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THE TRANSFORMATION OF HUMAN RESOURCE MANAGEMENT IN THE WEB3 ERA: BIBLIOMETRIC ANALYSIS

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Abstract. This study aims to explore the transformation of human resource management in the Web3 era through a bibliometric analysis of global research trends. The research investigates how decentralized technologies, such as blockchain, smart contracts, tokenization, and Decentralized Autonomous Organizations (DAO) reshape human resource management practices toward transparency, autonomy, and efficiency. Using a descriptive qualitative approach combined with bibliometric analysis, data were collected from the Scopus database (2020–2025) and analyzed using VOSviewer to map keyword networks, identify clusters, and determine research evolution. The findings reveal four major research clusters focusing on blockchain applications, human resource analytics, organizational transformation, and smart contract implementation. Results indicate a paradigm shift in human resource management from administrative functions to strategic, technology-driven roles emphasizing digital competence and data transparency. Moreover, the study highlights challenges in privacy, data regulation, and digital literacy as critical barriers to Web3 adoption in human resource systems. The research provides conceptual insights and a framework for understanding human resource management digital evolution, offering implications for policymakers and organizations to design adaptive, decentralized, and human-centered human resource management strategies.

Keywords: web3; human resource management; blockchain; dao; bibliometric analysis

I. INTRODUCTION

In recent years, organizations and the global community have undergone major transformations driven by digitalization, including the adoption of technologies such as artificial intelligence (AI), the Internet of Things (IoT), big data, and blockchain, which have significantly reshaped business models, operations, and economic value structures. The convergence of blockchain, IoT, and AI has been identified as a key driver of the digital transformation era, enabling the creation of new autonomous business models with digital agents capable of transacting independently [1]. These technologies enable organizations to automate processes, enhance operational efficiency, process data on a large scale, and create new data-driven experiences [2].

Technological transformation has fundamentally shifted the function of human resource management from traditional HR models toward more adaptive, responsive, and technology-driven approaches. Modern technologies such as big data, artificial intelligence (AI), and distributed ledger technology (blockchain) have compelled HR functions to move beyond administrative tasks toward a more strategic role. Transforming human resource management by developing digital competencies, enhancing interdepartmental collaboration, and leveraging data analytics has become a key strategy for addressing future challenges [3].

The rapid development of technology has fundamentally transformed how organizations manage human resources. The digitalization of human activities enables increased efficiency through the use of data, applications, and collaboration tools from anywhere and at any time [4]. The digitalization era is no longer limited to administrative automation but is gradually entering a new phase characterized by the concept of Web3. Web3 represents the next generation of the internet, emphasizing decentralization and granting users full access to and control over their identities and data [5].

In addition, the emergence of the Web3 concept marks a paradigm shift in the internet toward greater decentralization, trustless systems, smart contracts, and digital ownership, which in turn offers a new framework for a more inclusive and autonomous digital economy [5] [6]. This decentralized characteristic promises a shift of power from central platforms to users, strengthened ownership of digital data, and a more open economic model, while at the same time presenting challenges such as scalability, interoperability, and regulation. Furthermore, blockchain technology together with AI and IoT is increasingly becoming the foundation of the metaverse concept, which integrates the physical and virtual worlds through digital twins, IoT sensors, big data, and immersive computing infrastructure [7].

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Web3 presents significant transformations in traditional work patterns, including remote work, the gig economy, and the emergence of cross-border work norms. The gig economy and digital-based platforms enable workers to perform tasks from locations not bound to an office, but they also pose major challenges related to job insecurity, lack of social protection, and complex algorithmic control [8]. Organizational structures based on DAOs (Decentralized Autonomous Organizations) offer a decentralized decision-making mechanism that differs substantively from traditional corporate hierarchies [9]. In addition, the phenomenon of digital nomads shows that workers today are not only digitally connected but also geographically mobile, making national borders and office locations increasingly fluid. However, this also opens new opportunities as well as major challenges in managing cross-border workforces, ensuring data security, promoting social inclusion, and designing organizational structures capable of accommodating a high degree of flexibility [10].

