SYSTEMATIC LITERATURE REVIEW ON VARIOUS THEORIES, MODEL, FINDINGS, UTILISED IN AI, ML, DS - POWERED WORKFORCE ANALYTICS FOR ORGANISATIONAL EFFECTIVENESS

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Abstract

Workforce analytics has grown dramatically as an integral practice among organisations to improve their effectiveness and secure the necessary competitive advantage. It has the potential to transform the business practices and provide insights that can lead to making effective decisions. Workforce analytics involves the use of appropriate technologies like AI, ML and DS for the analysis of work-related data in order to optimise the human resource practices. Hence, this particular field has become of great interest to scholars and researchers considering the growing importance of effective HRM and advancement being made in the field of technology. A large amount of research has been done on the subject to provide the required insights into relationships between AI, ML and DS powered HR analytics and organisational effectiveness. The purpose of this article is to review the theories, models and findings associated with the AI, ML and DS powered workforce analytics in relation to organisational effectiveness. A systematic review of peer-reviewed articles from 2018-2023 has been done to address the purpose.

Keywords: *AI, ML, DS, workforce analytics, organisation*

1. Introduction

Data is increasingly being used in every field to gather appropriate insights and take relevant decisions for better sustainability. Human resources practices is no exception where data is being used for talent analysis, recruitment, learning and development, performance, employee well-being and retention (Margherita, 2022). This use of data for managing the workforce in an effective manner is termed as "Workforce Analytics" or "HR analytics". Workforce analytics engages in the collection, processing and management of data related to the workforce which is then analysed using appropriate tools and models (Zeidan and Itani, 2020). Workforce analytics, HR analytics, talent analytics and human capital analytics are the same term with the same meaning which helps organisations build the most effective workforce. Workforce analytics is having a strategic role in the growth and development of the workforce which is further contributing to organisational effectiveness. It is providing organisations with evidence based insights into their human resources practices to help them achieve the set goals and outcomes at the strategic level (Durai *et al.* 2019). Organisations are able to make better decisions regarding the needs and requirements of the employees which

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would provide the business with an edge in the market. Hence, workforce analytics can be said to be an important tool for competitive advantage in the market. "Artificial intelligence (AI)", "machine learning (MI)" and "data science (DS)" are the technological developments that are engaged in workforce analytics to aid the decision making process. With the development of time, numerous research have been conducted on the theories and models involving AI, ML and DS powered workforce analytics for organisational effectiveness to gain a better understanding of the subject matter. Hence, the purpose of this research is to explore and investigate the various theories, models and findings associated with AI, ML and DS powered workforce analytics for better organisational effectiveness.

2. Methodology

In this research, secondary data and "systematic literature review" has been used to address the above mentioned purpose of the work. Secondary data collection involved gathering data from existing sources about the research on the topic and reviewing them in a systematic manner to gain the necessary insights. The entire methodological approach involves reviewing and analysing previously done academic research using three distinct steps- (1) collecting previous studies (2) filtering through previous studies and (3) selecting articles for the review. The first steps of collecting previous studies involved gathering all the scholarly articles that were about HR analytics or workforce analytics from the online database Google Scholar. Hence, articles about 'HR analytics' and 'workforce analytics' were searched and collected from Google scholar. The second step was filtering through the search and looking for articles that were published from 2018 to 2023 with the key terms like 'AI', 'ML' and 'DS'. The last step in the process was selecting the articles that were able to provide key insights and were peer-reviewed in the process to meet the quality standards. Hence, these three steps helped with gathering all the necessary information for the successful completion of the work.
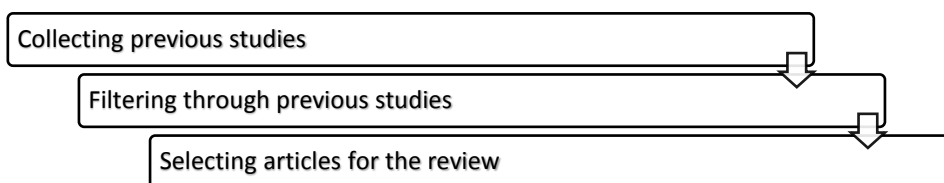

