

Implementation of Digital Human Resource Management (E-HRM) to Improve Organizational Efficiency in the Industry 4.0 Era

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ABSTRAK

Perkembangan teknologi pada era Industri 4.0 telah mendorong transformasi digital yang signifikan di berbagai sektor, termasuk pengelolaan sumber daya manusia. Electronic Human Resource Management (E-HRM) menjadi salah satu inovasi penting yang memungkinkan proses manajemen SDM dilakukan secara terintegrasi dan berbasis teknologi digital. Penelitian ini bertujuan untuk menganalisis manfaat, hambatan, dan strategi optimalisasi penerapan E-HRM dalam meningkatkan efisiensi organisasi. Metode yang digunakan adalah Systematic Literature Review (SLR) terhadap 70 artikel terpilih dari basis data Scopus, Web of Science, dan Google Scholar, dengan penerapan protokol PRISMA dalam proses seleksi literatur. Hasil penelitian menunjukkan bahwa penerapan E-HRM mampu memberikan dampak positif terhadap efisiensi organisasi melalui percepatan proses administrasi, penghematan biaya operasional, peningkatan akurasi data, serta pengambilan keputusan yang lebih cepat dan berbasis data (data-driven). Namun, sejumlah hambatan seperti resistensi budaya organisasi, rendahnya literasi digital, keterbatasan infrastruktur teknologi, dan tingginya biaya awal implementasi menjadi tantangan yang perlu diatasi. Strategi optimalisasi yang direkomendasikan meliputi pelatihan literasi digital berkelanjutan, dukungan manajemen puncak, serta integrasi teknologi berbasis kecerdasan buatan. Temuan ini menegaskan bahwa E-HRM dapat menjadi katalis utama dalam meningkatkan efisiensi dan daya saing organisasi di era transformasi digital.

Kata Kunci: Electronic Human Resource Management (E-HRM), Digital HR, Efisiensi Organisasi, Industri 4.0, Transformasi Digital

ABSTRACT

Technological developments in the Industry 4.0 era have driven significant digital transformation in various sectors, including human resource management. Electronic Human Resource Management (E-HRM) is a crucial innovation that enables integrated, digital-based HR management processes. This study aims to analyze the benefits, barriers, and optimization strategies for implementing E-HRM to improve organizational efficiency. The method used was a Systematic Literature Review (SLR) of 70 selected articles from the Scopus, Web of Science, and Google Scholar databases, with the PRISMA protocol applied in the literature selection process. The results show that implementing E-HRM can have a positive impact on organizational efficiency by accelerating administrative processes, saving operational costs, increasing data accuracy, and enabling faster, data-driven decision-making. However, several obstacles such as organizational cultural resistance, low digital literacy, limited technological infrastructure, and high initial implementation costs are challenges that need to be overcome. Recommended optimization strategies include ongoing digital literacy training, top management support, and the integration of artificial intelligence-based technology. These findings confirm that E-HRM can be a major catalyst in improving organizational efficiency and competitiveness in the era of digital transformation.

Keywords: Electronic Human Resource Management (E-HRM), Digital HR, Organizational Efficiency, Industry 4.0, Digital Transformation



INTRODUCTION

The development of digital technology over the past decade has had a significant impact on nearly all aspects of organizational management, including human resource (HR) management. The Industry 4.0 era is characterized by the integration of technologies such as the Internet of Things (IoT), Artificial Intelligence (AI), Big Data Analytics, and Cloud Computing into business processes. (Schwab, 2019). In the context of HR management, this transformation gave rise to the concept of Electronic Human Resource Management (E-HRM), which transforms traditional functions into digital technology-based ones. E-HRM encompasses online recruitment processes, e-learning-based training, digital performance assessments, and real-time employee data management through an integrated system.(Bondarouk & Brewster, 2016; Strohmeier, 2020). Digitalization of HR management offers organizations significant opportunities to improve operational efficiency. A study by Ruel et al., (2019) Studies have shown that implementing e-HRM can speed up HR administration processes by up to 60% and reduce operational costs by up to 30%. This is possible because technology automates administrative tasks that previously required extensive time and human effort, such as attendance management, payroll processing, and employee document storage.(Davenport, 2020)With a digital system, HR data can be accessed quickly, accurately, and securely, facilitating strategic decision-making.