Human resource functions that were initially administrative in nature, such as employee data recording, payroll, and compliance are gradually shifting toward a more strategic role within organizations, focusing on talent management, capability development, and creating competitive advantage through people [11]. Blockchain technology enables faster transactions, greater transparency, and the reduction of routine workloads in recruitment processes [12]. As business environments become increasingly complex and work processes become more digitalized, recruitment functions have begun leveraging technologies such as AI, machine learning, big data, chatbots, blockchain, and automation to optimize recruitment, training, compensation, and performance management. In addition, the implementation of blockchain in talent management functions has been found to have a significant effect on the efficiency of data verification and the transparency of talent management [13]. Concepts such as self-sovereign digital identity, tokenized rewards, and smart contract–based or autonomous HR systems are becoming relevant as the next step in the transformation of human resource management, where technology is not merely used as a supporting tool, but serves to create a decentralized, transparent, and value-oriented human resource ecosystem for both employees and organizations.

The Web3-based digital transformation presents new challenges for human resource management, particularly in terms of trust and the privacy of HR data stored on blockchain systems. Although blockchain technology offers high transparency and security, its application in managing employee data raises issues related to access rights, privacy, and compliance with data protection regulations [14]. In addition, regulatory and digital governance frameworks in many countries remain insufficiently mature to accommodate decentralized HR practices, creating the need for policy updates that are adaptive to smart contracts and decentralized autonomous systems[15]. Furthermore, limited digital literacy and technological skills can hinder the effectiveness of digital transformation expected from Web3 [16].

The urgency of this research lies in the need to gain a deep understanding of how the Web3 era is revolutionizing human resource management practices and paradigms through mechanisms of decentralization, data transparency, and technology-based automation such as blockchain and smart contracts. In addition, this study aims to examine the bibliometric landscape of previous literature on the application of Web3-related technologies, such as blockchain, smart contracts, and DAO in human resource management. This research employs bibliometric analysis to identify trends, gaps, and the direction of global research development related to the transformation of human resources in the Web3 era comprehensively. Through this approach, it is expected that a deeper conceptual understanding can be obtained regarding how human resource management adapts and transforms under the influence of digital decentralization. The findings of this study are anticipated to offer a new conceptual framework that explains the shift in the HR role from an administrative function to a strategic driver of organizational innovation, as well as serve as an initial reference for future research and the formulation of sustainable, digitally driven HR policies that are responsive to the dynamics of Web3 technologies.

II. RESEARCH METHOD

This study employs a descriptive qualitative approach combined with bibliometric analysis to identify, evaluate, and synthesize various scientific findings discussing the transformation of human resource management in the Web3 era. The data used in this research are secondary in nature and obtained from reputable international academic databases such as Scopus, aligned with the research topic. The literature search was conducted for the period 2020–2025 to ensure data currency and relevance to the rapidly evolving Web3 technologies. The keywords used include: 'Web3', 'blockchain', 'human resource management', 'human resource systems', 'DAO', and 'rewards'. The search process was performed using combinations of Boolean logic ('AND', 'OR') to expand the retrieval of relevant literature. The collected data were then imported into VOSviewer. Once imported, VOSviewer processed the data and matched them with the selected or desired keywords. VOSviewer subsequently converted the data into an interconnected data map.

