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# The Impact of Digital Transformation on the Effectiveness of Human Resource Management and Corporate Economic Performance in the Era of Industry 4.0

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### ABSTRACT

*This study analyzes the impact of digital transformation on the effectiveness of human resource management (HRM) and corporate economic performance in the Industry 4.0 era using a qualitative descriptive method based on library research from scientific journals, management theory books, and research reports related to digital transformation in Indonesia. The background of the study highlights the revolution in business operations through AI, big data, IoT, and cloud computing, which increases efficiency by 30-50% but poses challenges of employee resistance and a digital divide in Indonesia, where only 30-40% of the workforce is digitally ready. The problem formulation covers four aspects: the impact of digital transformation on HR effectiveness, the mediating role of HR effectiveness in the relationship between digital transformation and economic performance, moderating factors such as organizational culture and technological infrastructure, and optimization strategies for Indonesian companies. The literature synthesis results show a significant positive effect with a regression coefficient of  $\beta=0.34-0.41$  ( $p<0.05$ ), where AI recruitment reduces time-to-hire by 51.1%, virtual training increases relevance by 26.1%, and performance analytics increase accuracy by 50.8%, explaining 67% of employee performance variation. HR*

### KEYWORDS

*Digital transformation,  
HR effectiveness,  
Industry 4.0*

effectiveness strongly mediates ( $R^2=0.479-0.67$ ) ROA and revenue growth of 15-30%, with SME path analysis confirming a significant indirect effect (coefficient 0.592). Key moderators include adaptive culture ( $\beta$  moderation=0.29), infrastructure (reducing the digital divide by 25%), and digital competence. Strategic recommendations include mass reskilling (20% budget for LMS/AI), adoption of integrated HRIS, innovative culture via leadership commitment, Making Indonesia 4.0 collaboration, and digital KPI monitoring for optimal revenue growth. This study contributes to a human-centered digital HR framework for sustainable competitive advantage.

## 1. INTRODUCTION

The Industry 4.0 era is characterized by the deep integration of digital technologies such as Artificial Intelligence (AI), big data, the Internet of Things (IoT), and cloud computing, which are fundamentally revolutionizing business operations, creating smart manufacturing systems with equipment automation, real-time data analysis, and efficient physical-digital collaboration, thereby increasing operational efficiency by 30-50% in the manufacturing sector.<sup>1</sup> Digital transformation not only changes the production process from a conventional linear model to an interconnected ecosystem where IoT predictively monitors machines, AI optimizes decisions, big data provides strategic insights, and cloud computing supports global data scalability, but also revolutionizes human resource management (HRM) by shifting the focus from administrative to strategic, where effectiveness is measured through metrics such as recruitment time, performance assessment accuracy, and training relevance.<sup>2</sup>

In HR management, AI-based recruitment through applicant tracking systems and resume screening automates the selection process, reducing time-to-hire by up to 51.1% and improving hire quality by reducing subjective bias through machine learning algorithms, such as the Pymetrics platform, which objectively assesses candidates based on soft skills.<sup>3</sup> AI-based adaptive learning systems tailor content to individual needs, increasing relevance by 26.1% and employee satisfaction by 51.3%, enabling mass upskilling for digital competencies in the Industry 4.0 era. While employee performance analytics using predictive analytics and sentiment analysis from big data monitor engagement, turnover, and productivity in real-time with appraisal accuracy increasing by 50.8%, enabling HR to predict talent needs and retention strategies.

However, despite its benefits, digital transformation faces significant challenges such as employee resistance due to fear of job displacement and lack of digital skills, as well as the

<sup>1</sup> Aleksey G Tashkinov, "The application of industry 4.0 into the company's production activities through effective decision-making," *National decision of medicine*, 2025, 1-11, <https://doi.org/https://doi.org/10.1038/s41598-025-15688-0>.

<sup>2</sup> Halimatus Sa'diyah, "Transformasi industri dengan teknologi 4.0: Revolusi digital di era modern," *Maliki Interdisciplinary Journal (MIJ)* 2, no. 7 (2024): 356.

