EMPLOYING BUSINESS ANALYTICS IN INDUSTRY 4.0 SETTINGS FOR HUMAN RESOURCE ANALYTICS

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Purpose: The purpose of this publication is to present the applications of usage of business analytics in human resource analytics.

Design/methodology/approach: Critical literature analysis. Analysis of international literature from main databases and polish literature and legal acts connecting with researched topic.

Findings: This paper explores the transformative potential of business analytics within human resource (HR) analytics, particularly in the context of Industry 4.0. It highlights how the integration of advanced analytics tools and methodologies enables organizations to gain deep insights into workforce behaviors, trends, and patterns, ultimately facilitating more informed decision-making and strategic workforce management. Through applications such as talent acquisition and retention, performance management, workforce planning, and employee well-being, business analytics empowers HR professionals to optimize HR processes, enhance employee satisfaction, and drive organizational success. However, challenges such as data quality issues, privacy concerns, and skills gaps among HR professionals underscore the need for a strategic approach and investment in technology and talent to fully realize the benefits of business analytics in HR analytics.

Originality/Value: Detailed analysis of all subjects related to the problems connected with the usage of business analytics in the case of human resource analytics.

Keywords: business analytics, Industry 4.0, digitalization, artificial intelligence, real-time monitoring; human resource analytics.

Category of the paper: literature review.

1. Introduction

Industry 4.0 has introduced an era where interconnected systems generate vast amounts of data. This data, when harnessed effectively through business analytics, can provide deep insights into workforce behaviors, trends, and patterns. The integration of HR analytics within this framework allows organizations to move from a reactive to a proactive stance in managing human capital. By utilizing data-driven approaches, businesses can predict workforce needs, identify potential skill gaps, and align their HR strategies with overarching business goals. This predictive capability is crucial in an environment where the pace of technological change is rapid, and the demand for new skills is continually evolving.

A fundamental application of business analytics in HR analytics under Industry 4.0 is in talent acquisition and retention. Traditional recruitment processes, often subjective and time-consuming, can be significantly enhanced through the use of analytics. By analyzing data from various sources such as social media, job portals, and internal databases, businesses can identify the most suitable candidates with a higher degree of accuracy. Predictive analytics can forecast an applicant's potential performance and fit within the company culture, thus improving the quality of hires and reducing turnover rates. Furthermore, retention strategies can be optimized by identifying key factors that influence employee satisfaction and engagement. For example, analytics can reveal patterns in employee turnover, enabling organizations to implement targeted interventions to retain top talent.

Performance management is another critical area where business analytics in HR analytics proves invaluable. Traditional performance evaluations are often fraught with biases and inconsistencies. By applying data analytics, organizations can develop more objective and comprehensive performance metrics. Continuous monitoring of employee performance through real-time data allows for timely feedback and personalized development plans. This not only enhances individual productivity but also aligns employee objectives with organizational goals. Machine learning algorithms can analyze performance data to identify high-potential employees, enabling tailored leadership development programs that ensure a robust talent pipeline (Akundi et al., 2022).

Also, business analytics facilitates workforce planning and optimization, essential under Industry 4.0 conditions where the demand for skills is dynamic. Advanced analytics can model various workforce scenarios, helping organizations anticipate future labor needs and adjust their strategies accordingly. For instance, predictive models can estimate the impact of automation on job roles, allowing businesses to proactively reskill and upskill their workforce. This proactive approach ensures that employees remain relevant in the face of technological advancements, thereby reducing the risk of redundancy and enhancing overall workforce agility.

Employee well-being and workplace culture also benefit from the application of business analytics. Industry 4.0 emphasizes the human aspect of technology integration, recognizing that a satisfied and motivated workforce is crucial for innovation and productivity. Analytics can monitor and analyze employee engagement levels, work-life balance, and overall well-being. By identifying stress points and areas of dissatisfaction, organizations can implement initiatives to improve the work environment. For example, sentiment analysis of employee feedback can highlight concerns that may not be evident through traditional surveys, allowing for more targeted and effective interventions (Zeng et al., 2022; Pech, Vrchota, 2022).

Additionally, HR analytics can play a pivotal role in diversity and inclusion initiatives. By analyzing demographic data, hiring practices, and promotion patterns, businesses can identify and address potential biases within their systems. This data-driven approach ensures that diversity and inclusion strategies are based on empirical evidence rather than assumptions. Consequently, organizations can foster a more inclusive culture that leverages diverse perspectives and drives innovation.

The purpose of this publication is to present the applications of usage of business analytics in human resource analytics.

