Artificial Intelligence–Based Predictive Models in Human Resource Management and Their Importance in Developing Human Capital

A Systematic Review

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Abstract: The domain of human resource management is witnessing rapid transformation driven by advanced developments in artificial intelligence technologies, especially predictive models, which have become a pivotal tool for supporting strategic decision-making and developing human cap ital. This study aims to offer a systematic review of the scientific literature discussing the application of artificial intelligence–based predictive models in human resource management and to analyze their contributions to improving managerial decision-making effectiveness and human capital development within organization. The study adopts a systematic literature review methodology in accordance with PRISMA guidelines, drawing on the Science Direct and Taylor & Francis databases. The processes of searching, screening, and filtering resulted in the selection of 51 scientific studies, which were subjected to qualitative thematic analysis within various the oretical frameworks, most notably human capital theory and the knowledge-based view. The results demonstrate that predictive models contribute to enhancing the accuracy of recruitment decisions, predicting employee turnover, supporting strategic workforce planning, and determining skill gaps, thereby promoting human capital development. In contrast, the study emphasizes persistent challenges associated with data quality, algorithmic bias, and ethical and regulatory considerations. The study concludes by highlighting the need to adopt integrated governance frame works to ensure the effective and responsible use of predictive models in human resource management.

Keywords: artificial intelligence, predictive models, human resource management, human capital development advanced human resource analytics.

1 Introduction

The business world is experiencing rapid shift driven by advances in artificial intelligence technologies and huge data analytics, resulting in a reconfiguration of management practices and decision-making processes within organizations. In this regard, hu man resource management is no longer a traditional administrative function; rather, it has evolved into a strategic field that depends on predictive models to anticipate employees' future behaviors and promote the effectiveness of organizational decision making [5] [1]. Artificial intelligence–based predictive models have contributed to a

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qualitative transition in human resource management practices by allowing the prediction of job performance, employee turnover, and training needs, thereby supporting proactive workforce planning and more effective skill management [7]. This transformation reflects the growing dependence on advanced analytics to support strategic human resource decisions and align them with organizations' long-term objectives [11]. Furthermore, the development of human capital constitutes a central pillar for fulfilling organizational sustainability and competitive advantage, as it is closely related to skills development, competency management, and the building of future capabilities. The literature indicates that the use of predictive analytics contributes to determining skill gaps and guiding career development and continuous learning programs with greater accuracy and effectiveness [9] [6]. This study has gained increasing significance at both the academic and practical levels, given the notable expansion in the use of artificial intelligence in human resource management, alongside the relative scarcity of studies that have systematically explored the relationship between predictive models and human capital development. Therefore, the research problem revolves around the question of the extent to which artificial intelligence–based predictive models contribute to supporting and developing human capital within organizations. This research seeks to address this issue through a systematic re view of the scientific literature published between 2015 and 2024 in the Taylor & Fran cis and Science Direct databases, with the aim of analyzing research trends and deter mining knowledge gaps in this domain.

2 Literature Review

The accelerated development of artificial intelligence technologies and predictive analytics has brought about a profound shift in human resource management practices, transitioning them from a traditional role grounded in administrative procedures to a strategic function based on data analysis and evidence-based decision-making. [1] demonstrated that predictive human resource analytics allow organizations to move beyond descriptive analysis toward forecasting employee behaviours, such as job performance and turnover rates, thereby promoting the effectiveness of managerial decisions associated with human capital. Similarly, [11] indicated that integrating human resource analytics into strategic decision-making systems contributes to aligning human capital with organizations' long-term objectives. Other studies have concentrated on the role of machine learning and artificial intelligence technologies in advancing multiple human resource management functions. [7] highlighted that advanced artificial intelligence-based analytics promote the quality of recruitment decisions, workforce planning, and performance assessment by uncovering complex patterns that are difficult to detect utilizing traditional statistical methods. From a human capital development perspective, [6] indicated that predictive models contribute to determining future skill gaps and designing targeted development programs, thereby supporting the effective application of organizational strategy. [5] also emphasized that artificial intelligence does not replace human judgment in human resource management; rather, it fosters it by providing decision-makers with accurate and timely analytical insights. At the