Figure 1: Methodology used in the research
(Source: Self-developed)

3. Findings And Results

Author (s) and publication year	Aim of the article	Methodology	Findings

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Gurusinghe *et al.* (2021)	The article aims at developing a conceptual model answering questions like the factors impacting the use of HR analytics and the effect/impact of HR analytics on talent management outcomes	A literature review based approach has been used in the study to develop the required conceptual model	A conceptual model with the use of resource based theory and Technological-Organisational-Environmental (TOE) Framework has been developed for the examination of the relationship between predictive HR and talent management outcomes. The model developed in the study can successfully be used to assess the impact/role that predictive HR has on the key HR practice of talent management.
Faqihi and Miah (2023)	It involves designing new AI-based solutions/frameworks and investigating its suitability for talent management.	Design science methodology has been used in the work for developing the framework in support of relevant literature from SCOPUS database	AI based talent management system has been developed in the study with the moderation of diffusion of innovation theory (DOI) and Technological-Organisational-Environmental (TOE) Theory. The framework developed in the study can further help in solving AI-based problems related to talent growth.
Murugesan *et al.* (2023)	The correlation between digital HR and AI has been examined in the research along with the impact of HR digitisation on organisational design.	The descriptive design using a cross-sectional approach has been used in study to support the primary data collected from 271 participants working in HR professionals in Chennai and Bengaluru. The IBM SPSS software was used to analyse the data while AMOS was used to test the proposed model	AI can be of great help to HR professionals in all industries since it can help them understand the various patterns and behaviours of employees. AI can help HR professionals to provide the required work-life balance to the employees by analysing all the data in the process. It can further help HR managers in better understanding of the employees' feelings in the most appropriate manner and take actions accordingly. Hence, all the insights gained about employees using AI can be used improve the organisational design
Sakka *et al.* (2022)	The article has aimed at providing a proper idea	Secondary sources of information	AI can help in improving the abilities of HR managers to

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	into the impact that can be gained with introducing AI on various HR functions.	have been used in the proposed and the data has been analysed in multiple themes	process all the information that they have about the employees. This can further streamline the talent acquisition process, employee performance assessment and professional development to meet the unique needs of all employees.
Pradhan and Saxena (2023)	The study strives to highlight the importance of re-skilling the workforce which is necessary to advance the careers of employees with the introduction of AI in organisation	A deductive approach has been used in the study which is supported by the collection of secondary data. Research papers, websites, HR blogs, surveys, reports and publications have been used in the study.	The findings show that the applications and capabilities of AI has significantly increased over the years and in turn has become quite important in a number of fields. However, the most important hurdle in the process is upskilling the workforce to make them ready for the future of AI. Hence, it is very important to reskill and upskill the workforce for creating talents for meeting the changing employee demand.
Pessach *et al.* (2020)	A analytics framework has been proposed in the research to help HR recruiters with hiring and placement decisions	A large dataset consisting of recruitment records of thousands of employees over the decades has been used to develop the framework	Variable-order Bayesian Network (VOBN) model is the proposed machine learning model that can help recruiters make appropriate decisions reading the hiring of employees. The proposed model is something that can be of significant help to the HR professionals in hiring the right candidate at the right position while creating a balanced recruitment plan that can help in improving diversity and recruitment success rate.
Zhao *et al.* (2019)	The study aims to provide a reliable machine learning approach to predict employee turnover in an organisation.	Real along with simulated HR datasets from all types (small, medium and large) of organisations were used to perform numerical experiments involving various	"Random forest, decision tree, logistic regression, support vector machine, gradient boosting trees, extreme gradient boosting, K-nearest neighbour method, Naive Bayes method, random forest method and linear discriminant analysis" are the various machine learning methods that were applied to the datasets to identify

