



Big Data and Predictive Analytics for Strategic Human Resource Management: A Systematic Literature Review

Minwir Al-Shammari¹, Fatema Ahmed Al Bin Ali^{2*}, Mariam Abdulla AlRashidi^{3*} and Muneera Salem Albuainain^{4*}

Email address: *malshammari@uob.edu.bh; Fatema.albinali@gmail.com; m.a.alrashidi965@gmail.com; m.albouainin@gmail.com*

^{1,3,4} College of Business Administration, University of Bahrain

² College of Applied Studies, University of Bahrain

Abstract: In the digital transformation era, businesses generate vast amounts of data from various internal and external sources. This data explosion has not only led to the emergence of big data (BD) and predictive analytics (PA) but also revolutionized the way we approach strategic human resource management (SHRM). With the exponential growth of organizational data in volume, velocity, and diversity, there is a notable opportunity to investigate BD and PA methods that provide executives with future-oriented insights into talent dynamics. This study presents a concise overview of the main themes and patterns using a systematic literature review (SLR). Several studies have been conducted on adopting BD and PA techniques, yielding excellent results and offering valuable insights for strategic human resource management (SHRM) experts and future researchers. The search was restricted to articles written in English and published between 2016 and 2023. After conducting an initial search, approximately 50 articles were identified and screened for relevance using a set of inclusion and exclusion criteria. In the final sample, 21 articles published between 2016 and 2023 met the inclusion criteria. The SLR summary describes the essential findings and limitations. The SLR also evaluated the status of existing research on the topic and identified areas for future research.

Keywords: big data, performance analytics, systematic literature review, and strategic human resource management.

1. INTRODUCTION

Businesses produce enormous amounts of data from multiple internal and external sources in the age of digital transformation. In addition to bringing big data (BD) and predictive analytics (PA) to life, this data explosion has completely changed the way we think about strategic human resource management (SHRM). SHRM practices are changing due to the global workforce and the increasing significance of business analytics as a strategic organizational capability. SHRM specialists must know that businesses are now using these data-driven insights to guide their strategic SHRM practices and make important people management choices, opening up many opportunities [1].

The application of PA techniques in SHRM domains is not without difficulties. IT, organizational, and cultural barriers can make it difficult for HR to work well with analytics teams on human resources projects. Furthermore, persistent difficulties persist in striking a balance between

human judgment and anticipatory analysis and in resolving moral problems involving discrimination and privacy. These issues demand careful thought.

Various cutting-edge technology can significantly improve an organization's daily operations and policies. For instance, there are several advantages to using AI in the hiring process. By reviewing resumes and selecting the best matches according to predetermined standards, AI can expedite the first screening of applicants. Additionally, it may automate time-consuming chores like setting up interviews, sending follow-up emails, and even using chatbots to perform initial interviews. AI can also lessen bias in the recruiting process by emphasizing qualifications and abilities over personal traits. A new era of SHRM can be ushered in by these technological developments that can reduce time, increase efficiency, and help discover the best candidates for the job [2].



As BDA and PA have become more widely used, several studies have been conducted to evaluate adoption rates and pinpoint areas that need further research. Fifty-six publications were examined as part of Verma et al.'s systematic literature review (SLR) in 2021 to explore the background and essential issues of SHRM; the results show gaps to provide a solid multilevel framework for further study. To ascertain the tactical HRIS (T-HRIS) components discussed in the literature and how each aspect is represented, Votto et al. (2021) carried out an extensive literature review.

Analyzing publishing patterns over the last ten years provides essential information for future research. By examining how scholarly writing has developed, we can better understand the field's advances and identify significant emerging trends and patterns.

Research in this area might be developed by closely examining publishing patterns over the past ten years. Examining the development and evolution of scholarly writing enables us to understand the field's advances and identify significant emerging trends and patterns.

Despite these obstacles, BD and PA in SHRM have been thoroughly researched; an SLR was carried out to capture the dynamic landscape of this subject faithfully. This study highlights research gaps and provides knowledge of the tactical components of SHRM. Human resources analytics were the subject of a thorough literature analysis in Margherita's (2022) study. The report investigated the potential for exponential growth in HR analytics due to cognitive and artificial intelligence developments by offering a comprehensive framework and a research roadmap.

