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Article

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Impact of human factor management on company productivity: the moderating effect of digitalization

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ABSTRACT

The purpose of this research was to study the impact of human factor management on company productivity, with digitalization as a moderating variable, with emphasis on medium and large companies in the services sector, in Lima, Peru. This research has a quantitative approach and cross-sectional design. The technique used was structural equation modeling with the maximum likelihood estimation method. The study was carried out with a sample of 330 people from the banking sector in the city of Lima, in Peru. For statistical analysis, Confirmatory Factorial Analysis, and hypothesis testings, the SPSS AMOS tool was used. A conceptual model based on Dynamic Capability View theory was developed that allows us to better understand the phenomenon of the impact of human factor management on the productivity of companies, under the moderating effect of digitalization. As the main conclusions of this research, it was found that there is a positive relationship between the human factor management and the company productivity; likewise, it was found that digitalization has a moderating effect in the relationship between human factor management and productivity, with the exception of the human factor performance appraisal. These findings contribute to the existing literature and debate, as well as, allow to determine which dimensions of human factor management can be enhanced under the impact of a digital environment, thus contributing better to business performance.

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Introduction

Human factor is the set of knowledge, competence, attitude and behavior embedded in an individual (Rastogi, 2002), and is a key element in improving productivity and maintaining the competitive advantage of a company (Schulz, 1993). Companies must apply appropriate management practices to people, in order to take advantage of their possibilities and achieve an advantage through the human factor, in order to achieve better performance to respond to turbulent environments (Turulja & Bajgoric, 2018).

In today's highly variable and competitive environment, advanced digital tools enable companies to reduce costs, increase productivity, improve product development, achieve faster time to market, add value to products through dedicated services, and improve customer focus, in various elements of the value chain (Buer et al., 2021; Del Guidice et al., 2021). Industry 4.0 (I 4.0) refers to the fourth industrial revolution generated by the adoption of digital technologies in business and society (Urbach & Röglinger, 2019). Industry 4.0 emerges simultaneously with the fusion of technologies in a digital ecosystem, and the terms digitalization and Industry 4.0 are often used concomitantly (Hirsch-Kreinsen, 2016). The current phenomenon of accelerated digitalization of the I4.0 economy generates greater productivity, connectivity and various transformations in workforce skills (Androniceanu et al., 2020). The concept of Industry 4.0 is an opportunity for the development and improvement of competitiveness, but there are also complications for the management of the human factor such as the reduction of creativity, which can occur due to the automation of machines and the disappearance of the human factor in production

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technology (Horváth & Szerb, 2018). Therefore, managing the human factor in the era of digitalization represents one of the most important challenges, since it requires highly qualified personnel at all levels (Herceg et al., 2020; Khanzode et al., 2021).

In the last 30 years, multiple research studies have been carried out between the relationship: people management and company performance, proving that there is a positive relationship between them, and this link continues to be the subject of study (Dukić Mijatović et al., 2020). In the current context, the role of digitalization in company performance has increasingly increased, since digitalization is a profound phenomenon, with strong implications in all areas (Matt et al., 2015). While there are a growing number of research contributions on the performance consequences of HRM, the main findings fail to offer consistent and compelling evidence on HRM performance in a digital environment (Theres & Strohmeier, 2023).

The context of the COVID-19 pandemic, has significantly accelerated the pace of digitalization of HR processes (Zavyalova et al., 2022). Organizations invest in human resource management systems to improve employee productivity by increasing the use of technology (Lempinen & Rajala, 2014). Because digital transformation is replacing existing skill sets at an increasing rate, human factor specialists are required to accept and embrace the transformation, as well as develop their capacity to adapt to this new landscape (Scholz, 2017), this is why the biggest challenge of I4.0 seems not to be technology, but people (Ejsmont, 2021). Therefore, appropriate introduction of digital tools into personnel management systems can be the key to successful business operations in a modern information environment. This is a new world for HR technologies and project teams, which will open new opportunities to transform the impact of the human factor on business (Savastano et al., 2019). There is a paucity of research on workplace digitalization and its implications for implementation in organizations, particularly in relation to its impact on employee outcomes (Nguyen et al., 2024). There is a need to proactively identify and address challenges hindering the adoption of digital HRM practices to accelerate the process of digitalization of HRM (Chapano et al., 2023).

Literature review and hypotheses development

Human factor management was defined by Boselie (2010) as the relationship that exists between employees and the organization. Is the process of managing employees who use other resources to achieve organizational objectives (Schuler & MacMillan, 1984). It has been determined through empirical work that there are four dominant functions of human factor management: (a) recruitment and selection, (b) performance appraisal, (c) training, and (d) compensations (Evans, 2003; Fombrun et al., 1984; Scarbrough, 2003), and these are the dimensions that were adopted in this research.

Recruitment and selection is the organizationally articulated proposal, with theoretical and practical concepts, to search for employees, encourage them to apply and select them, with the objective of harmonizing the values, interests, expectations and competencies of people with the characteristics and demands of the position and the organization (Armstrong, 2009), according to Boselie et al. (2005) during this process, the right person who is selected for the required knowledge and qualifications will be assigned to the appropriate task position to reduce costs and maximize benefits. Performance appraisal can be defined as the continuous process of observing and evaluating employee performance against a predetermined work-related standard (Boselie et al., 2005), is a basic element of human factor management used as a mechanism to improve employee performance, provide feedback to employees, and providing the basis for many decisions (Cummings & Worley, 2000). Training is defined as the delivery of useful skills, ideas and knowledge through teaching, to be able to perform practical work in a qualified manner, training is the continuous effort and attempt designed to improve the skill and performance of the employee (Mahony et al., 2001). Compensations are the organizationally articulated proposal, with theoretical and practical concepts, to reward the performance and competence of employees through remuneration and incentives (Bohlander & Snell, 2009). Kahn (1990) stated that as employees perceive that their organization provides an adequate compensation package for their work, their level of commitment will be higher.

Productivity as a general concept is defined as the extent to which a company efficiently performs its basic functions (Wall et al., 2004). For measurement purposes, perceived labor productivity will be used in this research, which is the productivity of an organization affected by certain characteristics and behaviors of the worker, in which psychological and psychosocial processes are immersed (Saari & Judge,

2004). In this research, the focus was on perceived labor productivity for two reasons: (a) because changes in productivity related to digitalization are difficult to capture using economic measures, since such measures can cover a wide range of organizational activities and uses of IT (Brynjolfsson, 1993; Brynjolfsson & Hitt, 2003), and (b) productivity is a multidimensional construct that is difficult to evaluate using a quantitative statistic, such as task performance (De Lone & Mc Lean, 2003). Digitalization is defined as the socio-technical process of leveraging digitalized products or systems to develop new organizational procedures, business models, or commercial offerings (Saarikko et al., 2020). While digital transformation introduces many positive perspectives, uncritically insisting on the change can cause negative effects and jeopardize the achievement of optimal results (Barišić et al., 2021).