<sup>3</sup> Fredrick Kayusi et al., "AI-Driven HR Analytics: Transforming Talent Management and Employee Engagement," *Revista Multidisciplinaria Voces de América y el Caribe* 2, no. 1 (2025): 573.

digital divide that exacerbates inequality in access to technology. Employee resistance causes emotional distress from job uncertainty, where automation replaces routine tasks and triggers structural unemployment. In Indonesia, this is exacerbated by low digital competence among human resources, with only 30-40% of the workforce ready for Industry 4.0, while the digital divide between regions causes a skills gap that makes it difficult for low-skilled workers to adapt, potentially suppressing overall welfare and productivity.<sup>4</sup>

This challenge has a negative impact on the company's economic performance, such as ROA (Return on Assets) and revenue growth, where successful adoption can increase ROA by 20-25% through digital workforce optimization and revenue growth of 15-30% from process innovation, but resistance and skills gaps cause high turnover (5-10%), stagnation, or revenue decline of up to 10%, even though IoT automation has successfully driven revenue in manufacturing. Overall, the journal literature emphasizes the need for mitigation strategies such as reskilling training and adaptive culture to maximize the benefits of digital transformation while minimizing risks to HR effectiveness and economic performance.<sup>5</sup>

Based on the above background, several problems were formulated, including: *first*, How does digital transformation affect the effectiveness of human resource management in companies in the Industry 4.0 era? *Second*, To what extent does the effectiveness of human resource management mediate the relationship between digital transformation and company economic performance? *Third*, What factors (such as organizational culture and technological infrastructure) moderate What are the impacts? *Fourth*, what are the strategic recommendations for Indonesian companies to optimize digital transformation in human resource management?

## 2. METHODS

The method used in the preparation of this scientific paper is the descriptive method with a qualitative approach. Meanwhile, the type of research used is library research, which is research conducted using literature (library) in the form of books, encyclopedias, dictionaries, journals, magazines, documents, and previous research reports and so on that are related to the problem to be solved. In addition, library research will be used as a step for researchers in determining research topics, conducting studies on theories related to the topics being researched by collecting materials to be researched and analyzed further so that research results can be obtained. The most important idea in the discussion is to provide an understanding and knowledge of the impact of digital transformation on the effectiveness of HR management and corporate economic performance in the Industry 4.0 era. Data collection techniques were carried out through literature studies by collecting relevant literature from books on management and digital economy theory, scientific journals on Industry 4.0 and HRM, as well as research report documents related to digital transformation in Indonesian companies, which were then reviewed, synthesized, and analyzed thematically to describe patterns of influence and practical recommendations.

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<sup>4</sup> Sesilia, Angeliq Thennanda Putri, dan Tiya Anzela, "Pengaruh Teknologi Dalam Kesenjangan Keterampilan di Era Revolusi Industri 4.0 Terhadap Tenaga Kerja Sumber Daya Manusia," *Jurnal Ilmiah Kajian Multidisipliner Vol 8*, no. 12 (2024): 176.

<sup>5</sup> Dini Fajriyani et al., "Tantangan Kompetensi SDM dalam Menghadapi Era Digital (Literatur Review)," *JEMSI (Jurnal Ekonomi Manajemen Sistem Informasi) 4*, no. 6 (2023): 1010.

### 3. RESULTS AND DISCUSSION

#### The Impact of Digital Transformation on the Effectiveness of Human Resource Management in Companies in the Industry 4.0 Era

The impact of digital transformation on the effectiveness of human resource management (HRM) in companies in the Industry 4.0 era is positive and significant overall, as evidenced by various empirical studies and recent literature reviews that highlight improvements in operational efficiency, productivity, faster decision-making, and increased employee skills and job satisfaction through the integration of technologies such as AI, big data, cloud computing, and HR Information Systems (HRIS).<sup>6</sup> Specifically, digitization is revolutionizing core HR management functions from recruitment to talent development; for example, AI-based digital recruitment accelerates the process of finding and selecting more suitable candidates with a regression coefficient of  $\beta = 0.34$  ( $p < 0.05$ ), improving job-person fit and organizational attractiveness through data-driven screening, while technology-based training increases learning flexibility and effectiveness with  $\beta = 0.41$  ( $p < 0.01$ ), reducing training costs by up to 50% and accelerating employee adaptation time by up to 60%, as evidenced in a study in the IT services sector where the three digital HRM practices (recruitment, training, performance management) explain 67% of the overall variation in employee performance. Furthermore, digital performance management enables transparent, accurate, and real-time evaluation through predictive analytics, which does not only increases the objectivity of appraisals by up to 50.8% but also supports holistic measurement of HR effectiveness with metrics such as engagement, retention, and training ROI.<sup>7</sup>

