

## The effects of smart human resources 4.0 on employee job effectiveness: The mediating role of employee job satisfaction

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### ABSTRACT

The aim of this study is twofold. First, to explore the effect of smart human resources (HR) 4.0 practices on employee effectiveness. Second, to investigate the mediating role of employee job satisfaction in the relationship between these two latent variables. Distributing a questionnaire to gather data from a sample of HR managers and employees in Ministry of Digital Economy and Entrepreneurship, the results point out that smart HR 4.0 practices as a whole construct represent a significant predictor of employee job effectiveness as measured by employee performance based on their personal, social, methodological, and technical skills. As well, the results revealed that smart HR 4.0 embodies a significant predictor of employee job satisfaction. The results found a significant effect of the latter on employee job effectiveness, a significant mediating role of employee job satisfaction was established. The study provides a theoretical basis for further studies on such effects as well as an empirical ground from which companies could start to boost employee satisfaction and effectiveness through smart HR 4.0 technologies.

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## 1. Introduction

Employee job effectiveness is a very critical variable for both employees and organizations. Effective employees show high levels of productivity and performance, which in turn play a significant part in lifting organizational performance. Therefore, organizations seek to enhance employee job effectiveness to ensure employee adequate outcomes. Scholars found that employee job effectiveness is affected by numerous factors including human resource management (HRM) practices. The introduction of industry 4.0 concept results in various changes in how organizations should work. One critical domain that is significantly affected by industry 4.0 implementation is the HRM system (Al-Rwaidan et al., 2023). That is, employees must work in line with new technologies such as big data analytics, artificial intelligence, and Internet of things (Lertpiromsuk et al., 2022), which means that organizations are requested to integrated Industry 4.0 concepts and technologies into their HRM practices (Verma et al., 2020), which are called here smart HR 4.0 practices (Vereycken et al., 2021).

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Research on the effect of smart HR 4.0 practices on employee outcomes is still insufficient. Such practices emerged with the institution of new technologies such as Big Data and Artificial Intelligence and fast data networks (Imperatori et al., 2019). It comprises the same traditional HRM practices but with new methods that used to collect, process, and interpret employee data. Smart HR 4.0 practices cover employee recruitment and selection, employee training and development, employee performance appraisal and compensation (Venkatesh, 2017; Nocker & Sena, 2019; Vrchota et al., 2020; Strohmeier, 2020; Al-Alwan et al., 2022b; Wu, 2021). According to Shah et al. (2017), Big Data as a construct of five pillars (i.e., volume, velocity, variety, veracity, and value) can be utilized in HRM functions, for example, data volume is related to employee data such as costs of employee recruitment, costs of employee compensation and development, as well as employee health and sickness rates. Data velocity can be used to process data such as employee performance and training opportunities, while data variety enables the organization to collect data from different sources such as social media. Moreover, data veracity enables the organization to report accurate data on employee attitudes and behaviors, and finally, organizations should assess the value and usefulness of employee data for HRM functions.

As employee outcomes are affected by various factors, employee job satisfaction was introduced in the current study as a mediator between smart HR 4.0 practices and employee job effectiveness. Such an assumption is justified based on results of previous works in which employee job satisfaction was emerged as an antecedent of employee job effectiveness (Bhatti & Qureshi, 2007; Mukhlis et al., 2022; Ramli, 2018; Ali & Farooqi, 2014; Riyanto et al., 2021; Mohammad et al., 2020; Al-Ali et al., 2019). Therefore, the aim of this study is to explore the effect of smart HR 4.0 practices on employee job effectiveness as perceived by HR department's managers and to investigate the mediating role of employee job satisfaction between smart HR 4.0 practices and employee job effectiveness. This role is ensured if smart HR 4.0 practices are significantly related to both employee job satisfaction and employee job effectiveness, as well, the latter two variables are also significantly linked.

