Exploring the impact of big data driven technology towards e-recruitment efficiency and hr performance: The moderating effect of ethical technology

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ABSTRACT

Although fast progression of artificial intelligence has compelled organizations to adopt disruptive technologies however organizations have been remained unsuccessful to gain maximum benefits from these technologies especially in the domain of human resource management. Owing to the proliferation of disruptive technologies this study encapsulates how big data driven human resource practices enhance e-recruitment efficiency. Research model was tested with empirical data retrieved from employees. Overall, 367 employees have participated in this e-recruitment research survey. Results illustrates that big data driven human resource practices, information quality, service quality, big data culture and digital maturity demonstrated substantial variance R^2 75.2% in e-recruitment efficiency. Moreover, effect size f^2 analysis has disclosed large effect size of big data driven human resource practices and digital maturity in determining e-recruitment efficiency. This study has revealed that data driven human resource practices, digital maturity and big data service quality are core factors which enhance e-recruitment efficiency and hence these factors need managerial attention. Similarly, the moderating effect of ethical technology has established and revealed that higher intensity of ethical technology will stronger the relationship between e-recruitment efficiency and human resource performance. Therefore, policy makers could enhance recruitment efficiency and human resource performance by deploying ethical technology in human resource practices. This study is significant as it develops completely new research model backed by big data driven human resource practices and fills research gap between e-recruitment efficiency and human resource performance.

Keywords: *Big data driven HR practices, Data driven culture, Data driven information quality, Data driven service quality, Digital maturity, E-recruitment efficiency, Ethical technology.*

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Transparency: The author confirms that the manuscript is an honest, accurate, and transparent account of the study; that no vital features of the study have been omitted; and that any discrepancies from the study as planned have been explained. This study followed all ethical practices during writing.

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Highlights of this paper

- To investigate the impact of big data-driven HR practices on e-recruitment efficiency.
- To examine the impact of big data information quality and system quality on e-recruitment efficiency.
- To examine the impact of big data culture and digital maturity on e-recruitment efficiency.
- To test the moderating effect of ethical technology on the relationship between e-recruitment efficiency and HR function performance.

1. INTRODUCTION

The momentous rise of disruptive technology like big data analytics, internet of things and artificial intelligence is expected to grow sharply (Qu, Chen, Wang, Yang, & Zhang, 2025). Disruptive technologies are capable to analyze complex data, increasing operational efficiency, service reliability, igniting innovation and assisting organizations in decision making process (Kou & Lu, 2025). Therefore, with this global revolution organizations are compelled to use disruptive technologies to manage business operations and hence improving organizational performance (Qamar, Agrawal, Samad, & Chiappetta Jabbour, 2021; Qu et al., 2025). Big data driven technology has depicted tremendous potential in human decision making process and therefore importance of big data analytics cannot be ignored in human resource management. Big data driven technology has been successfully applied in different human resource functions such as evaluating employee performance, understanding employee state of emotional involvement, monitoring employee tasks and employee turnover (Dong, Tian, He, & Wang, 2025; Gursoy & Cai, 2025; Kumar, Raut, Mangla, Moizer, & Lean, 2024). For instance recent literature review conducted by Hamouche, Rofa, and Parent-Lamarche (2025) have established connection between artificial intelligence and human resource development. Similarly, authors like (Orero-Blat, Palacios-Marqués, & Leal-Rodríguez, 2025) have unveiled linkage between data orientation and big data capabilities. Moving further Garmaki, Gharib, and Boughzala (2023) have confirmed impact of big data and organization learning towards organizational performance. While these studies enhance existing body of knowledge in human resource domain however, studies with relation to big data analytics and recruitment function are relatively nascent and underdeveloped (Mariani, Machado, & Nambisan, 2023; Pereira, Hadjielias, Christofi, & Vrontis, 2023).

The electronic human resource management system comprises HR strategies, policies and practices backed by technology and positively impact human resource performance. Within human resource management system, e-recruitment is considered integral part of electronic human resource management. E-recruitment refers to a process of attracting, screening, assessing, selecting and recruiting individual from a pool of professional using data driven technology (Kucherov & Tsybova, 2022). Although studies have revealed that e-recruitment process has attracted candidates nevertheless organizations are still uncertain and unclear that how to gain maximum advantage using data driven technology (Hamouche et al., 2025; Kucherov & Tsybova, 2022). Owing to the broader range of disruptive technologies there is a growing need to conduct research to encapsulate how big data driven technology impact e-recruitment efficiency and enhance human resource management performance. Consequently, this study fills research gap with following research objectives. Primarily this study investigates impact of big data driven HR practices towards e-recruitment efficiency. Second, this study examines how big data information quality and system quality impact e-recruitment efficiency. Similarly, this study investigates impact of big data culture and digital maturity towards e-recruitment efficiency. This study has outlined moderating effect of ethical technology between the relationship of e-recruitment and human resource performance. Therefore, fourth objective of this study is to test the moderating effect of ethical technology between the relationship of e-recruitment efficiency and HR function performance. Thus, in following section detail literature review is conducted to establish connection

among exogenous and endogenous factors. In terms of unique this study is amongst few to discuss association between big data technology and e-recruitment efficiency. Another unique aspect of this study is to conceptualizing ethical technology as moderating factor between the relationship of e-recruitment efficiency and HR function performance. The remaining of this research is included literature review followed by hypotheses development, methodology, scale development, data collection, data analysis, results, discussion, study contributions, conclusion, study limitation and future research directions.

