



## Research article

# Digitizing success: Leveraging digital human resource practices for transformative productivity in Chinese SMEs

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## ABSTRACT

**Background:** & Purpose: In the rapidly evolving digital landscape, digital human resource (HR) practices in small and medium-sized enterprises (SMEs) have become a vital success factor. This study adopts the resource-based view of the firm to explore the complicated relationships among digital HR practices, digital transformation, innovative work behavior, disruptive innovation, and work productivity in the context of Chinese SMEs.

**Methods:** This study provides fundamental insights by drawing data from Jiangsu province, China. Data from 339 managerial staff members were collected and analyzed using SmartPLS (4.0) with a partial least squares structural equation model (PLS-SEM). Several measures, model fit, and hypothesis tests were conducted.

**Findings:** Digital HR practices significantly affect digital transformation, innovative work behavior, and productivity. Furthermore, digital transformation is a powerful driver that positively influences innovative work behavior and productivity in SMEs. Interestingly, innovative work behavior positively influenced work productivity, exemplifying the vital role of inspired thinking and problem-solving abilities. This study also investigates the moderating role of disruptive innovation, highlighting its influence on the association between digital HR practices and digital transformation. However, disruptive innovation does not significantly moderate the association between digital transformation and innovative work behavior, suggesting fascinating nuances for SMEs.

**Conclusion/value:** This research extends our understanding of the interaction between digitalization, HR, and innovation, and proposes practical implications for SMEs aiming to harness the transformative potential of digitization. Several theoretical and practical implications are developed for future studies on related SMEs.

## 1. Introduction

Digitization refers to a “digital alteration” and “digital disruption,” which is an emerging area of research currently [1]. This phenomenon indicates the excessive use of modern technology in almost all business areas, particularly human resource (HR) management. In HR management, technology usage is described as digital HR management or digital disruption [2]. Digital HR practices refer to the conversion of manual information (paper-based) into digital data for processing purposes [1]. Such changes in HR

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processes led by digitization are denoted as digital HR management, starting from simply posting job ads, training, and developing the workforce, to many more complex activities, such as devising organizational HR strategies. Considering digital HR practices fundamental for work productivity, small and medium-sized enterprises (SMEs) must accept digitization to compete efficiently [3]. For instance, eBay data for more than 20 countries show that all SMEs that used digital tools (IT) were able to export their goods and services, while approximately 2%–28 % of the SMEs not using such technologies were able to do so [4].

Considering the vast implications of digitization, China is also adopting technological innovations in business operations [5]. China performs exceptionally well in developing and deploying digital tools and has few prominent internet and communications technology firms. For example, Alibaba and Tencent's market capitalization exceeded \$800 billion, showing China's strong ambition to become an artificial intelligence (AI) leader, and is currently ahead of Europe [6]. Nevertheless, the question is the large-scale adoption of digital tools by large firms and SMEs. China also has firms that went bankrupt during the first half of 2020 (around 250,000 young SMEs in Guangdong) due to imbalances in their inputs and outputs [7]. Similarly, the pandemic had distinct effects on various sectors, as observed in the Jiangsu province empirical study by Gu, Ying [8]. Their findings show that the pandemic did not negatively impact the hospitality industry's supply chain management and product delivery, even though they experienced severe cash flow challenges.

On the other hand, the manufacturing sector experienced supply chain issues despite facing fewer financial difficulties [9]. Digitization, including AI, robotics, and cloud computing can help alleviate this imbalance [7]. Additionally, China lags behind in terms of industrial digitization/atomization. Approximately 187 industrial digital mechanisms per 10,000 employees in China, less than those in Germany, the US, Korea, and Japan [7]. Such deficiencies hinder work productivity. Thus, this study aims to find this gap starting from the roots, which are the implications of digital HR practices. Based on this evidence, the current study investigates this phenomenon in Jiangsu province's SMEs in China.

Recently, in the wake of increasing digitization, achieving higher work productivity levels for SMEs has been depends mainly on digital transformation [10]. To attain such digital transformation, SMEs need two essential features: digital tools in the value chain and transformations influencing the workforce, knowledge, and culture. The resources firms need to attain digital transformation include human, information technology infrastructure, and intangible resources such as management and technical skills [11]. HR offer firms a leading edge [12], and firms must merge HR and operational digitation to obtain the best possible outcomes. Likewise, the modernization of technology, including AI, has probed the digitization of several job roles and changing job requirements [12]. The necessary skills for these digital transformations include technical skills such as programming knowledge, big data analytics, intelligent systems, and robotics and soft abilities such as persistent learning of creative, analytical, and critical reasoning [13,14]. Although past research emphasized the essential mechanism of HR skills in contributing to digital transformation, there is a lack of assessment on how to recruit, train, develop, compensate, and manage the performance of employees using digital technologies. This study aims to determine how digital HR practices provide stepping stones in digital transformation, leading to innovative work behaviors and enhancing work productivity in Chinese SMEs.