**Table Calculating the Impact of Digitalization on HR Management Functions**

No.	Digital HRM Functions	Regression Coefficient ( $\beta$ )	Significance Level (p-value)	Main Impact	Effectiveness Calculation
1	AI-based recruitment	0.34	< 0.05	Accelerate the selection process for more suitable candidates, improve job-person fit	Contribution of performance variation: $\beta \times 100 = 34\%$ increase in candidate suitability
2	Technology-based training	0.41	< 0.01	Flexibility in learning, 50% reduction in training costs, 60% acceleration in employee adaptation	Contribution of performance variation: $\beta \times 100 = 34\%$ increase in candidate suitability

<sup>6</sup> Vanny Nuari Winanda dan Jhon Veri, "PENGARUH TRANSFORMASI DIGITAL TERHADAP MANAJEMEN SUMBER DAYA MANUSIA: SYSTEMATIC LITERATURE REVIEW," *Indo-Fintech Intellectuals: Journal of Economics and Business* 5, no. 2 (2025): 4486.

<sup>7</sup> Nurul Amalia Fitriyana, Nanang Suryadi, dan Raditha Dwi Hapsari, "The Role of Social Media and Online Reviews in Building Brand Loyalty Through Trust," *JIMKES Jurnal Ilmiah Manajemen Kesatuan* 13, no. 5 (2025): 3330–32, <https://doi.org/10.37641/jimkes.v13i5.3602>.

No.	Digital HRM Functions	Regression Coefficient ( $\beta$ )	Significance Level (p-value)	Main Impact	Effectiveness Calculation
3	Digital performance management	Not specific	Not specific	Real-time evaluation, appraisal objectivity +50.8%, engagement/retention/ROI metrics	Increase in objectivity: +50.8%; Total R <sup>2</sup> of the three practices = 67% variation in employee performance
	<b>Total of All Three Practices</b>	<b>R<sup>2</sup> = 0.67</b>	<b>p &lt; 0.01</b>	Explanation of 67% variation in employee performance in the IT services sector	<b>Combined effectiveness: 67%</b>

This influence is also evident in human resource adaptability, where digitization through information technology, communication, and collaborative tools accelerates work processes, increases efficiency, flexibility, and adaptability, but requires organizational social readiness such as adaptive leadership, technology-based training, role restructuring, and a culture of innovation, as illustrated in the case study of PT Pos Indonesia, which successfully maintained its competitiveness through socio-technical integration.<sup>8</sup> In a broader context, digital transformation significantly affects employee attitudes (job satisfaction, affective commitment), psychological factors (self-efficacy, resilience), and job aspects (engagement, autonomy), enriching dynamic capability theory with empirical evidence from top digital countries, where HR trends include the development of digital competencies, soft-hard skills, organizational culture, and innovative leadership.<sup>9</sup> In Indonesia, digital competencies have a significant positive effect on HR manager performance, transforming the role of HR from administrative to strategic partner, supported by a flexible adaptive organizational culture, while startups in the fintech and e-commerce sectors show high adoption with top management support, infrastructure, and a flexible culture that accelerates AI selection and digital training participation.<sup>10</sup>

Although predominantly positive, the impact of digital transformation also presents challenges that moderate its effectiveness, such as the need to improve employees' digital skills, data security risks, resistance to change, and infrastructure limitations in developing countries, which can lead to skills gaps and a temporary decline in efficiency if not managed with the

<sup>8</sup> Anton Susanto, "Implementasi Sistem ERP (Enterprise Resources Planning) PT Pos Indonesia: Sebuah Inisiasi dan Strategi," *Jurnal Penelitian POS dan Informatika* 1, no. 1 (2013): 173.

<sup>9</sup> Supriyadi, "Integrasi Sistem Informasi Manajemen SDM Dalam Transformasi Digital: Pengaruh Terhadap Efisiensi Operasional (Studi Pada Industri Manufaktur di Cilegon)," *Jurnal Ekonomi dan Bisnis* 4, no. 2 (2024): 240–41.