This study aims to perform a systematic literature review (SLR), investigate the possible advantages and difficulties in this quickly evolving sector, and pinpoint research trends to offer scholars and professionals insightful information. Understanding the use of PA in strategic workforce efforts helps improve HR practitioners' ability to make decisions. Academics can use this study as a reference to compile current information and pinpoint areas that require more research.

2. METHODOLOGY

This SLR was carried out using the following methodology (Figure 1): a thorough Google Scholar search. The search approach included several SHRM and BD-related terms, such as "Big data," "Workforce planning," "Predictive analytics," "Succession planning," and "Data quality." All articles released between 2016 and 2023 were included in the search parameters. Following a preliminary search, about fifty publications were found

and subjected to inclusion and exclusion criteria to determine their relevance. Twenty-one papers from 2016 to 2023 published in the final sample satisfied the inclusion requirements.

The review was limited to English-language articles that could be accessed through academic websites. Significant research published in languages, formats, or sources other than those listed may have been excluded from consideration. The evaluation did not consider whitepapers, case studies, and electronic books written by practitioners; it only looked at peer-reviewed academic literature.

3. FINDINGS

Numerous studies have examined how these two areas overlap in integrating BD and PA into SHRM, which has grown significantly in recent years. This section briefly summarizes the primary themes and patterns identified in the literature. It mainly concentrates on the essential findings and insights from the theoretical frameworks that serve as the study's foundation.

The SLR's analysis revealed essential problems with these techniques, as well as opportunities and challenges. The SLR summary (Table I) outlines the primary conclusions and restrictions. The SLR's objectives were to assess the state of the field's current research and pinpoint areas that require more investigation.

PA's workforce and succession planning applications have been the subject of numerous research. In their assessment of SHRM algorithms, Chang and Hackett [3] observed that although practitioners were interested in recruiting and compensation, academic research was more concerned with deterministic algorithms for operational optimization than with probabilistic approaches to HR problems. Recent empirical research by Mishra et al. [4] suggests that the impact of HR capabilities and IT deployment on organizational performance (OP) may be mediated by BD and PA diffusion.

Succession planning is one area where predictive approaches are being investigated. Jackson and Dunn-Jensen put forth a four-step procedure for coordinating succession planning with ambidextrous organizations [5]. Using data analytics for testing, realigning plans, identifying choice traps, and auditing ambidexterity levels were all part of the process. It shows how predictive tools may foster creativity and competency despite being conceptual. According to Hamilton and Sodeman, inadequate C-level support, issues with data integration, and ethical considerations are obstacles to applying BD to address strategic workforce questions [6].

The national background also appears to be necessary. In a qualitative case study of nine Finnish enterprises, Dahlbom et al. [7] found that human and technical constraints, including poor data quality, insufficient HR processes, and skill gaps, hindered the adoption of advanced analytics. There are difficulties when this is combined with traditional HR culture. On the other hand, Indian research offers more encouraging instances; Pillai and Sivathanu [2] found that HR decision-making and OP are enhanced by descriptive and predictive metrics when data quality is excellent.

The industry is also linked to varying outcomes. According to Mahmood et al.'s research [8], innovative job performance improved the financial performance of manufacturing firms when influenced by BD analytics and entrepreneurial orientation. However, causality could not be established; Verma et al. [9] found that SMEs faced more significant challenges. However, they did identify data quality as a critical factor in enhancing HR practices, service, and innovation competence via predictive tools.