level of systematic reviews, [10] introduced a comprehensive analysis of artificial intelligence applications in human resource management. Their results demonstrated that artificial intelligence–based predictive models contribute to enhancing recruitment quality, promoting talent retention, and supporting employee development, while simultaneously highlighting the significance of addressing ethical concerns and data governance issues. In a more recent study, [9] revealed that artificial intelligence–driven predictive analytics help organizations build resilient human capital by supporting continuous learning and skills reskilling. Moreover, [12] concluded that artificial intelligence–enabled human resource management systems represent an effective strategic tool for developing hu man capital and aligning it with the requirements of digital transformation and organizational sustainability.

3 Theoretical Foundations

The analysis of the role of artificial intelligence–based predictive models in human re source management and human capital development relies on a range of organizational frameworks and theories that explain the relationships between data, technology, and strategic decision-making within organizations. Human Capital Theory is a foundational theoretical framework in this context, positing that employees' knowledge, skills, and capabilities constitute a strategic asset that directly contributes to enhancing organizational performance and promoting competitive advantage. From this perspective, advanced analytical tools and predictive models are crucial as supportive mechanisms for human capital development, improving decisions associated with recruitment, training, and talent management. This approach is grounded in the Resource-Based and Knowledge-Based View (RBV), which highlights that rare and inimitable resources, most notably human capital enriched with analytical knowledge represent a critical source of sustainable competitive advantage. Within this framework, artificial intelligence–based predictive models pro mote organizations' capacity to leverage human resource data and transform it into strategically valuable knowledge, thereby supporting competency development and aligning HR practices with long-term organizational objectives [7]. Predictive models include a core theoretical foundation for advanced analytics in management sciences, relying on statistical methods and machine learning algorithms to uncover hidden patterns in historical data for forecasting future behaviors and outcomes. Theoretically, these models are based on probabilistic statistical analysis, which assumes that, despite their complexity, organizational phenomena follow pat terns that can be modeled and predicted given sufficient data and reliable measurement [4]. This premise allows the use of predictive models to understand future workforce trends and manage uncertainty in business environments. In the context of human resource management, predictive models are closely associated with Rational and Evidence-Based Decision-Making Theory, as they are used as supportive tools that reduce dependence on individual intuition and support managerial decisions grounded in quantitative, data-driven forecasts. [8] highlighted that the core value of predictive analytics lies not only in explaining organizational phenomena but also in allowing organizations to adopt proactive decisions that directly affect future performance. The effectiveness

of predictive models in HR management can also be understood through Complex Systems Theory, which sees organizational behavior as the outcome of intricate interactions among various individual, organizational, and environmental variables. From this standpoint, machine learning algorithms enable for modeling non-linear relationships and complex interactions among HR variables, such as performance, motivation, turnover, and skill development beyond the capabilities of traditional analytical approaches [2]. At a more integrative level, Data Value Theory supports this framework by conceptualizing predictive models as mechanisms for transforming raw data into strategic knowledge applicable in decision-making. In HR management, such models allow organizations to forecast future human capital needs, determine high-potential employ ees, and evaluate turnover risks, thereby aligning HR decisions with overarching organizational strategy [3]. Based on the above, these theoretical frameworks offer a coherent analytical foundation for understanding the role of artificial intelligence–based predictive models in supporting human resource management and developing human capital. They also lay the groundwork for a systematic shift to introducing the methodology used in this study and analyzing the literature through a rigorous systematic review framework.

4 Methodology

This research paper adopted a systematic literature review (SLR) approach to analyze scholarly output on the use of artificial intelligence–based predictive models in human resource management and their role in human capital development. This approach is particularly suitable for studies seeking to compile and analyze accumulated scientific knowledge in a structured and transparent manner, while mitigating bias and ensuring reproducibility of the study process.

4.1 Data Sources: Scientific studies were collected from two well-established academic databases known for their quality and extensive coverage in management and human resource domains: Science Direct and Taylor & Francis Online. The findings from each database formed separate sets of peer-reviewed articles, which together constituted the initial framework for the study sample.

