Mapping the Digital Shift: A Bibliometric Review of Human Resource Information Systems and Workforce Optimization in South African Construction.

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Abstract

Amidst the digital evolution of the construction industry, this study addresses the critical need to understand how Human Resource Information Systems (HRIS) enhance workforce training and operational efficiency. Utilizing a bibliometric analysis, a systematic literature review of the Scopus database was conducted using keywords including "human resources," "construction industry," and "information management," resulting in a final corpus of 29 relevant documents. These were analyzed and visualized using VOSviewer to map prevailing research themes. The analysis identified six dominant thematic clusters: Organizational Integration, Technological Innovation, Digital Integration, Workforce Optimization, Systems Management, and Operational Efficiency. These clusters collectively reveal a growing academic focus on leveraging HRIS to improve project delivery, strategic decision-making, cost control, talent development, and digital readiness. The findings offer practical insights for construction professionals and stakeholders, demonstrating HRIS's potential to optimize workforce performance, facilitate robust information flow, and align human resource strategies with emergent digital practices. This is particularly salient in developing contexts like South Africa, where skills shortages and demands for accountability make HRIS a vital driver of professional agility and sustainable change. Consequently, this research underscores how HRIS-driven digital transformation is fundamental to building resilient, future-ready workforce strategies, directly contributing to navigating disruption and fostering a sustainable built environment.

Keywords

Construction Industry, Digital Transformation, Human Resource Management, Information Management Systems, Workforce Management.

1. Introduction

Human Resource Management (HRM) remains a crucial function within organizations, focusing on aligning workforce capabilities with strategic goals. In recent years, HRM has developed to incorporate advanced technologies, data analytics, and strategic planning approaches (Castro et al., 2020; Schuler & Jackson, 2014). In the construction industry, HRM continues to face challenges such as labour shortages, safety concerns, and the need for skilled workers, which are exacerbated by technological and market developments (Wahdaniah et al., 2023). Effective HR practices, including targeted recruitment, training, and retention strategies, are essential for maintaining productivity and safety standards in this dynamic industry (Shofiana et al., 2025). HRIS encompasses systems and processes that integrate HRM with IT; therefore, it has become a vital tool for many organizations (Ngwenya et al., 2019). Recent literature underscores the significance of digital transformation in construction HRM. Human Resource Information Systems (HRIS), as a key component of digital HR strategies, have become increasingly advanced. They enable improved workforce planning, real-time data management, compliance tracking, and performance monitoring (Abuhantash, 2023). In construction, Ngwenya et al. (2019) iterates that HRIS supports the management of temporary and project-specific labour, automates administrative tasks, ensures transparency in operations, improves compliance with legal systems and enhances communication among stakeholders. These systems also facilitate data-driven decision-making, resulting in improved safety management, productivity, and talent development (Zhang et al., 2021). Managing human resources effectively proves significantly more complex than overseeing capital or technology, requiring specialized

tools to improve HRM performance and address critical workforce issues (Panjaitan, 2023). Moreover, recent studies highlight that integrating HRIS with Building Information Modelling (BIM) and project management tools can greatly optimize construction processes and human resource utilization (Liu et al., 2025). As construction projects become increasingly complex, leveraging these technological integrations enables firms to respond swiftly to staffing needs, minimize risks, and promote sustainable workforce practices.

The construction industry lags other sectors in adopting digital HR practices. Many studies in the past decade have concentrated on fields like IT or services, leaving a significant gap in construction-specific research. Consequently, the study aims to systematically map and analyze the intellectual structure and evolution of scholarly literature on the adoption and impact of Human Resource Information Systems (HRIS) and digital HR tools within the construction industry. It seeks to identify key publications, main research themes, emerging topics, and knowledge gaps to offer a foundational overview and guide future research in this area.