2. LITERATURE REVIEW

2.1. Big Data Driven HR Practices

With the emergence of artificial intelligence, a vigilant paradigm shift can be seen in human resource management system wherein big data is being used to evaluate employee performance (Hamouche et al., 2025; Yamin et al., 2024). Big data analytics has ability to examine HR matrices, external and internal human resource functions and hence facilitate personnel in decision making process (Alyoubi & Yamin, 2024; Verma, Singh, & Bhattacharyya, 2021). Therefore, bid data driven HR practices denotes to process of collecting complex HR data, aligning and analyzing data with different sources and predict employee training orientation and performance (Verma et al., 2021; Yamin, 2022). According to Verma et al. (2021) data driven human resource practices boosts talent acquisition by identifying organization staffing need, selecting right candidate for best suited job and hence improve human resource performance. In the context of recruitment authors like (Arslan, Cooper, Khan, Golgeci, & Ali, 2022) have established that data driven human resource practices are capable to scrutinize job applications and assist policy makers in screening and selection process which in turn enhance efficiency in recruitment process. Prior studies have emphasized that data drive HR practices are capable to translate information into feasible action plan, improve time and efficiency management (Arslan et al., 2022; Chen, Khan, & Chen, 2024; Verma et al., 2021; Yamin, 2022). Moreover, studies have revealed that information retrieved from big data is useful for knowledge creation and innovation and hence augment recruitment process (Chen et al., 2024; Verma et al., 2021). Consistent with above arguments and supported by prior studies conducted by Arslan et al. (2022); Chen et al. (2024) and Verma et al. (2021) following hypothesis is postulated:

H_1: Big data driven HR practices are positively related to e-recruitment efficiency.

2.2. Big Data Analytics Information and Service Quality

The big data analytics has been acknowledged as an innovative tool that assist policy makers to understand dynamic market trends (Morales-Serazzi, González-Benito, & Martos-Partal, 2023; Xu, Sarfraz, Sun, Ivascu, & Ozturk, 2025). Nevertheless, competency of the big data analytics is connected with information and service quality. Big data information ecosystem evolves process of collecting information through internal and external sources, optimizing that information for decision making and sharing that information to disclose new insight (Al Mamun, Reza, Yang, & Aziz, 2025; Fosso Wamba, Akter, Trinchera, & De Bourmont, 2019). Although big data analytics has ability to retrieve maximum available information however there is confusion on big data driven information quality architecture (Fosso Wamba et al., 2019). For instance, big data analytics algorithm is completely rely on existing structured and unstructured data. Nevertheless, a key challenge is that how inferior quality of information should be scrapped or retained in big data analytics (Côrte-Real, Ruivo, & Oliveira, 2020; Fosso Wamba et al., 2019). Therefore, information quality is key a component in big data analytics. Big data information quality provides deep insight about employee performance, compensation, appraisal, work schedule, training needs and hence speedup recruitment and selection process (Abdalatif & Yamin, 2022; Shafqat, Zhang, Ahmed, Ullah, &

Zulfiqar, 2024). Aside of information quality service quality is also considered an essential component of big data analytics. Service quality ensures that managers are capable to accomplish task correctly and timely and hence improve human resource system (Kholaif & Xiao, 2023; Sweiss & Yamin, 2024; Mohammad Ali Yousef Yamin, 2024). The extent literature has established that big data information quality and service quality assists employee in decision making process and boost recruitment and selection process (Al Mamun et al., 2025; Côrte-Real et al., 2020; Fosso Wamba et al., 2019; Morales-Serazzi et al., 2023; Xu et al., 2025). Following above arguments big data information and service quality are theorized as.

H_2: Big data information quality is positively related to e-recruitment efficiency.

H_3: Big data service quality is positively related to e-recruitment efficiency.

2.3. Data Driven Culture and Digital Maturity

The emergence of big data analytics in business paradigm has proven ability to increase innovation and organizational performance. Nevertheless, majority of the organizations have failed to gain maximum advantages from data analytics due to lack of data driven culture (Dalain et al., 2025; Orero-Blat et al., 2025; Mohammad Ali Yousef Yamin, 2020). Therefore, data driven culture has become crucial element and need to be investigated how data driven culture enhance digital transformation and organizational competency. The term data driven culture is the extent wherein employees make decision based on the insights retrieved from big data analytics. Studies have demonstrated that with cultural adaptability allow employees to transform decision making with big data analytics (Conte & Siano, 2023; Garmaki et al., 2023; Orero-Blat et al., 2025). Data driven culture is basically embedded into a fit between data driven technology and organization culture. According to Garmaki et al. (2023) have asserted that data driven decision making should not be limited to executives decisions and there is need of culture in organizations to share data from top to down level which improve quality of the decision making. Similarly, organizations embedded into data driven culture are more efficient in recruitment process (Conte & Siano, 2023). Beside data driven culture importance of digital maturity cannot be ignored in achieving human resource system performance. Digital maturity is the degree wherein an organization has integrated data technology into business strategies and operations (Pham, Tran Hoang, Nguyen Tran, & Nguyen Phan, 2024). Precisely, digital maturity reflects to organizational capability to use data driven insight effectively (Leso, Cortimiglia, Ghezzi, & Minatogawa, 2024). Prior studies have revealed that digital maturity enhance organization competency and human resource performance (Leso et al., 2024; Mick, Kovaleski, Mick, & Chiroli, 2024; Pham et al., 2024). Therefore, data driven culture and digital maturity are hypothesized as.

H_4: Big data driven culture is positively related to e-recruitment efficiency.

H_5: Digital maturity is positively related to e-recruitment efficiency.