		methods.	the reliable approach. The ten mentioned machine learning approaches have been discussed in detail in the research along with the way they need to be applied to the datasets. On the other hand, the extreme gradient boosting method has been found as the most appropriate one for large datasets.
Falletta and Combs (2021)	The meaning of HR analytics has been explored in the study while introducing the HR analytics cycle as the right framework to gather appropriate insights into HR that can further help with the achievement of the strategic objectives.	HR analytics cycle is the framework that has been used in the study to review gain a complete overview of HR analytics	HR analytics framework is a seven-step process that improves the HR capabilities with evidence based and ethical HR practices. These seven steps can provide HR leaders with the most valuable insights to make smarter workforce decisions and create effective HR strategy. It is also something that can help with ethical decision making and help the leaders avoid any missteps or make questionable decisions in the process
Peeters *et al.* (2020)	The purpose is to examine the key ingredients required by HR analytics team to improve organisational performance	A narrative literature review was done in the study to gather the required insights. The 'People Analytics Effectiveness Wheel' is the model that was used to introduce the findings of the study.	"Products, stakeholder management, enabling resources and governance structure" are the four categories of ingredients that are required by the HR analytics team for organisational effectiveness. Machine learning and AI become quite important to identify patterns and improve accuracy of HR analytics teams. The data set is one of the critical factors in each of the ingredients of the wheel and AI & machine learning both can help in identifying the complex relationships within the datasets.
Tursunbayeva *et al.* (2018)	The goal was to gain an understanding of the nature, application and capability of HR analytics along with the	A quasi-systematic scoping review was done in the study with the analysis of	The rapid pace at which technology is changing and developing in the modern world, it is only important for HRM to be ready for PA in order to address

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	issues arising in the field	secondary sources to gain the required insights about people analytics	new innovation and market demands. The analysis done in the study found a significant change in PA in the last 15 years. The commercial PA market is quite diverse with tools that offer numerous strategic and functional benefits.
Chalutz Ben-Gal (2019)	A review based on return on investment (ROI) in relation to HR analytics is the goal of the study	This is a review paper making use of 4-step review and analysis methodology	In this analytics driven world which makes use of data to support and make decisions in various business functions, the ROI model is one of the most effective frameworks for HR managers. The ROI model can significantly contribute to HR analytics and improve the entire process. The ROI model has been able to identify the HR functions that provides the most ROI and they are- workforce planning and recruitment & selection.
Zhang *et al.* (2021)	The research is focused on mapping the evolution of literature on big data related to HRM	A bibliometric review has been done using clustering algorithm which is based upon big data paradigm for the quantitative assessment of the entire research on the topic	Bid data is somewhat of an emerging field in context to HRM and significant research is still required in the future to get a proper idea of the subject matter. However, there are rapid development being made in the field of big data which provides opportunities along with challenges to HRM. Big data can help organisations at multiple levels and aid all the HRM functions from recruitment, selection and turnover. However, gathering of large amount of data to aid the entire process is one of the biggest challenges with big data
McIver *et al.* (2018)	The article aims to improve people's understanding of data analytics for workforce management to achieve	Secondary method of data collection has been used in the study to develop the right	The agile development process has been proposed in the study for the better integration of workforce analytics into the decision making process. Data analytics provides

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	organisational success	approach of integrating data analytics into the HRM practices	HR with various opportunities that can help them drive the business towards success. However, to make the most out these, it is important for HR professionals to ask the right questions and use the right metrics
Garcia-Arroyo and Osca (2021)	The novelty, implications and challenges of Big Data has been review in the study	41 articles about big data in HRM has been analysed to complete the work	Big data has been highlighted as an new approach/methodology that can manage employee data in an effective manner but still they present numerous challenges various level like technology, ethics and methodology
El-Kassar and Singh (2019)	To explore the level to which the HR practices in a business have an influence on corporate ethics, big data innovation and competitive advantage	A survey of 215 participants from the MENA region and GCC was done to test the relationship	Big data and predictive analytics are two important technologies that aid innovation with HR practices in the way of providing the required/necessary advantage. The acceptance of big data from the top management becomes integral to gain the required benefits.
Nasar *et al.* (2021)	The data analytics for the various e-HRM activities has been proposed in the study	Four Datasets downloaded from Kaggle website have been manipulated and handled for the purpose. The use of various data analytics techniques has been used for the various e-HRM activities	An e-HRM model working on the principles of HRIS has been outlined with the necessary support of IoT based applications to make the large size of data available manageable. All the various functions of e-HRM have effectively been analysed in the work with certain scope for further work.
Singh and El-Kassar (2019)	To examine the extent to which the integration of big data technologies and green HRM can enhance the performance of the firm among other things	A survey of 522 participants working in companies in the MENA region and GCC were used to collected the data with the application of the	The sustainability of the firm can be enhanced in a significant manner with the integration of big data technologies and green HRM along with green SCM. The decision making process can significantly improve with big data and a talented and motivated workforce will be developed in