Hypothesis and conceptual model

Recruitment and selection and productivity

Personnel selectivity is an important human resource practice that directly and indirectly affects organizational outcomes such as productivity and sales (Katou & Budhwar, 2007). Appropriate selection or staffing is one of the most important practices for business performance, the appropriate selection of employees helps organizations grow, generate better productivity, quality and greater profitability (Chadwick & Li, 2018). Furthermore, the use of selection techniques associated with high predictive validity can facilitate the detection of highly productive employees and the optimization of person-job-organization fit (Hunter & Hunter, 1984). Based on the aforementioned, the following hypothesis is proposed:

Hypothesis 1a (H1a): There is a positive relationship between the human factor recruitment and selection and productivity.

Performance appraisal and productivity

When clear and reasonable performance appraisal metrics, standards, and practices are used to develop objectives and provide relevant feedback, it can be helpful to both the individual being appraised and the organization, however, poorly executed performance appraisals can be detrimental to the employee. organizational performance, successful performance appraisals depend on employees and managers working together (Larson, 1989). Saks (2006) argued that if employees feel that their organization offers benefits based on their performance, which is measured fairly, they will be obligated to the organization and will lead to a higher level of commitment on their part, in addition, the use Performance-related pay has been proposed as a productivity-enhancing mechanism that directs employee behavior in the desired direction. Based on the aforementioned, the following hypothesis is proposed:

Hypothesis 1b (H1b): There is a positive relationship between the human factor performance appraisal and productivity.

Training and productivity

Studies show a positive impact of human factor training on productivity (Bartel, 1994; Black & Lynch, 1996). Bartel (1994) found that investment in training increases productivity. Training has been examined as a driver of productivity, both in human factors and economic theory (Acemoglu & Pischke, 1998). Training seen as a learning process can have a positive economic value because it develops employees' knowledge and skills, thus improving their productivity (Riley et al., 2017). Providing adequate training to employees can help improve their skills, which will subsequently increase their productivity (Wang et al., 2010). Based on the aforementioned, the following hypothesis is proposed:

Hypothesis 1c (H1c): There is a positive relationship between human factor training and productivity.

Compensations and productivity

Offering high wages and benefits such as employee compensation can improve productivity by facilitating both the attraction and retention of a superior workforce (Shaw et al., 1998). Cozzarin and Jeffrey (2014) found that the largest contributor to work productivity is the employee's salary. Profit sharing is especially encouraged as an instrument to harmonize the interests of employees, management and

shareholders, and induces greater productivity through the effects on corporate culture, entrepreneurship, group cooperation and mechanisms of social application (Shepard & Edward, 1994). Kazaz and Ulubeyli (2007) argued that factors that increase employee motivation and productivity include incentive pay, equal pay for workers performing similar tasks, and adequacy of pay. Based on the aforementioned, the following hypothesis is proposed:

Hypothesis 1d (H1d): There is a positive relationship between human factor compensations and productivity.

Moderating effect of digitalization

Digitalization has an impact on key aspects for the development of the human factor such as: information, new jobs, internet, technology, training, new skills, automation, communication, innovation, professionals, productivity, artificial intelligence, digitalization, e-contracting, and the internet of things (Sima et al., 2020). Digitalization can be the engine for improving processes and products, creating value for customers; furthermore, the use of digital technology can improve staff productivity, with positive effects on the company's financial performance (Zhou et al., 2021). However, technology transformation can be problematic as well, and may bring obstacles to routine business due to the adaptability of employees; when the company's capabilities and resources cannot match the level of digitalization, the company will be trapped in the digital paradox, which can even generate negative returns (Kohtamäki et al., 2020). The link between digitalization in general and productivity is clear, however, how digitalization affects productivity is not well understood (Atrostic & Nguyen, 2005). People management practices are strongly correlated with productivity, and digitalization allows for improvements in performance that can be linked to productivity gains, but this depends on the presence of certain skills and knowledge that require training to take advantage of digital technologies (Horváth & Szerb, 2018). Digitalization strongly affects human factor practices and procedures, specifically by using human factor information systems, the role of human resources in contributing to the digitization strategy is not sufficiently emphasized (Barišić et al., 2021).

Moderation recruitment and selection – productivity

The adoption of new technologies and the digitalization of organizational processes have forced the rapid evolution of human factor management practices, requiring the development and adoption of new competencies, new forms of employment and agile recruitment and selection processes (Kagermann, 2015). The use of digital tools in human factor management helps establish a strategy for talent acquisition and redefine recruitment processes by creating a profitable and effective operating model (Horváth & Szabó, 2019; Sima et al., 2020). The increasing use and growth of teleworking has allowed the emergence of alternative employment strategies, as well as the application of a virtual environment in the process of planning, searching, evaluating, selecting and hiring talent (Cortellazzo et al., 2019). Research has shown that IT tools in human factor management not only help recruit top talent, but also retain them, lead to low recruitment and onboarding costs, and maintain high productivity (Colbert et al., 2016).

Based on the aforementioned, the following hypothesis is proposed

Hypothesis 2a (H2a): Digitalization has a moderating effect on the relationship between the human factor recruitment and selection and productivity.

Moderation performance appraisal – productivity

Due to the effects of digital transformation, human factor management can introduce a results-based performance management system, where employee performance is measured exclusively based on their performance and not on the time spent working (Ulrich et al., 2013; Horváth & Szabó, 2019). In this sense, and to allow and accommodate rapid technological change and development, organizations are expected to develop procedures and establish practices for a continuous re-evaluation of employee competencies, as well as to introduce new forms of work organization (Sakellaridis et al., 2011). Digital

transformation allows organizations to introduce performance monitoring technology to track employees' work performance and the results achieved (Li, 2018). The use of digital technology tools allows organizations to better assess workforce requirements, monitor employee performance and productivity, optimize revenue, and reduce operating costs (Ritter & Pedersen, 2020).

Based on the aforementioned, the following hypothesis is proposed

Hypothesis 2b (H2b): Digitalization has a moderating effect on the relationship between human factor performance appraisal and company productivity.

Moderation training – productivity

The emergence and rapid development of digital technologies, enable organizations to develop new employee skills and competencies, resulting in efficient product optimization and overall improvement in organizational performance and competitiveness (Branca et al., 2020; Li, 2018). In carrying out its strategic role, learning and development are an integral part of the contemporary practice of human factor management, referring especially to improving the knowledge and skills of its employees with transferable and specialized skills, thus providing them with competitive advantage and making them more resistant to change (Ancarani & Di Mauro, 2018; Ulrich et al., 2013).