The implementation of E-HRM has become increasingly relevant since the COVID-19 pandemic, which forced organizations worldwide to adopt remote working systems and increased reliance on technology.(Kuncoro & Suharto, 2021). StudyLee et al., (2021)found that companies that had implemented e-HRM before the pandemic had a higher level of adaptation to changes in the work environment compared to those still using conventional systems. This system allows recruitment, training, and performance evaluation processes to continue without face-to-face meetings, thus supporting the continuity of organizational operations. While the benefits of e-HRM are widely recognized, its implementation has not always gone smoothly. Challenges include employee resistance to technological change, limited digital literacy, and uneven technological infrastructure.(Rahmawati et al., 2022). In addition, the initial costs of implementing a comprehensive E-HRM system are often a barrier, especially for medium and small-scale organizations.(Strohmeier & Parry, 2021). StudyNguyen & Teo, (2020)added that the success of E-HRM implementation does not only depend on the technology itself, but also on an effective change management strategy.

A number of studies have examined the impact of E-HRM on organizational efficiency. For example,Marler & Fisher (2019)found that e-HRM can improve data accuracy and speed up decision-making in the public sector. However, most of this research is partial and focuses on a single aspect of the HR function, such as recruitment or training. Hameed et al., (2022)also emphasized that the integration of E-HRM into the entire HR management cycle is rarely discussed comprehensively, thus providing a less complete picture of its contribution to organizational efficiency. Furthermore, most international studies have focused on E-HRM implementation in developed countries with mature technological infrastructure, while studies in developing countries like Indonesia are still limited.(Putri & Hartati, 2023). However, the context of developing countries has different characteristics, such as the level of technological readiness, work culture, and unique employment regulations.(Nasution & Fakhri, 2020)This situation

indicates a research gap to explore how e-HRM can be implemented effectively in organizational environments facing infrastructure and resource constraints. Furthermore, previous research tends to separate discussions of the benefits and challenges of e-HRM implementation, without linking the two in an integrative manner to generate optimization strategies. For example, the study Strohmeier (2020) discusses aspects of technology and automation, while studies Rahmawati et al., (2022) While research has highlighted employee resistance, it is rare to find research that combines both perspectives to produce readily implementable solutions. This limitation reinforces the importance of holistic and contextual studies.

The identified research gaps are: 1) the lack of studies that comprehensively examine the implementation of E-HRM from upstream to downstream (end-to-end process) in the HR management cycle in Indonesian organizations. 2) the limited number of studies that integrate the analysis of benefits and challenges to formulate applicable implementation strategies. 3) the lack of research that adapts the discussion of E-HRM to the context of developing countries that have limited digital infrastructure and technological literacy. The novelty of this research is to develop an analysis model for E-HRM implementation that not only measures its impact on organizational efficiency but also identifies obstacles and formulates optimization strategies based on local conditions in Indonesia. This approach combines technical, managerial, and cultural perspectives, thus providing practical contributions for policymakers and HR managers. Based on this background, the purpose of this research is to analyze the implementation of digital human resource management (E-HRM) in improving organizational efficiency in the Industry 4.0 era, with a focus on identifying benefits, challenges, and optimization strategies relevant to the organizational context in Indonesia.

METHODS

This study uses a qualitative approach with the Systematic Literature Review (SLR) method to obtain a comprehensive overview of the implementation of Electronic Human Resource Management (E-HRM) and its contribution to organizational efficiency in the Industry 4.0 era. This method was chosen because it is able to systematically integrate the results of empirical and conceptual research, so that the resulting findings are valid, structured, and replicable. The literature review process was carried out based on the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) protocol that allows researchers to track, filter, and select sources transparently. (Snyder, 2019). The data sources used in this study come from scientific publications in reputable international journals indexed by Scopus (Q1–Q4) and Web of Science, national journals accredited by SINTA, conference proceedings, and official reports from international institutions such as the OECD, ILO, and the World Economic Forum. The types of publications selected include empirical articles using survey methods or case studies related to E-HRM, conceptual articles discussing E-HRM theories or models, and publications relevant to the topic of organizational efficiency in the digital era.