2. Methods

This study employed a systematic bibliometric analysis to map the knowledge of research concerning Human Resource Information Systems (HRIS) and Workforce optimization within the construction industry. The methodology was designed to be reproducible and transparent, encompassing data collection, filtration, and analytical steps, as illustrated in Figure 1.

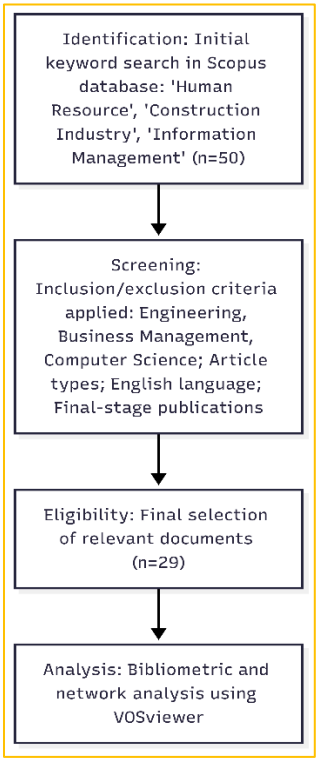

Fig. 1. Methodology employed

The primary source of bibliographic data was Scopus, chosen for its extensive coverage of high-quality, peer-reviewed literature in the fields of engineering, computer science, and business management (Baas et al., 2020). The search strategy used ensured the intersection of three core concepts: the specific industry (construction), the functional domain (human resources), and the technological solution (information management). The following Boolean search string was performed in the Article Title, Abstract, and Keywords fields on 24th June, 2025: ("human resources") AND ("construction industry") AND ("information management"). The initial search yielded 50 documents. To ensure the relevance and quality of the final dataset, a set of eligibility criteria was applied via document type, subject area, language and publication stage. Documents were limited to Articles, Conference Papers, Book Chapters, and Review Articles to capture the full field of original and synthesized research. The subject area was limited to Engineering, Business Management, and Computer Science to maintain a focus on the technical and applied aspects of HRIS within the construction context. The language was restricted to English for easy comprehension of the output. Then it was limited to the Final publication stage to exclude any in-press or unpublished documents. The metadata of

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the 29 final publications (including titles, authors, keywords, abstracts, citation data, and bibliographic information) was exported from Scopus in a compatible format (CSV).

The analysis was conducted in two forms: descriptive bibliometric analysis, network analysis, and visualization. The descriptive aspects included the basic characteristics of the examined literature, such as the distribution of publications over the years (annual publication trend) and the global distribution of publications, showing leading countries. The refined data set was imported into VOSviewer (version 1.6.19), a software tool for visualizing bibliometric networks as used in similar studies (McAllister et al., 2022). A keyword co-occurrence analysis was performed to identify hotspots and the conceptual structure of the field. In this analysis, the software maps the strength of associations between keywords based on how frequently they appear together in publications. The unit of analysis was set to "Author Keywords" with a minimum number of occurrences of a keyword set to 2. This process led to the identification of six distinct thematic clusters, each representing a major research focus area within the domain. The network visualization maps generated by VOSviewer illustrate these clusters, the density of topics, and the relationships between them.

3. Results

3. 1 Publication Distribution Analysis

The annual publication trends analysis reveals that research output on HRIS for workforce optimization in the construction industry has historically been limited but shows signs of gradual growth. Between 2000 and 2011, the field was largely underexplored, with only a single publication appearing each year. This early period indicates a niche research interest with minimal academic engagement. From 2012 onwards, the field began to gain traction. A noticeable rise occurred in 2013–2015, culminating in two publications in 2014, suggesting that HRIS were beginning to receive greater scholarly recognition as part of the broader digitalization agenda in construction. The most productive period emerged between 2016 and 2020, with publication output peaking at three contributions in 2016, 2018, and 2019. This surge aligns with the global acceleration of digital transformation, particularly the integration of human resource information systems and workforce optimization tools within industries undergoing structural and technological change (Kim & Ok, 2016; Ngwenya et al., 2019). However, after 2020, the trend reverted to a plateau of one publication per year, reflecting a relative decline in intensity. This may indicate either a disruption of academic output during the COVID-19 pandemic or the shift in research focus toward broader themes of digital transformation, such as artificial intelligence, BIM integration, or Industry 4.0 applications in human resource management. (Mo et al., 2020). The trend analysis is presented in Figure 2.