Based on the aforementioned, the following hypothesis is proposed

Hypothesis 2c (H2c): Digitalization has a moderating effect on the relationship between human factor training and company productivity.

Moderation compensations – productivity

Compensation is an important function of human factor management that refers to the remuneration system in relation to the work performed, compensation systems must remain in line with the changes, and compensation is now based on performance (Llinas & Abad, 2020). The demands proposed by I4.0, that is, greater integration between culture and values, stimulated by globalized work practices, encourage employers to change compensation systems for systems based on performance, skill, knowledge, competition and productivity (Shamim et al., 2017). Furthermore, human factor management must create monetary and non-monetary incentives for workers who proactively acquire the necessary skills and competencies, thereby decreasing training costs and increasing labor productivity (Nair, 2019).

Based on the aforementioned, the following hypothesis is proposed:

Hypothesis 2d (H2d): Digitalization has a moderating effect on the relationship between human factor compensations and productivity.

In Figure 1 can see the proposed Conceptual Model that graphically collects the relationship between the variables with their Hypotheses, based on the support found in the literature review.

Theoretical framework

Due to changes in the business environment resulting from various types of development trends, such as information technology and business globalization, Teece et al. (1997) pointed out that only those companies that have the ability to effectively coordinate and redistribute competencies, as well as internal and external resources to respond timely to changes in the business environment, could be the winners in the global market. They started from the perspective based on Resources Based View resources under a dynamic context, and proposed the Dynamic Capability View (DCV) theory, according to which the success of the company depends on its ability to renew competencies to achieve congruence with the changing business environment (Teece et al., 1997). Dynamic capabilities are defined as the firm's abilities to integrate, build and reconfigure competencies, as well as internal and external resources, to

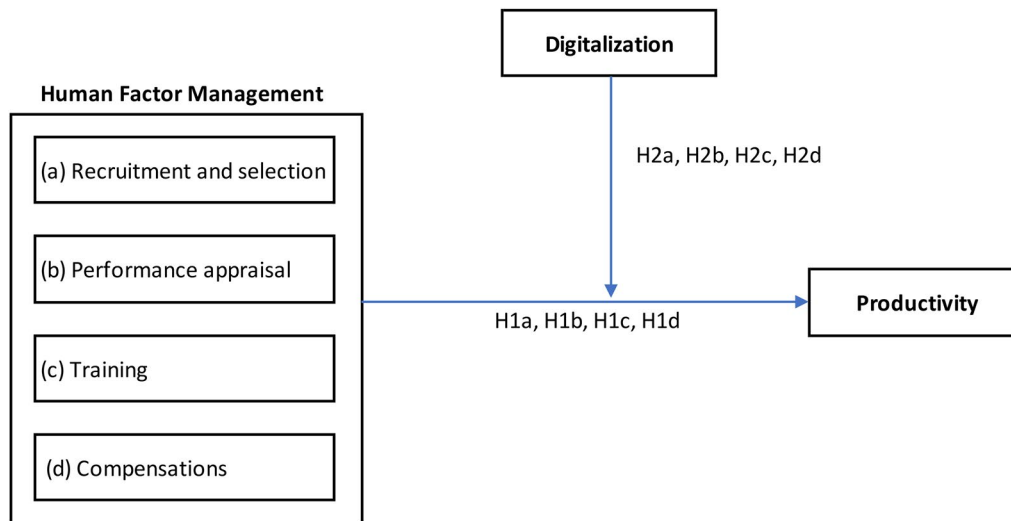


Figure 1. Conceptual model.

cope with a rapidly changing environment (Wang et al., 2007). In this study, DCV was used since it aims to study the company's ability to manage its human and technological resources, and thus achieve productivity in a changing and competitive environment such as that generated by digitalization.

Furthermore, investments in human capital can increase employee productivity and financial results (Black & Lynch, 1996; Pfeffer, 1998; Snell & Dean, 1992). Furthermore, investment in people and information technology results in better individual performance, increased organizational productivity, economic development, as well as other social benefits (Lynham & Cunningham, 2006; Nafukho et al., 2004). As the level of human capital increases, people develop more productive means of accomplishing tasks, increasing a firm's productivity (Black & Lynch, 1996). From this perspective, Becker's Human Capital Theory (1964) was also used, which postulates that human capital investments in the training and education of employees can have a positive economic value, because they develop and nourish knowledge and skills. of these employees, thus improving their productivity. According to this theory, it has been shown that investments in human capital positively influence measures related to productivity (Bartel, 1994; Ichniowski et al., 1997; Lepak & Snell, 1999; Sepúlveda, 2010).

Methodology

Given that the phenomenon to be investigated consists of the study of the moderating effect of digitalization in the relationship between the variables management of the human factor and productivity, this research will be carried out with a quantitative approach since results are sought as a result of measurement and deduction, with a certain precision (Zikmund et al., 2010). The design will be Non-Experimental of the Transversal type, since the aim is to observe the phenomenon at a certain time (Slevitch, 2011). The proposed model include reflective constructs since causality is directed from the construct to the measurement indicators (Henseler et al., 2016).

Population and sample

Population object of the investigation is determined by the employees of the 813 agencies that make up the 17 banks that operate in Metropolitan Lima. The universe of Peruvian companies is limited to the services sector because it is the most susceptible to the replacement of employees due to automation, this being among one of those most affected due to digitalization (Frey & Osborne, 2017). Medium and large companies are chosen because they usually have more advanced human factor management systems, and a level of digitalization that allows us to better appreciate the phenomenon of impact on productivity (Basl, 2017; Buer et al., 2021; Ghobakhloo & Fathi, 2019; Horváth & Szabó, 2019; Mittal et al., 2018). And finally, the banking sector is delimited by: (a) Being an economic

activity that intensely discusses strategies for digitalization due to strong competition (Breidbach et al., 2020; Ozuem et al., 2018); and (b) The use in banks of individual digitized human factor management practices and systems has increased considerably, as senior management has focused on the quality of human resources processes and productivity to improve competitiveness (Sabir et al., 2015).

The sample size was determined following what was indicated by Hair (2010), who recommended a proportion of respondent to indicator of 10:1 for multivariate analysis. This study has six variables with 32 indicators in total, therefore, the minimum sample size for this study should be 320 (10 x 32). After collecting information in field, 330 measurements were obtained. The sampling technique adopted was proportional stratified random probability sampling, in which each member of the sample size was randomly selected from each given sample stratum (Tagod et al., 2021). The 812 banking branches identified for the 17 banks in Metropolitan Lima were splitted by strata according to the number of branches that each bank has, as shown below. From this stratification, the random sample per stratum was calculated proportionally, according to the size calculated for the sample $N=320$. For the selected branches, the key informants were middle to senior management personnel officials with direct or indirect involvement in the company's strategic objectives. Customer front line personnel were not considered, because their perception of productivity and human resources policies could be biased (De Bruin et al., 2021).