2. The selected aspects of business analytics usage in human resource analytics

Business analytics in the context of human resource (HR) analytics under Industry 4.0 conditions represents a significant paradigm shift, emphasizing the transformation of raw data into actionable insights that drive strategic decisions. The advent of Industry 4.0, characterized by the integration of cyber-physical systems, the Internet of Things (IoT), cloud computing, and cognitive computing, has amplified the importance and complexity of HR analytics. This new industrial era demands a more sophisticated approach to managing human resources, leveraging advanced technologies and analytical methodologies to enhance organizational efficiency, employee satisfaction, and overall productivity (Ghibakholl et al., 2022).

The integration of business analytics into HR analytics under Industry 4.0 conditions represents a transformative approach to managing human capital. By leveraging advanced analytical tools and methodologies, organizations can gain a deeper understanding of their workforce, enhance talent acquisition and retention, optimize performance management, and ensure workforce agility. Furthermore, analytics can improve employee well-being, foster a positive workplace culture, and support diversity and inclusion initiatives. As Industry 4.0 continues to evolve, the strategic application of HR analytics will be crucial for organizations seeking to thrive in this dynamic and interconnected industrial landscape (Bakir, Dahlan, 2022).

Table 1 contains descriptions of how business analytics is used in the case of human resource analytics.

Table 1.
The usage of business analytics in human resource analytics

Aspect of human resource analytics	Description of Usage of Business Analytics
Talent Acquisition	Analyzing data from social media, job portals, and internal databases to identify suitable candidates, predict their performance, and ensure cultural fit.
Employee Retention	Utilizing sentiment analysis and predictive modeling to identify factors influencing employee satisfaction and engagement, and implementing targeted retention strategies.
Performance Management	Monitoring employee performance in real-time, using machine learning to develop objective performance metrics, and providing personalized feedback and development plans.
Workforce Planning	Employing scenario modeling and predictive analytics to anticipate future labor needs, optimize workforce size, and address the impact of automation and technological changes.
Employee Well-being	Conducting sentiment analysis to monitor engagement, work-life balance, and overall well-being, identifying stress points, and improving the work environment.
Diversity and Inclusion	Analyzing demographic data to detect and address biases in hiring, promotion, and other HR practices, fostering an inclusive culture based on empirical evidence.
Training and Development	Using data analytics to identify skill gaps, personalize training programs, and measure the effectiveness of training initiatives to ensure continuous employee development.
Succession Planning	Leveraging predictive analytics to identify potential leaders, assess readiness for promotion, and develop tailored succession plans to ensure leadership continuity.
Compensation and Benefits	Analyzing compensation data to ensure competitive and equitable salary structures, and using predictive models to design benefit programs that enhance employee satisfaction and retention.
Employee Engagement	Using survey data and sentiment analysis to gauge employee engagement levels, identify areas for improvement, and implement strategies to enhance overall engagement.
Attendance and Leave Management	Analyzing attendance data to identify patterns and trends in absenteeism, and implementing strategies to improve attendance and manage leave effectively.
Compliance and Risk Management	Using analytics to monitor and ensure compliance with labor laws and regulations, and identifying potential risks related to HR practices.
Employee Lifecycle Management	Tracking and analyzing data throughout the employee lifecycle, from onboarding to offboarding, to optimize each phase and enhance overall employee experience.
Organizational Development	Analyzing organizational data to identify structural inefficiencies, optimize organizational design, and support strategic change initiatives.
Workforce Diversity	Using analytics to assess the diversity of the workforce, monitor progress on diversity initiatives, and ensure the representation of different groups within the organization.

Source: (Adel, 2022; Akundi et al., 2022; Olsen, 2023; Aslam et al., 2020; Bakir, Dahlan, 2022; Cillo et al., 2022; Ghibakholl et al., 2022, Javaid, Haleem, 2020, Javaid et al., 2020; Cam et al., 2021; Charles et al., 2023; Greasley, 2019; Hurwitz et al., 2015; Nourani, 2021; Peter et al., 2023).

3. Software used in human resource analytics analysis in Industry 4.0 conditions

Business analytics software has become an indispensable tool in modern human resource (HR) analytics, revolutionizing the way organizations manage their workforce. With the advent of sophisticated analytics platforms, HR professionals can now leverage data-driven insights to make strategic decisions that drive organizational growth and performance. The usage of business analytics software in HR analytics encompasses a wide range of functions, from talent acquisition and retention to performance management and workforce planning (Adel, 2022).