The inclusion criteria for this study included publications published between 2019 and 2025, written in English or Indonesian, explicitly discussing E-HRM implementation and its impact on organizational efficiency, and containing identifiable empirical data or analysis. Exclusion criteria included articles without full text,

publications that only discussed conventional HR management without digitalization aspects, and studies that were too broad in scope without direct relevance to the research topic. The literature search was conducted through four main databases: Scopus, Web of Science, Google Scholar, and Garuda (for national journals). The keywords used were "Electronic Human Resource Management" OR "E-HRM", "Digital Human Resource Management" OR "Digital HRM", "Organizational Efficiency" OR "Organizational Performance", and "Industry 4.0" OR "Digital Transformation". These keywords were combined using the Boolean operators AND and OR to generate more relevant searches. For example, a search could use the following combination:

("E-HRM" OR "Electronic Human Resource Management") AND ("Organizational Efficiency" OR "Organizational Performance") AND ("Industry 4.0" OR "Digital Transformation").

The article selection process followed the four stages of PRISMA: identification, initial screening, eligibility assessment, and inclusion. In the identification stage, all articles matching the keywords were collected from the database. The initial screening stage was conducted to eliminate duplication and publications that did not meet the inclusion criteria. The eligibility assessment stage was conducted by reading the abstracts and conclusions of the articles to ensure their relevance to the research objectives. The final stage was inclusion, which included articles that had passed the selection process into the final analysis. Data analysis was conducted through thematic analysis, which consisted of three main stages. First, the researchers extracted data by recording key information from each article, such as author name, year of publication, country or industry context, focus of E-HRM functions (e.g., recruitment, training, performance appraisal), organizational efficiency indicators, and findings related to implementation barriers and strategies. Second, the collected data were categorized into key themes, such as the benefits of E-HRM on efficiency, implementation barriers, and optimization strategies. Third, the researchers conducted a narrative synthesis to integrate the results from various studies to obtain a complete and interconnected picture. The validity of the research results was maintained through the application of the PRISMA protocol and clear inclusion-exclusion criteria, while reliability was strengthened by detailed documentation of each stage of the literature search and selection. Source triangulation was conducted using various databases and publication types to reduce bias and broaden the scope of the study. With this method, the research is expected to produce a current literature map on E-HRM implementation, identify the relationship between its implementation and organizational efficiency, and formulate strategic recommendations relevant to the Indonesian context.

RESULTS AND DISCUSSION

Based on a Systematic Literature Review (SLR) process following the PRISMA protocol, of the 450 initial publications identified, 70 articles met the inclusion criteria after screening and eligibility assessment. The articles spanned the period 2019–2025, spanning various sectors such as banking, manufacturing, education, and government, and came from both developed and developing countries, including Indonesia.

The results of the thematic analysis revealed three main themes:

1. Benefits of implementing E-HRM on organizational efficiency.

2. Barriers and challenges to E-HRM implementation.
3. Optimization strategy for implementing E-HRM in the Industry 4.0 era.

Of the 70 articles summarized in this journal, there are 6 main findings from the analyzed literature:

Table 1. Summary of 6 Literatures Analyzed

N O	AUTHOR & YEAR	CONTEXT/COUNT RY	E-HRM FOCUS	IMPACT ON EFFICIENCY	CHALLENGE
1.	Lee et al. (2021)	South Korea	Digital recruitment & training	Recruitment time ↓40%, training costs ↓30%	Cultural adaptation
2.	Ruel et al. (2019)	Dutch	Integrated HRIS	Administrative automation, increased data accuracy	Technology readiness
3.	Nguyen & Teo (2020)	Vietnamese	Real-time performance dashboard	Faster & more accurate decision making	Employee resistance
4.	Rahmawati et al. (2022)	Indonesia	Digital HR implementation	HR process efficiency, cost reduction	Low digital literacy
5.	Hameed et al. (2022)	Pakistan	AI Integration in E-HRM	Turnover prediction, increased retention	High implementation costs
6.	Strohmeier & Parry (2021)	Strohmeier & Parry (2021)	Strohmeier & Parry (2021)	Strohmeier & Parry (2021)	Strohmeier & Parry (2021)

1. Benefits of E-HRM Implementation on Organizational Efficiency

The results of the literature synthesis show that the implementation of Electronic Human Resource Management (E-HRM) has a significant contribution in increasing the operational efficiency of organizations in various sectors. Lee et al., (2021) reported that South Korean companies that adopted digital recruitment and training systems experienced a 40% reduction in recruitment time and a 30% reduction in training costs. These efficiencies were achieved through automation of the selection process, candidate file screening, and online training delivery, which reduced the need for physical facilities and logistics. Ruel et al., (2019) emphasized that the integration of Human Resource Information Systems (HRIS) into E-HRM enables more accurate employee data management, reduces

data duplication, and accelerates administrative processes such as attendance and payroll. This increased data accuracy has direct implications for strategic decision-making, as valid data forms the basis for long-term HR planning.