## 2. Literature review

### 2.1 Smart HR 4.0 practices

Traditional human resource management practices include several practices such as employee recruitment and selection, employee training and development, employee performance appraisal, employee job planning. Organizations cannot depend only on these traditional practices in today's world that are inspired by new technologies (Verma et al., 2020) such as industry 4.0 technologies. Hence, organizations should readjust their policies of human resources (Vereycken et al., 2021), i.e., to adopt smart human resource 4.0 in order to gain numerous benefits such as performing human resource operations quickly and efficiently, attracting, developing and retaining new-age talents, and leaner human resource departments (Sivathanu & Pillai, 2018). In the industry 4.0 era, organizations are required to adopt new smart human resource practices to cope with industry 4.0 requirements. These practices, as conceptualized by using industry 4.0 related technologies such as Big Data Analytics, Internet of Things, and Artificial Intelligence in line with fast data networks such as 5G to effectively manage human resources, include digital practices such as smart job application, online or virtual training, continuous performance feedback, and skill data-based compensation (Imperatori et al., 2019; Mohammad et al., 2022; Mohammad, 2019; Verma et al., 2020). Research on smart HR 4.0 practices indicates that these new technologies play significant roles in achieving the intended goals of human resource management. For example, prior works in this regard emphasized the significance of Big Data Analytics, Internet of Things, and Artificial Intelligence in carrying out HR practices including employee recruitment and selection, employee training and development, employee performance appraisal, employee compensation and motivation, and employee engagement (Yawalkar, 2019; Venkatesh, 2017; Wu, 2021; Strohmeier, 2020; Nocker & Sena, 2019; Vrchota et al., 2020). Hence, the current study focuses on three major smart HR 4.0 practices related to employee recruitment and selection, employee training and development, and employee performance appraisal and compensation as a whole construct named smart HR 4.0 practices.

### 2.2 Employee job satisfaction

Satisfied employees are those who find no differences between their perceptions on job-related variables and work reality conditions. Therefore, employee job satisfaction refers to employee perceptions of job-related factors such as work environment, leadership styles, social factors (Ispik et al., 2021), workload (Inegbedion et al., 2020), internal marketing practices, organizational health (AlHamad et al., 2022), HRM practices like HR planning (Al-Hawary & Shdefat, 2016). Alegre et al. (2016) added that employee job satisfaction can be explained through the combined effects of employee-organization relationship, employee-supervisor relationship, and employee-coworker relationship. Conducting a systematic review of the literature, Lee et al. (2020) identified various facilitators of job satisfaction such as adequate job resources, career development, organizational systems, employee training, employee motivation, and positive organizational values. Khan et al. (2019) indicated that employee satisfaction mediates the effect of HRM practices (recruitment and selection, performance appraisal and compensation) on employee job performance.

### 2.3 Employee job effectiveness

Definitions of employee job effectiveness assume existence of desired characteristics or inputs that lead to higher levels of employee performance or productivity, which in turn positively affects organizational performance. The construct was defined

as employee contribution to work role through appropriate inputs related to employee performance, employee turnover intention, and employee absenteeism (Lertpiromsuk et al., 2022). For Mackay et al. (2017), employee job effectiveness refers to employee performance enhancement to show higher productivity. Numerous conceptualizations of employee job effectiveness are found in the literature. It was assessed using employee performance, employee turnover intention, and employee absenteeism (Lertpiromsuk et al., 2022), organizational commitment, employee attendance, and employee job performance (Jiang et al., 2011). Deeming employee job effectiveness as a construct of employee performance and productivity, Jain (2015) assessed employee job effectiveness through factors affecting employee ability to perform job tasks such as physical and cognitive factors like lack of new technologies and physiological factors. In the current study, employee job effectiveness is operationalized using industry 4.0 skills. According to Lertpiromsuk et al. (2022), such skills are divided into four categories, which are personal skills, social skills, methodological skills, and technical skills. The authors indicate that personal skills are related to employee ability to work under pressure, leadership, flexibility, emotional intelligence, and continuous learning, while social skills comprise language and communication, ability to transfer knowledge, and teamwork. Moreover, the authors added that methodological skills embrace abilities such as problem-solving, entrepreneurial thinking, decision making, and researching skills, and finally, technical skills are related to employee knowledge of advanced technologies, information technology security, process understanding, and information and communication technology. These skills are categorized into major categories, which are personal, social, and professional skills (Vrchota et al., 2020). Measuring employee job effectiveness through employee skills can be justified referring to citations of some scholars (e.g., Karim et al., 2012; Sivathanu & Pillai, 2018; Verma et al., 2020; Vereycken et al., 2021) who stated that employee skills are one criterion of those (i.e., knowledge, skills, and attitude) required to ensure employee effective performance of business operations and tasks.