4.2 Research Strategy: A systematic search strategy was applied using composite keywords combined with Boolean operators. The main keywords included: Artificial Intelligence, Predictive Models, HR Analytics, Human Resource Management, Human Capital Development.

The research was applied to article titles, abstracts, and keywords to ensure the inclusion of studies directly relevant to the research topic.

4.3 Inclusion and Exclusion Criteria: Clear criteria were determined for selecting studies. Inclusion criteria were:

▪ Articles published in peer-reviewed journals,

▪ Written in English,

▪ Published relatively recently, directly addressing predictive models or applications of artificial intelligence in human resource management or human capital development. Exclusion criteria included studies that were:

▪ Not peer-reviewed,

▪ Purely technical without administrative or organizational relevance,

▪ Lacking analysis or applications relevant to the research topic.

4.4 Screening and Selection Procedures (PRISMA): The study selection process followed the PRISMA flowchart and involved several sequential phases:

− **Identification:** The initial database research included: 132 articles from Science Direct 94 articles from Taylor & Francis for a total of 226 articles determined in the first phase.

− **Duplicates Removal**: After merging the two sets, 38 duplicate articles were removed, leaving 188 articles.

− **Screening:** The remaining articles were screened grounded in titles and abstracts, resulting in the exclusion of 96 articles that were not directly relevant to the study, leaving 92 articles.

− **Eligibility:** Full-text reviews of the remaining articles led to the exclusion of 41 articles due to:

- Lack of a predictive focus,
- Focus on artificial intelligence without HR context,
- Weak relevance to human capital development.

− Final Inclusion

Finally, 51 scientific studies were selected for qualitative systematic analysis. These studies formed the final sample upon which the review results were based.

5 Findings

The qualitative systematic analysis of the studies included in this review yielded a set of results that reflect prevailing research trends in the use of artificial intelligence–based predictive models in human resource management, while also highlighting their contributions to human capital development within organizations. The thematic analysis demonstrates that the findings can be categorized into four interrelated main themes:

5.1 Areas of Application of Predictive Models in Human Resource Management: The results indicated that the most common applications of predictive models are in recruitment and selection, turnover prediction, performance evaluation, and talent management. Most studies demonstrated that machine learning algorithms are employed to analyze resumes, predict candidate-job fit, and estimate turnover probabilities, thereby enabling more proactive decision-making compared to traditional methods that rely solely on human judgment.

5.2 Types of Models and Algorithms Used: The review revealed that studies utilized a wide range of predictive models, encompassing logistic regression, decision trees, random forests, artificial neural networks, and deep learning algorithms. More recent studies highlighted an increasing dependence on more complex models due to their superior ability to handle non-linear relationships and multi-dimensional big data in the context of human resource management.

5.3 Added Value of Predictive Models in Human Capital Development: The results suggest that the value of predictive models extends beyond enhancing ad ministrative efficiency to fostering human capital development. Most studies confirmed that these

models assist in determining current and future skill gaps, supporting training and development decisions, and guiding investments in human capital with greater ac curacy and alignment with organizational strategic objectives.

5.4 Challenges and Limitations of Implementation: Despite the significant potential indicated, the results also demonstrated common challenged, encompassing data quality issues, algorithmic bias, a lack of analytical expertise within HR departments, and ethical and regulatory concerns related to AI use. Numerous studies highlighted that the absence of clear governance frameworks may limit the effective use of predictive models and impact their acceptance by decision-makers and employees.

The findings of this systematic review demonstrate that artificial intelligence–based predictive models represent a promising strategic tool in human resource management, with clear potential to support human capital development provided that appropriate data infrastructure, specialized analytical competencies, and clear ethical and regula tory frameworks are in place to guide their application.