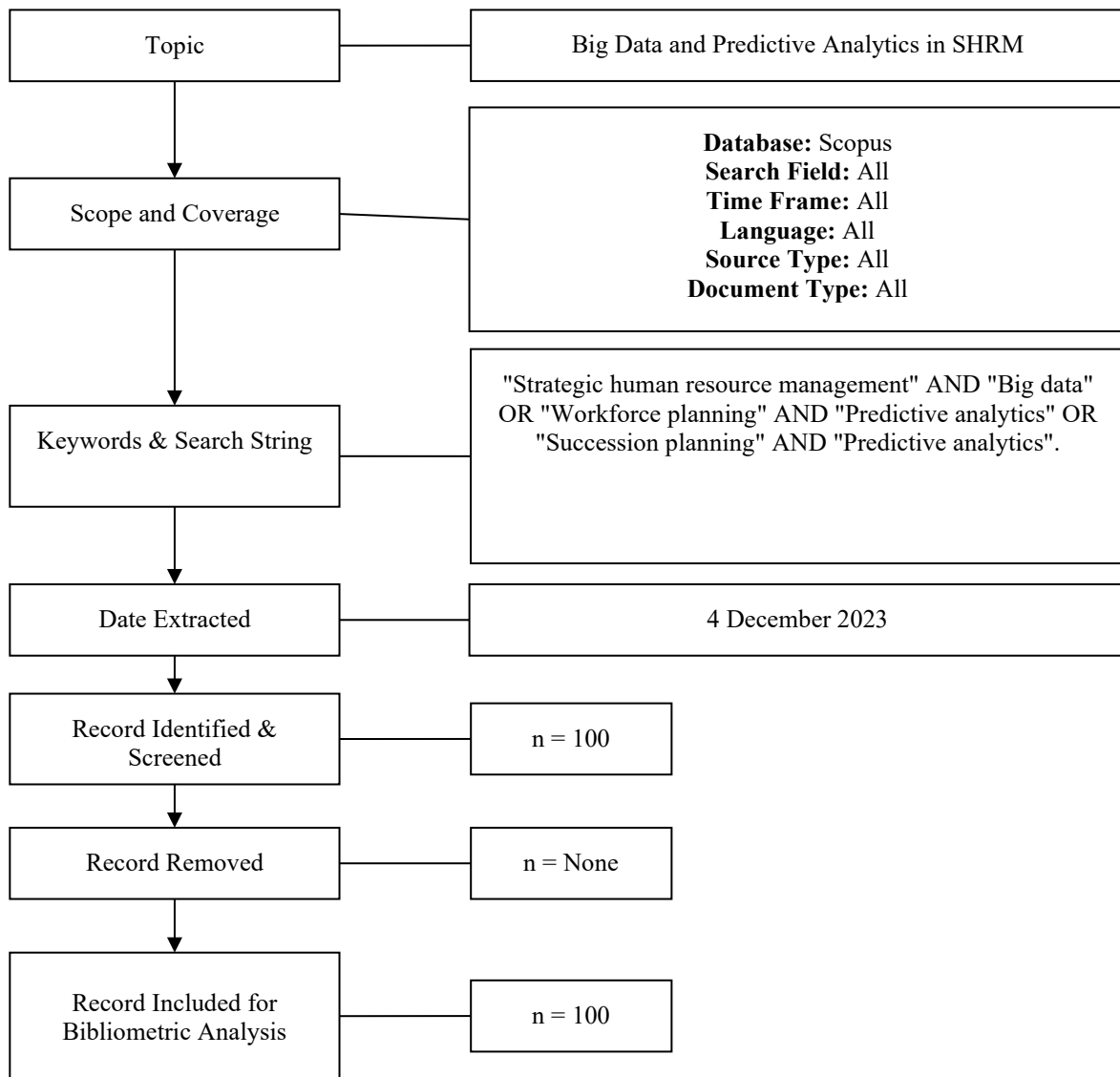


Figure 1: Flow chart of the SLR search process.



