the six outer HR dimensions. These connections represent their interdependence and dynamic interaction. For instance, technical competence is closely tied to training and development, as structured learning initiatives serve to enhance and

maintain professional skills. Similarly, digital readiness is influenced by training programs and leadership behavior, which together facilitate technology adoption and cultural transformation within construction organizations.

The absence of directional arrows in the diagram is intentional. It highlights the bidirectional nature of influence among HR factors, suggesting that improvements or deficiencies in one area can affect and be affected by others. This underscores the importance of adopting an integrated HR strategy rather than treating each dimension in isolation.

This diagram illustrates the central role of human resource (HR) dimensions in shaping project management effectiveness within the construction sector. At the center lies the project performance goal, surrounded by six strategic HR dimensions: technical competence, leadership and behavior, training and development, digital readiness, motivation and culture, and occupational health and safety (OHS). Each dimension connects directly to the central node, representing its independent contribution to project outcomes. In addition, interconnections among the outer nodes reflect the interdependent nature of HR functions. For example, technical competence is closely linked to training and development, highlighting how structured learning initiatives are essential for building and updating workforce expertise. The absence of directional arrows indicates that these relationships are bidirectional, emphasizing mutual influence rather than linear causality. This model underscores the need for an integrated and adaptive HR strategy to enhance workforce capability and sustain construction project success.

4.2. Core HR Dimensions in Driving Project Effectiveness

This study emphasizes the strategic importance of human resource (HR) quality in optimizing construction project management. Through a comprehensive literature review, six interrelated HR dimensions—technical competence, leadership, training, digital readiness, motivation, and occupational health and safety (OHS)—have emerged as critical factors in achieving project success. Each of these dimensions contributes uniquely to core performance metrics such as cost efficiency, timeliness, quality control, and sustainability.

Technical competence ensures precision in execution, while leadership influences team dynamics and innovation. Training supports upskilling, and digital readiness facilitates integration of advanced technologies. Motivation drives engagement and productivity, whereas OHS safeguards employee well-being and operational continuity. Importantly, these dimensions do not function in isolation; their dynamic interconnections demand a unified and adaptive HR strategy.

An integrated approach enables better alignment between workforce capabilities and project demands, enhances responsiveness to change, and fosters long-term resilience. As construction projects become more complex, data-driven, and sustainability-focused, the strategic role of HR integration grows more critical. By addressing HR development holistically, organizations can better manage risk, improve collaboration, and deliver successful project outcomes in a competitive and rapidly evolving industry landscape.

4.3. Functional Contributions of Each HR Dimension

Technical competence and experience are fundamental to achieving productivity, cost efficiency, and timely delivery in construction projects. The literature supports the argument that skilled professionals reduce execution risks and optimize project performance, particularly in large-scale or complex endeavors [53]. Strategic HR allocation—ensuring that the right personnel with appropriate skills are deployed at each project phase—has been shown to align workforce capacity with technical and logistical demands [2].

Leadership and organizational behavior further contribute to project effectiveness by fostering team collaboration, decision-making, and risk mitigation. Transformational and participatory leadership styles enhance stakeholder engagement and cultivate environments of trust, accountability, and innovation. When paired with work discipline and loyalty, these leadership qualities strengthen team cohesion and ensure consistent performance in dynamic construction settings.

Human resource training and development are critical for equipping workers with the competencies needed to meet evolving project challenges. Emerging technologies such as virtual simulations and immersive learning environments have demonstrated their effectiveness in improving safety and task proficiency. Institutionalizing continuous learning frameworks enables firms to address skill gaps and prepare the workforce for specialized roles, especially amid the digital transformation of the construction industry. Digital readiness and technological adaptability are both necessary and challenging. Although barriers such as limited digital literacy and organizational resistance persist, the benefits of digital integration—such as streamlined communication, improved coordination, and operational resilience—are evident. Strategic

investment in upskilling and digital leadership development is vital for aligning HR capabilities with technology-driven construction processes.

Motivation and work culture play a vital role in workforce retention, engagement, and productivity. Recognition, fair compensation, inclusive leadership, and opportunities for career advancement collectively enhance job satisfaction and build organizational commitment. A supportive culture that values diversity and psychological safety also contributes to team cohesion and reduces turnover, which is especially important in labor-intensive construction environments.