Measures

Measurement instruments for the variables under study were extracted from existing instruments derived from a review of the literature in the areas of interest of human factor management, productivity, and digitalization. The data were obtained through an online survey with a questionnaire, to employees of the banking agencies selected through stratified random sampling. The questionnaire was adapted from instruments already validated in recognized research in journals Q1 and Q2 for the variables under study. It was prepared in Spanish by translating from articles in English, and then this translation was validated by a professional translator to guarantee similarity of meaning and semantic equivalence between these languages (Schaffer & Riordan, 2003). A five-point Likert scale (1 = "strongly disagree" and 5 = "strongly agree") was used in this study. All survey participants received previously an Informed consent protocol for surveys, which was approved by Comité de Ética de la Investigación para Ciencias Sociales, Humanas y Artes de la Pontificia Universidad Católica del Perú, with Opinion Number: 053-2023-CEI-CCSSHAA/PUCP.

To measure the human factor management through the four dimensions determined by the literature: (a) recruitment and selection, (b) performance evaluation, (c) training and development, and (d) compensation, it was used as a measurement instrument the questionnaire used by Tessema and Soeters (2006), who measured recruitment and selection practices with five indicators, employee performance appraisal practices with six indicators, training practices with six indicators, and compensation practices with six indicators. To measure perceived productivity, the Ko and Choi (2019) instrument was used using three items: (a) general productivity of employees, (b) efficiency of the work process, and (c) competitiveness of the process through costs reduction. Other studies have used perceived work productivity on the basis that it is a valid and reliable measure (Ahmad & Allen, 2015; Bryson et al., 2006; Goodhue & Thompson, 1995). For the digitalization variable, an instrument of eight indicators used by Sánchez et al. (2022) in order to include the Post COVID 19 effects in the measurement instrument, which contains items related to the importance of digitalization, Digital Transformation strategies, the opportunities promoted by digital technologies, the tools for business digitalization, innovation capabilities, corporate culture regarding digital concepts, the level of employee commitment to the function performed, and teleworking. Information was collected in the second half of 2023, and lasted three months.

Data analysis

The structural equation modeling (SEM) technique with covariance structure analysis (CB) was used to analyze the data. Following the instructions of Hair (2010), the research model was analyzed in two stages: (a) In the first, the measurement model was analyzed to establish its validity and reliability by performing a confirmatory factor analysis (CFA) using the AMOS software package with maximum

likelihood estimates; (b) In the second stage, the structural model was evaluated to test hypotheses that propose the relationships between the variables; (c) The moderation analysis of the digitalization variable was carried out using the PROCESS MACRO package.

Reliability of the measurement model was evaluated through: Cronbach's alpha coefficient (1951), the values obtained from Composite Reliability (CR), and the loading factors (Factor loading); For these parameters, values of 0.7 or more were considered as criteria to establish a reliable scale (Nunnally, 1978; Sekaran & Bougie, 2016; Ferrando et al., 2022). For convergent validity, the Average Variance Extracted (AVE) was used as a statistical technique, which must be greater than 0.50. The measurement model must meet three criteria to claim convergent validity: $AVE > 0.5$, $CR > 0.70$, and $CR > AVE$ according to Hair (2010). To determine discriminant validity, the Heterotrait-Monotrait (HTMT) relationship was used. The HTMT is mainly used to evaluate the distinctiveness of latent constructs in SEM models; to claim discriminant validity, all values must be below 0.85 (Henseler et al., 2016; Hair et al., 2017).

Results

Reliability analysis (Cronbach's alpha)

Table 1 shows the results of reliability analysis using Cronbach's Alpha for the different variables. Greater values of Cronbach's Alpha typically indicate enhanced reliability, the reliability value in each construct is above 0.70 (Nunnally, 1978). The study exhibits strong internal consistency, as evidenced by their respective Cronbach's Alpha values, indicating that the scales employed to evaluate these factors are reliable and uniform in appraising the desired concepts.

Confirmatory factor analysis (CFA)

Confirmatory factor analysis (CFA) is a crucial analytical framework that evaluates the reliability and validity of constructs in research outcomes. Multiple metrics, such as construct reliability (CR), Composite Reliability (CR), factor loadings, and various criteria analyses, are used to assess the effectiveness of the measurement model. Construct reliability (CR) measures the internal consistency and reliability of a construct in a research study. Composite Reliability (CR) evaluates the internal consistency of latent variables or constructs, considering factor loadings of indicators and their corresponding measurement errors. A coefficient of reliability (CR) exceeding 0.70 is considered satisfactory, signifying a high level of reliability. Average Variance Extracted (AVE) measures the extent to which a construct captures variance compared to the variance caused by measurement error. A commonly accepted criterion for adequacy is an AVE value exceeding 0.50, indicating that the construct accounts for a greater proportion of variance than measurement error. Factor loadings are numerical values that indicate the magnitude and direction of the association between observed variables and latent constructs. To ensure that indicators adequately assess desired constructs, factor loadings should be both significant and relatively high, often exceeding a threshold of 0.70. The Fornell-Larcker Criterion Analysis is a statistical technique used in academic research to assess the discriminant validity of constructs in a measurement model. It involves comparing the square root of Average Variance Extracted (AVE) for each construct with the correlations existing between said construct and other constructs. The discriminant validity of the construct can be ascertained by examining cross-loadings, the Heterotrait-Monotrait Ratio (HTMT) Analysis, and the Fornell-Larcker criterion. Hair (2010) state that a cut-off value of 0.5 was applied to all factor loading for reflective constructs. Thus, the items having loading values less than 0.5 were eliminated from analysis

Table 1. Cronbach's Alpha values.

Variables Name	Cronbach's Alpha	Number of items	N
Recruitment & selection	0.846	5	330
Performance Appraisal	0.897	6	330
Training	0.938	6	330
Compensations	0.937	5	330
Digitalization	0.912	8	330
Productivity	0.877	3	330

(Refer to Table 2). High loadings suggest that there is a higher degree of shared variation across the constructs, whereas low loadings highlight the model's incredibly restricted explanatory power and decrease the estimated parameters connecting the construct (Côte-Real et al., 2017).

Convergent validity was assessed using outer loadings, composite reliability (CR), and average variance extracted (AVE). The final AVE and CR are greater than the normal values of 0.5 and 0.7, respectively, as a result of the factor loadings below 0.5 being deleted (see Table 3).