The basics of developing innovation in a firm are to assist and stimulate all employees seeking novel ways to attain aims and objectives and perform duties [15]. The literature suggests that culture denotes the expression of numerous individuals who show their behavior and trust that history has shaped their behavior toward innovation [16]. Innovation is a characteristic of individuals with resilience to transformations and innovative work behavior includes the flexibility to respond to consistent changes [16]. Such innovative work behavior not only encourages employees to use unusual (digital) ways to complete their job tasks to make them accessible, but also contributes to the overall work productivity of the organization. We believe that such innovative work behavior has is triggered by modern digital tools available online quickly and in abundance, allowing employees to work smartly. For instance, hundreds of job application forms are difficult to process, and a HR officer uses AI tools to extract information from all forms in minutes and compile information in an online data sheet, making decisions easier [17]. Similarly, from an organizational perspective, Zirar [18] argued that digital technologies (e.g., AI) allowed companies to allow their employees to work smartly and contribute to work productivity levels. In connection with innovative work behaviors, disruptive innovation refers to innovation that makes work functions more doable and desirable using the latest technology [19]. Similarly, to achieve innovative work behavior, the disruptive innovation of digitization in SMEs is a critical trigger for boosting the transitions from digital HR practices, digital transformation, and innovative work behavior of employees.

Previous studies examined several mechanisms of productivity, digitalization, and innovation activities. For instance, Zirar [18] reported in their literature review that AI improves employees' work productivity by improving their innovative capabilities, leading to innovation goals. In comparison, the digitization of HR practices, such as sorting job applications, is easier using AI technologies [17]. Sharma, Luthra [20] proposed a model to align industry 4.0 technologies in HR practices, such as digital training, performance evaluation, and employee feedback, to enhance employee productivity. Kharlamov and Parry [21] examined the effects of digitization on firm performance and productivity using text mining and an econometric assessment of secondary data from the UK. Using three-year survey data, digitization was also found to positively affect productivity and human work in Germany's production industries [22]. Using a panel data approach, Lee, He [23] examined the positive role of digitization toward green productivity and sustainable development in China. Similarly, several studies have examined the emerging significance of digitization in several settings toward innovation. For instance, digitization enhances innovation in retail businesses [24], service process innovation [25], digital innovation in entrepreneurial ecosystems [26], digitization of entrepreneurship [27], and digital leadership in the innovation performance of firms [28].

Despite the plethora of research on productivity, digitization, and innovation, few comprehensive studies address the effects of digital HR practices in Chinese SMEs. This study seeks to address this gap by examining the direct effects of digital HR practices on transformation, creative work practices, and productivity within SMEs. To address the lack of such insights in this context, we assess the mediating role of innovative work behavior and digital transformation, and investigate how disruptive innovation might boost the

effectiveness of digital HR practices, based on empirical data collected from employees working in manufacturing SMEs in China. This study specifically aims to find a predictor model that enhances the work productivity of SMEs in the digital transformation mechanism. We therefore contribute empirically to the literature by addressing the following research questions.

- 1) How do digital HR practices directly affect digital transformation, innovative work behavior, and productivity?
- 2) What is the mediating role of digital transformation and innovative work behavior in the connection between digital HR practices and the work productivity of SMEs?
- 3) How does disruptive innovation trigger efficiency in digital HR practices toward digital transformation and innovative work behavior?

The remainder to this article includes a literature review and hypotheses development in the next section. We subsequently discuss the methodology, empirical testing, discussion, and theoretical and practical implications of the research. We conclude with detailed recommendations for SMEs to devise relevant policies.

## 2. Literature review and research hypotheses

### 2.1. Theoretical foundation: resource-based view (RBV) of the firm

The RBV strongly emphasizes a company’s distinctive resources and capabilities for establishing long-term work productivity [29]. RBV focuses on identifying and leveraging “valuable, rare, inimitable,” and organized resources and competencies to gain a competitive edge. These relate to the four variables of this study: digital HR practices, digital transformation, innovative work behavior, and disruptive innovation. We argue that the RBV underlines the importance of cutting-edge HR technology and the