Occupational health and safety (OHS) is a critical dimension with direct implications for sustainability and performance. Robust safety practices not only minimize risks and disruptions but also foster employee well-being and organizational trust. Integrating OHS into HR frameworks transforms safety from a compliance requirement into a strategic function that supports long-term project viability.

4.4. Toward an Integrated HR Strategy

The interconnectedness of human resource (HR) dimensions underscores the urgency of implementing a holistic and adaptive HR strategy in the construction sector. Rather than addressing HR components in isolation, construction firms must pursue a unified framework that integrates technical competence, leadership, training, digital readiness, motivation, and occupational health and safety (OHS) into a single strategic vision. Such an approach enables better alignment of human capital with operational needs across all project phases.

This integration allows organizations to build resilience in a rapidly changing environment shaped by digital transformation, regulatory shifts, and labor market volatility. Key tools like Building Information Modeling (BIM) exemplify how digital adoption intersects with workforce readiness, requiring both leadership commitment and systematic upskilling [54]. A flexible HR strategy supports real-time decision-making, fosters collaboration, and ensures continuity by deploying the right talent at the right time.

Moreover, ongoing workforce development—through targeted training, succession planning, and motivation systems—contributes to a culture of innovation and long-term sustainability. By embracing this integrated approach, construction firms can more effectively manage risks, optimize project outcomes, and maintain a competitive edge in an increasingly complex industry landscape.

4.5. Policy and Institutional Implications

Policy-level recommendations advocate for the development of HR systems that support safety, innovation, and workforce empowerment. Establishing performance benchmarks and providing platforms for lifelong learning are essential steps toward building an agile and capable labor force [55]. Moreover, aligning HR planning with labor market dynamics ensures effective talent utilization and mitigates workforce shortages [56].

Government and institutional collaboration is essential for building a sustainable construction workforce. Strategic partnerships among policymakers, industry leaders, and educational institutions can facilitate the creation of standardized training systems and enhance labor market preparedness [57]. Such collaborations are crucial to ensuring that HR strategies are integrated with national development goals and sustainability priorities.

Finally, embedding sustainability principles within HR development reinforces the environmental, social, and economic responsibilities of the construction sector. Green HRM initiatives and knowledge-sharing cultures foster innovation and resource efficiency while supporting leadership engagement. A forward-thinking HR approach rooted in stakeholder collaboration can drive industry transformation and enhance long-term project success.

5. CONCLUSION

This study concludes that human resource (HR) quality plays a decisive and strategic role in determining the effectiveness of construction project management. Through a thematic narrative review of empirical literature, six critical HR dimensions were identified: technical competence, leadership and organizational behavior, training and development, digital readiness, motivation and work culture, and occupational health and safety (OHS). These elements collectively influence core project performance metrics—namely, cost, time, quality, and sustainability. Findings demonstrate that HR quality impacts not only operational outcomes but also the long-term viability of construction initiatives. Moreover, integrating HR strategies with digital transformation, sustainability objectives, and inclusive practices significantly enhances workforce adaptability and project resilience. For the construction sector to evolve in line with technological and ecological shifts, stakeholders must adopt holistic, policy-driven HR management approaches. This includes investing in workforce development, aligning HR practices with project demands, and fostering leadership and safety cultures. Future research and policy efforts should focus on deepening the linkages between strategic HR interventions and broader industry transformations toward sustainable construction.

REFERENCES

[1] A. Abujraiban and G. J. Assaf, "Effect of strategic planning of human resources in management performance," *Civ. Eng. J*, vol. 8, no. 8, pp. 1725–1738, 2022.

[2] R. D. Putri and R. A. Machfudiyanto, "Optimizing human resource allocation in construction projects in indonesia: A comprehensive analysis of influencing factors," in *E3S Web of Conferences*, vol. 517. EDP Sciences, 2024, p. 05004.

[3] M. Ghattas, H. Bassioni, and E. Gaid, "Human resources management influence on projects performance: A study of contractors professionals working on construction projects in egypt," in *IOP Conference Series: Earth and Environmental Science*, vol. 1056, no. 1. IOP Publishing, 2022, p. 012039.

[4] S. O. Ametepey, C. Aigbavboa, W. D. Thwala, and H. Addy, "A bibliometric review of the trends of construction digitalization research in the last decade," 2024.

[5] J. Yang, H. Yuan, and L. Zhang, "Influence factors on general contractor capability in the context of transforming china," *Advances in Civil Engineering*, vol. 2020, no. 1, p. 8874579, 2020.