### 3. Hypotheses development and research conceptual model

#### 3.1 Smart HR 4.0 practices and employee job effectiveness

New smart HR practices that emerged based on industry 4.0 technologies, which the authors termed here “smart HR 4.0” practices should promote employee necessary skills (Vrchota et al., 2020; Lertpiromsuk et al., 2022) or in other words should boost employee job effectiveness. Big Data analytics, for example, help organizations in employee recruitment and selection through identifying employee potential pools, assisting organizations to design customized training plans and programs to meet specific needs of old and new employees, evaluating the return of training investment at the individual level based on each employee performance, collecting and analyzing employee data to offer adequate compensations, as well as aiding organizations to understand the drivers behind employee turnover and therefore develop sufficient policies to enhance employee retention (Nocker & Sena, 2019). On the other hand, Internet of Things, as a capability of connecting physical things to the Internet and to work in a smart manner (Strohmeier, 2020), helps organizations to collect and analyze employee data in order to develop fitting policies that heighten employee productivity, as well as supports organizations to make good decisions (Venkatesh, 2017). In the same context, Internet of Things benefits for human resource management covers employee recruitment and selection, employee training and development, as well as employee performance management. That is, Internet of Things supports HR departments to determine employee characteristics and build basis for future recruitment and selecting employees based on their personalities and job necessities, assists HR departments to identify employees learning efficiency and comparing work productivity prior and post employee training, and to enable HR departments to assess employee contributions and to catch causes of employee high performance, therefore, reward and motivate other employees to show higher levels of performance (Wu, 2021). Other studies (e.g., Yawalkar, 2019) highlight the importance of artificial intelligence for HR practices such as minimizing bias in HR decisions. Based on these studies, the aim of this study is to investigate the effect of smart HR 4.0 practices on employee job effectiveness as introduced in the following hypothesis:

**H<sub>1</sub>:** *Smart HR 4.0 practices have a significant effect on employee job effectiveness.*

#### 3.2 Smart HR 4.0 practices and employee job satisfaction

The effect of HRM practices on employee job satisfaction is well documented in the literature. Alsafadi and Altahat (2021) found significant effects of HRM practices on employee job satisfaction as measured by job stability and job enrichment. The results of Onyema (2014) indicate that HRM practices (recruitment & selection, training & development, performance appraisal & compensation) are significant predictors of employee job satisfaction. Moreover, Miah and Hafid (2019) point out significant effects of HRM practices (training & development, performance appraisal, compensation & benefits package, employee promotion, work environment) on employee job satisfaction. However, Mira et al. (2019) found that HRM practices had no significant effect on employee job satisfaction. In terms of the effect of smart HR 4.0 practices on employee job satisfaction, it was observed that few studies were carried out to investigate such an effect. Shah et al. (2017) indicate that a key cause behind the importance of Big Data is its focus on data volume and other features such as data type (variety), speed of data generation (velocity), data consistency (variability) and data quality (veracity). The authors emphasize that organizations can access and process a large volume of data to generate new insights for strategic and operational purposes, as well, organizations are able to explore employee attitudinal and behavioral factors in order to support organizational change, and these factors are very important to enhance employee job satisfaction. One exploratory study (Verma et al., 2020) concluded that smart HR 4.0 had long-run effects on employee job satisfaction as well as organizational productivity. Therefore, the study aims at testing the following hypothesis:

**H<sub>2</sub>:** *Smart HR 4.0 practices have a significant effect on employee job satisfaction.*

3.3 Employee job satisfaction and employee job effectiveness

Outcomes of job satisfaction as reported in the literature include its effect on employee productivity (Bhatti & Qureshi, 2007), employee performance (Ramli, 2018), and employee engagement (Ali & Farooqi, 2014), which means that employee productivity and performance can be enhanced based on employee job satisfaction (Sabuhari et al.,2020). Explaining the casual relationship between job satisfaction and job effectiveness could refer to the drivers of job satisfaction that supports employee competencies. Based on prior works on employee job satisfaction, it was noted that employees who are satisfied with various factors such as supervisor cooperation, communication style, working conditions, pay (Sabuhari et al.,2020), work duties (Ocen et al.,2017) and HRM practices (Latif, 2012; Mira et al., 2019) have high levels of employee commitment (Ocen et al.,2017), employee extra roles (Riyanto et al.,2021), employee engagement (Djoemadi et al.,2019) and have high levels of performance (Al-Ali et al.,2019). Hence, it was expected that employee job satisfaction is positively related to employee job effectiveness. As the latter is assessed based on employee personal, social, methodological, and technical skills, it was assumed that satisfied employees are stimulated to capture new skills, which contribute to their performance. In order to test such an argument, the following hypothesis was postulated:

**H3:** Employee job satisfaction has a significant effect on employee job effectiveness.

4. Research Methodology

4.1 Research sample

The study population comprises all HR managers and employees working at the Ministry of Digital Economy and Entrepreneurship. A sample consisted of 200 participants. A questionnaire was designed to collect data on research latent variables. It was developed based on previous works. A total of 200 questionnaires were administered to sample members and 178 questionnaires were received complete and adequate for data analysis with a response rate of 89%.

4.2 Research measurements

Smart HR 4.0 practices are measured using 6 items related to three key HR practices, which are employee recruitment and selection, employee training and development, as well as employee performance appraisal. These items are developed based on prior works on both industry 4.0 technologies and HR practices (Verma et al.,2020; Imperatori et al., 2019; Vrchota et al.,2020; Lertpiromsuk et al., 2022; Strohmeier, 2020; Venkatesh, 2017; Wu, 2021). Employee satisfaction was measured using 5 items adapted from a study highlighted the importance of employee development for job satisfaction (Latif, 2012). Employee job effectiveness was measured based on employee skills 4.0, which are personal skills, social skills, methodological skills, and technical skills and their role in improving employee performance. Each category was assessed using three items; i.e., 8 items were used to measure employee job effectiveness. These items are adopted from Lertpiromsuk et al. (2022).

4.3 Study conceptual model

Based on the previous-developed hypotheses, a conceptual model was constructed as portrayed in Fig .1. The model was built to show the effect of SHR 4.0 on employee job effectiveness (EJE) as assumed in H1, and the effect of SHR 4.0 on employee job satisfaction (EJS) as postulated in H2, and the effect of EJS on EJE as introduced in H3. Testing these three hypotheses encompasses the mediating role of EJS in the effect of SHR 4.0 on EJE.

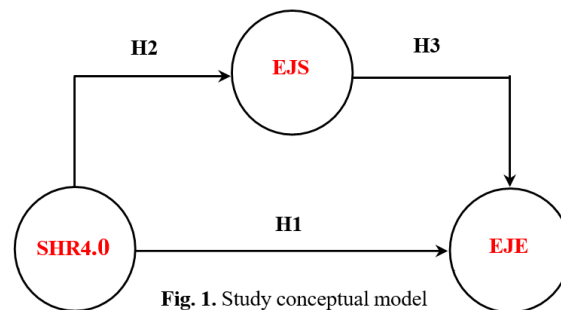


Fig. 1. Study conceptual model

5. Validity and reliability

Validity was tested using convergent and discriminant validity. Factors loadings, which should be greater than 0.50 (Ispik et al.,2021), and the average variance extracted (AVE) are used to assess convergent validity while discriminant validity was evaluated through Heterotrait-Monotrait-Ratio (HMR). Values of HMR should be less than 0.85 (Vadivel et al.,2022). Reliability was measured using Cronbach’s alpha coefficient ( $\alpha$ ) and composite reliability (CR) which should be higher than 0.70 (Al-Ali et al.,2019; Lina & Al-Hawary, 2022; Mohammad, 2020). The results of validity and reliability criteria are met as all