The Heterotrait Monotrait Ratio (HTMT) Analysis and the Fornell-Larcker criteria can also be used to confirm the discriminant validity of reflective measurement models. The Fornell-Larcker criteria states that the square root of AVE for each latent construct should be bigger than the correlations of any other latent construct. Table 4 shows that the square root of AVE for each construct is greater than the correlation for each construct (Hair et al., 2017). All subsequent statements in each construct had factor loadings ranging from 0.539 to 0.914, and the computed t-values were judged to be significant at the $p < 0.001$ level. Table 6 show the goodness of fit values (CMIN = 730.518, CMIN/df = 2.093, NFI = 0.92, IFI = 0.956, TLI = 0.945, CFI = 0.956, RMR = 0.029, RMSEA = 0.058) are within acceptable bounds. Its show the confirmatory factor analysis model has been fitted. Figure 2 represents the measurement model for this study.

Structural equation modelling

Table 5, show the direct effect, in this table check the relationship between independent and dependent variables. H1a: Recruitment and selection demonstrates a positive correlation with productivity ($\beta = 0.14$, $T = 2.064$, $p = 0.039$), meaning that there is a 0.14 unit gain in productivity for every unit increase in recruitment selection. At the traditional significance threshold ($p < 0.05$), this association is considered

Table 2. Result summary for factor loading & validity of constructs.

Constructs	Indicator	Loadings	AVE	CR	Item Deleted Due to Low Loadings
Recruitment & Selection	RS5	0.746	0.564	0.838	RS3
	RS4	0.722			
	RS1	0.727			
	RS2	0.788			
	EDD6	0.815			
Performance Appraisal	EDD5	0.882	0.655	0.883	EDD2, EDD3
	EDD4	0.79			
	EDD1	0.754			
	CAP6	0.887			
Training	CAP5	0.808	0.724	0.940	
	CAP4	0.837			
	CAP3	0.903			
	CAP2	0.834			
	CAP1	0.803			
	COMP1	0.841	0.761	0.941	
Compensations	COMP2	0.914			
	COMP3	0.894			
	COMP4	0.87			
	COMP5	0.79			
	DIG1	0.75	0.625	0.929	
Digitalization	DIG2	0.784			
	DIG3	0.826			
	DIG4	0.796			
	DIG5	0.836			
	DIG6	0.834			
	DIG7	0.859			
	DIG8	0.539			
Productivity	PROD1	0.842	0.710	0.880	
	PROD2	0.886			
	PROD3	0.798			

Table 3. Model fitness values.

Model	CMIN	CMIN/DF	IFI	T L I	NFI	RFI	RMR	CFI	RMSEA
Default model	730.518	2.093	0.956	0.945	0.92	0.9	0.029	0.956	0.058

Table 4. Discriminant validity HTMT.

	Recruitment & selection	Performance Appraisal	Training	Compensations	Digitalization	Productivity
Recruitment & selection	0.751					
Performance Appraisal	0.744	0.810				
Training	0.684	0.806	0.851			
Compensations	0.680	0.699	0.752	0.872		
Digitalization	0.590	0.621	0.704	0.581	0.791	
Productivity	0.580	0.621	0.686	0.608	0.749	0.843

Table 5. Direct effects.

Dependent Variable		Independent Variables	B	S.E	T	P	Accepted/Rejected
Productivity	<—	Recruitment Selection	0.14	0.068	2.064	0.039	Accepted
Productivity	<—	Performance Appraisal	0.09	0.074	1.209	0.227	Rejected
Productivity	<—	Training	0.225	0.068	3.298	***	Accepted
Productivity	<—	Compensation	0.138	0.051	2.71	0.007	Accepted
Productivity	<—	Digitalization	0.279	0.047	5.882	***	Accepted

Table 6. Moderation effects.

X * W		DV	β	S.E	F	C.R	P	LLC	ULC
RS*DIG	→	Productivity	0.118	0.044	7.223	2.687	0.008	0.032	0.205
EDD*DIG	→	Productivity	0.081	0.046	3.157	1.777	0.077	-0.009	0.171
CAP*DIG	→	Productivity	0.08	0.037	4.808	2.193	0.029	0.008	0.152
COMP*DIG	→	Productivity	0.097	0.036	7.095	2.664	0.008	0.25	0.168

statistically significant. H1b: Performance Appraisal shows a positive effect in productivity ($\beta=0.09$, $T = 1.209$, $p=0.227$), but the conventional criterion of significance ($p>0.05$) does not support this association. H1c: Training shows a significant positive correlation with productivity ($\beta=0.225$, $T = 3.298$, $p<0.001$); this means that an increase of one unit in training corresponds to a 0.225 unit increase in productivity, and it is thought that there is strong statistical significance in this association. H1d: Compensation also shows a positive relationship with productivity ($\beta=0.138$, $T=2.71$, $p=0.007$), meaning that a 0.138 unit increase in productivity is correlated with a rise in compensation; then there is statistical significance in this association. Digitalization has a significant positive effect on productivity ($\beta=0.279$, $T = 5.882$, $p<0.001$). This means that for every unit rise in digitalization, there is a corresponding gain in productivity of 0.279 units, the statistical significance of this association is very high. Recruitment Selection, Compensation, Training, and Digitalization have statistically significant positive effects on productivity. Performance Appraisal shows a positive effect, but it's not statistically significant at conventional levels.

Figure 3, shows the structural model.

Digitalization moderation effect results

H2a: RS*DIG -> productivity

The beta coefficient of the interaction between Digitalization (DIG) and Recruitment Selection (RS) is 0.118, meaning that DIG and RS together have a favorable influence on productivity. With a statistically significant interaction effect ($C.R. = 2.687$, $p=0.008$), it is possible that productivity is greatly impacted by the combined influence of RS and DIG. This interaction has a confidence interval that varies from (0.032 to 0.205). See Figure 4.

H2b: EDD*DIG -> productivity

The beta coefficient of the interaction between Digitalization (DIG) and Performance appraisal (designated as EDD) is 0.081, suggesting a positive but rather minor effect on productivity. With a marginally significant correlation ($C.R. = 1.777$, $p=0.077$), the interaction effect appears to have a weaker impact than the one that came before it. This interaction's confidence interval spans from (-0.009 to 0.171). See Figure 5.