[6] J. Zhang and Z. Chen, "Exploring human resource management digital transformation in the digital age," *Journal of the knowledge economy*, vol. 15, no. 1, pp. 1482–1498, 2024.

[7] N. Van Tam, T. Watanabe, and N. L. Hai, "Factors constraining work motivation in construction projects: a case study in vietnam," in *Proceedings of the Creative Construction e-Conference*, 2022, p. 021.

[8] A. M. Abdillahi, Z. Ö. P. Biçer, and S. Bayram, "Assessment of construction site management practices: A case study of a construction project in hargeisa," *Journal of Advanced Research in Natural and Applied Sciences*, vol. 10, no. 1, pp. 228–242, 2024.

[9] T. Al Amri, "The economic impact of covid-19 on construction industry: Oman's case," *European Journal of Business and Management Research*, vol. 6, no. 2, pp. 146–152, 2021.

[10] A. George, E. Aboagye-Nimo, and S. Mamphey, "The effects of skills shortages on construction costs in the uk," *Proceedings of the Institution of Civil Engineers-Management, Procurement and Law*, vol. 175, no. 2, pp. 78–86, 2022.

[11] W. Chen, Z. Yang, H. Yan, and Y. Zhao, "Promoting construction labor professionalization: an evolutionary game perspective," *Sustainability*, vol. 15, no. 12, p. 9688, 2023.

[12] M. N. Sadiq and M. S. Nawaz, "Nexus between ambidextrous leadership and xenophobia in construction project success," *iRASD Journal of Management*, vol. 4, no. 2, pp. 330–345, 2022.

[13] L. J. Boshomane and S. Naidoo, "Leadership factors influencing successful project delivery: The case of a south african civil engineering company," in *Proceedings of the International Conference on Industrial Engineering and Operations Management Nsukka, Nigeria*, 2022, pp. 5–7.

[14] M. Muneer, N. Khan, M. Awais Hussain, Z. Shuai, A. A. Khan, R. Farooq, M. A. Moawwez, and M. A. U. R. Tariq, "A quantitative study of the impact of organizational culture, communication management, and clarity in project scope on constructions' project success with moderating role of project manager's competencies to enhance constructions management practices," *Buildings*, vol. 12, no. 11, p. 1856, 2022.

[15] U. Zaman, L. Florez-Perez, M. Anjam, M. Ghani Khwaja, and N. Ul-Huda, "At the end of the world, turn left: examining toxic leadership, team silence and success in mega construction projects," *Engineering, Construction and Architectural Management*, vol. 30, no. 6, pp. 2436–2462, 2023.

[16] M. Zavari and M. R. Afshar, "The role of site manager transformational leadership in the construction project success," *International Journal of Building Pathology and Adaptation*, vol. 41, no. 5, pp. 1067–1085, 2023.

[17] N. Nuraini, I. Basalamah, H. Hanadelansa, and S. Murniati, "Examining the impacts of human resource management hrm-financial management alignment: a qualitative review of accounting literature," *Atestasi: Jurnal Ilmiah Akuntansi*, vol. 7, no. 1, pp. 442–458, 2024.

[18] M. Battour, M. Barahma, and M. Al-Awlaqi, "The relationship between hrm strategies and sustainable competitive advantage: testing the mediating role of strategic agility," *Sustainability*, vol. 13, no. 9, p. 5315, 2021.

[19] S. Batra, "Framework of socialisation, authentic leadership and affective commitment for construction professionals," *Construction Economics and Building*, vol. 20, no. 1, pp. 77–95, 2020.

[20] W. Widyanty, A. Daito, S. Riyanto, and D. Nusraningrum, "Gaining a competitive advantage through strategic human resource management in indonesian construction industry," *Management Science Letters*, vol. 10, no. 9, pp. 2021–2028, 2020.