2.4. Ethical Technology

The recent data driven digital transformation has played significant role in improving human civilization and businesses across the globe (Gursoy & Cai, 2025; Stahl & Eke, 2024). Although data driven technology has brought ease in human lives however technology centered societies are facing some ethical challenges pertaining to data security, mismanagement of information, trust deficit, data privacy and non-compliance with regulatory guidelines (Bankins, 2021; Saurabh, Arora, Rani, Mishra, & Ramkumar, 2022; Mohammad Ali Yousef Yamin & Abdalatif, 2024). Therefore, data driven technology must be accountable for long term sustainability and to gain maximum benefit from big data analytics (Kamila & Jasrotia, 2025; Rodgers, Murray, Stefanidis, Degbey, & Tarba, 2023). Literature has established that ethical technology promotes moral business practices resulting long term

sustainability in business operations (Bankins, 2021; Saurabh et al., 2022; Sweiss & Yamin, 2024; Mohammed Ali Yousef Yamin, 2019). In terms of human resource system past studies have established that ethical technology protect employee sensitive data, ensures data encryption and compliance with data protection regulations (Dennis & Aizenberg, 2022; Figueroa-Armijos, Clark, & da Motta Veiga, 2023; Rodgers et al., 2023; Tursunbayeva, Pagliari, Di Lauro, & Antonelli, 2022). According to Rodgers et al. (2023) stated that ethics in technology boost technology user confidence which in turn enhance task performance. Another study conducted by Figueroa-Armijos et al. (2023) has disclosed that ethical technology perception boost jobseeker trust and hence improve accuracy in recruitment data. Following above arguments one can infer that ethical technology brings efficiency in recruitment process and enhance human resource performance (Dennis & Aizenberg, 2022; Figueroa-Armijos et al., 2023). Therefore, this study has assumed that ethical technology moderates the relationship between e-recruitment efficiency and human resource performance and conceptualized following hypotheses.

H_6: E-recruitment efficiency is positively related to human resource performance.

H_7: Ethical technology moderates the relationship between e-recruitment efficiency and human resource performance.

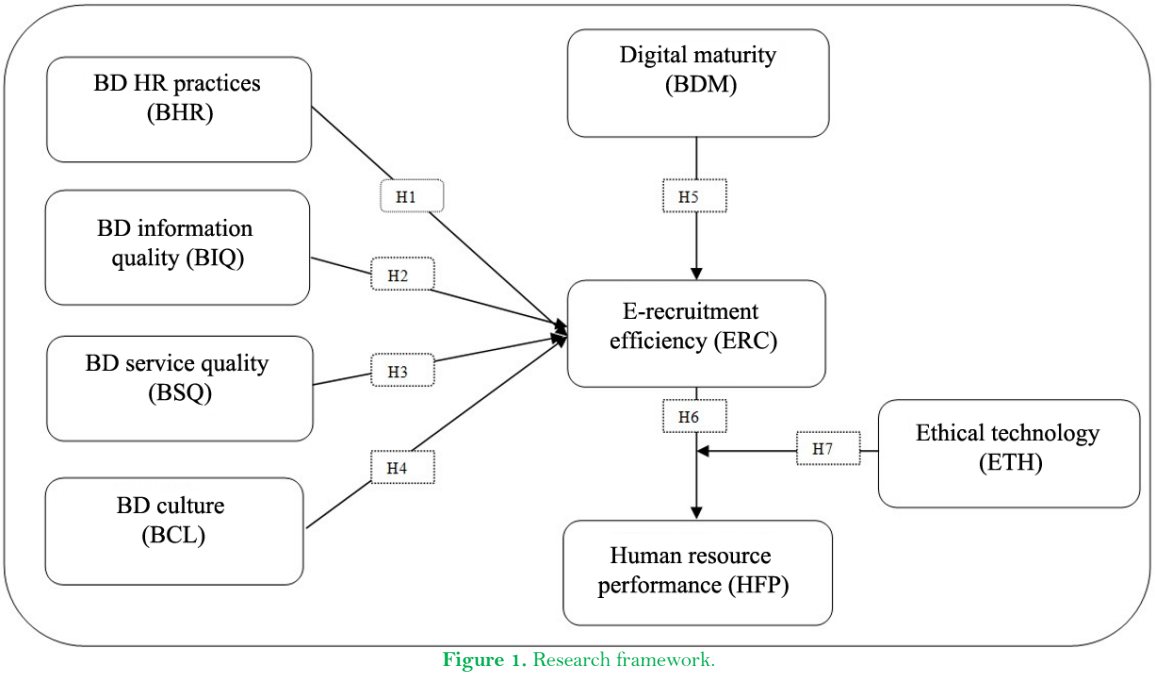

Figure 1. Research framework.

3. METHODS

3.1. Research Methods and Scale Development

This study is grounded in positivism research paradigm and hence followed quantitative research methods to develop research model. Prior to conceptualization of research hypotheses problem statement is outlined with adequate research gap. Thereafter, literature review is conducted to formulate hypotheses. These hypotheses are analyzed with empirical data backed by quantitative research approach. Data are collected through structured questionnaires. The survey questionnaire is divided into three sections. At first cover letter is given that explains purpose of the research briefly. Afterward, second section of the questionnaire seeks respondents' information. Next to this third section of the questionnaire comprise scale items to measure outlined factors. These scale items are adapted from past literature and future verified with structural equation modelling approach. Scale items for the factor big data driven human resource practices were adapted from Verma et al. (2021) and Mohammad Ali Yousef Yamin (2024). Big data driven information quality items were adapted from Côrte-Real et al. (2020). Therefore, big

data driven service quality scale items were adapted from Côrte-Real et al. (2020) and Rahi et al. (2024). Data driven culture items were adapted from Leal-Rodríguez, Sanchís-Pedregosa, Moreno-Moreno, and Leal-Millán (2023) and Orero-Blat et al. (2025). Digital maturity items were adapted from Orero-Blat et al. (2025) and Pham et al. (2024). Moving further e-recruitment efficiency items were adapted from L'Écuyer and Raymond (2023) and Kucherov and Tsybova (2022). Similarly, human resource performance items were adapted from L'Écuyer and Raymond (2023). Therefore, scale items for scale ethical technology were adapted from Figueroa-Armijos et al. (2023). These scale items are enumerated on seven-point Likert scale wherein 1 denotes to strongly disagree and 7 indicates to strongly agree. The items measurement on seven point Likert scale is also consistent with past studies (Rahi, Alnaser, & Ghani, 2019; Rahi et al., 2024).