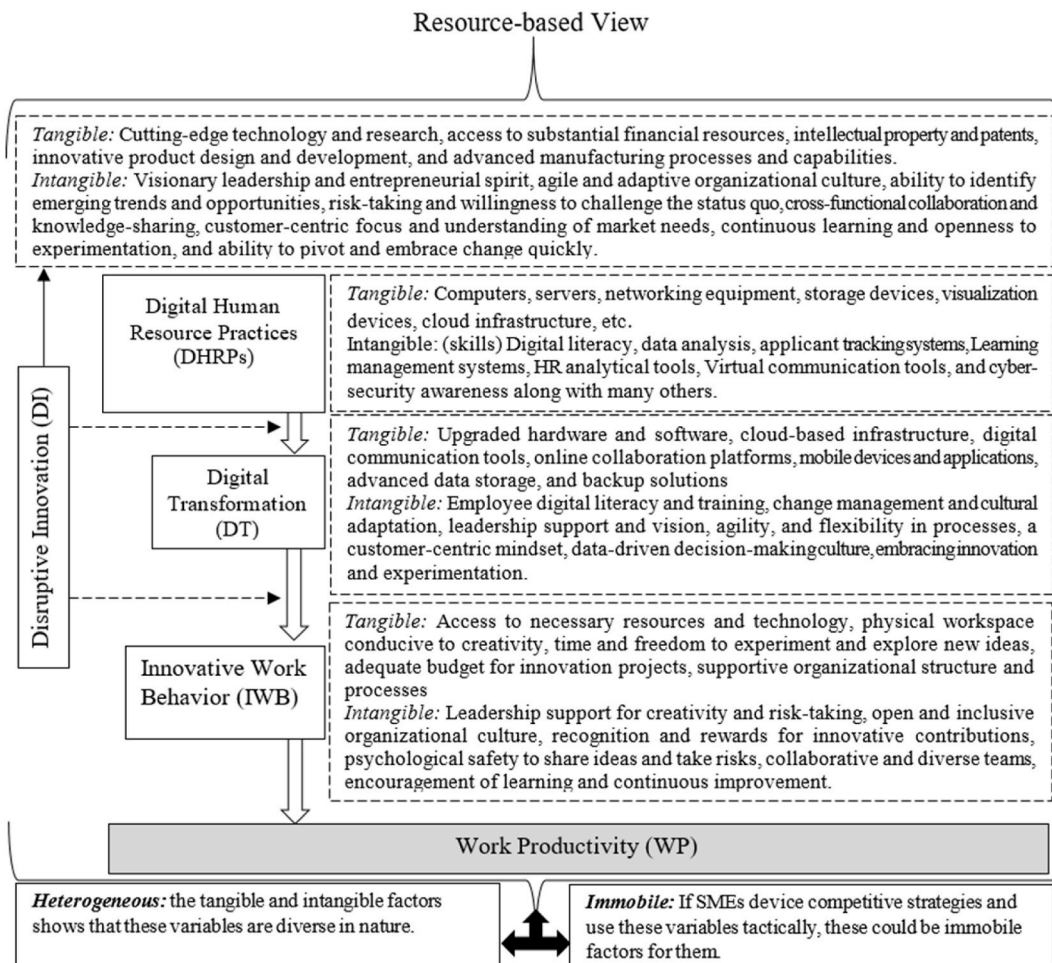


Fig. 1. Integration of Resource-based view and research model.

Sources: Authors’ elaboration, RBV concepts by Barney [29].

uncommon skill in managing digital HR procedures, which might be challenging to mimic. These resources can contribute to a sustained competitive advantage if integrated into the company and coordinated with the HR strategy and goals. Regarding digital transformation, the RBV identifies distinctive technological aptitudes and resources that provide SMEs with a competitive edge. Identifying the unique and uncommon elements of the transformation process, such as a visionary leadership group, may result in a long-lasting competitive advantage. Effective management of these resources promotes the success of digital transitions and ongoing adaptation. The RBV emphasizes an innovative and engaged workforce as a valuable resource in the context of innovative work behavior. SMEs can acquire a competitive edge by fostering a culture that encourages innovation, making innovation a rare and unique capability. The business strategy's overall organization and integration of innovation efforts increase a firm's competitive position. The RBV concentrates on identifying valuable breakthrough ideas and distinctive talents necessary for executing disruptive innovation. A competitive edge can be achieved by highlighting the uniqueness and impeachability of specific abilities. Disruptive innovations are effectively developed and deployed when resources are strategically organized and positioned (see Fig. 1).

2.2. Role of digital HR practices

Digital HR practices refer to converting traditional HR practices into online/digital systems, such as collecting recruitment data in soft form, screening applications using AI tools, and conducting online interviews [2]. Digital and electronic HR management is crucial in numerous aspects including organizational performance [20], organizational health [30], employee performance [31], and diverse workforce efficiency [32]. Similarly, AI positively affects work productivity by improving workforce innovation abilities [18]. Digitization alters HR practices, such as data mining, for recruiting using AI tools to make applicant screening easy and quick [17], contributing to firms' digitization efforts. Employee productivity can also be enhanced using digital HR practices such as training, performance feedback, and evaluation [20]. Firm productivity is also positively enhanced by digitizing key business practices [21]. Digitization influences employee productivity in the production industry in Germany [22], sustainable development and green productivity in China [23], innovation in retail businesses [24], service process innovation [25], digital innovation in entrepreneurial ecosystems [26], digitization of entrepreneurship [27] and digital leadership in the innovation performance of firms [28]. However, to the best of our knowledge, there is scarce empirical evidence on the direct association of digital HR practices with the digital transformation, innovative work behavior, and work productivity of SMEs. We contend that, when considered in the context of the RBV, digital HR practices are important assets that support a company's competitive edge. Consequently, these practices can aid in digital transformation by offering the instruments and procedures required to properly adjust to technological advancements. Furthermore, by encouraging creative work habits, digital HR practices help a company make better use of its HR, boosting its output. Therefore, by highlighting the significance of valuable resources in promoting organizational performance, the RBV supports the following hypothesis (Fig. 2).