<sup>10</sup> Odjie Samroji, "Transformasi Digital Fungsi SDM: Dari Administrasi ke Mitra Strategis," *Akselerasi.id*, 2025, <https://akselerasi.id/transformasi-digital-fungsi-sdm-dari-administrasi-ke-mitra-strategis/#:~:text=Transformasi Digital Fungsi SDM: Dari,ke Mitra Strategis - Akselerasi.id>.

right strategies, such as investment in training and organizational restructuring. A bibliometric study of 112 Web of Science articles (since 2011) confirms that HRM supports digital transformation through sustainable practices, digital competencies, and environmental innovation, with a predominance of empirical quantitative research recommending a future agenda focused on the impact of the COVID-19 pandemic and employee expectations of Industry 4.0 technology. Empirically, HR digitalization improves overall employee performance, with HRIS+AI+big data increasing the efficiency and accuracy of HR planning in the Industry 5.0 era, as well as supporting an adaptive culture for sustainable innovation. In conclusion, the impact of digital transformation is positively transformative on the effectiveness of HR management in the Industry 4.0 era, with strong evidence from regression, SLR, and studies. cases that emphasize human-technology integration for competitive advantage, although challenges need to be mitigated for optimal realization.

### **The Effectiveness of HR Management as a Mediator of Digital Transformation-Economic Performance**

The effectiveness of human resource management (HRM) significantly and positively mediates the relationship between digital transformation and corporate economic performance in the Industry 4.0 era, with empirical evidence from various studies showing that HRM is not only a passive recipient of technology but also functions as a crucial mediator that transforms digital inputs into economic outputs through increased competence, process efficiency, and organizational innovation.<sup>11</sup> Specifically, path analysis on Indonesian MSMEs reveals that effective HRM, including proper selection, continuous training, and employee development, has a significant direct effect on performance (coefficient 0.592,  $p < 0.005$ ) while digital transformation acts as a partial mediator that strengthens this indirect effect by explaining 47.9% of performance variation, where HR practices integrated with technology such as HRIS and AI result in increased operational efficiency that translates into economic metrics such as ROA and revenue growth through mechanisms such as administrative automation that frees up HR to focus on strategy. These findings are consistent with Marler & Boudreau (2017) cited in recent literature, where digital transformation shifts the HR management paradigm from routine tasks to strategic activities such as workforce planning and talent development, thereby creating a significant indirect mediating effect on organizational productivity, as evidenced by the Sobel test or bootstrapping in SEM analysis, which shows a p-value  $< 0.05$  for the mediation path in the MSME sample with a high response rate.<sup>12</sup>

Furthermore, HR effectiveness mediates this relationship through psychological and operational dimensions; for example, the integration of digital technology in HR strategies improves employee performance with a strong mediation coefficient through the adaptation of HR strategies, where a systematic literature review identifies that adaptive organizational culture and digital training serve as a bridge connecting the adoption of AI/cloud computing with economic indicators such as revenue growth (15-30%) and operational cost reduction (20-40%), with a partial mediation effect reaching  $R^2 = 0.67$  in case studies of organizations implementing HRIS and online learning platforms. In the context of digitizing traditional HR functions such as recruitment (reducing time-to-hire by 50%), training (improving real-time

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<sup>11</sup> Mardiyah et al., "Transformasi Digital Manajemen Sumber Daya Manusia: Konsep, Fungsi, Tantangan dan Solusi," *Jurnal Inovasi Keuangan dan Manajemen* 5, no. 4 (2024): 171–75.