3.2. Sampling, Data Collection and Descriptive Analysis

The core objective of this study is to investigate how big data driven technology along with human resource practices boosts e-recruitment process. Therefore, the population of this study is employees working in information technology and software sector. Likewise, unit of analysis in this study is employee working in information technology sector. The information technology and software sector is most relevant as employees working in these organizations have better knowledge about big data driven technology (Inamdar et al., 2021). Looking at this immense research population sample size is selected for the purpose of data collection. For sample computation guidelines provided (Rahi, 2017) have been followed. According to Rahi (2017) suggested that items should be five times or ten times higher to unveil adequate study sample size. Following this, the sample size of the study ranging from a minimum of 125 (25×5) to a maximum of 250 (25×10) is considered satisfactory. The respondents of this study were selected knowingly from the IT sector; therefore, a purposive sampling approach was used for data collection. Data were collected in a voluntary setting, where respondents were free to either participate or decline participation in the e-recruitment survey. Moreover, respondents were assured that their personal identity, including their names and organizational affiliations, would not be disclosed.

This study is cross-sectional and collects data at one point in time using structured questionnaires. For data collection, 409 questionnaires were distributed among employees working in the information technology sector. These respondents were asked to participate in the research survey and share their e-recruitment experiences. The e-recruitment survey was conducted in Riyadh, Saudi Arabia. Questionnaires were distributed physically by visiting employees' offices; however, prior to these visits, consent was obtained from the employees through phone calls. The data collection process took approximately three months, starting from 2 November 2024 to 28 January 2025. During this period, several phone calls and visits were made, and respondents were requested to return the questionnaires on time. Although 409 respondents were approached, 367 showed willingness to participate and completed the survey, resulting in a response rate of 89%. Among the 367 respondents, 321 were male and 46 were female. Regarding age, 107 respondents were between 21 and 30 years old. In addition, 205 respondents were between 31 and 40 years old, while 55 respondents were between 41 and 50 years old. Respondents were also asked to report their total years of work experience. Descriptive statistics revealed that the majority (213 respondents) had 6 to 10 years of experience, followed by 118 respondents with 11 to 15 years of experience. Only 36 respondents had 1 to 5 years of experience.

4. DATA ANALYSIS

4.1. Multicollinearity Issue and Common Method Variance

The multicollinearity issue and data bias were tested prior to conducting the structural equation modeling analysis. Multicollinearity occurs when two factors are highly correlated with each other. Accordingly, the data were examined using the Variance Inflation Factor (VIF), following the criterion that VIF values must be lower than 3.3. The results showed that none of the VIF values exceeded 3.3, thereby confirming that multicollinearity is not a concern. Similarly, data bias may arise when information for both independent and dependent variables is collected simultaneously through a single survey instrument. Therefore, addressing common method bias is essential before performing inferential analysis. To minimize this issue, the survey questionnaire items were mixed during distribution. Furthermore, Harman's single-factor test was employed using a threshold of 40% for the first unrotated factor. The analysis revealed that the maximum variance explained by the first factor was only 18%, which is substantially below the threshold. These findings confirm that the data are free from significant bias. Thus, factor reliability and hypotheses testing were carried out using the structural equation modeling approach.

4.2. Structural Equation Modeling

The structural equation modeling (SEM) approach has the capability to analyze multiple factors simultaneously; therefore, the data were analyzed using this approach. There are two well-known methods for SEM assessment: variance-based SEM (VB-SEM) and covariance-based SEM (CB-SEM). In this study, the variance-based SEM approach was adopted because the research aims to develop a completely new model rather than test an existing one. Following the variance-based SEM procedure, the data were evaluated through the measurement model and the structural model. The measurement model ensures that the constructs demonstrate reliability and discriminant validity, whereas the structural model examines path significance and the explained variance. Indicator reliability was confirmed using factor loadings, following the threshold of > 0.60. Subsequently, construct reliability was assessed using composite reliability and Cronbach's alpha, both of which must exceed 0.70. Similarly, convergent validity was evaluated using the Average Variance Extracted (AVE). The literature suggests that AVE values must be greater than 0.50 to establish convergent validity. The results show that all AVE values exceeded this threshold, thereby confirming the convergent validity of the constructs. The measurement model results are presented in Table 1 demonstrating adequate indicator reliability, convergent validity and factors reliability.

Table 1. Indicators reliability and validity.

Indicators	Loading	c-alpha	CR	AVE
BCL1: Employees are encouraged to use big data in this organization.	0.955	0.869	0.902	0.755
BCL2: Employees get equal opportunity to learn big data analytics tools.	0.841			
BCL3: Adequate infrastructure is available to run data analytics programs.	0.804			
BDM1: This organization is ready to embrace digital transformation.	0.879	0.901	0.938	0.835
BDM2: Organization is following digital transformation in holistic manners.	0.938			
BDM3: Employees are capable to bring digital transformation at workplace.	0.924			
BHR1: Big data assists in recruitment and selection process.	0.919	0.876	0.914	0.730
BHR2: Big data assists in appraisal of employees.	0.835			
BHR3: Big data helps to deal grievances and complaints.	0.937			
BHR4: Big data assist in reviewing employee performance.	0.706			
BIQ1: Information provided by big data is well structured.	0.859	0.778	0.871	0.693
BIQ2: Big data driven information is accurate.	0.845			
BIQ3: Information provided by big data is free from any errors.	0.791			
BSQ1: Big data driven HR services are correct.	0.857	0.905	0.941	0.842
BSQ2: Big data driven analytics improve human resource services.	0.945			
BSQ3: Big data assists managers to accomplish tasks quickly.	0.947			
ERC1: Big data driven recruitment is cost effective.	0.849	0.874	0.922	0.798
ERC2: Big data driven recruitment reduces operational expenses.	0.916			
ERC3: Big data driven recruitment boosts HR team performance.	0.912			
ETH1: Applicants data are secured in big data driven recruitment.	0.796	0.784	0.874	0.699
ETH2: Big data analytics is capable to follow ethical standards during hiring.	0.822			
ETH3: While video interviewing data analytics ensures confidentially.	0.887			
HFP1: Data driven technology improves HR manager performance.	0.954	0.910	0.943	0.848
HFP2: Training and development programs are designed with data analytics.	0.898			
HFP3: Big data driven evaluation increases employee satisfaction.	0.909			