Besides that, Nguyen & Teo, (2020) found that utilizing real-time performance dashboards facilitates managers' direct monitoring of employee performance, enabling faster and more accurate decision-making. This aligns with Strohmeier's (2020) research, which highlights that e-HRM supports the principle of data-driven decision-making, which has been empirically proven to accelerate organizational response to market changes and customer needs. In Indonesia, Rahmawati et al. (2022) reported that companies implementing e-HRM experienced up to a 35% acceleration in HR administration processes and increased transparency in recruitment processes. This transparency not only increases employee trust in company policies but also strengthens employer branding in the labor market.

Overall, the benefits of E-HRM on organizational efficiency can be grouped into three main dimensions:

- Time efficiency – through the acceleration of HR administrative and operational processes.
- Cost efficiency – through reduced use of physical resources, logistics and manual labor.
- Decision-making efficiency – through the provision of accurate and up-to-date data to support strategic decisions.

2. Barriers and Challenges to E-HRM Implementation

Despite offering numerous benefits, e-HRM implementation is not without complex obstacles. Rahmawati et al. (2022) noted that one of the biggest obstacles in Indonesia is low digital literacy among employees, particularly among generations unfamiliar with using technology in their daily work. This obstacle impacts the low adoption rate and effectiveness of e-HRM systems. Strohmeier & Parry (2021) added that another challenge is limited technological infrastructure, particularly in organizations operating in areas with unstable internet access. This factor can hamper the smooth operation of e-HRM systems that rely on high connectivity. Furthermore, resistance to change is also a significant issue. According to research, Bondarouk & Brewster, (2016) This resistance often arises from employees' fear of job loss due to automation or discomfort with using new technology. Organizational culture also influences the success of e-HRM implementation. Organizations with cultures that are less adaptable to innovation tend to experience greater barriers to adoption.

Another financial challenge is the high initial cost of implementation. Hameed et al. (2022) reported that software procurement, training, and e-HRM system integration require significant investment, which can be a barrier, especially for small and medium-sized enterprises (SMEs). In general, barriers to e-HRM implementation can be categorized as follows:

- Technical barriers: infrastructure limitations, system integration issues, and data security.

- Human resource barriers: low digital literacy, resistance to change, and lack of technological skills.
- Financial barriers: high initial costs and system maintenance costs.

3. E-HRM Implementation Optimization Strategy

Overcoming these obstacles requires a systematic and sustainable implementation strategy. One strategy identified in the literature is improving employee digital literacy. Bondarouk et al. (2017) emphasize the importance of ongoing training programs that focus not only on the technical use of e-HRM but also on understanding the strategic value of this technology for the organization. Top management support is another crucial factor. Strohmeier (2020) states that commitment from company leaders, both in the form of policies and budget allocations, can accelerate the adoption process and increase implementation success. This is reinforced by findings from Hameed et al. (2022), which show that organizations with strong leadership support have up to a 25% higher success rate in e-HRM implementation than those with weak support.

The use of Artificial Intelligence (AI) and Machine Learning (ML)-based technologies is also a trend in optimization strategies in the Industry 4.0 era. Lee et al. (2021) showed that AI integration in e-HRM enables more precise employee turnover prediction, training needs identification, and human resource placement optimization. Furthermore, the strategy of integrating e-HRM systems with other technology platforms such as Enterprise Resource Planning (ERP) and Customer Relationship Management (CRM) can create a more comprehensive data ecosystem, thereby improving cross-departmental coordination (Nguyen & Teo, 2020).

CONCLUSION

Based on this research, it can be concluded that the results of this study reveal that the implementation of Electronic Human Resource Management (E-HRM) makes a significant contribution to organizational efficiency in the Industry 4.0 era. Its implementation can accelerate administrative processes, reduce operational costs, improve data accuracy, and support data-based decision-making. However, several challenges remain, including organizational cultural resistance, low employee digital literacy, limited technological infrastructure, and high initial implementation costs. To overcome these obstacles, an optimization strategy is needed in the form of continuous digital literacy training, full support from top management, and the use of artificial intelligence-based technology to expand the analytical and predictive functions of E-HRM. These findings confirm that E-HRM can be a major catalyst in increasing organizational efficiency and competitiveness if implemented with the right strategy and comprehensive support from all stakeholders.

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