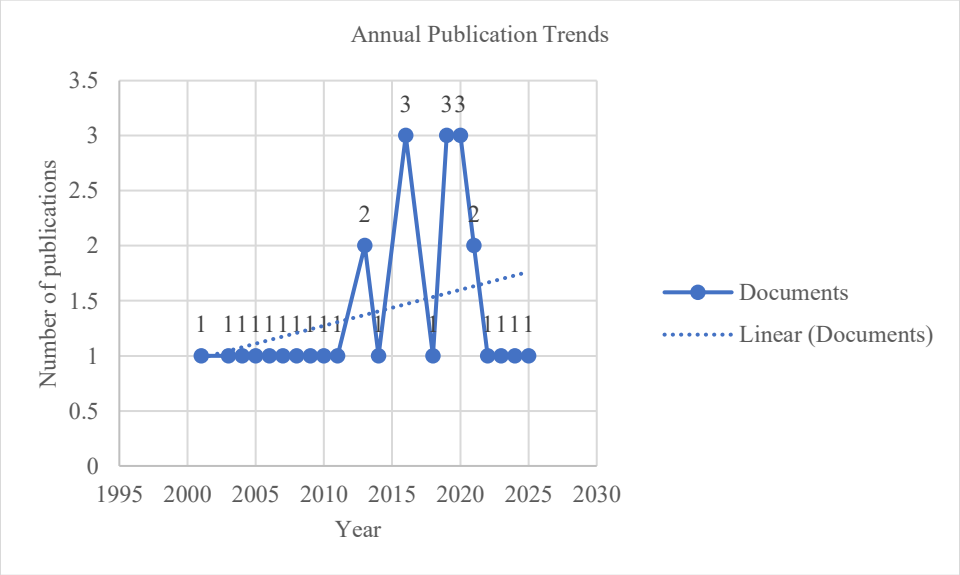

Fig. 2. Annual publication Trends

Despite this fluctuation, the linear trendline demonstrates a gradual upward trajectory, confirming that HRIS remain an evolving field of inquiry and construction research, especially in the South African context. This indicates

increasing recognition of digital HR tools as strategic enablers for managing labour efficiency. The trend supports the call for proactive workforce strategies that align with the industry's adoption of technology. The steady growth highlights both the increasing recognition of HRIS as a driver of workforce efficiency and the potential for deeper academic exploration in alignment with the industry's ongoing digital shift.

The distribution of publications by country with a minimum of two publications per one citation threshold reveals that research in this field is globally dispersed, with notable contributions from both developed and emerging economies (see Table 1).

Table 1. Global Publication Distribution Trends.

Country	Publications	Citations
United States of America	5	87
United Kingdom	4	152
Hong Kong	3	79
Australia	2	154
Taiwan	2	13
Germany	2	12