III. RESULT AND DISCUSSION

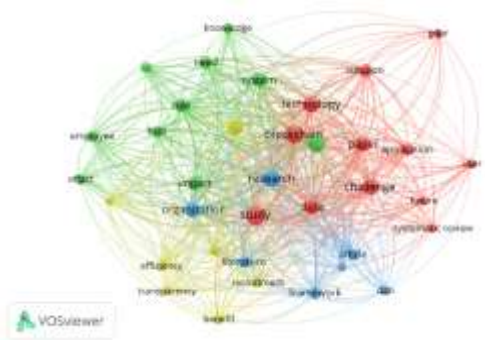

Fig. 1 Research Mapping Model

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The visualization of the mapping model in Figure 1 shows four clusters: cluster 1 in red, cluster 2 in green, cluster 3 in yellow, and cluster 4 in blue. The size of each node and the distance between them visually represent the strength of their linkages [17]. Overall, research on blockchain, human resource management, and DAOs remains correlational in nature. Furthermore, the dataset from the articles will be analyzed to examine the relationships between the main variables in each cluster and the cluster indicators that may potentially serve as novelty in the research.

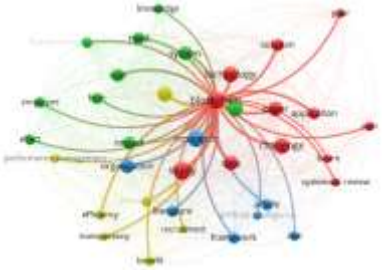

Fig. 2 Cluster 1 Mapping Visualization

The mapping visualization in Figure 2 represents Cluster 1 (red), which contains 12 items, consisting of blockchain, application, challenge, data, future, GDPR, paper, solution, study, systematic review, technology, and user. Blockchain serves as the core of the cluster with a total of 35 link connections. This visualization indicates that the topic of blockchain functions as a central research hub connecting various domains, ranging from technological aspects and implementation challenges to organizational and human resource impacts.

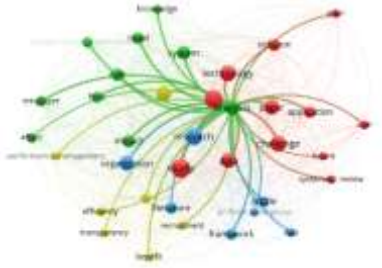

Fig. 3 Cluster 2 Mapping Visualization

The mapping visualization in Figure 3 shows Cluster 2 (green), which consists of 10 items: analysis, effect, employee, HRM, human resource management, impact, knowledge, need, role, and system. *Analysis* functions as the central node with a total of 35 link connections. The mapping findings indicate that recent research trends tend to focus on exploring the role of technology and data analytics in the development of organizational systems and managerial innovation.

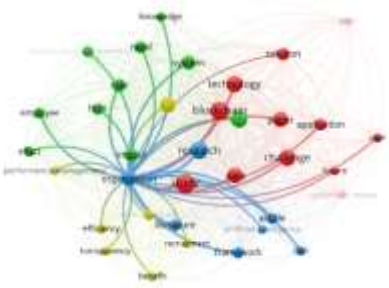

Fig. 4 Cluster 3 Mapping Visualization

The mapping visualization in Figure 4 shows Cluster 3 (yellow), which includes 7 items: organization, article, artificial intelligence, DAO, framework, literature, and research. *Organization* serves as the central node with 33 link connections. The mapping results indicate that research studies focus on organizational dynamics that emphasize the application of blockchain-based systems to enhance managerial effectiveness and promote efficiency in human resource management within the context of modem organizations.

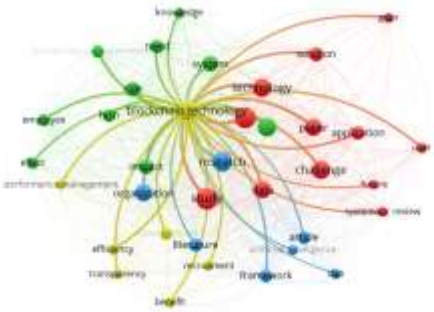

Fig. 5 Cluster 4 Mapping Visualization

The mapping visualization in Figure 5 shows Cluster 4 (blue), which consists of 7 items: blockchain technology, benefit, efficiency, performance management, recruitment, smart contract, and transparency. *Blockchain technology* serves as the main node with 35 link connections. The mapping results indicate that blockchain technology is the primary focus, demonstrating strong associations with technical, managerial, and conceptual aspects, which reflects a multidisciplinary approach in the literature on blockchain technology integration across various sectors.