After establishing convergent validity factors discriminant validity is assessed with multiple analysis including heterotrait-monotrait ratio, Fornell and Larcker and cross loading analyses (Rahi et al., 2024; Mohammad Ali Yousef Yamin, 2024). Discriminant validity of the factors ensures that factors measure distinct concepts and hence this analysis is considered critical. The heterotrait-monotrait ratio analysis is the latest analysis to examine discriminant validity of the factors. This method has suggested that none of the heterotrait-monotrait ratio should be higher than 0.85 or 0.90 (Rahi et al., 2024; Mohammad Ali Yousef Yamin, 2024). Data are analyzed with heterotrait-monotrait ratio analysis. Results demonstrate that heterotrait-monotrait ratios are less than threshold value. This finding has established that factors are discriminant and measure distinct concepts. Result of the HTMT analysis is exhibited in Table 2.

Table 2. Heterotrait-monotrait ration matrix.

Factors	BCL	BDM	BHR	BIQ	BSQ	ERC	ETH	HFP
BCL								
BDM	0.160							
BHR	0.096	0.368						
BIQ	0.083	0.335	0.328					
BSQ	0.079	0.235	0.445	0.288				
ERC	0.124	0.703	0.761	0.565	0.617			
ETH	0.157	0.073	0.101	0.079	0.054	0.059		
HFP	0.125	0.343	0.468	0.433	0.308	0.580	0.133	

The cross-loading analysis is employed to confirm discriminant validity of the factors. Following cross loadings analysis indicators loadings are compared with other factors. To achieve adequate discriminant validity criterion is that loading of the factors should be higher when comparing to other factors. Data are analyzed and revealed that factor loadings are higher in comparison to other factors loadings. Therefore, these findings have established that factors are discriminant and valid. Factors cross loading are shown in Table 3.

Table 3. Cross loadings analysis.

Factors	BCL	BDM	BHR	BIQ	BSQ	ERC	ETH	HFP
BCL1	0.955	0.119	0.141	0.077	0.058	0.159	0.153	0.143
BCL2	0.841	0.146	0.042	0.065	0.037	0.066	0.084	0.069
BCL3	0.804	0.074	0.048	0.039	0.058	0.039	0.106	0.090
BDM1	0.039	0.879	0.341	0.274	0.186	0.602	0.051	0.316
BDM2	0.144	0.938	0.309	0.267	0.214	0.572	0.035	0.262
BDM3	0.184	0.924	0.304	0.230	0.181	0.548	0.037	0.275
BHR1	0.105	0.264	0.919	0.268	0.364	0.617	0.115	0.402
BHR2	0.123	0.434	0.835	0.354	0.372	0.715	0.024	0.350
BHR3	0.091	0.279	0.937	0.201	0.404	0.616	0.079	0.398
BHR4	0.047	0.143	0.706	0.107	0.222	0.361	0.052	0.291
BIQ1	0.077	0.219	0.232	0.859	0.219	0.386	0.020	0.362
BIQ2	0.041	0.202	0.187	0.845	0.216	0.376	0.017	0.289
BIQ3	0.071	0.281	0.304	0.791	0.167	0.396	-0.052	0.259
BSQ1	0.002	0.204	0.287	0.226	0.857	0.477	-0.045	0.176
BSQ2	0.074	0.197	0.439	0.229	0.945	0.526	-0.067	0.309
BSQ3	0.081	0.184	0.397	0.207	0.947	0.507	-0.009	0.303
ERC1	0.064	0.470	0.487	0.430	0.483	0.849	0.021	0.366
ERC2	0.132	0.560	0.722	0.407	0.539	0.916	0.063	0.564
ERC3	0.143	0.645	0.645	0.414	0.449	0.912	0.038	0.468
ETH1	0.171	-0.023	0.030	-0.029	-0.060	0.011	0.796	0.089
ETH2	0.082	0.067	0.080	0.039	-0.029	0.078	0.822	0.086
ETH3	0.106	0.066	0.083	-0.023	-0.024	0.033	0.887	0.104
HFP1	0.127	0.297	0.384	0.358	0.218	0.469	0.095	0.954
HFP2	0.134	0.286	0.437	0.328	0.369	0.540	0.085	0.898
HFP3	0.091	0.278	0.343	0.319	0.191	0.443	0.132	0.909

The Fornell-Larcker criterion is another method to compute discriminant validity of the factors (Rahi et al., 2024). This method ensures discriminant validity square root of average variance extracted. To ensure that factors are discriminant this method has recommended that square root of average variance extracted should be grater in correlation matrix. Nevertheless, data are analyzed with Fornell-Larcker analysis. Results revealed that square root of average variance extracted are higher in correlation matrix. These findings have confirmed that data are discriminant and measure unique concept. The values of square root of average variance extracted can be seen in Table 4.

Table 4. Fornell-Larcker analysis.