**Hypothesis 1a.** Digital HR practices contribute to the digital transformation of work.

**Hypothesis 1b.** Digital HR practices increase innovative work behavior.

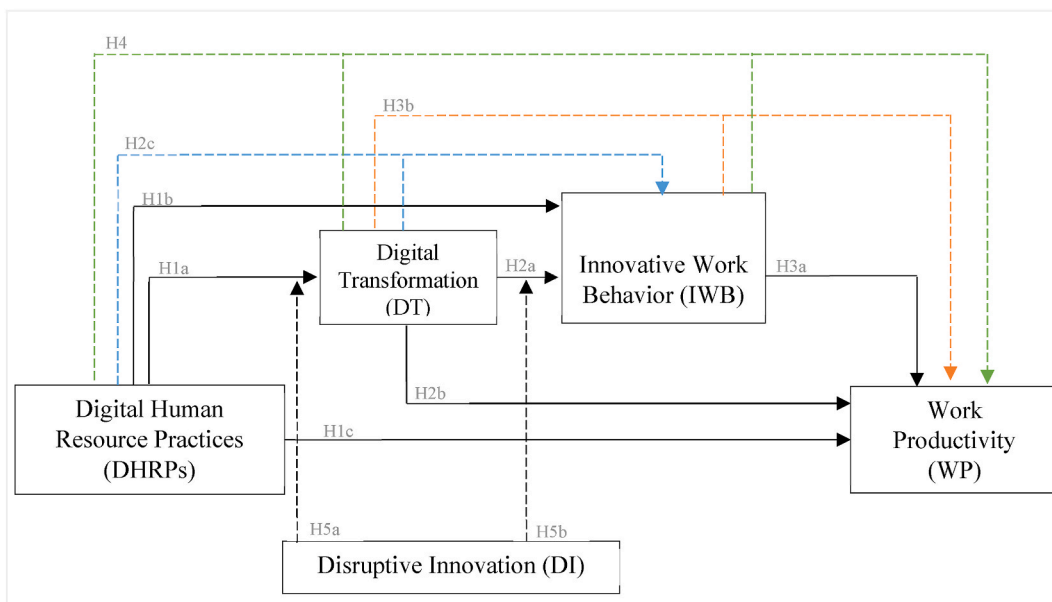


Fig. 2. Research framework. Source: Authors' elaboration (2023).

**Hypothesis 1c.** Digital HR practices increase work productivity.

### 2.3. Role of digital transformation

Digital transformation denotes the thorough and strategic integration of digital technology, processes, and capabilities into an organization's operations and business models. The key goal of digital transformation is to improve and optimize a company's operations, customer interactions, and value delivery to stakeholders in an ever-changing digital context [2]. Previous studies identified an association between digital transformation and several outcomes such as the organizational performance of universities [33], digital innovation and innovative work behavior [34], and digital leadership and innovative work behavior [35]. Digital transformation improves firms' innovation performance by improving product and process innovation [36]. It helps create targeted and diverse teams, sets iterative goals, and manages talent and persistent learning in firms [37]. The focus on employee performance management as a key HR activity is a predictor of innovative work behavior, leading to firm digitization [38]. Managing employee performance effectively leads to innovative work behavior in the digital era. This evidence proves that digital transformation helps improve innovation, work behavior, and productivity in firms. Digital transformation can assist in managing the effective digitization of HR practices concerning enhanced work productivity [17]. While digital transformation alters numerous organizational outcomes, little information is available on the direct influence of digital transformation on innovative work behavior and work productivity and its mediating role. Within this framework, digital transformation is a strategic asset that helps businesses maximize efficiency and improve value creation in the digital era. Digital transformation complements the RBV's focus on using valued resources to gain a competitive edge by giving employees access to unique digital resources, encouraging innovation, and empowering them. Thus, the hypotheses are supported by the possibility that digital transformation enhances innovative work behavior and productivity by streamlining organizational procedures and enabling the use of digital resources.

**Hypothesis 2a.** Digital transformation improves innovative work behavior.

**Hypothesis 2b.** Digital transformation improves work productivity.

**Hypothesis 2c.** Digital transformation positively mediates the relationship between digital HR practices and innovative work behavior.