One of the primary areas where business analytics software excels in HR analytics is talent acquisition. These software applications enable HR teams to analyze vast amounts of data from various sources, including social media, job portals, and internal databases, to identify and attract top talent. Advanced analytics capabilities, such as predictive modeling and machine learning algorithms, allow organizations to predict candidate performance and cultural fit, leading to more effective hiring decisions. In addition to talent acquisition, business analytics software plays a crucial role in employee retention efforts. By utilizing sentiment analysis and predictive modeling, HR professionals can identify factors influencing employee satisfaction and engagement. Armed with these insights, organizations can implement targeted retention strategies to retain top talent and reduce turnover rates, ultimately enhancing organizational stability and productivity.

Performance management is another area where business analytics software adds significant value. These platforms enable real-time monitoring of employee performance metrics and provide actionable insights for managers and team leaders. With features like personalized feedback and development plans, organizations can optimize employee performance, identify high-potential talent, and foster a culture of continuous improvement. Also, workforce planning benefits immensely from the usage of business analytics software in HR analytics. These platforms offer sophisticated tools for scenario modeling and predictive analytics, allowing organizations to anticipate future labor needs and adapt their strategies accordingly. By analyzing workforce data and trends, HR professionals can proactively address skill gaps, optimize workforce size and composition, and mitigate the impact of technological changes on the workforce (Du et al., 2023; Fjellström, Osarenkhoe, 2023; Castro et al., 2014; Wang et al., 2023).

Table 2 highlighting examples of software and applications used in human resource analytics, along with descriptions of their usage. This table provides an overview of how different business analytics software applications are used in HR analytics, highlighting their descriptions and key features to support various HR functions.

Table 2.

The usage of business analytics software in human resource analytics

Software/Application	Description	Key Features
SAP SuccessFactors	Comprehensive HR management suite offering analytics for various HR functions.	Workforce analytics, talent management, performance and goals tracking, learning and development, succession planning, and predictive analytics.
Workday	Cloud-based HR and finance software with robust analytics capabilities.	Real-time analytics, workforce planning, talent management, compensation analysis, employee engagement metrics, and predictive analytics.
Oracle HCM Cloud	Integrated suite of applications for managing human resources, payroll, and talent.	Workforce modeling, predictive analytics, talent acquisition, performance management, employee wellness tracking, and comprehensive reporting.
ADP Workforce Now	HR management software providing analytics tools for payroll, benefits, and talent management.	Talent analytics, compensation benchmarking, turnover prediction, employee engagement insights, and compliance tracking.
IBM Watson Talent	AI-powered HR solutions focusing on talent acquisition, employee engagement, and performance management.	Cognitive talent insights, predictive hiring, workforce sentiment analysis, personalized career development, and retention strategies.
Tableau	Data visualization software used for HR analytics to gain insights from various data sources.	Interactive dashboards, real-time data visualization, predictive analytics, customizable reports, and integration with multiple data sources.
Visier	People analytics platform designed to help HR professionals make data-driven decisions.	Predictive analytics, workforce planning, talent management insights, diversity and inclusion tracking, and intuitive data visualization.
Microsoft Power BI	Business analytics tool providing interactive visualizations and business intelligence capabilities for HR.	Real-time data analysis, customizable dashboards, integration with various data sources, predictive modeling, and detailed reporting.
Cornerstone OnDemand	Talent management software offering analytics for learning, performance, and succession planning.	Learning analytics, performance metrics, talent benchmarking, succession planning, and workforce insights.
SAS HR Analytics	Advanced analytics software offering a range of tools for HR data analysis.	Predictive analytics, talent management, employee performance tracking, retention analysis, and comprehensive HR reporting.
Ultipro	Comprehensive HR, payroll, and talent management software with robust analytics.	Predictive analytics, employee sentiment analysis, talent acquisition metrics, compensation planning, and workforce management insights.
Informatica	Data integration and analytics platform used for consolidating and analyzing HR data.	Data integration, real-time analytics, predictive modeling, comprehensive reporting, and data quality management.
Qlik Sense	Data analytics platform providing powerful tools for HR data visualization and analysis.	Associative data indexing, real-time analytics, predictive analytics, interactive dashboards, and integration with various data sources.

Cont. table 2.

Zoho People	HR management software with analytics features for employee data and performance.	Employee performance tracking, sentiment analysis, leave management insights, workforce analytics, and customizable reporting.
PeopleSoft (by Oracle)	Comprehensive HR solution offering analytics for various HR processes.	Workforce analytics, talent management, performance and goal tracking, predictive modeling, and detailed reporting.