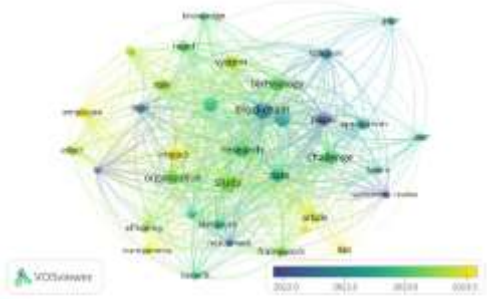

Fig. 6 VOSViewer Overlay Visualization

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Figure 6 visualizes the publication period through a gradient color code. Research topics such as human resource management, recruitment, and GDPR had been central areas of focus prior to 2022, represented in purple. As the color gradient shifts toward green, research attention during 2022–2023 began to move toward themes such as organization, blockchain technology, efficiency, and application. Entering 2023, there is a noticeable increase in interest toward issues of transparency, DAO, employee, and artificial intelligence, illustrated in yellow. Thus, this visualization confirms a shift in scientific focus toward the application of blockchain and decentralized systems in modern management and organizational practices.

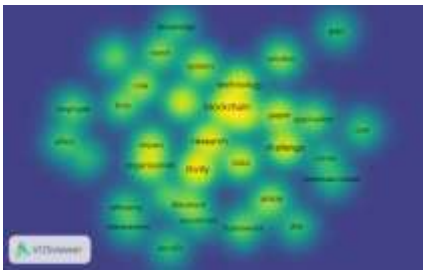

Fig. 7 VOSViewer Density Visualization

Figure 7 illustrates the density of keywords in the research field, highlighting the concepts most frequently referenced in the literature and correlated with blockchain. The yellow areas indicate regions with high keyword occurrence, while green to blue areas represent lower frequencies. It is evident that the words 'blockchain,' 'technology,' 'research,' and 'study' have the highest density, indicating that these topics are the main focus in the analyzed literature. Other terms such as 'organization,' 'challenge,' 'data,' and 'system' are positioned near the center of the map, showing their strong connection to the core themes. Meanwhile, terms like 'efficiency,' 'framework,' and 'transparency' appear in lower-density areas, suggesting supporting themes or emerging subtopics within the context of blockchain research.

Transformation of Human Resource Management in the Web3 Era

The comparison of the evolution from Web1, Web2, to Web3 in the context of organizations and digital interaction shows that Web1 is characterized by reading (read-only), Web2 introduces writing capabilities (read-write) but remains within centralized platform ecosystems, while Web3 adds the ability to participate and contribute (read-write-own) through an infrastructure that enables distributed control and value creation via tokenization. Web3, as the next-generation architecture, leverages blockchain to provide greater security, privacy, and user autonomy compared to previous generations of the web [5].

In the era of decentralization and Web3 technologies, the role of the human resource function within organizations has undergone a fundamental shift from administrative tasks toward technology-driven strategic functions. Research by [18] demonstrates that digital human resource management practices transform HRM from merely operational roles toward fostering employees' digital competencies and supporting strategic decision-making. Furthermore, a study by [19] reveals that technologies such as blockchain enable many administrative HR functions, such as payroll, performance management, and credential verification to be automated or decentralized, allowing HRM to focus on value-adding strategic functions. The human resource management function is no longer solely administrative but evolves into a strategic partner that leverages technology to create competitive advantage.

Furthermore, the implications for organizational models and digital competencies of human resources are also highly significant. The study by [18] found that the integration of digital HR practices moderately and positively enhances employees' digital competencies, such as through e-learning and digital onboarding, although the effectiveness is strongly influenced by organizational culture. In the context of Web3, where organizational models are shifting toward decentralization, digital competencies among human resources become essential for individuals and teams to effectively participate in a more adaptive, open, and digitized work environment. The read-write-own concept, which is central to the Web3 narrative, also transforms employment relations and organizational structures. With decentralization and shared ownership of digital assets or work communities, employment relationships are no longer linear or top-down. This shift requires organizational structures that support greater participation, flexibility, and autonomy to align with the read-write-own paradigm rather than traditional command-and-control work relations.