### 2.4. Role of innovative work behavior

Innovative work behavior usually refers to how people can assist in the initiation and deliberate introduction of valuable and new creativity, procedures, products, and processes [39]. Innovative work behavior is a critical factor in determining job productivity within organizations [40]. Employees are better at problem-solving and spotting workflow inefficiencies when encouraged to think creatively and offer fresh ideas [39]. They boost productivity by implementing creative solutions that streamline procedures, save time, and utilize resources better. Innovative thinking-driven continual improvement and changes in absorptency enable firms to remain competitive in dynamic circumstances [39]. Individuals at all firm levels can contribute to organizational success through their innovative work behavior, which is typically beyond an individual's role and is thus proactive conduct aimed at creating, sharing, and implementing new ideas in the workplace [38]. Workers' innovative work behavior may help firms manage the heightened need for innovation through digitalization [41,42]. HR management practices should be seen as signals that companies send to their leaders and staff, explaining what behaviors and outcomes are acceptable, supported, promoted, and finally rewarded (e.g., innovative work behavior) [43]. Based on Verhoef, Broekhuizen [44], the digitalization of HR practices can be donated as incorporating technology in such practices, which leads to the use of digital HR practices to improve employee work productivity and innovative behaviors (digital transformation). The authors highlight the limited research on the specific digital transformation mechanisms that help firms improve their performance and productivity. Ultimately, creative work practices encourage cooperative and forward-thinking companies to benefit from increased production and long-term success [45]. Few studies examined the mediating mechanism of innovative work behavior, such as work performance and the tourism industry's performance [46]. Firms can improve productivity and flexibility by promoting employee innovation, consistent with the RBV's focus on using resources to gain a competitive edge. Thus, as suggested by [Hypothesis 3a](#), inventive work behavior probably increases job output. Furthermore, the RBV supports the mediation hypotheses by highlighting how creative work practices and digital transformation work together to increase productivity by making the most use of valuable resources and streamlining organizational procedures.

**Hypothesis 3a.** Innovative work behavior improves work productivity.

**Hypothesis 3b.** Innovative work behavior positively mediates the relationship between digital transformation and work productivity.

**Hypothesis 4.** Digital transformation and innovative work behavior positively mediate the relationship between digital HR practices and work productivity.

### 2.5. Role of disruptive innovation

Technological disruption occurs when a novel technology outperforms the leading conventional technology. By contrast, technological disruption occurs when a new technology overtakes the present one in terms of enactment [47]. We argue that when new



technologies in HR practices become available in the market, traditional technologies become obsolete and encourage firms to adopt them to outperform their competitors, leading to disruptive innovation in their firms. As Si and Chen [48] explain, several businesses do not apply the concept of disruptive innovation as they should and remain less competent in the industry. According to Majumdar, Banerji [49], disruptive technologies lead to disruptive innovation that benefits both businesses and society. For instance, 3D printing disrupts the conservative technology of construction and manufacturing and the transition from brick-and-mortar stores to online stores. New skills in the workforce are required to avoid joblessness [49]. While we focus on disruptive innovation, which is different from disruptive technology, disruptive innovation refers to the introduction of new products or services or significant organizational changes that disrupt existing organizational processes in the industry [50]. Disruptive innovation positively affects digital transformation [51]. Three key types of disruptive innovations—technological variations, innovative products, business frameworks and solutions, and organizational culture influence business success [52].

China's SMEs face both the possibilities and problems of disruptive innovation. Traditional SME processes and practices may become outdated as new technologies arise, thus requiring adaptation to remain competitive. However, SMEs have limited funding and may find it difficult to implement new technologies, which puts them in danger of lagging behind their rivals [5]. To be relevant and long-lasting in China, where the business environment is changing quickly, SMEs must manage the shift toward disruptive technologies. By embracing disruptive innovation, SMEs can increase their market reach, boost productivity, and improve product offers [7].

Furthermore, SMEs that effectively harness disruptive ideas can not only flourish in the cutthroat market but also advance society by spurring economic growth and employment creation as China's economy continues to digitize and modernize [9]. While there is scarce evidence of the direct effects of disruptive innovation on innovative work behavior, indirect paths such as disruptive leadership are negatively related to innovative behaviors [53]. As disruptive innovation encourages businesses to adopt new HR technologies and drive organizational change, it positively moderates the relationship between digital HR practices and digital transformation [48]. Disruptive innovation, on the other hand, fosters a culture of adaptation and creativity in reaction to technology improvements, strengthening the connection between digital transformation and inventive work practices. Disruptive innovations are catalysts that speed up the adoption of transformational initiatives and digital HR practices, encouraging creative work habits within a company [49]. Thus, the relationship between disruptive innovation with innovative work behavior requires further exploration. Matching with the RBV [29], this study proposes that the ability to disrupt innovations and adopt modern technology whenever needed is both perceptible (e.g., technological hardware) and imperceptible (e.g., employees' abilities and skills to use modern technology). These elements ultimately assist the firm in adopting digital HR practices, transforming digitally, developing innovative work behavior, and achieving higher work productivity. The RBV highlights that companies that can successfully implement new ideas and disrupt industries use both real (e.g., technology hardware) and intangible (e.g., personnel talent) resources to propel their businesses forward. As disruptive innovation increases a firm's resource base and competitive advantage, it is likely to reinforce the links described in the hypotheses.

**Hypothesis 5a.** Disruptive innovation positively moderates the relationship between digital HR practices and digital transformation.

**Hypothesis 5b.** Disruptive innovation positively moderates the relationship between digital transformation and innovative work behaviors.