Table I: Systematic Literature Review Summary

#	AUTHOR	KEY FINDINGS	LIMITATIONS
1	Alessandro Margherita [1]	106 critical concepts associated with HR analytics were identified and classified into three main categories (enablers, applications, value) and six sub-categories. The study provided an integrative definition and comprehensive inventory of HR analytics ideas and research topics.	Literature was limited to English, which could exclude some perspectives. Journal quality was based on something other than impact factors, which could include some lower-quality sources.
2	Rajasshrie Pillai, Brijesh Sivathanu [2]	Descriptive and predictive non-financial and financial metrics of HR practices were uncovered. HR data quality moderates the relationship between HR practice outcomes and HR metrics. HR metrics help in HR decision-making for SHRM and affect OP.	Data was collected only from Indian companies may not be generalizable to other contexts of self-reported interview data.
3	Maggie M. Cheng, Rick D. Hackett [3]	Practitioner interest in algorithms has grown exponentially compared to academic research in recent years. Most academic research focuses on deterministic algorithms for operation optimization rather than probabilistic algorithms related to SHRM questions. Areas of recruitment, training, and compensation have attracted more practitioners than academic interest. Algorithms described in academic research are not accurate "black boxes," while practitioner articles provide little algorithm detail. Compared to traditional statistical modeling, algorithmic research needs to revise the theory.	The study only included high-quality academic journals, excluding some sources. More focus could be given to the specific algorithms examined.
4	Deepa Mishra, Zongwei Luo, Benjamin Hazen, Elkafi Hassini, Cyril Foropon [4]	The results show that BDPA diffusion mediates the influence of IT deployment and HR capabilities on OP. IT deployment and HR capabilities also directly affect BDPA diffusion, which relates to OP.	Collected data from a single country, which may limit generalizability. Cross-sectional study design limits the ability to determine causality.
5	Nicole C. Jackson, Linda M. Dunn-Jensen [5]	A four-step process is proposed for auditing organizational levels for ambidexterity, recognizing decision-making traps, realigning succession plans for ambidexterity, and testing plans using data and analytics. This process can help build competency and innovation through ambidexterity.	The model needs to be conceptual and empirically tested. Implementation challenges still need to be fully explored.
6	R.H. Hamilton, William A. Sodeman [6]	BD could help address strategic questions about developing knowledge starts and enhancing firm capabilities. However, challenges include lacking C-suite support, analyzing dispersed data, stakeholder collaboration, and legal/ethical concerns. Social media, video analytics, and IoT data may help evaluate performance.	Empirical research relies not on a review of existing literature. Future research is needed to test ideas in practice.
7	Pauli Dahlbom, Noora Siikanen and Pasi Sajasalo, and Marko Jarvenpää [7]	The results indicate that both technical and human obstacles, operating with fundamental HR processes and traditional information systems, and poor data quality hinder the adoption of advanced HRA. These results, combined with the need for more analytics and business understanding skills, the inability to go beyond reporting, and misconceptions related to BD and traditional	The study's explorative nature limits the depth of its investigation into specific topics. The data come from the Finnish context, which may limit generalizability.



		compliance-oriented HR culture, pose further challenges for the HR function's data analytics capacity and business partner role.	There were a small number of interviews.
8	Faisal Mahmood and Maria Saleem, Antonio Ariza-Montes and Heesup Han [8]	The study uncovered sequential mediation of organizational innovation and competitive advantage in the relationship between employee innovative job performance and firms' financial performance. The relationship was more robust when firms' BD analytics and entrepreneurial orientation were higher.	Data was collected only from manufacturing firms in Pakistan, limiting generalizability. Cross-sectional design prevents determining causality.
9	Surabhi Verma, Vibhav Singh, Som Sekhar Bhattacharyya [9]	Bibliometric analysis revealed research gaps in exploring constructs like SHRM practices, HR service quality, OP, and innovation competency regarding BD. Empirical analysis showed that better BD quality improves HR practices, service quality, and SME innovation competency.	Survey data are collected using convenience sampling, which limits generalizability. Due to the cross-sectional design, causality cannot be established.
10	Steven McCartney, Na Fu [10]	Five significant emerging debates/challenges were identified: 1) Inconsistency in definitions of people analytics, 2) Missing evidence of impact, 3) Lack of readiness, 4) Ownership debates, and 5) Ethical/privacy concerns.	The review is limited to articles published in ABS journals during a specified period so that it may exclude other relevant works. The thematic analysis relies on the researcher's interpretation.
11	Steven McCartney and Na Fu [11]	The study's findings support the proposed chain model, suggesting that access to HR technology enables HR analytics, which facilitates EBM and enhances OP.	Data was collected from a single country, so generalizability may be limited. Potential for common method bias as data was self-reported. Causality cannot be determined due to cross-sectional design.
12	Hila Chalutz Ben-Gal [12]	Empirical and conceptual research yields higher ROI than case-based and technical studies. Workforce planning and recruitment/selection yield the highest ROI. The framework presented to understand how HR analytics tools influence ROI.	Literature only included peer-reviewed sources, some grey literature was excluded. The categorization of articles is subjective and open to interpretation.
13	Rabia Imran, Mansour Naser Alraja and Basel Khashab [13]	Results supported hypotheses that GHRM and BD positively impact green innovation, and green innovation positively influences sustainable performance.	Cross-sectional design limits conclusions about causality. Convenience sampling limits generalizability. Self-report data risks common method bias.
14	Mandeep Kaur, Franco Gandolfi [14]	Proposed an I-HRM model showing how integrating AI in various HR functions across the talent lifecycle can create organizational value. AI can enhance talent acquisition, employee engagement, retention, development, growth, compensation, rewards, and recognition.	The conceptual model was not empirically tested, but there was a small sample size for interviews.