The United States leads in terms of publication volume, producing five documents that collectively attracted 87 citations. This reflects the USA's established position in HR technology innovation and its active research ecosystem. However, the moderate citation impact suggests these works may be less central to shaping global academic discourse. In contrast, the United Kingdom ranks second in output (four publications) but records a high citation count (152 citations). This indicates that UK-based research, while not the most prolific, is very influential and widely referenced in the field. Similarly, Australia, with only two publications, has generated a disproportionately high 154 citations, demonstrating the significant impact of a limited number of key studies. These findings suggest that a small cluster of research works from these countries has driven much of the academic debate on HRIS and workforce optimization. Meanwhile, Hong Kong contributes three publications and 79 citations, highlighting its active engagement with HRIS research, likely showing its regional leadership in digital adoption and technology integration. In comparison, Taiwan (2 publications, 13 citations) and Germany (2 publications, 12 citations) show modest citation impacts, suggesting either more recent engagement with the topic or less visibility of their research in the global academic network. This distribution indicates that while the global North dominates publication and impact, there is clear international interest (Dmytrenko et al., 2020; Thomas Ng et al., 2001). For South Africa, only a publication by Ngwenya et al. (2019) was recorded from the documents retrieved. This highlights an opportunity to expand research visibility and impact by drawing on global best practices while contributing context-specific insights on HRIS towards workforce optimization in construction. It also highlights structural challenges such as limited investment in HRIS research and weaker institutional linkages between academia and industry.

3.2 Keyword Cluster Themes Analysis

The keyword co-occurrence analysis was performed to ascertain the recurring themes and density of topics being researched in this field. Keywords are important as they aid in extracting research content and concepts, particularly in emerging research areas (Van Eck & Waltman, 2014). Hence, the bibliographic data ascertained was used to visualise the network visualization map presented as Figure 3.

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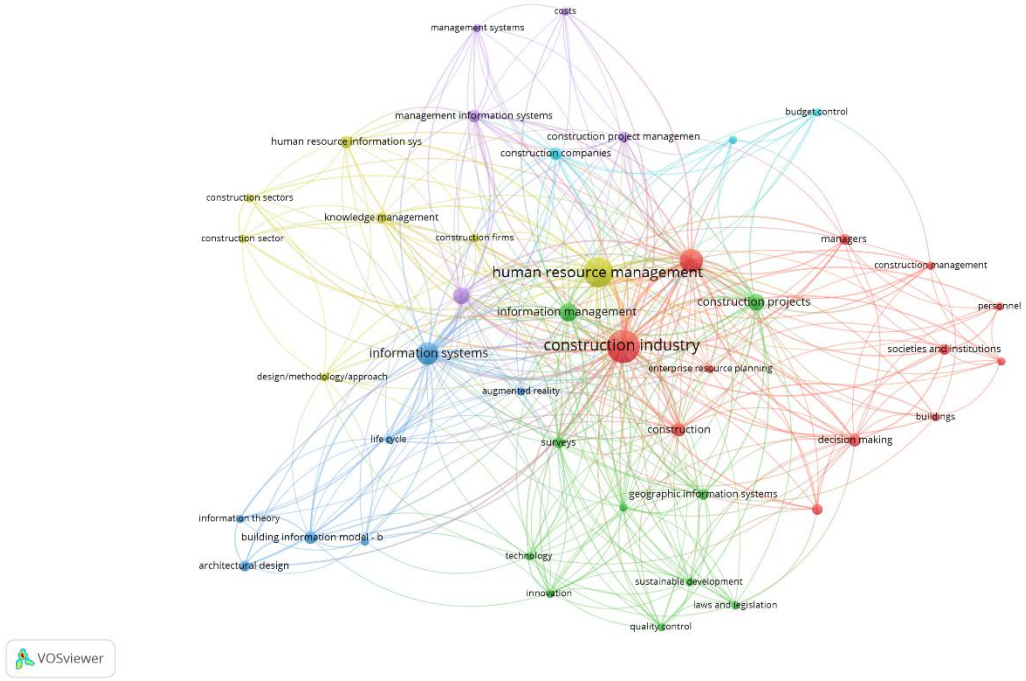

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Fig. 3. Network Visualization map

The dominance of clusters around "human resource management" and "information systems" reflects global priorities in digitizing workforce practices, which align with broader construction industry trends toward efficiency and innovation. The following analysis provides the six thematic clusters identified from the literature examined.