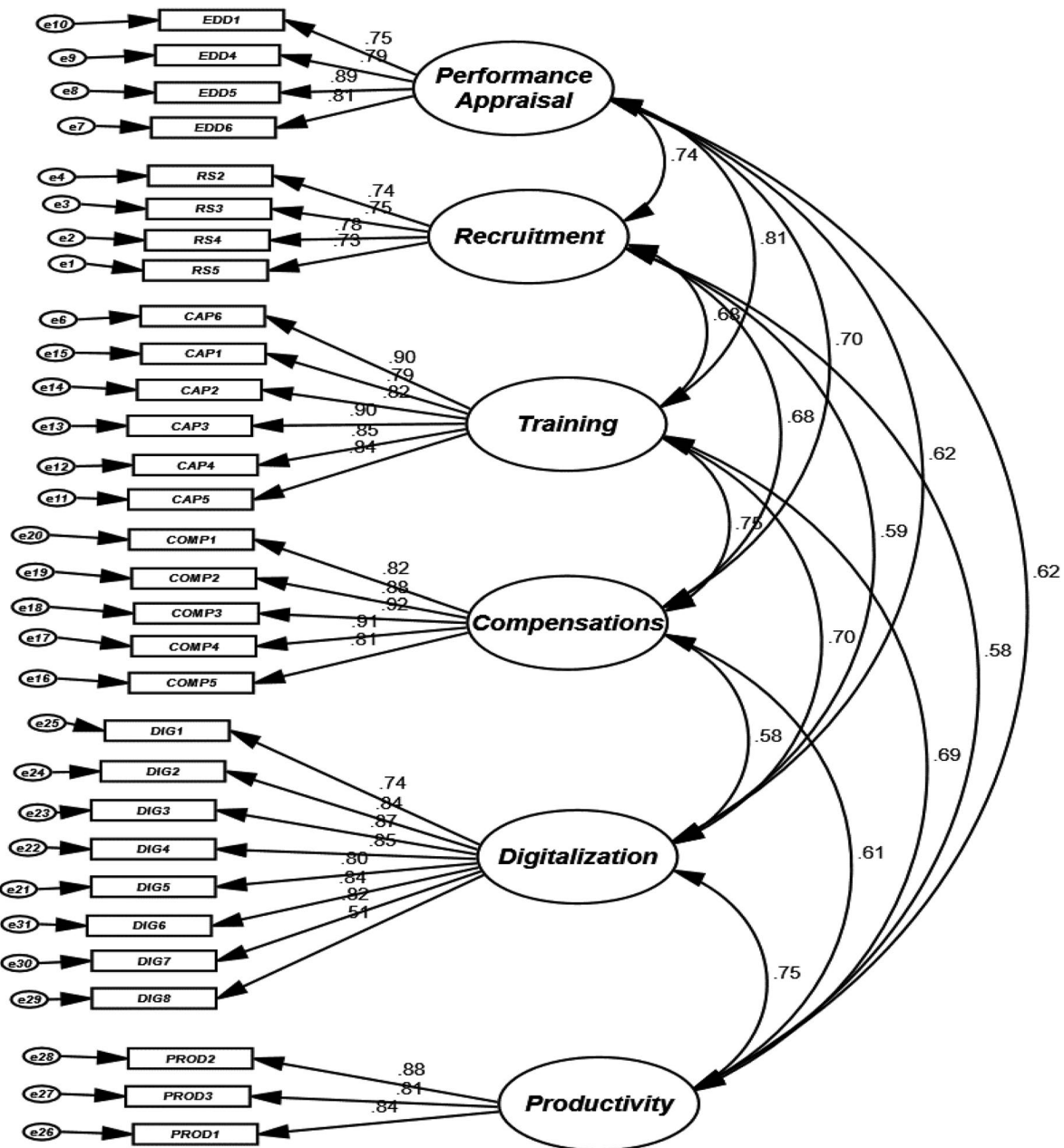


Figure 2. Measurement model.

H2C: CAP*DIG -> productivity

The beta coefficient of the interaction between Digitalization (DIG) and Training (designated as CAP) is 0.08, suggesting that it has a favorable effect on productivity. With a statistically significant interaction effect (C.R. = 2.193, $p=0.029$), there may be a considerable combined influence on productivity. This interaction has a confidence interval that varies from (0.008 to 0.152). See Figure 6.

H2d: COMP*DIG -> productivity

A beta value of 0.097 indicates that compensation (COMP) and digitization (DIG) have a favorable joint effect on productivity. With a statistically significant interaction effect (C.R. = 2.664, $p=0.008$), a considerable joint influence is suggested. This interaction has a confidence interval that spans from (0.25 to 0.168). See Figure 7.

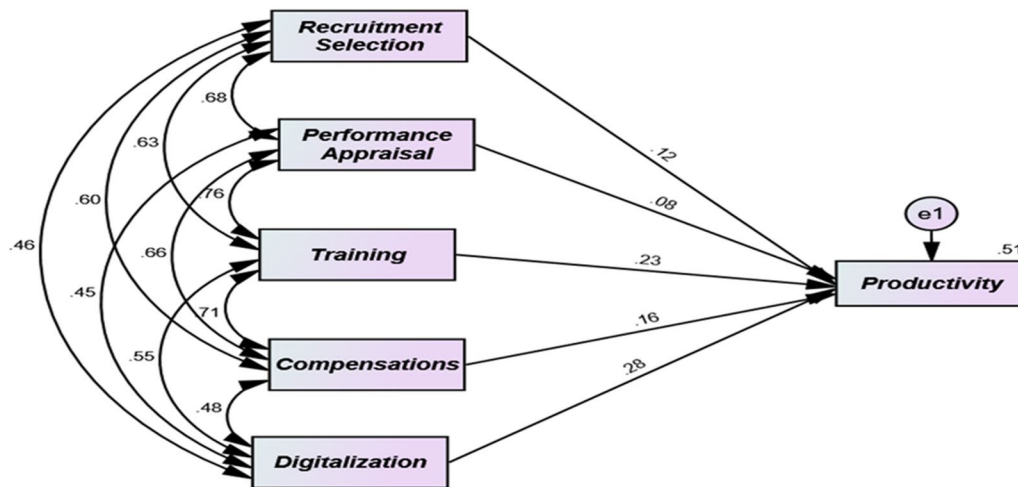


Figure 3. Structural equation modelling.

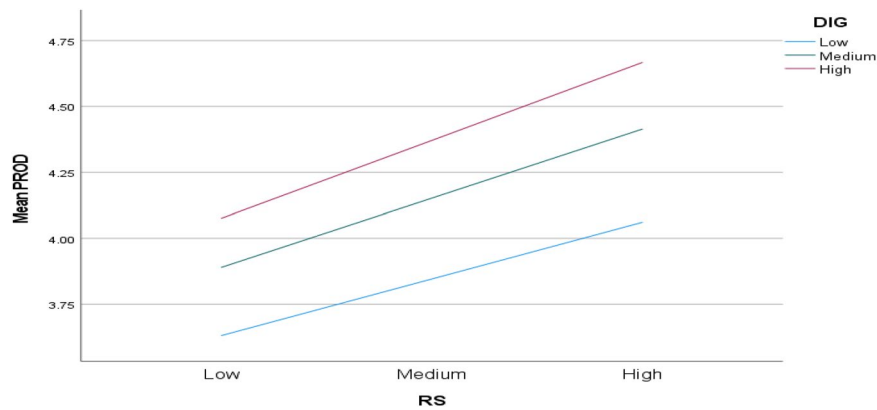


Figure 4. Moderation effect RS*DIG relationship on productivity.