## 2.6. Work productivity

Work productivity denotes the assessment of employee effort, work efficiency, engagement, perfection, and effectiveness, showing the efforts of HR on productive outcomes [54]. Thus, to achieve results, it is desirable for employees put forth effort when using limited inputs, which is referred to as work productivity [55]. Work productivity is a complex phenomenon; does not have a single standard definition; and varies according to business type, size, and contexts [56–58]. Work productivity may include the integration of employee work performance and organizational productivity, leading to the quality of work. By contrast, some studies reported that work productivity is altered by several elements such as supportive leadership, work environments, personal capabilities, integrated inspirational rules, and the standard operating procedures of organizations [59]. Work productivity can be measured from several perspectives such as financial, human, organizational capital, and organizational attributes [60,61] and depends on a bundle of factors. Russo, Hanel [62] explained that numerous psychological (e.g., self-discipline, need for authority, relatedness, and technical skills), physiological (e.g., diet, sleep, physical activity), social (e.g., social contact and communications), and situational factors (e.g., financial security, and office environment) alter work productivity accordingly. Suhariadi, Sugiarti [63] reported that, during COVID-19, working from home improved teachers' productivity. Vara-Horna, Díaz-Rosillo [64] reported the negative effects of workplace sexual harassment on victims' productivity. The professional self-identity of hotel employees positively affected their work productivity [65]. These examples illustrate the multifaceted nature of productivity. Although work productivity does not depend on a single workplace factor, it can be examined from several perspectives and contextual settings. This study investigates the relationship between digital HR practices and employees' work productivity directly and through the mediation of digital transformation and the innovative work behavior of employees in SMEs. The HR management of a firm fundamentally leads its employees to strive to improve their productivity both directly [66] and indirectly [67]. In addition, digitizing HR practices makes it convenient for employees to perform daily tasks by saving time and effort [20]. Thus, we investigate how this mechanism works in Chinese SMEs.

### 3. Methods

#### 3.1. Analytical methods

This study assesses the influence of digital HR practices on the work productivity of Chinese SMEs through the serial mediation of digital transformation, innovative work behavior, and moderating mechanisms of disruptive innovation among the relationships of digital HR practices, digital transformation, and innovative work behaviors. Following Creswell and Creswell [68], this study uses a quantitative method because of its suitability for finding correlations among the proposed constructs. Similarly, this study focuses on a deductive approach based on a robust literature review. This approach comprehends observations, develops hypotheses, collects testable data, and determines the proposed hypotheses [69]. We therefore use a time-lagged survey-based data collection tool because it helps collect data swiftly and effectively to provide prompt insights into the target population and make relevant decisions on propositions. Similarly, the choice of time-lagged data collection is supported by relevant studies on innovation performance [36], work productivity [56], and innovative work behavior [39].

#### 3.2. Population, sampling, and data collection

This assessment focuses on SMEs in Jiangsu province, China. The province's GDP is the second highest in the country (2021) after Guangdong, comprising approximately 10.2 % of the country's total GDP. The province has a substantial private sector, having 2.21 million SMEs in 2020 compared to 286,000 as of 2002 [70]. However, such a large population is challenging to survey fully and drawing a reasonable sample remains an issue. Therefore, this study drew the sample size following Kline [71] and gathered ten times more observations than the number of items used. This study involved five variables and 37 items; thus, the required number of observations was 370.

The survey was designed online and distributed (using social media sites such as QQ, WeChat, Weibo, and email) among managerial employees of manufacturing SMEs in Jiangsu Province. The initial question asked respondents to identify whether they worked in a manufacturing firm as managerial staff; if yes, they were advised to continue responding to the survey. In the survey, respondents were assured that their data would only serve as an analysis for this study and would be kept confidential. To ensure anonymity, respondents were not asked to provide any identifiable personal information. The data were collected using a time-lag method in three rounds (from January to July 2023), with a two-month time lag to eliminate common method bias, as suggested by Podsakoff, MacKenzie [72]. Based on a simple random sampling technique, approximately 660 questionnaire invites were sent in the first round, and 432 responses were received. After the first round of data collection, a computer-based code was placed on all responses to match the responses in the second and third phases. The first round included data on the respondents' demographic information and SMEs' work productivity. In the second round, data on innovative work behaviors and digital HR practices were collected, and approximately 401 responses were collected. In the third and final rounds, data on digital transformation and disruptive innovation were collected, and approximately 352 responses were collected. Two soft prompts were directed at respondents in every round to ensure that they responded. After matching the responses from all three rounds, approximately 339 useable surveys were received for further testing (a 51 % response rate).

Table 1 shows that approximately 59 % of the respondents were male and 41 % were female. According to age, 8 %, 26 %, 47 %, 17 %, and 3 % of the respondents were 20–25, 26–30, 31–35, and 33–40 and 40+ years old, respectively. While 47 % of the respondents had undergraduate degrees, 52 % had graduate degrees, and 1 % had a PhD. When asked about the age of the SMEs they represented, 1

**Table 1**  
Demographic information of responses.

Items		n	%
Gender	Male	201	59.3
	Female	138	40.7
Age (Years)	20–25	26	7.7
	26–30	89	26.3
	31–35	159	46.9
	36–40	56	16.5
	Above 40	9	2.7
Education	Undergraduate	159	46.9
	Graduate	175	51.6
	PhD	5	1.5
Job Level	First-level Management	15	4.4
	Middle-level Management	172	50.7
	Higher-level Management	152	44.8
Age of SMEs (Years)	Less than 1	5	1.5
	1–5	77	22.7
	6–10	187	55.2
	11–15	43	12.7
	Above 15	27	8.0

Notes: Sample size = 339.