Factors	BCL	BDM	BHR	BIQ	BSQ	ERC	ETH	HFP
BCL	0.869							
BDM	0.132	0.914						
BHR	0.113	0.349	0.854					
BIQ	0.076	0.282	0.291	0.833				
BSQ	0.058	0.212	0.411	0.241	0.917			
ERC	0.130	0.630	0.702	0.464	0.549	0.893		
ETH	0.143	0.045	0.078	-0.007	-0.044	0.047	0.836	
HFP	0.129	0.312	0.425	0.364	0.288	0.530	0.112	0.921

4.3. Hypotheses Analysis

Data are further analyzed with structural model assessment. The structural model assessment analyzes hypotheses with path coefficient value, significance level and t-statistics. Although path significance and path coefficient statistics are enough to present path strength however hypotheses are further evaluated with t-statistics. Therefore, data are bootstrapped with sample of 5000 as recommend by prior studies (Rahi, 2023; Rahi et al., 2024; Yamin, 2022). Moreover, bootstrapping procedure is also favourable as it mitigates data normality issue. Therefore, hypotheses are established with bootstrapping procedure. Results of the hypotheses can be seen in Table 5.

Table 5. Hypothesis testing.

Hypothesis	Direction	β	STDEV	t-value	p-values	Decision
H1	BHR -> ERC	0.413	0.057	7.253	0.000	Supported
H2	BIQ -> ERC	0.174	0.033	5.239	0.000	Supported
H3	BSQ -> ERC	0.256	0.041	6.204	0.000	Supported
H4	BCL -> ERC	0.005	0.043	0.123	0.451	Not- supported
H5	BDM -> ERC	0.381	0.056	6.802	0.000	Supported
H6	ERC -> HFP	0.526	0.063	8.387	0.000	Supported

Results of the hypotheses analysis demonstrate that big data driven human resource practices are positively associated with e-recruitment efficiency and statistically supported by $\beta = 0.413$, STDEV 0.057, t-value 7.253, $p < 0.000$ and hence H1 is confirmed. The relationship between big data information quality and e-recruitment efficiency is found significant and hence confirmed H2 backed by $\beta = 0.174$, STDEV 0.033, t-value 5.239, $p < 0.000$. Similarly, big data service quality is positively related to e-recruitment efficiency and backed by $\beta = 0.256$, STDEV 0.041, t-value 6.204, $p < 0.000$ and hence H3 is confirmed. Nevertheless, relationship between big data culture and e-recruitment efficiency is found insignificant and therefore H4 is rejected following statistics of $\beta = 0.005$, STDEV 0.043, t-value 0.123, $p < 0.451$. Therefore, digital maturity has revealed positive influence e-recruitment efficiency and backed by $\beta = 0.381$, STDEV 0.056, t-value 6.802, $p < 0.000$ and hence establishing H5. Similarly, the relationship between e-recruitment efficiency and human resource performance is found significant and statistically backed by $\beta = 0.526$, STDEV 0.063, t-value 8.387, $p < 0.000$ and confirmed H6. These findings have established that except big data culture all exogenous factors have positive impact in determining e-recruitment efficiency of a firm.

4.4. Coefficient of Determination R^2 and Effect Size f^2

Though hypotheses are tested with structural assessment however accumulated variance is yet to be examined. Therefore, values of the coefficient of determination R^2 are taken into consideration. Results indicate that jointly big data driven human resource practices, information quality, service quality, big data culture and digital maturity demonstrated substantial variance R^2 75.2% in e-recruitment efficiency. Moreover, factors like ethical technology and e-recruitment efficiency have explained substantial variance R^2 30.2% in human resource performance and hence confirmed validity of the research model. Beside coefficient of determination factors effect size is computed with f^2 analysis following threshold value of 0.02, 0.15 and 0.35 demonstrating small, medium and large effect size respectively. Results indicate that big data driven human resource practices and digital maturity have disclosed large effect size in determining e-recruitment efficiency. Therefore, big data service quality has exhibited medium level of effect size in measuring e-recruitment efficiency. Big data information quality has depicted small effect size towards e-recruitment efficiency. Consistent with hypotheses data culture has depicted no effect size towards e-recruitment efficiency. Results are further evaluated by selecting human resource performance as outcome factor.

Findings direct that in achieving human resource performance factors like e-recruitment is considered the most influential factor with large effect size. Results of the effect size analysis can be seen in Table 6.

Table 6. Coefficient of determination R^2 and effect size analysis f^2.

E-recruitment efficiency coefficient of determination R^2 75.2%		
Effect size towards e-recruitment efficiency		
Factors	**Results**	**Impact**
Digital maturity	0.489	Large
Big data driven human resource practices	0.507	Large
Big data driven information quality	0.106	Small
Big data driven service quality	0.216	Medium
Big data driven culture	0.000	No-effect
Human resource performance coefficient of determination R^2 30.2%		
Effect size towards human resource performance		
Factors	Results	Impact
Ethical technology	0.006	Small
E-recruitment efficiency	0.396	Large

4.5. Importance Performance Matrix

Data are analyzed with importance performance matrix analysis. The purpose of this analysis is to disclose unique factor using importance and performance indexes. Moreover, this method estimates data by rescaling data from 1 to 10. For data analysis human resource performance is taken as an outcome factor. Data are analyzed with importance performance matrix algorithm. Results indicate that in combined model factors like e-recruitment efficiency is considered most important factor in improving human resource performance. Therefore, big data human resource practices is found second most important factor in measuring human resource performance followed by digital maturity. Similarly, big data service quality has shown notable importance in measuring human resource performance. Moving further big data information quality and ethical technology have shown least importance in measuring human resource performance. These results demonstrates that e-recruitment efficiency, big data human resource practices, digital maturity and big data service quality are most central factors which need managerial attention to boost human resource performance of a firm. Results of the importance performance matrix are exhibited in Table 7.

Table 7. Importance performance matrix.