<sup>12</sup> Landreas Utama Lie, Sudarmiatin, dan Ludi Wishnu, "Peran Mediasi Transformasi Digital dalam Pengelolaan SDM terhadap Peningkatan Kinerja UMKM: Path Analysis," *Jurnal Manajemen dan Bisnis Ekonomi* 2, no. 4 (2024).

competencies), and performance appraisal (50.8% higher accuracy), HR effectiveness acts as a black box that converts digital investments into competitive advantages, as evidenced by in-depth interviews with HR practitioners showing increased organizational productivity through role restructuring and employee resistance mitigation, with economic implications in the form of higher training ROI and talent retention contributing to ROE and NIM in the service sector. Challenges such as digital competency gaps and resistance can weaken this mediation if not addressed. However, qualitative studies confirm that strong management support and effective communication strengthen the mediation pathway, resulting in sustainable performance.<sup>13</sup>

**Table Calculating the Effectiveness of HR Mediation in HR Digitalization**

No.	Aspects of HR Effectiveness Mediation	Mediation Coefficient	Economic Impact	Digital HRM Functions	Effectiveness Calculation
1	Adaptation of HR Strategy (Partial Mediation)	$R^2 = 0.67$	Revenue growth: 15-30%	AI/Cloud Computing Integration	Strong mediation: 67% of variation explained; $ROI = (15\%+30\%)/2 = 22.5\%$ growth
2	Reduction in Operating Costs	Not specific	Cost reduction: 20-40%	HRIS & Online Learning Platforms	Average efficiency: $(20\%+40\%)/2 = 30\%$ ; Total cumulative impact: 52.5%
3	Digital Recruitment	Not specific	Time-to-hire reduction: 50%	Automated recruitment process	Time savings: 50%; Contribution to employee performance mediation
4	Digital Training	Not specific	Real-time competency improvement	Online learning platform	Direct competency improvement; Part of $R^2=0.67$
5	Digital Performance Assessment	Not specific	Accuracy improvement: 50.8%	Predictive analytics appraisal	Objectivity +50.8%; Engagement/retent

<sup>13</sup> Suryati Eko Putro, "Strategi SDM untuk Meningkatkan Kinerja Karyawan di Era Digital," *Management Studies and Business Journal (PRODUCTIVITY)* 1, no. 3 (2024): 405–10.

No.	Aspects of HR Effectiveness Mediation	Mediation Coefficient	Economic Impact	Digital HRM Functions	Effectiveness Calculation
					ion/ROI metric support
	<b>Total Mediation Effect</b>	<b>R<sup>2</sup> = 0.67</b>	<b>ROE/NIM improvement (Service Sector)</b>	<b>Case studies HRIS implementation</b>	<b>Mediasi pathway: 67% + economic gains 22.5-30%</b>

Empirically, the degree of mediation is quantified in various structural models; in MSMEs, the indirect effect of HR management through digital transformation reaches high significance ( $p = 0$ ), explaining 47.9% of performance variation, while in large organizations, digital HR practices mediate up to 60% of the relationship between technology and economic outcomes through increased employee engagement and self-efficacy. Bibliometrics from recent literature (2011-2025) support that digital HRM is the main mediator in the dynamic capability framework, where sustainable practices and digital competencies amplify the effect of transformation on ROA (positive coefficient of 0.34-0.59), although the full mediating effect is rarely achieved due to moderating factors such as infrastructure. In conclusion, the effectiveness of HR management strongly mediates the relationship between digital transformation and economic performance (partially explaining up to 67% of the variation), with practical recommendations for human-technology integration to optimize ROA and revenue growth in the Industry 4.0 era.<sup>14</sup>

No.	Organizational Context	The Mediation Effect of HR Management	Statistical Significance	Performance Variations Explained	Economic Indicators	Additional Coefficient
1	<b>MSMEs</b>	Indirect effect through digital transformation	$p = 0$ (very significant)	47.9%	ROA improvement	-
2	<b>Large Organizations</b>	Digital HR practices as mediators	Not specific	60% (technology-economic outcomes relationship)	Employee engagement & self-efficacy → ROA	-

<sup>14</sup> Kashif Nadeem et al., "Digital transformation and industry 4.0 employees: Empirical evidence from top digital nations," *Technology in Society* 76 (2024): 102434, <https://doi.org/10.1016/j.techsoc.2023.102434>.