15	Jinou Xu and Margherita Emma Paola Pero [15]	A framework for the resource orchestration process in BDA adoption is presented. The authors associated developing and deploying relevant individual, technological, and organizational resources and capabilities with organizational BDA adoption and implementation phases. They highlighted that organizational BDA adoption can be initiated before consolidating the complete resource portfolio. Resource acquisition, capability development, and competency internalization can occur alongside BDA adoption through structured processes and governance mechanisms.	Case studies are based in Europe, so they may not generalize to other geographic contexts. Data is based on retrospective accounts, which can be subject to recall bias. Future research could incorporate a longitudinal perspective.
16	David Angrave, Andy Charlwood, Ian Kirkpatrick, Mark Lawrence, Mark Stuart [16]	It was found that HR's lack of understanding of analytics, combined with limitations of HRIS/talent management software and issues with the analytics industry, means HR analytics has yet to progress beyond operational reporting. These risks exclude HR from strategic influence and do not benefit organizations or employees. Academics need to help HR develop strategic analytics skills.	It is not based on primary research, so it needs empirical evidence. There is potential for bias, as the concerns raised are conceptual rather than backed by data.
17	Abdul-Nasser El-Kassar, Sanjay Kumar Singh [17]	The proposed model proved to be a fit. The hypotheses were supported, and implications were discussed. Green innovation practices positively influence competitive advantage and organizational and environmental performance. Corporate environmental ethics, stakeholders' views, and market demand for green products positively influence green innovation practices.	Data was collected via a convenience sample in a specific region, which may limit generalizability.
18	Paula de Camargo Fiorini, Charbel Jose Chiappetta Jabbour, Enzo Barberio Mariano, Ana Beatriz Lopes de Sousa Jabbour, Bruno Michel Roman Pais Seles [18]	It has identified 19 organizational theories that have been applied in the BD literature and discussed each one. It has also developed a research agenda with potential future questions at the intersection of each theory and BD.	The literature review is based on one database and may need to include some studies. Future empirical research is still required to test proposals from the research agenda.
19	Tan Yoon Yeh, Mafas Raheem [19]	Descriptive and PA applications in HR are focused on staffing and retention. Talent development is an underexplored area, and data quality and skills are significant challenges.	No empirical data collection or analysis was conducted.
20	Francisco J. Álvarez-Gutiérrez, Dianna L. Stone, Ana M. Castaño, Antonio L. García-Izquierdo [20]	Most articles have recently been published. The majority focus on economic outcomes. The importance given to ethics is growing. We need a framework for SUHRA based on the triple bottom line.	A limited number of empirical studies are available because the field is relatively new. Further research is needed.



21	José Garcia-Arroyo and Amparo Osca [21]	Five clusters of HR practices where BD has been applied were identified: selection and hiring, evaluation and development, information, learning, and knowledge, and strategy, efficiency, and performance. BD offers new SHRM opportunities and technical, methodological, and ethical challenges.	The review is limited to academic literature, excluding some practitioner perspectives. Databases searched were limited in number.
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Implementation issues are often found to be problematic. Margherita [1] discovered in an SLR that obstacles to HR analytics included technical problems, a deficiency of analytical abilities, and a failure to go beyond reporting. Additionally, there have been discussions about moral issues and the absence of impact evidence, as McCartney and Fu [10] point out. It seems essential to have sufficient preparation and to position usage inside a well-defined value framework, like ROI [11,12]. Several variables influence success, such as the industry, country, technological challenges, and cultural preparedness.