Source: Authors' elaboration.

% were less than 1, 23 % were 1–5, 55 % were 6–10, 13 % were 11–15, and 8 % were over 15 years of age. Lastly, regarding the job level of the respondents, approximately 4 % were in first-level managerial positions, 51 % were in middle-level managerial positions, and 45 % were in high-level management, which shows the diversity of the study sample.

#### 4. Results

This study used SmartPLS 4 to analyze the data and perform a partial least square equation model (PLS-SEM). This tool implies partial least squares to assess the model parameters. It is generally more reliable for complicated data with several model variables [73]. PLS-SEM can handle complex variables and complicated relationships [74]. Also, the Smart PLS uses an integrative algorithm that permits quick assessment of complex models.

##### 4.1. Assessment of measures

This study adopted several Smart PLS tests to inspect the scales' validity and reliability. First, item loadings of the scales were tested to see if they were suitable to assess each construct. As per Hair, Risher [74], the results of items loading must be  $\geq 0.70$ , and in this study, the values are all higher than the given threshold, which confirms the suitability of the adopted items. Secondly, Cronbach's Alpha (CA) has been tested. Internal consistency, or how thoroughly connected items are related, is assessed by Cronbach's alpha. It is observed as an instrument of scale reliability, with a threshold of  $\geq 0.70$  [75]. In this study, all the findings of CA are in the satisfactory range (Table 2). Third, this study examined the scales' composite reliability (CR). Like Cronbach's alpha, composite reliability (also called construct reliability) is a test for scale questions of internal consistency. As per Fornell and Larcker [76], it is equal to the whole amount of real score variance concerning the whole scale score variance, and its value should be  $\geq 0.70$ . Put another way; it designates the common variance among the experiential variables implied to identify a latent construct [76]. All the results of CR are in the

**Table 2**  
Measurement model results.

Factors	Items	Mean	Std.	Loadings	CA	CR	AVE
Work Productivity	WP1	3.740	0.898	0.865	0.807	0.91	0.517
	WP2	3.729	1.112	0.898			
	WP3	3.696	0.924	0.885			
	WP4	3.676	0.941	0.856			
	WP5	3.979	1.035	0.792			
	WP6	3.891	0.818	0.795			
	WP7	3.973	1.068	0.742			
	WP8	3.882	0.881	0.795			
Digital Transformation	DT1	3.558	1.430	0.922	0.964	0.965	0.848
	DT2	3.552	1.059	0.883			
	DT3	3.442	1.424	0.938			
	DT4	3.619	1.172	0.916			
	DT5	3.419	1.394	0.934			
	DT6	3.496	1.444	0.932			
Innovative Work Behavior	IWB1	3.578	1.095	0.845	0.956	0.963	0.720
	IWB2	3.879	0.925	0.821			
	IWB3	3.829	1.118	0.927			
	IWB4	3.761	1.162	0.922			
	IWB5	3.643	1.406	0.937			
	IWB6	3.802	1.126	0.919			
	IWB7	3.850	0.989	0.873			
	IWB8	3.853	0.951	0.778			
	IWB9	3.879	1.062	0.750			
	IWB10	3.923	1.081	0.771			
Digital Human Resource Practices	DHRP1	3.941	0.994	0.775	0.942	0.946	0.715
	DHRP2	4.038	0.987	0.878			
	DHRP3	4.047	1.046	0.884			
	DHRP4	3.938	0.977	0.896			
	DHRP5	3.917	0.980	0.850			
	DHRP6	3.847	0.996	0.842			
	DHRP7	3.873	1.064	0.824			
	DHRP8	3.894	1.022	0.893			
Disruptive Innovation	DI1	3.681	1.064	0.885	0.921	0.924	0.759
	DI2	3.740	1.058	0.860			
	DI3	3.761	1.199	0.883			
	DI4	3.814	1.201	0.848			
	DI5	3.785	1.149	0.878			

Notes: CA = Cronbach Alpha, CR = Composite Reliability, AVE = Average Variance Extracted, Std. = standard deviation, DHRPs = Digital human resources practices, DT = Digital transformation, IWB = Innovative work behavior, WP = Work productivity, DI = Disruptive innovation.

Source: Authors' elaboration.



satisfactory range. Fourth, the average variance extracted (AVE) was assessed. AVE is a test for likening the variation apprehended by a construct to the change after the measurement error. An AVE of around 0.50 is strongly recommended as an overall rule and for passable convergence. A lower than 0.50 AVE shows that study questions account for more errors than the variance in research constructs. An AVE should be tested for each concept in any measurement model and should be  $\geq 0.50$ . This meets the rule of thumb for all study constructs shown in Table 1, where all AVE values are  $\geq 0.50$  (Table 2).