No.	Organizational Context	The Mediation Effect of HR Management	Statistical Significance	Performance Variations Explained	Economic Indicators	Additional Coefficient
3	<b>Bibliometrics (2011-2025)</b>	Digital HRM as the primary mediator in the dynamic capability framework	Not specific	-	ROA (positive coefficient)	$\beta = 0.34-0.59$
4	<b>Overall Model</b>	Effectiveness HR management (partial mediation)	Not specific	Up to 67% variation	ROA & revenue growth	Full mediation is rarely achieved (infrastructure moderation)
	<b>Total Cumulative Effect</b>	<b>Strong mediation across studies</b>	$p \leq 0$	<b>47.9%-67%</b>	<b>ROA Optimization Industry 4.0</b>	$\beta = 0.34-0.59$

### **Moderating Factors of Digital Transformation Impact on Economic Performance**

The factors that moderate the impact of digital transformation on human resource management (HRM) effectiveness and corporate economic performance in the Industry 4.0 era are diverse and multidimensional, with organizational culture and technological infrastructure as the main moderators often identified in empirical literature, where both can strengthen or weaken the causal relationship depending on the level of maturity of their implementation. Organizational culture serves as a critical moderator because it encompasses adaptive values such as innovation, flexibility, and acceptance of change that influence technology adoption;<sup>15</sup> studies show that organizations with a digital-oriented culture characterized by leadership support, open communication, and tolerance for failure increase HR effectiveness by 35-50% through reduced employee resistance and increased engagement, while hierarchical or risk-averse cultures moderate negatively by causing skills gaps and high turnover (up to 15%), as evidenced in a moderation regression analysis of Indonesian companies where adaptive culture increased the  $\beta$  coefficient of digital transformation from 0.34 to 0.59 ( $p < 0.01$ ). Furthermore, technological infrastructure acts as an enabling prerequisite that moderates the accessibility and scalability of digital transformation, where stable broadband availability, mature cloud computing, and IoT-AI integration enhance HR effectiveness through real-time analytics (reducing HR processing time by 30-40%) and predictive workforce planning. However, weak infrastructure, such as in rural areas of Indonesia, weakens the impact by up to 25% due to the

<sup>15</sup> Radeswadri, "Manajemen Sumber Daya Manusia : Tren dan Tantangan di Era Digital," *Bedelau: Journal of Education and Learning* 5, no. 1 (2024): 6-7.

digital divide, with findings from BPS and World Economic Forum reports linked in The journal asserts that infrastructure investment positively moderates ROA through an 18.5% increase in human resource productivity.<sup>16</sup>

Other significant factors include employee digital competence as a crucial internal moderator, where the level of technological literacy (such as AI and data analytics skills) strengthens HR mediation by increasing self-efficacy and job satisfaction by up to 51.3%. but low competency (only 30-40% of Indonesian HR is digitally ready) causes a skills mismatch that negatively moderates economic performance, as illustrated in the case studies of PT Pos Indonesia and the Ministry of Communication and Information Technology, which show that reskilling training is a mandatory intervention to turn negative effects into positive ones. Top management support also strongly moderates, with high leadership commitment (through a 20% budget allocation for digital HR) amplifying the impact of transformation on HR effectiveness ( $\beta$  moderation-0.29,  $p < 0.05$ ), while a lack of strategic vision hinders integration, as in the qualitative analysis of MSMEs, which revealed that top management support is the main gatekeeper for mitigating cultural resistance. Government regulations and policies also moderate through frameworks such as the Job Creation Law and the Making Indonesia 4.0 program, which reinforce positive impacts with tax incentives for infrastructure, but the inconsistency of data privacy regulations (ITE Law) can negatively moderate due to cybersecurity risks that reduce employee trust. Budget and financial resources complete the list of external moderators, where funding constraints (a major obstacle in Indonesia's public sector) weaken implementation by up to 31%, according to a study by the Manado Communication and Information Agency, while optimal allocation yields a digital training ROI of up to 4:1, which translates to revenue growth.<sup>17</sup>

These interactions between factors are complementary, for example, an innovative culture supported by strong infrastructure and high competence creates a multiple moderation effect that explains up to 67% of the variation in HR effectiveness, as in the SEM model from a literature review that integrates dynamic capabilities theory, with the recommendation that companies should prioritize cultural audits and infrastructure upgrades to maximize the impact of digital transformation. Overall, these moderators form a contingency framework in which success depends on holistic synergy, with consistent empirical evidence from Indonesian studies emphasizing the urgency of phased interventions for an optimal transition to Industry 4.0.<sup>18</sup>

### **Strategic Recommendations for Indonesian Companies to Optimize Digital Transformation in Human Resource Management**

Strategy recommendations for Indonesian companies to optimize digital transformation in human resource management in the Industry 4.0 era include A holistic approach that focuses on improving digital competencies, integrating HR technology, adaptive organizational culture,

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<sup>16</sup> Angga Wahyudi et al., "Dampak Transformasi Era Digital Terhadap Manajemen Sumber Daya Manusia," *Jurnal Bintang Manajemen (JUBIMA)* 1, no. 4 (2023): 106–8.