The human resource management paradigm in the Web3 era brings substantial changes to HR functions: a shift toward technology-driven strategic roles, the need for reorganization and digital competency development in increasingly flexible and decentralized organizational models, and adaptation to new forms of work relationships characterized by participation, shared ownership of data or contributions, and flatter, more open organizational structures.

DAO-Based Human Resource Governance

In organizational models without traditional hierarchies such as DAOs, the structure of human resource management decision-making changes drastically because authority is no longer concentrated in managers or formal leaders, but is distributed among community members through blockchain mechanisms and smart contracts. For example, [20] show that DAOs are built on three core principles: decentralization, automation, and autonomy, which replace the traditional chain of command. This means that HR functions such as recruitment, collaboration, and worker participation can be managed in a peer-to-peer and transparent manner.

In the context of collaboration and work participation, [21] find that members of DAO communities contribute knowledge and human resources openly through online platforms, with work structures being virtual and collaborative. This directly affects how human resources collaborate in organizations without traditional hierarchies. Nevertheless, this transformation also introduces significant challenges related to accountability, leadership, and power distribution. [20] note that agency theory remains relevant because, despite decentralized structures, relationships between contributors and organizational outcomes still pose

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moral hazard issues and require internal control mechanisms that differ from those in traditional organizations. Furthermore, [21] highlight that member participation is often low despite structures enabling broad collaboration. This means that ideal power distribution does not always align with actual practice, creating challenges for adaptive leadership and accountability within DAOs.

Implementing human resource structures in DAO-based HR governance faces challenges of coordination, leadership, and accountability [22]. Accountability challenges include variability in token holders, concentration of voting power, lack of centralized control, and distributed accountability, all of which create risks that strategic decisions may lack legitimacy or be delayed [22]. Beyond HR functions, the blockchain technology underlying DAOs alters administrative architecture through automation of bonuses and incentives via smart contracts. As a result, HR professionals must redefine their roles toward facilitating a participatory ecosystem, which requires managing cultural change, training contributors, and adapting governance structures [19].

Overall, DAOs reshape the human resource management model. HR decision-making can be carried out more openly and collectively. Worker collaboration and participation increase because online community mechanisms allow broader contributions. However, challenges related to accountability, leadership, and power distribution become critical factors that must be addressed for HR governance to succeed in DAO contexts. Therefore, for organizations adopting DAO models in their HR functions, designing mechanisms for measuring participation, ensuring fair power distribution, and establishing accountability systems aligned with decentralized characteristics is essential.

Token-Based Reward System

The implementation of token-based rewards (tokenized rewards) within companies introduces several important aspects. Tokenized rewards provide incentives in the form of digital tokens and potentially enhance motivation and transparency in compensation. Experimental study by [23] on customer loyalty programs found that token-based rewards increase perceived economic value and the attractiveness of the program through the effects of novelty and psychological ownership when compared to traditional rewards. Although the context involves customers rather than employees, these findings are relevant for organizations considering token-based incentives for their workforce. This implies that employees may experience similar psychological benefits when tokenized rewards are applied to internal performance systems. [24] further shows that blockchain-based tokens can indeed trigger information-sharing behavior among individuals, but also indicates that overly mechanistic incentives may undermine intrinsic motivation. Therefore, implementing tokenized rewards for employees must be carefully designed, not merely as 'token bonuses,' but connected to desired activities and accompanied by transparency to ensure motivational effectiveness.