Source: (Adel, 2022; Akundi et al., 2022; Olsen, 2023; Aslam et al., 2020; Bakir, Dahlan, 2022; Cillo et al., 2022; Ghibakholl et al., 2022, Javaid, Haleem, 2020, Javaid et al., 2020; Cam et al., 2021; Charles et al., 2023; Greasley, 2019; Hurwitz et al., 2015; Nourani, 2021; Peter et al., 2023).

4. Advantages and problems of business analytics usage in human resource analytics

Business analytics empowers HR professionals to make decisions based on data rather than intuition or guesswork. By analyzing large volumes of HR data, including employee demographics, performance metrics, and engagement levels, organizations can gain valuable insights into workforce trends, preferences, and behaviors. This allows for more informed decision-making across various HR functions, such as talent acquisition, performance management, and employee development (Charles et al., 2023).

With the help of business analytics, HR can streamline and optimize the talent acquisition process. By analyzing recruitment data, organizations can identify the most effective sourcing channels, assess the quality of candidates, and optimize the selection process. Predictive analytics can also help HR predict candidate success and cultural fit, leading to better hiring decisions and reduced turnover rates.

The advantages of using business analytics in human resource analytics are numerous and far-reaching. By leveraging data-driven insights, organizations can optimize HR processes, enhance employee satisfaction and engagement, and drive strategic workforce initiatives that contribute to organizational success (Greasley, 2019).

Table 3 contains the advantages of using business analytics in human resource analytics within Industry 4.0 conditions, along with descriptions for each advantage. These advantages demonstrate the transformative impact of business analytics on HR analytics, enabling organizations to leverage data-driven insights to attract, retain, and develop talent, optimize performance, and drive strategic workforce initiatives (Nourani, 2021).

Table 3.
The advantages of using business analytics in human resource analytics

Advantage	Description
Data-Driven Decision Making	Business analytics in HR enables data-driven decision-making processes. By analyzing large volumes of data, HR professionals can make informed decisions regarding talent acquisition, performance management, and workforce planning, leading to better outcomes and more efficient use of resources.
Predictive Analytics	With predictive analytics, HR can forecast future trends and outcomes based on historical data and current patterns. This allows organizations to anticipate talent needs, identify potential risks, and develop proactive strategies to address challenges such as turnover and skill shortages. Predictive analytics also help in optimizing workforce planning and resource allocation.
Improved Talent Acquisition	Business analytics facilitates more effective talent acquisition processes. By leveraging data analytics, HR can identify the most suitable candidates, predict their potential performance, and ensure cultural fit within the organization. This leads to better hiring decisions, reduced time-to-fill positions, and improved overall quality of hires, enhancing organizational performance and competitiveness.
Enhanced Employee Retention	Analytics enables HR to identify factors influencing employee turnover and satisfaction. By analyzing data on engagement, performance, and other relevant metrics, organizations can implement targeted retention strategies, address issues proactively, and create a more conducive work environment. This helps in reducing turnover rates, retaining top talent, and fostering a culture of loyalty and commitment.
Optimized Performance Management	Business analytics software provides insights into employee performance and productivity. By monitoring key metrics in real-time and using advanced analytics techniques, HR can identify high-performing employees, address performance issues promptly, and develop personalized development plans. This leads to improved individual and team performance, enhanced employee engagement, and alignment with organizational goals.
Strategic Workforce Planning	Analytics facilitates strategic workforce planning by providing insights into current workforce capabilities and future needs. HR can use data analytics to identify skill gaps, anticipate changes in demand, and align workforce strategies with business objectives. This enables organizations to adapt to evolving market conditions, leverage emerging opportunities, and ensure the availability of talent to drive growth and innovation.
Better Employee Well-being	By analyzing employee feedback, sentiment, and other relevant data, HR can gain insights into employee well-being and satisfaction. Business analytics enables HR to identify stress points, address concerns, and implement initiatives to improve the work environment and overall employee experience. This leads to higher levels of employee engagement, productivity, and well-being, contributing to organizational success.

Source: (Adel, 2022; Akundi et al., 2022; Olsen, 2023; Aslam et al., 2020; Bakir, Dahlan, 2022; Cillo et al., 2022; Ghibakholl et al., 2022, Javaid, Haleem, 2020, Javaid et al., 2020; Cam et al., 2021; Charles et al., 2023; Greasley, 2019; Hurwitz et al., 2015; Nourani, 2021; Peter et al., 2023).

Table 4 contains the problems of using business analytics in human resource analytics within Industry 4.0 conditions, along with descriptions for each advantage. These problems highlight the challenges and obstacles organizations may encounter when using business analytics in HR analytics. Addressing these issues requires a strategic approach, investment in technology and talent, and a commitment to ethical and responsible data practices.