<sup>17</sup> Guruh Suksmono Aji dan Iva Khoiril Mala, "Meningkatkan Kualitas SDM Untuk Mencapai Keunggulan Kompetitif Perusahaan di Era Digital: Tren, Inovasi, dan Tantangan," *Jumek : Jurnal Manajemen dan Ekonomi Kreatif* 2, no. 3 (2024): 8–10.

<sup>18</sup> Engelbertha Evrantine Silalahi, Ahmad Zubir Ibrahim, dan Fransiskus Xaverius Lara Aba, "Efek Moderasi Sumber Daya Manusia terhadap Hubungan Dokumen Perencanaan, Lingkungan Birokrasi, dan Uang Persediaan dengan Penyerapan Anggaran Daerah Khusus Ibu Kota Jakarta," *JURNAL LOCUS: Penelitian & Pengabdian* 4, no. 10 (2025): 9704.

and inclusive change management, as synthesized from various empirical journal studies and current literature. **First**, prioritize mass reskilling and upskilling through e-learning and AI-based digital training and microlearning, with a minimum budget allocation of 20% of the HR budget for platforms such as LMS (Learning Management Systems) and webinars, which have been proven to reduce the skills gap by up to 40% and increase employee adaptability in companies, where cross-functional training and digital creativity result in a 30-50% increase in employee performance through methods such as virtual reality simulations and predictive analytics for content personalization. This strategy is supported by findings that digital competencies are a key prerequisite, with specific recommendations to master AI, big data analytics, and soft skills such as creative problem solving and agile teamwork, enabling companies to save up to 60% on training costs while accelerating ROI through reduced turnover due to technological unpreparedness.<sup>19</sup>

**Second**, adopt integrated HR technologies such as HRIS (Human Resource Information Systems), AI-based applicant tracking systems for recruitment, and real-time performance analytics, which automate administrative processes (reducing time-to-hire by 50% and operating costs by 20-40%) and shift the role of HR from administrative to strategic, such as workforce planning and talent development, as illustrated in a study of Indonesian MSMEs that showed a 67% increase in organizational efficiency through cloud computing and big data for predictive workforce planning. Companies are advised to start with piloting in small departments before full scalability, including the use of TikTok/LinkedIn for employer branding and Gen Z recruitment, as well as integrated applications for payroll, benefits, and engagement monitoring management. **Third**, build an adaptive organizational culture through strong leadership commitment, transparent communication, and change management programs to overcome employee resistance, where top-down management support has been proven to strengthen adoption by up to 35% by creating tolerance for failure, team collaboration, and innovation values, as recommended in a literature review that emphasizes restructuring HR roles to support sustainable transformation.<sup>20</sup>

**Fourth**, strengthen technology infrastructure and ecosystem collaboration, including stable broadband investment, cyber security in accordance with the ITE Law, and partnerships with the government through the Making Indonesia 4.0 program for tax incentives and national digital certification, which moderates the positive impact of transformation by up to 25% in the manufacturing and service sectors. Case studies show that synergy with the Ministry of Manpower for national training optimizes ROA through increased HR productivity. Fifth, implement continuous monitoring and evaluation with digital KPIs such as engagement score, retention rate, and training ROI, using predictive analytics for real-time strategy adjustments, and focusing on inclusivity to reduce the digital divide between regions, with 5-10 year trend predictions highlighting the role of AI automation and the metaverse for development. Hybrid human resources. This phased implementation-starting with an assessment of organizational

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<sup>19</sup> Nurlaeli Mahmudah, Dewi Cahyani, dan Moh. Ali, "Transformasi Digital Dalam Pengelolaan Sumber Daya Manusia: Tinjauan Konseptual dan Studi Literatur," *Pendas : Jurnal Ilmiah Pendidikan Dasar* 10, no. 4 (2025): 282.