IPMA for human resource performance		
Factors	**Importance**	**Performance**
Digital maturity	0.201	60.733
Big data human resource practices	0.217	61.318
Big data information quality	0.092	71.608
Big data service quality	0.135	62.439
E-recruitment efficiency	0.526	61.473
Ethical technology	0.065	60.236
Big data culture	0.003	68.281

4.6. Moderating Analysis

Data set includes moderating factor namely ethical technology. With the help of past literature this study has assumed that ethical technology moderates the relationship between e-recruitment efficiency and human resource performance. Therefore, the moderating path is tested with product indicator approach. Data are bootstrapped and results revealed that significant moderating effect of ethical technology between e-recruitment efficiency and human

resource performance and supported by β= 0.127, STDEV 0.069, t-statistics 1.829 significant at 0.034 and hence H7 is established. Statistical results are shown in Appendix A containing path coefficient and t-values. Moving further moderating relationship is also analyzed with simple slope graph to see the strength of the moderating relationship. Results as exhibited in simple slope graph depict that ETH at + ISD is presenting inclining trend that indicate higher level of ethical technology will strengthen the relationship between e-recruitment efficiency and human resource performance. Simple slope graph can be seen in Figure 2 with positive and negative trends of ethical technology.

Figure 2. Simple slope graph.

5. DISCUSSION

The fast progression of disruptive technologies has changed business practices and has played essential role in achieving firm performance. Among these technologies that have emerged in the business paradigm, big data analytics have gained large attention of the policy makers. The use of big data analytics enables firms to compete in dynamic market and offers long-lasting competitive advantages. Moreover, with the arrival of fourth industry revolution firms are now transforming talent on boarding, talent development and off boarding process with data driven human resource practices. Although big data driven HR practices have shown pivotal role in recruitment process due to cost effective and quick screening characteristics however firms have remained unsuccessful to gain maximum benefits from this technology in HR domain (Arslan et al., 2022). To address this issue current study has developed research model ground in data driven factors and investigates e-recruitment efficiency and human resource performance of a firm. The research model has outlined factors such as big data HR practices, big data service quality, big data information quality, big data culture and digital maturity and investigating impact of these factors on e-recruitment efficiency. These factors are empirically examined with multiple assumptions. Finally, findings are compared with past studies. For instance results have indicated that big data driven human resource

practices are positively associated with e-recruitment efficiency and hence this finding is consistent with past studies (Arslan et al., 2022; Chen et al., 2024; Verma et al., 2021).

The relationship between big data information quality and e-recruitment efficiency is also found significant and consistent with past studies (Al Mamun et al., 2025; Fosso Wamba et al., 2019). Likewise, big data service quality is positively related to e-recruitment efficiency and in line with past studies (Al Mamun et al., 2025; Côrte-Real et al., 2020; Fosso Wamba et al., 2019; Morales-Serazzi et al., 2023; Xu et al., 2025). Nonetheless, relationship between big data culture and e-recruitment efficiency was found insignificant and hence this outcome is inconsistent with past studies (Conte & Siano, 2023; Garmaki et al., 2023; Orero-Blat et al., 2025). Digital maturity has revealed positive influence e-recruitment efficiency and this finings is consistent with prior studies(Leso et al., 2024; Mick et al., 2024; Pham et al., 2024). Moving further the relationship between e-recruitment efficiency and human resource performance is found significant and consistent with past research studies (Conte & Siano, 2023; Garmaki et al., 2023; Orero-Blat et al., 2025; Rodgers et al., 2023). Aside of hypotheses testing results indicate that jointly big data driven human resource practices, information quality, service quality, big data culture and digital maturity have revealed substantial variance R^2 75.2% in e-recruitment efficiency. In extended model has confirmed that ethical technology moderates the relationship between e-recruitment efficiency and human resource performance and hence endorsed arguments established by past studies (Dennis & Aizenberg, 2022; Figueroa-Armijos et al., 2023). Concerning with collective variance results indicate that ethical technology and e-recruitment efficiency have explained substantial variance R^2 30.2% in human resource performance. Similarly, this study has several contributions to theory and practice and illustrated in following sections.

5.1. Theoretical Contributions

This study has several contributions to theory and academic literature, especially in the domain of human resource management and information system. For instance, this study has established that big data driven HR practices influence e-recruitment efficiency and hence enrich human resource literature in big data analytics setting. Similarly, this study has unveiled core antecedents of e-recruitment namely information quality, system quality and digital maturity. Moreover, results have confirmed positive impact of information quality, system quality and digital maturity towards e-recruitment efficiency. Therefore, establishing association among information quality, system quality and digital maturity and predicting e-recruitment efficiency is valuable and substantially contributed to information system literature. Likewise, literature review was conducted in detail to conceptualize moderating effect of ethical technology between e-recruitment efficiency and human resource performance. Thereafter, the moderating effect of ethical technology is confirmed and disclosed that higher intensity of ethical technology will strengthen the relationship between e-recruitment efficiency and human resource performance and hence this finding adds a new dimension into human resource management and information system literature. The theoretical validity of the model was confirmed with variance explained. For instance, factors like big data driven human resource practices, information quality, service quality, big data culture and digital maturity have revealed substantial variance in e-recruitment efficiency and hence confirmed that factors outlined in research model have potential to measure e-recruitment efficiency and human resource performance of a firm. Thus, establishing theoretical validity of the research model has provided clear direction to academicians to understand factors which influence e-recruitment efficiency and human resource performance and hence contributes to human resource literature.