[21] V. Siamuzwe-Manase, K. R. Halcro, B. Kumar, and M. Skitmore, "Project-oriented strategic management of uk construction firms–towards corporate diversification: critical literature review," *Built Environment Project*

and Asset Management, vol. 14, no. 6, pp. 937–955, 2024.
[22] H. Aguinis, R. S. Ramani, and N. Alabduljader, "Best-practice recommendations for producers, evaluators, and users of methodological literature reviews," *Organizational research methods*, vol. 26, no. 1, pp. 46–76, 2023.
[23] C. Rojon, A. Okupe, and A. McDowall, "Utilization and development of systematic reviews in management research: What do we know and where do we go from here?" *International Journal of Management Reviews*, vol. 23, no. 2, pp. 191–223, 2021.
[24] N. F. Tawfig and S. Kamarudin, "Influence of organizational culture, sustainable competitive advantages, and employees' commitment on strategic human resources management in the banking sector of saudi arabia," *Business Management and Strategy*, vol. 13, no. 1, pp. 13–33, 2022.
[25] Z. Sun, W. Wang, W. Wang, and X. Sun, "How does digital transformation affect corporate social responsibility performance? from the dual perspective of internal drive and external governance," *Corporate Social Responsibility and Environmental Management*, vol. 31, no. 2, pp. 1156–1176, 2024.
[26] I. A. Ijaola, G. I. Idoro, and M. G. Oladokun, "Key training practice indicators for optimal site supervisors' utilisation in construction firms," *Journal of Engineering, Design and Technology*, vol. 19, no. 1, pp. 149–163, 2021.
[27] Z. Zhang, G. Ni, H. Lin, Z. Li, and Z. Zhou, "Linking empowering leadership to work-related well-being and project citizenship behavior in the construction context: a self-determination perspective," *International journal of managing projects in business*, vol. 16, no. 2, pp. 232–257, 2023.
[28] S. Çomu, B. Yücel, and I. A. Kıral, "Comparing the safety awareness of workers on the virtual and real construction site using eye-tracking technology," 2023.
[29] M. Kesavan, P. Dissanayake, C. Pathirana, M. Deegahawature, and K. Silva, "Developing a new construction supervisory training programme focusing on productivity and performance improvement of labour operations," *Engineer: Journal of the Institution of Engineers, Sri Lanka*, vol. 55, no. 4, 2022.
[30] S. L. Zulu, A. M. Saad, S. O. Ajayi, M. Dulaimi, and M. Unuigbe, "Digital leadership enactment in the construction industry: barriers undermining effective transformation," *Engineering, Construction and Architectural Management*, vol. 31, no. 10, pp. 4062–4078, 2024.
[31] M. Zailani, A. Ibrahim, and Y. Bahago, "Critical motivational factors for enhancing employee performance in construction firms based on correlation and principal component analyses," *Nigerian Journal of Technology*, vol. 39, no. 3, pp. 647–653, 2020.
[32] I. Kapur and P. Tyagi, "Entrepreneurial orientation driven employee retention: mediating role of human capital development," *Development and Learning in Organizations: An International Journal*, vol. 37, no. 5, pp. 8–10, 2023.
[33] M. YILMAZ and S. YILDIZ, "The importance of occupational health and safety (ohs) and ohs budgeting in terms of social sustainability in construction sector," *Journal of Building Material Science*, vol. 2, no. 1, 2021.
[34] O. Z. Oni, A. Olanrewaju, and S. C. Khor, "Fuzzy synthetic evaluation of the factors affecting health and safety practices in malaysia construction industry," *Journal of engineering, design and technology*, vol. 22, no. 6, pp. 1773–1796, 2024.
[35] S. Sigdel, "Assessment of technical capacity and performance of local builders in residential building construction sites," *Baltic Journal of Real Estate Economics and Construction Management*, vol. 11, no. 1, pp. 160–171, 2023.
[36] H. Abdulla, C. McCauley-Smith, and S. Moradi, "Revealing contribution mechanisms of project managers' technical competencies toward success in oil and gas projects," *International Journal of Managing Projects in Business*, vol. 16, no. 4/5, pp. 641–663, 2023.
[37] H.-L. Chen, "Impact of communication on capital project performance: a mediated moderation model," *Sustainability*, vol. 13, no. 20, p. 11301, 2021.
[38] S. A. Mahfouz, Z. Awang, H. Muda, and A. S. Bahkia, "Mediating role of employee commitment in the relationship between transformational leadership style and employee performance," *Humanities & Social Sciences Reviews*, vol. 8, no. 2, pp. 624–637, 2020.
[39] K. Ssenyange, "The impact of leadership styles on government construction project success: A structural equation modelling approach," *International Journal of Finance, Insurance and Risk Management*, vol. 13, no. 3, pp. 50–75, 2023.
[40] Y. B. Sitopu, K. A. Sitinjak, and F. K. Marpaung, "The influence of motivation, work discipline, and