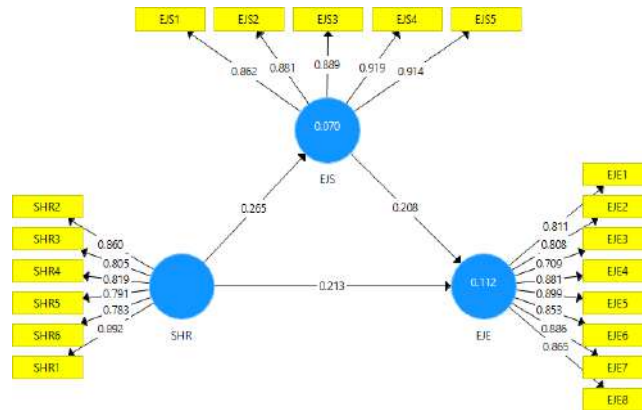
factor loadings are higher than 0.5, VAE values are greater than 0.50 (Mandal et al.,2016), and HMR values are less than 0.85, alpha and CR values are higher than 0.70as shown in Table 1.

**Table 1**  
Results of validity and reliability

Variable	Items	Factor loading	AVE	HMR			$\alpha$	CR
Employee Job Effectiveness (EJE)	EJE1	0.811	0.707	EJE	EJS	SHR	0.941	0.951
	EJE2	0.808						
	EJE3	0.709						
	EJE4	0.881						
	EJE5	0.899						
	EJE6	0.853						
	EJE7	0.886						
	EJE8	0.865						
Employee Job Satisfaction (EJS)	EJS1	0.862	0.798	0.261			0.937	0.952
	EJS2	0.881						
	EJS3	0.889						
	EJS4	0.919						
	EJS5	0.914						
Smart HR4.0 (SHR)	SHR1	0.892	0.682	0.273	0.279		0.907	0.928
	SHR2	0.860						
	SHR3	0.805						
	SHR4	0.819						
	SHR5	0.791						
	SHR6	0.783						
	SHR7	0.892						

**6. Structural model test**

The predictive relevance of the model was assessed using Stone-Geisser’s Q<sup>2</sup> value, which should be higher than zero (Hair et al., 2016). The results showed acceptable values for SHR (0.550), EJS (0.687), and EJE (0.620). In terms of collinearity as evaluated by the variance inflation factor (VIF) with a threshold of less than 5 (Akinwande et al., 2015). The results pointed out that all VIF values were less than 5. Moreover, it was found that the model fits the current data well as the value of the Standardized Root Mean Square Residual (SRMR) was less than 0.08 (Shi et al.,2018) (SRMR = 0.069), and the value of the normed fit index (NFI) is close to 0.90 (Mak & Sockel, 2001) (NFI = 0.813). The results of the structural model test as shown in Fig. 2 indicate that SHR is positively related to both EJS and EJE. Detailed results of hypothesis testing are displayed in Table 2. The results showed that SHR has a total effect on EJE ( $\beta = 0.268, P = 0.000$ ), which is divided into a direct effect ( $\beta = 0.213, P = 0.010$ ) and an indirect effect ( $\beta = 0.055, P = 0.044$ ). Furthermore, the results revealed that SHR has a total effect on EJS ( $\beta = 0.265, P = 0.003$ ), and the latter has a total effect on EJE ( $\beta = 0.208, P = 0.014$ ). These results confirm that study hypotheses are supported.