6 Discussion

This section seeks to explain the results of the systematic review and link them to the theoretical frameworks underlying the study, offering a deeper understanding of the role of artificial intelligence–based predictive models in human resource management and their importance for human capital development. The findings of this systematic review largely confirm what has been reported in previous literature regarding the fundamental transformation brought about by artificial intelligence technologies and predictive models in human resource management. The results show that the increasing use of predictive models in the areas of recruitment, turnover prediction, and performance evaluation is consistent with the findings of [1], who emphasised that predictive human resource analytics enable organisations to move from descriptive analysis to predicting job behaviour, thereby enhancing the effectiveness of human capital-related management decisions. The results also support the findings of [11], which showed that integrating predictive analytics into strategic decision-making systems contributes to aligning human capital with the long-term goals of organisations. This is clearly evident in the results, which highlight the strategic role of predictive models in workforce planning and directing investments in human resources to serve the organisational vision. With regard to the types of models and algorithms used, the results are consistent with those of [7], as the review showed that the increasing reliance on machine learning algorithms and complex models enables human resource departments to discover patterns and relationships that are difficult to detect using traditional statistical methods, which positively reflects on the quality of hiring decisions and performance evaluations. From the perspective of human capital development, the results of this study are consistent with those reported by [6], confirming that predictive model's con tribute to

identifying current and future skill gaps and supporting training and development decisions, thereby enhancing the effective implementation of organisational strategy. These results also support [5] argument that artificial intelligence does not replace human judgement, but rather enhances it by providing decision-makers with accurate and timely analytical insights, which is reflected in the results that highlighted improved decision-making quality without eliminating the human role. At the level of methodological reviews, the results of this study are consistent with those of [10], where the results confirmed that AI-based predictive models contribute to improving the quality of recruitment, enhancing talent retention, and supporting employee development, while also pointing to ethical challenges and data governance issues. This reinforces the findings of this study, which revealed the persistence of problems related to algorithmic bias, data quality, and the absence of clear regulatory frameworks. Finally, the results are consistent with the findings of [9] and [12], as the review showed that AI-supported predictive analytics is a strategic tool for building resilient human capital capable of adapting to the requirements of digital transformation and organisational sustainability, provided that the appropriate in frastructure, analytical capabilities and supportive regulatory frameworks are in place.

7 Conclusion

This research paper aimed to provide a systematic review of the scientific literature on the use of artificial intelligence–based predictive models in human resource management, with a particular focus on their role in supporting decision-making and human capital development. The analysis of the included studies utilizing the PRISMA methodology demonstrated that predictive models have become an increasingly strategic tool, contributing to enhancements in recruitment practices, turnover prediction, strategic workforce planning, and the identification of skill gaps, thereby improving the efficiency of human capital management and aligning it with organizational objectives. The findings also highlight that the true value of these models lies not only in their analytical capabilities but also in how they are integrated within administrative and or ganizational systems, supporting organizational learning and evidence-based decision making. Conversely, the review indicated persistent challenges associated with data quality, algorithmic bias, ethical considerations, and the limited practical application of these models in certain organizational contexts. This emphasizes that the successful adoption of artificial intelligence in human resource management requires a comprehensive approach that combines technical, human, and organizational dimensions. Despite the important contributions of the included studies, this systematic review de termined numerous ongoing research gaps. First, there is an overemphasis on applied and technical aspects at the expense of a comprehensive theoretical framework linking predictive models to human resource management and organizational behaviour theories. Furthermore, the literature indicates a clear lack of longitudinal studies capable of measuring the sustained effect of predictive models on human capital development over time. Moreover, there is insufficient attention to behavioral and human dimensions as sociated with employee and manager acceptance of AI-supported decisions, as well as

limited applied frameworks addressing ethical concerns and algorithmic bias. The literature also suffers from geographic concentration in specific organizational contexts, which restricts the generalizability of results across different organizational and cultural environments. These gaps represent significant research opportunities to develop more comprehensive theoretical and applied models that address contemporary challenges in human resource management. Therefore, there is a clear need for future research that moves beyond a purely technical and applied focus, seeks to build integrated theoretical and interpretive frameworks, uses longitudinal research designs, and considers behavioral, ethical, and contextual dimensions. Such efforts would help maximize the strategic value of predictive models in advancing human capital development.

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