From the standpoint of fairness, trust, and performance, a compensation system that is fair and transparent can positively influence job satisfaction, loyalty, and employee performance. [25] found that reward and compensation systems grounded in fairness, clarity, and employee involvement are positively associated with performance. When tokenized rewards are properly structured, for example, through clear vesting mechanisms, contribution-based distribution, and tokens that hold accessible or utilizable value, they can reinforce trust and performance. [26] found that "pay for performance" systems have a positive effect on task performance, emphasizing the importance of perceived fairness in compensation. In the context of tokenized rewards, [27] shows that blockchain-based systems increase perceived transparency by +30.6% and perceived fairness by +18.4% in experimental groups compared to traditional systems.

From a broader human resource management perspective, blockchain technology brings legal, ethical, and regulatory challenges to the implementation of tokenized reward systems. [19] found that blockchain in human resource management can replace several traditional HR functions such as rewards, administration, and performance management through smart contracts that automatically execute employment clauses and reward disbursements. This requires organizations to pay close attention to labor regulations, token taxation, employee rights to personal data, and token governance to ensure that reward distribution does not create legal or ethical risks.

Smart Contract and the Automation of Recruitment and Talent Management Processes

In the context of talent management and recruitment, blockchain technology offers mechanisms for rapid, secure, and decentralized credential verification. [12] found that blockchain-based recruitment systems can enhance transaction speed and reliability while reducing costs and administrative burdens in the hiring process. Smart contracts can automate portions of the employment agreement, for example, when a candidate is accepted, a digital contract can be executed immediately without substantial manual intervention, thereby strengthening transparency and accountability. The study by [28] shows that blockchain applications for human resource management, including recruitment through candidate data verification and selection can reduce data manipulation and accelerate selection decisions. The use of blockchain in credential verification and smart contracts serves as a strategic solution for addressing efficiency and trust barriers in modern recruitment.

The decentralized talent marketplace enables a recruitment model that differs from traditional practices, eliminating the need for a single intermediary and allowing direct participation between candidates and recruiters through blockchain-based platforms. [29], using topic modeling on job postings in China, found increasing demand for blockchain-related talent, indicating that the labor market is becoming more open to new capabilities associated with blockchain technologies. A decentralized talent marketplace allows individuals to present their verified credentials to various recruiters without relying on traditional channels. This implies that hiring can become faster, more transparent, and more reliant on digital reputation.

Nevertheless, significant challenges arise in implementing blockchain in recruitment, particularly regarding data privacy and platform standardization. [12] identified adoption challenges that include technological, organizational, and external environmental factors such as regulation and data

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privacy. Furthermore, the study by [30] highlights obstacles such as high initial implementation costs, lack of interoperability standards across blockchain platforms, and concerns over privacy and ethics in managing candidate data. The decentralized nature of blockchain indeed enhances transparency and resistance to manipulation. However, it also raises issues regarding who controls personal data, how data can be deleted or updated when necessary, and how security can be ensured across different blockchain networks. [19] notes that replacing traditional human resource functions with blockchain-based smart contracts may eliminate certain administrative or reward-related tasks, but simultaneously raises questions about human responsibility and control over these systems. Therefore, the successful implementation of decentralized talent marketplaces depends heavily on the development of standards, regulations, and technical frameworks to maintain data integrity and privacy in distributed environments.

Privacy, Security, and Data Regulation in Human Resource Management in the Web3 Era

In the Web3 ecosystem, the primary challenges related to privacy, security, and regulation are closely tied to data ownership and self-sovereign identity (SSI). The Self-Sovereign Identity (SSI) model offers a new paradigm in which individuals have direct control over their digital identities, including the storage and use of personal data, without relying entirely on centralized identity providers. A systematic study by [31] shows that SSI allows users to share only selective portions of their personal data with service providers, significantly enhancing user privacy. However, despite its promising vision, the technical and regulatory implementation of SSI still faces a number of obstacles, one of which is compliance with the General Data Protection Regulation (GDPR). [32] notes that the SSI paradigm, which relies on decentralized networks, must contend with regulatory challenges in the European Union. Therefore, data ownership and sovereign identity remain complex domains when combined with the characteristics of blockchain technology and existing regulatory frameworks.