Emerging conceptual work is putting forth new conceptual frameworks. Through green innovation, an original path model examined how green SHRM and BD affect sustainable performance [13]. Intelligent HRM (I-HRM) models anticipate how AI can improve talent processes and improve talent processes throughout an organization's employee lifetime [14]. Adopting BD analytics should be a developmental process that gradually develops the necessary competencies, according to Xu and Pero [15].

Although implementation challenges still exist, research on PA application in SHRM is expanding. National settings, industry considerations, and organizational readiness are essential for unequal impacts. While conceptual work proposes integrative models, empirical validation is still in its early stages. There are generally opportunities to enhance strategic decision-making using data-driven insights; however, the potential is now constrained by talent gaps and other obstacles.

One recurring factor in numerous studies is the imperative for HR professionals to cultivate additional proficiencies. The discovery by Cheng and Hackett [3] that algorithms documented in scholarly research deviated from "true black boxes" indicates the need for greater transparency. Angrave et al. [16] argued that HR risks being excluded from strategic influence without a more profound comprehension of analytics. They emphasized the significance of collaboration between HR and analytics teams, as emphasized in other works.

Most research conducted today uses cross-sectional designs, which limits the conclusions about causation. For

example, Verma et al. [9] identified correlations between variables but not causality. Sample limitations also come into play; data often comes from industries, countries, or convenience sampling rather than random selection. For example, El-Kassar and Singh [17] only collected information from businesses in the Middle East and North Africa.

Furthermore, a lot of territory is yet largely unexplored. Fiorini et al.'s SLR of management theory and BD [18] discovered a thorough analysis of the junction of BD and organizational ideas. These are opportunities worth looking into more. Rather than predictive or prescriptive analytics, a significant amount of research focus is presently being placed on descriptive and diagnostic approaches (Cheng and Hackett [3], Tan Raheem [19]). This underutilization of analytical methods requires more consideration.

Some conceptual gaps are also present in practitioner work and academic research. The interest in algorithms among practitioners has increased dramatically, as reported by Cheng and Hackett [3]. In addition, Garcia-Arroyo and Oscars [21] SLR observed that economic results had received more attention than the "triple bottom line" representing a sustainable strategy.

4. DISCUSSION

Despite continuous improvements, the current body of knowledge about PA applications in SHRM still has a lot of holes. To fully realize the strategic advantages of applying BD and predictive tools to enhance important HR initiatives, more research should concentrate on particular contextual factors, expand the scope of data sources and analytical techniques, empirically test conceptual models, and investigate novel and creative application areas. Since their problems are multifaceted and interdisciplinary, better collaboration between HR analytics and other departments is essential. It is anticipated that advancements in these fields would support the expansion of data-driven decision-making in SHRM.

The SLR found that although BD and PA research in the SHRM domains is still in its infancy, there is still much room to grow the corpus of knowledge. Several conceptual models are proposed, including these



methods within frameworks like sustainable performance, intelligent SHRM, and succession planning. Nevertheless, actual data is still required to support these theories.

Variations in the effects have been noted, depending on the unique country, industry characteristics, and the organization's preparedness. This result indicates a need for more studies tailored to the specific situation. It would be beneficial to employ broader sample sources, longitudinal designs, and mixed-methods research methodically to overcome the constraints of current cross-sectional surveys and small sample sizes.

Attention should also be given to exploring novel technologies, such as machine learning algorithms, and implementing extra strategic procedures in HR. Skills development is crucial for HR to effectively collaborate with analytics teams on strategic projects from a practical perspective. Continual examination is necessary to address the technical obstacles of scattered data sources, integration requirements, and privacy/ethics considerations. Emerging sustainable models still connect people's activities to many organizational results beyond just economic ones.