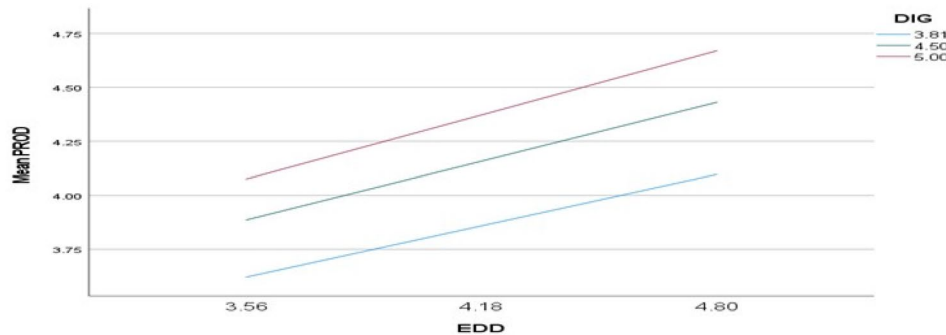


Figure 5. Moderation effect EDD*DIG relationship on productivity.

The Table 6, show the moderation effect data on the impact of independent variables (X) and moderators (W) on the dependent variable (DV) - productivity. The data includes beta coefficients, standard errors, F-values, critical ratios, p-values, and lower and upper limits of confidence. The Table 7 shows the total Hypothesis tests Summary.

Discussion

The purpose of this research was to fill the gap in the literature about the evaluation of the impact of human factor management on the productivity of companies under the moderating effect of

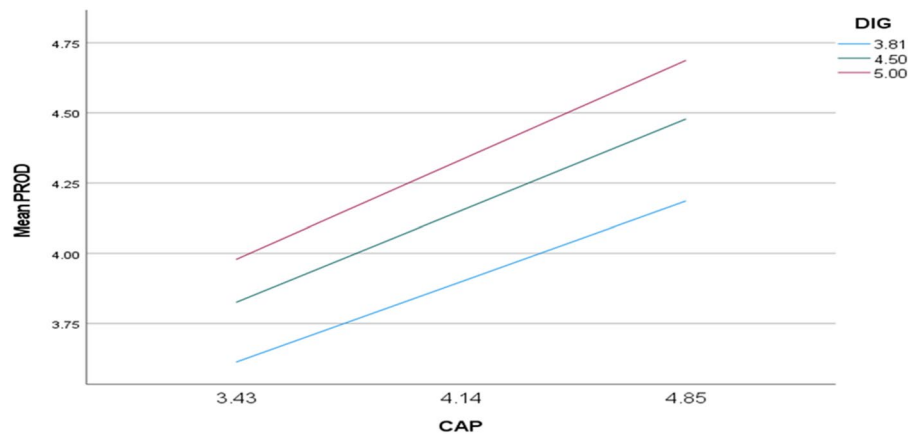


Figure 6. Moderation effect CAP*DIG relationship on productivity.

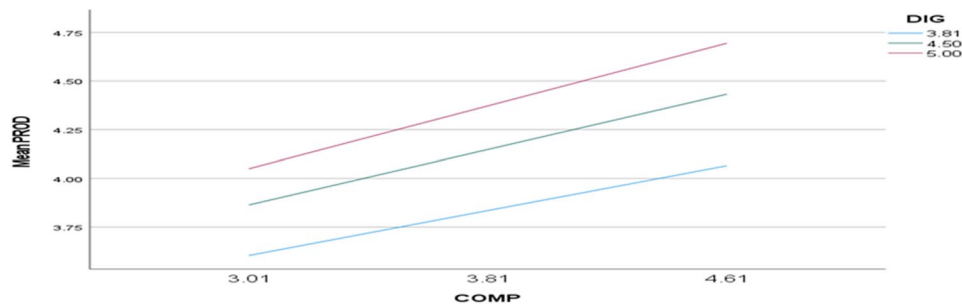


Figure 7. Moderation effect COMP*DIG relationship on productivity.

Table 7. Hypothesis tests summary.

Hypothesis	Hypothesis Statements	Supported/Non-Supported
H1a	There is a positive relationship between the human factor recruitment and productivity.	Supported
H1b	There is a positive relationship between the human factor performance appraisal and productivity	Non-Supported
H1c	There is a positive relationship between the human factor training and productivity.	Supported
H1d	There is a positive relationship between the human factor compensations and productivity.	Supported
H2a	Digitalization has a moderating effect on the relationship between the human factor recruitment and productivity.	Supported
H2b	Digitalization has a moderating effect on the relationship between human factor performance appraisal and productivity.	Partially supported
H2c	Digitalization has a moderating effect on the relationship between human factor training and productivity.	Supported
H2d	Digitalization has a moderating effect on the relationship between human factor compensations and productivity.	Supported

digitalization. Taking into consideration that the latent variable human factor management can be measured through the dimensions: recruitment and selection, performance evaluation, training, and compensation (Evans, 2003; Fombrun et al., 1984; Scarbrough, 2003), the findings revealed that Recruitment and selection demonstrates a positive correlation with productivity ($\beta=0.14$, $p=0.039$), with a considerable statistical significance; this proves that the appropriate selectivity of personnel directly affects the results of the organization such as productivity, and that the use of selection techniques associated with high

predictive validity can facilitate the detection of highly productive employees (Chadwick & Li, 2018; Hunter & Hunter, 1984; Katou & Budhwar, 2007). Besides, Performance Appraisal has shown a positive effect in productivity ($\beta=0.09$, $p=0.227$), but the conventional criterion of significance ($p>0.05$) does not support this association; this could be because in the banking sector of Peru performance evaluations are not appropriate, in accordance with what was maintained by Larson (1989), who indicated that when clear and reasonable personnel performance evaluation metrics, standards and practices are used to achieving objectives and providing relevant feedback can be useful to both the individual being evaluated and the organization, however, poorly executed performance evaluations can be detrimental to the organization's performance; this result may also suggest the lack of a variable that could mediate this relationship such as worker motivation or satisfaction. Training has shown a significant positive correlation with productivity ($\beta=0.225$, $p<0.001$) finding a strong statistical significance in this association; this confirms what most studies indicate that show a positive impact of human factor training on productivity, and that providing adequate training to employees can help improve their skills, which will subsequently increase their productivity (Bartel, 1994); Black & Lynch, 1996, Wang et al., 2010). Compensation also shows a positive relationship with productivity ($\beta=0.138$, $p=0.007$) that means a high statistical significance in this association, which is consistent with the literature that offering high salaries and benefits as labor compensation can improve productivity and that the largest contributor to labor productivity is the employee's salary as well as profit sharing (Cozzarin & Jeffrey, 2014; Kazaz & Ulubeyli, 2007; Shaw et al., 1998; Shepard & Edward, 1994).