**Fig. 2.** Study structural model

On the basis of hypothesis testing, it was noted that EJS has a significant mediating role between SHR and EJE as outlined by the indirect effect of this construct in the effect of SHR on EJE ( $\beta = 0.055, P = 0.044$ ).

**Table 2**  
hypotheses testing results

Constructs and paths				Total effects		Direct effects		Indirect effects	
H1	SHR	→	EJE	0.268	0.000	0.213	0.010	0.055	0.044
H2	SHR	→	EJS	0.265	0.003	0.265	0.003	-	-
H3	EJS	→	EJE	0.208	0.014	0.208	0.014	-	-

## 7. Research discussion, implications and conclusion

### 7.1 Discussion

The first hypothesis assumes that smart HR 4.0 practices have a significant effect on employee job effectiveness. Such an assumption was supported by the current data, which interprets that smart HR 4.0 practices are significant predictors of employee job effectiveness. The results could be due to accompanied features of smart HR 4.0 practices that are inherited from the new technologies such as Big Data Analytics. Through utilization of such practices, organizations are able to collect a large volume of data from varied sources, generate new insights on their employee attitudinal and behavioral factors ensuring data quality and value for organizational purposes (Shah *et al.*, 2017) such as building strategies, and hence policies as well as programs. The second hypothesis, which postulates that smart HR 4.0 practices have a significant effect on employee job satisfaction, was also supported. Generally, employees are satisfied if there are no differences between their perceived and actual job conditions. In HRM context, employees are satisfied if they receive adequate training, fair compensation, and accurately evaluated in terms of productivity and performance (Khan *et al.*, 2019; Lee *et al.*, 2020; AlHamad *et al.*, 2022). Then, smart HR 4.0 practices, which provide opportunities for smart job applications, employee virtual training, continuous performance feedback, as well as skill data-based compensation (Imperatori *et al.*, 2019; Verma *et al.*, 2020) should improve employee satisfaction. Furthermore, the results accepted the hypothesis that employee job satisfaction has a significant effect on employee job effectiveness. It was stated that employee job satisfaction is a key antecedent of employee effectiveness in terms of employee engagement, commitment, extra roles, productivity and performance (Ali & Farooqi, 2014; Ocen *et al.*, 2017; Ramli, 2018; Al-Ali *et al.*, 2019; Sabuhari *et al.*, 2020; Djoemadi *et al.*, 2019; Riyanto *et al.*, 2021). On the basis of these results, it was noted that employee job satisfaction is a significant mediator between smart HR 4.0 practices and employee job effectiveness.

### 7.2 Research implications and conclusion

Various implications arise based on the current results. Theoretically, the study underlines an emerging topic on smart HR 4.0 and its impact on employee job satisfaction and employee job effectiveness. It contributes to the literature, particularly, in the absence of similar studies on such effects, and emphasizes the importance of integrating industry 4.0 technologies for HR functions. Empirically, the study instructs organizations that in current times, technologies have a crucial potential to effectively and efficiently carry out HRM functions, which boost employee and organizational outcomes. The study concluded that increasing employee job effectiveness in line with latest technology advancements depends on using the potential effects of smart HR 4.0 practices keeping an eye on employee satisfaction. These practices enhance employee perceptions of job conditions and enrich employee personal skills, social skills, methodological skills, and technical skills.

## 8. Limitations and suggestions for future research

Limitations of this study are two. First, deeming smart HR 4.0 practices as a whole construct measured using nine items, therefore, researchers are recommended to separate such a construct into several factors to explore the effect of each one on the dependent variable. Second, despite that the required data are collected from HR managers and employees and the sample size is adequate, data are collected from industrial companies. Hence, future studies are encouraged to gather data from various companies from several sectors. Basically, researchers are requested to examine the effects of smart HR 4.0 practices on employee outcomes like employee satisfaction and employee effectiveness to generalize the current results, as well as to test the effects of such practices on other employee outcomes such as employee commitment.

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