5.2. Practical Contributions

The current research has provided numerous useful directions for policy makers and HR managers to understand factors which enhance e-recruitment efficiency. Consistent with hypotheses results this study has unveiled that factors like big data driven human resource practices, information quality, service quality, big data culture and digital maturity are key factors which enhance e-recruitment efficiency. This outcome has suggested that managers could achieve efficiency in recruitment process by deploying big data driven human resource practices, big data driven information quality, data driven service quality and digital maturity recruitment process. Nevertheless, results are further compared with effect size analysis. Results indicate that big data human resource practices and digital maturity have large effect size. This finding suggests that if human resource managers have limited resources still, they can achieve maximum efficiency in recruitment process through data driven human resource practices and digital maturity among employees. Big data driven human resource practices are capable to foster e-recruitment process which is cost effective and more sustainable. Similarly, digital maturity will encourage employees to keep using big data driven by human resource practices which in turn bring efficiency in recruitment process and boost human resource performance. Additionally, broader perspective is viewed by evaluating importance performance index. The performance index has revealed that data driven human resource practices, digital maturity and big data service quality are core factors which enhance e-recruitment efficiency and boost human resource performance and hence these factors need managerial attention. Moreover, the moderating effect of ethical technology is established and revealed that higher intensity of ethical technology will strengthen the relationship between e-recruitment efficiency and human resource performance. As e-recruitment process seeks personal information of the candidates and therefore data sensitivity is critical issues. Nevertheless, ethical technology will boost individual confidence resulting in more accurate data during recruitment process. Therefore, policy makers could enhance recruitment efficiency and human resource performance by deploying ethical technology in human resource management practices.

6. CONCLUSION

The advent of big data driven technology in business practices can be seen as an opportunity to foster organizational performance. Nevertheless, organizations have remained unsuccessful to gain maximum benefits from these technologies especially in the domain of human resource management. Therefore, current study encapsulates how big data driven human resource practices enhance e-recruitment efficiency and human resource performance. Similarly, this study has theorized moderating effect of ethical technology between the relationship of e-recruitment efficiency and human resource performance. Statistical findings illustrate that big data driven human resource practices, information quality, service quality, big data culture and digital maturity explained substantial variance R^2 75.2% in e-recruitment efficiency. Likewise, ethical technology and e-recruitment efficiency have explained substantial variance R^2 30.2% in human resource performance. Moreover, effect size f^2 analysis has disclosed large effect size of big data driven human resource practices and digital maturity in determining e-recruitment efficiency. However, big data culture has shown insignificant impact in measuring e-recruitment efficiency. Concerning with post-hoc analysis results demonstrate that e-recruitment efficiency, big data human resource practices, digital maturity and big data service quality are central factors in achieving human resource performance. To practice this study has revealed that data driven human resource practices, digital maturity and big data service quality are core factors which enhance e-recruitment efficiency and hence these factors need managerial attention. Similarly, this study directs that policy makers could enhance recruitment efficiency and human resource performance by deploying ethical technology in human resource management system. In terms of uniqueness this

study is amongst few which has conceptualized big data analytics and human resource practices altogether to investigate e-recruitment efficiency and human resource performance.

6.1. Limitations and Future Research Directions

Despite numerous contributions this study has some limitations and therefore noted to impute future research directions. First, e-recruitment efficiency is measured with big data driven human resource practices, information quality, service quality, big data culture and digital maturity. However, this study does not claim to include all factors which impact e-recruitment efficiency. Therefore, future researchers are suggested to review literature and extend existing models with some other unique factors. Another limitation of this study is related to research design. This study has collected data at once i.e. consistent with cross-sectional methods. Nevertheless, conducting surveys in longitudinal setting could reveal useful findings. Concerning theory, although this study has underpinned two core factors of Delone and McLean model namely information and service quality however future researcher are encouraged to add more theories in research model like task technology fit model and technology organization and environment framework. Data of this study is collected from employees working in information technology and software sector. Nevertheless, future researchers are suggested to conduct research survey in other Saudi sectors including health, tourism and petroleum sectors. Thus, conducting research in other sectors will expand the scope of current research.

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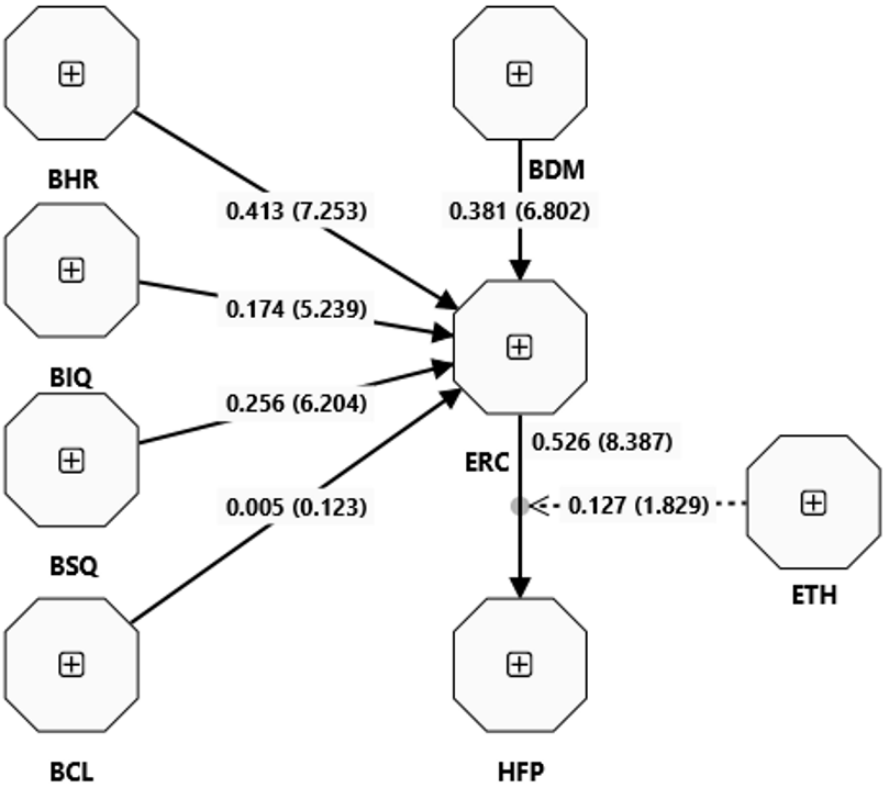

Appendix A. Path and coefficient and t-values.