Organizational Integration (red): This theme reveals a cluster of research that focuses on the structural and managerial dimensions of construction organizations, highlighting how HRIS can support effective decision-making, personnel development, and quality service delivery in project environments (Raiden et al., 2004). HRIS facilitates the integration of HR management within the organizational framework. Hence, there is a need for integrating digital tools such as enterprise resource planning and HR modules within construction management systems to enhance the coordination, training, and performance monitoring of professionals (Dung-Hai Liang et al., 2011). The presence of keywords like "managers," "personnel," "training," and "quality of service" underlines the central role of organizational learning and institutional development in navigating digital transformation across societies and construction institutions.

Technological Innovation (green): This cluster reveals scholarly works that centre on the role of emerging technologies and digital information systems, such as GIS and information management tools, in transforming construction project delivery (Mesároš et al., 2021). It reflects the increasing need for innovation in quality control, sustainability, and regulatory compliance, with HRIS positioned as part of the broader digital ecosystem supporting smarter, legally aligned, and more efficient human resource practices within construction environments (Ngwenya et al., 2019).

Digital Integration (blue): This cluster highlights the convergence of advanced technologies such as Building Information Modelling (BIM), augmented reality, and information systems with architectural design and supply chain processes (Isikdag & Underwood, 2010; Mo et al., 2020). It emphasizes the importance of lifecycle thinking and seamless data exchange in enhancing decision-making and operational efficiency (Vadithe et al., 2025); positioning HRIS as a complementary system that supports the digital transformation of construction project delivery and workforce coordination.

Workforce Optimization (yellow): This segment concentrates on research into how construction companies and the wider construction industry can boost productivity and competitiveness through the integration of HRIS, effective human resource management, and knowledge management practices (AboAbdo et al., 2019; Ngwenya et al., 2019). It highlights the importance of well-designed methodologies and systems that align workforce capabilities, particularly

those of professionals like a project manager, with organizational goals and technological progress (Isikdag & Underwood, 2010).

Systems Management (purple): This cluster further emphasises literature on the role of integrated management systems, such as HRIS and other MIS platforms, in supporting construction project management, cost control, and information utilization (Lee & Kim, 2018). It reflects how structured information systems enhance decision-making, streamline operations, and enable data-driven management of resources and personnel across construction projects (Panjaitan, 2023).

Operational Efficiency (turquoise): This cluster ultimately emphasizes research that highlights the importance of streamlining operations in construction companies, with a focus on budget control and accident prevention as key performance indicators (Tsai, 2014). It emphasizes how HRIS can contribute to safer, more cost-effective project environments by improving workforce planning, compliance monitoring, and risk management practices (Wahdaniah et al., 2023).