compensation on employee performance," *Golden Ratio of Human Resource Management*, vol. 1, no. 2, pp. 72–83, 2021.
[41] G. Wijonarko, N. Muksin, and I. Rajiani, "The loyalty imperative: Understanding the link between organizational culture and employee commitment," *Journal of Infrastructure, Policy and Development*, vol. 8, no. 4, pp. 1–17, 2024.
[42] M. M. Mtotywa and S. Mdlalose, "The influence of assessment on training to improve productivity of construction companies," *Problems and Perspectives in Management*, vol. 21, no. 1, p. 169, 2023.
[43] B. Ramadan, H. Nassereddine, T. Taylor, and P. Goodrum, "Impact of workforce training on worker performance in the construction industry," in *Proceedings of the Creative Construction Conference 2023*, 2023, pp. 319–324.
[44] M. Hu, J. Miroslaw *et al.*, "Green construction workforce training using virtual reality," in *Automation in Construction toward Resilience*. CRC Press, 2023, pp. 73–90.
[45] Y. Gholami, *Investigating adoption of digital technologies in construction projects*. Linkopings Universitet (Sweden), 2023.
[46] P. Fatimah, A. Sodri, and U. S. Hamzah, "Smart technology in construction industry: Opportunity during covid-19 pandemic," *International Journal of Applied Sciences and Smart Technologies*, vol. 5, no. 1, pp. 27–38, 2023.
[47] E. Kissi, K. Eluerkeh, C. Aigbavboa, M. Addy, and P. Babon-Ayeng, "Project managers' competencies in the era of digitalization: the case of the construction industry," *Built Environment Project and Asset Management*, vol. 15, no. 1, pp. 165–189, 2025.
[48] Y. Fang, S. Li, and E. I. Daniel, "A new conceptual framework for analyzing the social capital of construction project teams," in *International Symposium on Advancement of Construction Management and Real Estate*. Springer, 2020, pp. 875–890.
[49] T. Saha and S. Bhattacharya, "Impact of inclusiveness on organizational commitment among employees of it industry," *Cardiometry*, no. 22, pp. 395–405, 2022.
[50] A. N. Ghanbaripour, R. J. Tumpa, R. Y. Sunindijo, W. Zhang, P. Yousefian, R. N. Camozzi, C. Hon, N. Talebian, T. Liu, and M. Hemmati, "Retention over attraction: A review of women's experiences in the australian construction industry; challenges and solutions," *Buildings*, vol. 13, no. 2, p. 490, 2023.
[51] Y. Yang, A. P. Chan, M. Shan, R. Gao, F. Bao, S. Lyu, Q. Zhang, and J. Guan, "Opportunities and challenges for construction health and safety technologies under the covid-19 pandemic in chinese construction projects," *International journal of environmental research and public health*, vol. 18, no. 24, p. 13038, 2021.
[52] N. Ishak, M. I. B. Mansor, A. C. Ahmad, A. S. Jaafar, and N. Jaffar, "Hindrance in safety management practices in the construction of infrastructure projects," *Int. J. Acad. Res. Bus. Soc. Sci*, vol. 12, no. 8, pp. 798–806, 2022.
[53] I. Abdullahi, C. Watters, G. Kapogiannis, and M. K. Lemański, "Role of digital strategy in managing the planning complexity of mega construction projects," *Sustainability*, vol. 15, no. 18, p. 13809, 2023.
[54] A. T. Yu, I. Wong, Z. Wu, and C.-S. Poon, "Strategies for effective waste reduction and management of building construction projects in highly urbanized cities—a case study of hong kong," *Buildings*, vol. 11, no. 5, p. 214, 2021.
[55] B. E. Frimpong, R. Y. Sunindijo, and C. Wang, "Towards improving performance of the construction industry in ghana: a swot approach," *Civil Engineering Dimension*, vol. 22, no. 1, pp. 37–46, 2020.
[56] Y. Yusana, S. Helmi *et al.*, "Optimization of human resources in the construction industry at pt. superior pusadega," *Sinergi International Journal of Management and Business*, vol. 2, no. 4, pp. 186–197, 2024.
[57] S. N. Rahmadani and H. Heriyanto, "Peran manajemen sdm terhadap kinerja karyawan pada perusahaan konstruksi pt. marisa jaya abadi," *Wawasan: Jurnal Ilmu Manajemen, Ekonomi dan Kewirausahaan*, vol. 3, no. 1, pp. 237–242, 2025.