The conflict between blockchain characteristics, such as immutability and public ledgers to GDPR regulations is particularly evident. Blockchain is designed to record transactions permanently and transparently for participating nodes, while GDPR is built on the assumption that personal data can be modified or erased upon request and that a clear data controller must exist. [33] conclude that public and immutable ledgers create a fundamental conflict with data subject rights under GDPR. Moreover, [34] highlights that blockchain technology and GDPR cannot be deemed categorically compatible or incompatible, as their compatibility depends heavily on specific architectures, blockchain types, and data storage models.

A number of technical and architectural solutions have been proposed in the literature to bridge blockchain and Web3 technologies with regulations such as GDPR. First, off-chain storage, storing personal data externally while keeping only pointers or hashes on the blockchain is one of the most frequently discussed approaches. [35] note that hashing-out or off-chain storage is the most widely explored solution for processing personal data in a GDPR-compliant manner within blockchain environments. This method allows personal data that requires modification or deletion to be stored outside the ledger, enabling compliance with rights of erasure or correction, while the blockchain stores only commitments or verifiable proofs. Second, in the context of SSI, although it promises individual control over data, further evaluation is needed to determine whether its technical and procedural frameworks align with GDPR principles such as data minimization, access/correction rights, and the right to erasure. Third, within smart contract governance, clear governance models including defined roles for data controllers and processors in decentralized networks must be integrated from the design phase

The success of managing privacy, security, and regulatory compliance for human resource data in the Web3 era depends greatly on how blockchain technologies and SSI frameworks are designed and implemented. Challenges such as ledger immutability, public transparency, and decentralization remain significant regulatory barriers. However, adopting architectural strategies such as off-chain storage, pseudonymization, and strengthened smart contract governance aligned with regulatory frameworks like GDPR offers a pathway toward balancing technological innovation with personal data protection. Although challenges persist, including global regulatory harmonization, defining data controllers within distributed networks, and creating feasible data deletion mechanisms. Thoughtful approaches can support the development of a more secure human resource management system in the Web3 landscape.

IV. CONCLUSIONS

The transformation of human resource management in the Web3 era marks a paradigm shift from administrative functions toward a strategic, technology-driven role that leverages decentralization, blockchain, smart contracts, and tokenization. This bibliometric analysis shows that Web3 enables more transparent, efficient, and participatory human resource governance through the implementation of Decentralized Autonomous Organization (DAO)–based organizational models and tokenized digital compensation systems. The integration of blockchain into recruitment and talent management enhances the efficiency of data verification, the transparency of work processes, and trust among stakeholders. However, these developments also introduce significant challenges related to data privacy, legal regulation, and employee digital literacy. The transformation of human resource management in the Web3 era is not merely a technological shift but also a transformation in organizational values and culture toward more autonomous, collaborative work models that emphasize shared ownership of data and digital contributions. The primary limitation of this study lies in its bibliometric nature, which does not involve empirical data or quantitative testing that could illustrate the real-world implementation of Web3 technologies across various organizational contexts. The literature sources, spanning the period 2020–2025, also limit the depth of longitudinal analysis regarding the evolution of concepts and the implementation of these technologies.

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Moreover, much of the analyzed literature remains focused on conceptual and technological aspects rather than behavioral, ethical, or social dimensions that may influence the success of decentralized human resource management transformation. Future research is recommended to integrate empirical approaches, both quantitative and qualitative, to directly examine the impact of Web3 technology adoption on employee performance, motivation, and engagement. Comparative studies across industries could enrich understanding of how contextual factors, such as organizational culture and digital readiness, affect the effectiveness of DAO adoption or tokenization systems in human resource management. Further studies should also explore moderating variables such as digital literacy, organizational trust, and data protection policies to identify optimal conditions for implementing Web3 in modern work environments.

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