4. Discussion-Synthesis of Themes and Knowledge Gaps

To improve Human Resource Management (HRM) through Human Resource Information Systems (HRIS) in the construction industry, particularly from a South African perspective, several key insights can be drawn from the literature reviewed. In South African construction organizations, HRM practices such as recruitment and selection, training and development, and compensation systems are widely implemented, while performance appraisal practices are less effectively used. This highlights a need for a more balanced approach to HRM practices to enable comprehensive development and performance evaluation of professionals and stakeholders (Aghimien et al., 2023). This system aligns with labour legislation and can streamline HR processes, making it a valuable tool for managing professionals in the construction industry. In the South African construction context, HRIS has also been found to ensure compliance with labour regulations while providing management with clearer business insights. For example, Ngwenya et al. (2019) reported that an HRIS in a Gauteng construction firm complied with national labour laws and provided a “clear vision” of the business, saving time and reducing errors from manual processes. HRIS can play a significant role in enhancing HRM by providing a clear view of business operations, thereby saving time and reducing human errors. Wang (2024) note that firms are rapidly adopting HRIS for data collection and analysis, with HRIS playing a “pivotal role in improving operational efficiency” and competitiveness. In South Africa, where many construction firms are modernising, embracing these technological innovations in HRIS is essential to remain competitive. Delery and Gupta (2016) observe that HRIS improves access to vital HR data and record accuracy, which optimizes decision-making across the organization. In South African construction firms, where digital transformation is ongoing, integrated HRIS can eliminate information silos. For example, centralizing HR data that was previously spread across sites or departments. Vadithe et al. (2025) also suggest that HR analytics enables organizations to assess and optimize employee performance by identifying each individual’s knowledge, skills, and abilities (KSAs) and analyzing performance patterns. A study in Ethiopia identified common issues that can limit HRIS effectiveness, including inadequate access to timely information, connectivity problems, complex system setup, and limited user knowledge (Bangura, 2024). Change management literature (Stouten et al., 2018) further emphasizes that introducing a new technology such as HRIS can modify workflows and even power dynamics, sometimes causing discomfort among staff. Therefore, in South Africa’s construction industry, management must lead the change carefully, communicating benefits to employees (such as reduced paperwork or faster approvals) and providing support during the transition. HRIS in construction enhances operational efficiency related to HR and workforce management. Improving operational efficiency is a key benefit of HRIS adoption. Whether through time saved, errors reduced, or smarter data use, an HRIS enables construction organizations in South Africa and worldwide to manage their human resources more effectively. The clusters demonstrate how HRIS can be operationalized into practical strategies. This integration suggests that effective workforce strategies must combine digital platforms with managerial and institutional reforms.

There is a notable lack of studies specifically examining how HRIS can enhance the management of professionals in the industry. In the wider construction of HRM literature, empirical research remains limited. Construction industries in developing countries face serious HR challenges, high staff turnover, skills shortages, and poor workforce management (Aghimien et al., 2024; Ngwenya et al., 2019). Literature offers little insight into how HRIS tools could address these issues (e.g., by identifying skill gaps or predicting staffing needs). The potential of HRIS to support professional talent retention, development, and knowledge management remains under-explored, creating a significant knowledge gap. No established frameworks or models have linked HRIS data (such as skills, experience, availability) with project outcomes over time. This highlights a gap in understanding how digital HR systems can be utilized to optimize the deployment and performance of the construction workforce within multi-project construction organizations.

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5. Conclusions

The bibliometric analysis of 29 scholarly documents reveals six key research themes. These clusters converge on the role of HRIS as a catalyst for workforce optimization, aligning human resources with the strategic and operational demands of construction. It further reveals growing research interest in HRIS in the construction context. Additionally, the analysis revealed that the global North dominates publication and impact, with the USA leading in volume and Australia leading with high-impact publications. While studies acknowledge that adopting HRIS/e-HRM in the construction industry poses challenges, they often fail to conduct a thorough analysis of these obstacles. Commonly mentioned barriers include high implementation costs, inadequate IT infrastructure, and difficulties in integrating HRIS with other systems. However, detailed research on how to overcome these barriers within construction contexts remains limited. The study suggests therefore, that construction managers should prioritize adopting HRIS platforms to streamline recruitment, skills tracking, and performance management. HR professionals can leverage data-driven insights from these systems to formulate training programs based on needs assessment and improve workforce allocation. At the policy level, firms should consider formalizing digital HR practices through clear guidelines and capacity-building initiatives to ensure consistent and sustainable implementation. Additionally, to address the current regional imbalance, further empirical research into developing and emerging markets is essential. Comparative studies could analyze HRIS adoption in construction across different countries to identify context-specific challenges. Such research would deepen understanding of how cultural, economic, and regulatory factors influence digital HR implementation. It would also help determine whether findings from developed nations are applicable elsewhere or if new models are necessary for the Global South. Research could also explore best practices for implementing HRIS in resource-limited construction environments, for instance, phased adoption approaches, cloud-based systems to reduce IT costs, or training programmes to develop HRIS skills among staff. These findings provide a foundational benchmark for future comparative studies across other developing countries, where similar dynamics between HRIS adoption and workforce optimisation remain underexplored.

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