<sup>20</sup> Marthen Lanteng, "Strategi Pengelolaan Sumber Daya Manusia dalam Menghadapi Era Digitalisasi," Website DJKN, 2024, <https://www.djkn.kemenkeu.go.id/kpkn1-parepare/baca-artikel/17199/Strategi-Pengelolaan-Sumber-Daya-Manusia-dalam-Menghadapi-Era-Digitalisasi.html>.

readiness ensures that the transformation is not only efficient but also human-centric, resulting in 15-30% revenue growth and long-term competitive advantage for Indonesian companies.<sup>21</sup>

**Table of Calculations for the Effects of Digital HR Management Mediation**

No.	Key Strategies	Key Components	Budget/Technology	Quantitative Impact
1	Mass Reskilling & Upskilling	E-learning, AI training, microlearning, VR simulations, predictive analytics	≥20% of HR budget for LMS & webinars	Skills gap ↓40%; Employee performance ↑30-50%; Training cost ↓60%; Fast ROI via turnover reduction
2	Adoption of Integrated HR Technology	HRIS, AI applicant tracking, real-time performance analytics, cloud computing	Pilot in a small department, full scalability	Time-to-hire ↓50%; Operating cost ↓20-40%; Efisiensi organisasi ↑67% (MSMEs Indonesia)
3	Adaptive Organizational Culture	Leadership commitment, transparent communication, change management	Top-down support, tolerance for failure, team collaboration	Transformation adoption ↑35%; Overcoming employee resistance
4	Infrastructure Strengthening & Collaboration	Stable broadband, cybersecurity (Electronic Information and Transactions Law), partnership Making Indonesia 4.0	Tax incentives, national digital certification	Moderate impact of transformation ↑25% (manufacturing & services); Optimal ROA via Ministry of Manpower training

<sup>21</sup> Inviolata Rogo dan Usman Radiana, "Strategi dan Tantangan Transformasi Digital dalam Pengembangan SDM Pendidikan," *Journal of Mandalika Literature* 5, no. 4 (2024): 1081.

5	Continuous Monitoring & Evaluation	Digital KPIs (engagement score, retention rate, training ROI), predictive analytics	Real-time adjustment, regional inclusivity, 5-10 year predictions (AI/metaverse)	Revenue growth ↑15-30%; Long-term competitive advantage
<b>Total Cumulative Impact</b>	<b>Holistic Human-Centric Approach</b>	<b>Assessment readiness → Phased implementation</b>	<b>Strategic allocation budget</b>	<b>67% efficiency + 15-30% revenue + optimal ROA</b>

#### 4. CONCLUSION

Based on the discussion of the above material, several conclusions can be drawn, including: *first*, digital transformation has a positive and significant impact on the effectiveness of human resource management (HRM) in Industry 4.0 companies, with empirical evidence showing an increase in operational efficiency of up to 67% through AI recruitment (beta = 0.34), digital training (beta = 0.41), and real-time performance analytics, which reduce costs by up to 50% and increase employee adaptability, although challenges such as skills gaps require mitigation through an innovative culture.

*Second*, HRM effectiveness strongly mediates the relationship between digital transformation and economic performance (partially up to  $R^2 = 0.67$ ) where path analysis on Indonesian SMEs confirms a significant indirect effect (coefficient 0.592,  $p < 0.005$ ) that explains 47.9-60% of the variation in ROA and revenue growth through administrative automation and increased employee engagement.

*Third*, the main moderating factors include an adaptive organizational culture that strengthens the impact by 35-50% ( $\beta$  moderation from 0.34 to 0.59), stable technology infrastructure that reduces the digital divide by 25%, employee digital competence, top management support (beta = 0.29), regulations such as the Job Creation Law, and financial budgets, with complementary synergies explaining 67% of the variation in effectiveness through the dynamic capabilities framework.

*Fourth*, strategic recommendations for Indonesian companies include mass reskilling (20% budget for LMS/AI), adoption of integrated HRIS, building an adaptive culture via leadership commitment, strengthening infrastructure through Making Indonesia 4.0, and monitoring sustainable digital KPIs, which holistically result in 15-30% revenue growth and human-centric competitive advantage.

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