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		dynamic capabilities theory	the process.
Huselid (2018)	The study aims to provide recent insights in the field of workforce analytics	Eight diverse papers have been used in the study to present new theories, methods and tools	It can be found that the use of workforce analytics can help in effective management of the workforce by enhancing the ability of leaders and managers to take right decisions to achieve the strategic objectives. Hence, a comprehensive understanding of the same needs to be developed by HR managers to make the most out of HR analytics
Nocker and Sena (2019)	The opportunities associated with talent analytics for an organisation has been explored in this paper	A number of case studies have been used in the study to provide the required insights and this further indicates the use of secondary data and multiple themes to complete the work	Machine learning has been identified as the key tool and important skill in talent analytics for organisations to understand employee behaviour. Machine learning can be used for the analysis of social media posts of the applicants and to understand the characteristics that they have not declared on the CV. Unsupervised machine learning can significantly be used by organisations to support recruitment while supervised ML can help in predicting outcome when it comes to talent analytics
Jain *et al.* (2023)	A broad view on the effective integration of AI in HRM functions	Case studies and secondary data has been used in the study to address the mentioned aim of the work	The application of AI is very important for HRM and it is something that can supplement the human resources of the business. Speed and accuracy with talent acquisition can increase while enabling customised professional development. The productivity and performance of the organisation will significantly improve with the use of AI in human resource management.
França *et al.* 2023	To provide appropriate and valuable insights into the relationships between HR practices	A bibliometric analysis of journals, citations, articles, indexes	AI can help in identifying the right skills that are required for competitive advantage in the market and thus is quite important

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and AI.	and keywords has been done to produce the required results	for talent management. HR managers need to be proactive with the use of AI to completely revolutionise their management practices. AI and machine learning can help organisations uncover new insights while evaluating the potential of employees in a significant manner.

4. DISCUSSION

The use of analytics in the field of HRM is something that has been an interesting subject of discussion at various levels. A large amount of research has been done on the subject to provide the required insights on the subject and present appropriate theories, models and findings for better understanding of the topic. The systematic review that has been done in the above section of the study has reviewed the contribution of certain researchers in the field of workforce analytics to highlight their theories, model and findings. All of the studies have highlighted the potential of AI, ML and DS powered workforce for improving the effectiveness of the organisation. On the other hand, some of the researchers have also talked about the challenges that are faced in the application of the same in an organisation. There are certain ethical issues that need to be kept in mind with the use of workforce analytics along with the development of appropriate skills to gain the most out of these technologies. When it comes to AI powered workforce analytics, Gurusinghe *et al.* (2021) has proposed a model developed using the TOE framework and resources based theory which can improve organisational effectiveness. VOBN has been proposed by Pessach et al. (2020) for using ML-powered analytics to gain the same outcome. Chalutz Ben-Gal (2019) further proposed the ROI model for the use of DS-powered models to improve organisational effectiveness. On the other hand, the theories and findings of all the research that have been reviewed above have provided the same insights regarding the use of AI, ML or DS powered workforce analytics. It has been made quite clear by other researchers that the use of workforce analytics in any form can help with increasing the organisational effectiveness.

5. CONCLUSION

Workforce analytics is a growing field of interest for all the stakeholders involved in the process and there still remains a lot to explore about the concept to gain the most out of these technologies. The systematic review has been able to highlight the positive aspects associated with the use of AI, ML and DS powered workforce analytics for organisational effectiveness with the help of the theories, models and findings. However, very few studies have been conducted on the subject that highlights the challenges or negative side of using the same for improving organisational effectiveness. The systematic review was unable to incorporate these aspects in the research due to lack of relevant literature. Hence, there remains a scope to

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conduct a research on the challenges or shortcoming involved with the use of these workforce analytics for improving organisational effectiveness.

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