This review provides a synopsis of the current research on BD and prediction methods in SHRM. Considerable advancements have been achieved in outlining the potential advantages of these methods and the obstacles limiting their implementation. To fully harness the transformative power of data-driven decision-making, it is crucial to conduct further empirical testing of conceptual frameworks, explore new methodological and contextual factors, and prioritize addressing skills gaps and implementation challenges. These efforts contribute to filling existing knowledge gaps and advancing the potential of SHRM.

Focusing on overlooked research areas offers numerous noteworthy prospects for further investigation in SHRM. Longitudinal studies and randomized trials can establish a causal relationship between variables and provide valuable insights. Moreover, broadening the context range through data collection from many industries or countries would enable the examination of the results' applicability.

A mixed-methods technique can be utilized to enhance research, which involves integrating qualitative interviews, focus groups, or observation with quantitative analysis. This holistic method can enhance theory development and provide a more comprehensive grasp of the subject matter by empirically evaluating proposed conceptual models and frameworks.

Utilizing advanced methodologies like machine learning, natural language processing, and spatial analytics in SHRMt might enhance the area. Partnering with enterprises to implement experimental treatments informed by research findings can result in essential assessments and tangible implementations. Studying competency frameworks and performing skills gap analyses can provide insights into the need for upskilling.

Moreover, research must focus on strategic processes and outcomes that have yet to be well investigated, going beyond the scope of recruiting and retention. Future research includes areas such as innovation or engagement. Developing customized evaluation procedures for HR strategy contexts and comparing various analytical tools are crucial in determining the best appropriate tactics for diverse SHRM difficulties.

Additionally, examining the role of interactive dashboards and data visualization in sensemaking and decision-making inside SHRM may provide insightful information. Understanding how to effectively communicate and incorporate predictive insights into decision-making processes and company culture is crucial. Furthermore, analyzing change management techniques and the leadership skills required to support implementing data-driven projects across functions is essential.

It is crucial to carefully assess the balance between the need for analysis, employees' rights, and the level of transparency inside the business. Analyze privacy and ethics frameworks to determine the most effective practices. Additionally, gather input from the workforce using a combination of research approaches to gain valuable insights on how analytics may best enhance engagement, development, and well-being.

Frameworks that establish data governance and explain responsibilities across HR, IT, and analytics teams must be evaluated to improve outdated HRIS systems and integrate various internal and external data sources. Assessing the value added by predictive technologies concerning the costs and level of supervision needed for companies of varying sizes is crucial.

Working with vendors to test innovative people analytics technologies like blockchain, augmented analytics, or artificial intelligence can offer new insights into the field. Return on investment analyses and identifying non-financial metrics that accurately reflect the short-, medium-, and long-term consequences of these tactics are necessary for assessing the efficacy of SHRM programs.

Addressing these opportunities with a robust multidisciplinary team effort can raise SHRM's

comprehension and application of BD and PA to new heights. Considering the needs of different stakeholders can improve both academic research and practical application, leading to new insights as the field proliferates.

5. CONCLUSION

To sum up, there is much room for growth and more research on PA in SHRM. There are still many opportunities to investigate the theoretical underpinnings, contextual components, and practical applications that underpin this emerging field. More studies in this area could advance our academic knowledge and guide practical application within businesses. The HR department may effectively serve as a strategic business partner by employing data-driven decision-making.

Addressing the complicated issues in this sector requires constant cooperation between several disciplines. Information systems, management, data science, SHRM, and Industrial-Organizational Psychology must address technological, human, and implementation elements. We can only manage PA's complexity in SHRM by using an interdisciplinary approach.

With the number of data and analytical techniques proliferating, academics and practitioners need to develop sustainable, ethical practices that prioritize the interests of all stakeholders. These practices include addressing issues related to improving capacities, overseeing ethical oversight, managing change, and demonstrating the company's observable advantages of PA.

In the end, employing and implementing PA has the potential to completely transform how companies allocate and utilize their most precious resource: human capital. By implementing this innovative tool, organizations can enhance their ability to manage resources and make strategic decisions that lead to long-term success.

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