Regarding moderation effects of digitalization, it was found that digitalization significantly moderates the relationship between human factor management and company productivity, except with the performance appraisal, which showed an interaction effect with a weaker impact than in the other sub-constructs of human factor management. This proves that people management practices are strongly correlated with productivity, and digitalization allows improvements in performance that can be linked to productivity gains, but this depends on the presence of certain skills and knowledge that require training to take advantage of the digital technologies (Horváth & Szerb, 2018).

Conclusions

The main conclusion of this study is that human factor management has a positive impact on the perceived productivity of the company, with the exception of the Performance appraisal subconstruct. Likewise, it is proven that digitalization has a significant moderating effect on the relationship between the management of human factor and productivity, with the exception also of performance appraisal, whose moderating effect is partial. All this, within the framework of a constantly changing environment in which digitalization is progressively and increasingly affecting the management of companies, in accordance with the theoretical framework adopted from the Dynamic Capability View, in which the success of companies depends on their ability to renew their competencies within changing business environments. Taking positive advantage of the changes that this implies constitutes a challenge for modern companies, particularly in the competitive banking sector where the proposed model was tested.

The results obtained also have political implications within the company, since human factor management policies and practices must adapt to the required changes and people's performance.

Human resource management should prioritize training programmes to help employees adapt to new technologies within organizations.

By providing training and digital tools to improve innovation and decision-making, companies can prepare the next generation of human resources and business leaders for the challenges they may face. This is especially relevant in light of the economic impact of pandemics and other unpredictable global events, which can have lasting effects on the economy. The rapid advancement of digital technologies and the need for quick solutions demand that human resource management implement digital technologies throughout the human resources value chain. Digitalization of human resource management practices poses challenges, and these need to be monitored during the whole process.

This article provides evidence that human resource management in a digital environment plays a key role in the performance of companies, and therefore, future research should be continued and intensified.

Implications of the study

Theoretical implications

Till the date, current research on I4.0 technologies and implementation has largely ignored the impact on the human factor; systematic consideration and attention to the human factor in the digital transformation of work can avoid negative consequences for individual employees, production organizations and for society as a whole (Neumann et al., 2021). The impact of Industry 4.0 on employees remains a relatively unexplored topic (Ejsmont, 2021). Similarly, Ribeiro-Navarrete et al. (2021) revealed that, although digitalization creates value for companies and offers a number of benefits, little research has been done so far on its effect on business performance. Taking into consideration the aforementioned, from the theoretical perspective this study contributes by providing empirical evidence that tests the moderating effect of digitalization in the relationship between the management of the human factor and productivity, achieving a better understanding of the phenomenon, contributing to the existing literature and debate, as well as providing the basis for future theoretical developments in this area, through a conceptual model that allows a better understanding of the phenomenon under study.

Practical implications

From a practical perspective, many companies still do not fully understand the effect of digitalization on performance, consequently, they invest in information and communication technologies without a well-thought-out strategy (Truant et al., 2021). Although companies are expected to provide financial and human resources to support the implementation of digital tools, barriers to investment in digitalization may arise due to: (a) High costs; (b) the need to acquire new skills, capabilities and internal competencies; and (c) the risks of obsolescence (Büchi et al., 2020). Contrary to expectations, some companies that are digitally transforming do not see the human factor as a driving force, but rather as an obstacle to the implementation of Industry 4.0, when the human factor lacks the necessary competencies and skills (Herceg et al., 2020). Therefore, there is a need for a comprehensive evaluation of the results of digitalization in personnel management, as well as the effectiveness of its changes (Anand et al., 2020). From a practical point of view then, the present study is significant for the following reasons:

- It allows us to determine which dimensions of human factor management can be better enhanced under the influence of a digital environment, thus contributing better to business performance. Indeed, from the results it can be verified that recruitment, training, and compensation are those that have the greatest impact on productivity under the effect of digitalization.
- It allows us to better understand the effect of digitalization on people's productivity, so that investments in information technologies are more effective and are a means to achieve the desired competitiveness.

Having as a theoretical axis the Dynamic Capability Vision (DCV) according to which the success of the company depends on its ability to renew skills to achieve competitiveness in a changing business environment (Teece et al., 1997), the importance of studying more the link between good practices of the human factor with the productivity of the company, under the context of digital transformation, makes it necessary to develop a new conceptual model like the one proposed, which allows us to determine which human factor management functions contribute the most to organizational achievements, and how the phenomenon of digitalization affects this relationship, with which organizations could enhance the benefits obtained from this, thus being able to achieve the desired competitiveness (Sotnikova et al., 2020).

Limitations of the study

The main limitation of the study is that the population and sample were composed only of banking entities in Metropolitan Lima, which is why future research is required to generalize the results of the study to other business sectors and other geographical areas. Likewise, the target population focused on

medium and large companies, so these results could not be applicable to small companies since these normally do not have human factor management systems or an advanced level of digitalization. The latent variable human factor management was measured with four sub-constructs; different results can probably be obtained with more explanatory sub-constructs, as proposed by other authors. On the other hand, the data sources of the questionnaires depended exclusively on the subjective qualification of the employees. Finally, another limitation of the study is the research design, which, being cross-sectional, limits the collection of information to a period of time.

Authors contributions statement

Kuong Rodríguez Jorge Ulises performed the conception and design, analysis and interpretation of the data, and the drafting of the paper. Arana Barbier Pablo José contributed revising it critically for intellectual content, and the final approval of the version to be published. Both authors agree to be accountable for all aspects of the work.

Disclosure statement

The authors declare no conflict of interest.

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Ethic declaration

The authors confirm that all participants received an Informed consent protocol for surveys, which was approved by Comité de Ética de la Investigación para Ciencias Sociales, Humanas y Artes de la Pontificia Universidad Católica del Perú, with Opinion Number: 053-2023-CEI-CCSSHAA/PUCP.

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Data availability statement

The authors confirm that understand the terms of the share upon reasonable request data policy. The data that support the findings of this study are openly available in Data support repository at https://drive.google.com/drive/u/0/folders/1AyMHIDkqov8o2TpUpFRwMxNYUIU7_tKA.

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