Table 4.

The problems of using business analytics in human resource analytics

Problem	Description
Data Quality Issues	Poor data quality, including inaccuracies, inconsistencies, and incomplete data, can undermine the effectiveness of HR analytics initiatives. Data errors and inconsistencies can lead to incorrect conclusions and decisions, impacting the reliability and validity of HR analytics insights.
Privacy Concerns	Analyzing employee data raises privacy concerns related to data protection regulations and ethical considerations. HR analytics initiatives must adhere to strict privacy regulations and ensure that employee data is handled responsibly and ethically. Failure to address privacy concerns can damage employee trust and lead to legal and reputational risks for the organization.
Lack of Data Integration	HR data is often siloed across different systems and platforms, making it challenging to integrate and analyze effectively. Lack of data integration can result in fragmented insights and hinder the ability to derive meaningful conclusions from HR analytics initiatives. Organizations must invest in robust data integration solutions to overcome this challenge and leverage the full potential of HR data.
Bias in Data and Algorithms	Bias in HR data and algorithms can lead to unfair and discriminatory outcomes, impacting recruitment, performance evaluation, and other HR processes. Biased data and algorithms can perpetuate existing inequalities and reinforce systemic biases, undermining the fairness and objectivity of HR analytics initiatives. Organizations must address bias in data and algorithms to ensure fairness and equity in HR practices.
Skills Gap	HR professionals may lack the necessary skills and expertise to effectively leverage business analytics tools and techniques. The complexity of analytics platforms and the need for specialized skills in data analysis, statistics, and data visualization can pose a significant challenge for HR teams. Organizations must invest in training and development programs to bridge the skills gap and build analytical capabilities within the HR function.
Resistance to Change	Implementing HR analytics initiatives often requires a cultural shift within the organization, which may face resistance from employees and stakeholders. Resistance to change can stem from fear of job insecurity, lack of trust in data-driven decision-making, or skepticism about the value of analytics. Overcoming resistance to change requires strong leadership support, effective communication, and stakeholder engagement.
Cost and Resource Constraints	Implementing and maintaining business analytics tools and infrastructure can be costly and resource-intensive. Organizations may face budget constraints, limited IT resources, and competing priorities, which can impede the adoption and scalability of HR analytics initiatives. Organizations must carefully balance costs and resources to ensure the sustainability and effectiveness of HR analytics initiatives.

Source: (Adel, 2022; Akundi et al., 2022; Olsen, 2023; Aslam et al., 2020; Bakir, Dahlan, 2022; Cillo et al., 2022; Ghibakholl et al., 2022, Javaid, Haleem, 2020, Javaid et al., 2020; Cam et al., 2021; Charles et al., 2023; Greasley, 2019; Hurwitz et al., 2015; Nourani, 2021; Peter et al., 2023).

5. Conclusion

The integration of business analytics into human resource (HR) analytics within the context of Industry 4.0 represents a significant advancement in managing human capital. Industry 4.0 has ushered in an era where interconnected systems generate vast amounts of data, offering unprecedented opportunities for organizations to gain insights into workforce behaviors, trends, and patterns. By harnessing the power of business analytics, organizations can transition from reactive to proactive approaches in managing their human resources. One fundamental

application of business analytics in HR analytics under Industry 4.0 is in talent acquisition and retention. Through the analysis of data from various sources, businesses can identify suitable candidates more accurately and predict their potential performance and cultural fit within the organization. Additionally, analytics can help in optimizing retention strategies by identifying key factors influencing employee satisfaction and engagement.

Performance management also benefits significantly from the application of business analytics. By leveraging real-time data and advanced analytics techniques, organizations can develop more objective performance metrics, provide timely feedback, and identify high-potential talent for leadership development programs. Also, business analytics facilitates strategic workforce planning, allowing organizations to anticipate future labor needs, address skill gaps, and adapt their strategies accordingly. Analytics also play a crucial role in enhancing employee well-being, fostering a positive workplace culture, and supporting diversity and inclusion initiatives.

While the advantages of using business analytics in HR analytics are substantial, organizations may encounter challenges such as data quality issues, privacy concerns, and skills gaps among HR professionals. Addressing these challenges requires a strategic approach, investment in technology and talent, and a commitment to ethical and responsible data practices.

Despite these challenges, the transformative potential of business analytics in HR analytics is undeniable. By leveraging data-driven insights, organizations can optimize HR processes, enhance employee satisfaction and engagement, and drive strategic workforce initiatives that contribute to organizational success in the dynamic and interconnected landscape of Industry 4.0.

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