Furthermore, following Fornell and Larcker [76] advice, this study evaluated the discriminant validity by tests such as Heterotrait-monotrait (HTMT) and Fornell-Larcker criterion. It was suggested by Henseler, Ringle [77] that the HTMT is more suitably associated with the Fornell and Larcker test, satisfactory (Table 3). According to Table 3, Fornell-Larcker demonstrates that HTMT results are lower than 0.90 above the correlations. Thus, the criteria for discriminant validity were met. The research also aimed to measure the variance of the inflation factor test (VIF) used to evaluate the data's multicollinearity problem. The outcomes of VIF fewer than ten should be used [78]. Table 4's VIF data demonstrates no multicollinearity in the data.

The present study investigated the structural model implying the Smart-PLS technique of 10,000 bootstraps [79]. The model fitness was assessed using standardized root means square (SRMR) data. The SRMR must be less than 0.08, as suggested by Henseler, Ringle [77], and according to the most recent results of Cho, Hwang [80], the findings of the SRMR should be lower than 0.08 for a sample size of more than 100. An SRMR outcome of 0.074 indicated a model fitness range that was suitable. According to Chin [81], satisfying results of  $R^2$  should be higher than 0.1; the structural model also clarified that 59 % of changes in work productivity, 38 % of changes in digital transformation, and 61 % of changes were observed by the predicting variables (Table 4). The results of  $Q^2$  must also be more than 0. The current study's  $R^2$  and  $Q^2$  are more significant than 0.1; as a result, the model's predictive significance was obtained [82].

Because we collected the data on outcomes and predictor constructs from the same respondents, we used Harman's single factor test to assess the possibility of the common method bias (CMB) using SPSS [72]. Usually, CMB exists when the total variation of one factor is higher than half of the variation in the process. The test in this study shows a 36.1 % variance explained by a single factor which is less than the given threshold of 50 %. In addition, as suggested by the latest studies single factor test has some limitations [83]; thus we also applied a marker variable approach using SmartPLS (4.0). we included a marker variable in the model, which was theoretically unrelated to the constructs of the study [84]. The assessment showed that the variation in the  $R^2$  with (WP = 0.589, DT = 0.389, IWB = 0.589) and without (WP = 0.592, DT = 0.383, IWB = 0.621) a marker variable was less than 10 % as suggested in the past studies showing no issue of CMB in the data [84].

#### 4.2. Hypothesis testing

The findings of the PLS-SEM show that digital human resource practices have a positive and significant relationship with digital transformation ( $\beta = 0.366$ ,  $t = 6.291$ ), innovative work behavior ( $\beta = 0.282$ ,  $t = 5.496$ ), and work productivity ( $\beta = 0.135$ ,  $t = 2.323$ ), and H1a, b, and c was accepted. Also, digital transformation positively and expressively associated with innovative work behavior ( $\beta = 0.503$ ,  $t = 8.270$ ) and work productivity ( $\beta = 0.552$ ,  $t = 6.717$ ), and H2a and b were accepted. Innovative work behavior is also positively and significantly associated with work productivity ( $\beta = 0.207$ ,  $t = 2.162$ ), leading to accepting H3a. When tested for the mediating relations, it was noticed that the digital transformation positively and meaningfully mediated the relationships between digital human resource practices and innovative work behavior ( $\beta = 0.182$ ,  $t = 5.232$ ). Innovative work behavior also significantly arbitrated the relationship between digital transformation and work productivity ( $\beta = 0.104$ ,  $t = 2.108$ ). Likewise, all the mediating hypotheses were accepted: digital transformation and innovative work behavior positively and significantly mediated the association between digital human resource practices and work productivity ( $\beta = 0.138$ ,  $t = 2.969$ ) (Table 5, Fig. 3). Lastly, the moderating relation of disruptive innovation was examined. It was found that disruptive innovation positively moderated the connection between digital human resource practices and digital transformation ( $\beta = 0.083$ ,  $t = 2.181$ ). Fig. 3 shows that disruptive innovation strengthens

**Table 3**  
Discriminant validity testing.

Heterotrait-monotrait Ratio (HTMT)					
	DHRP	DI	DT	IWB	
DI	0.434				
DT	0.517	0.561			
IWB	0.615	0.565	0.755		
WP	0.492	0.475	0.664	0.602	
Fornell-Larcker Criterion					
	DHRP	DI	DT	IWB	WP
DHRP	0.846*				
DI	0.407	0.871*			
DT	0.495	0.532	0.921*		
IWB	0.590	0.534	0.729	0.849*	
WP	0.515	0.480	0.737	0.667	0.646*

Notes: \* shows the square root of AVE, DHRPs = Digital human resources practices, DT = Digital transformation, IWB = Innovative work behavior, WP = Work productivity, DI = Disruptive innovation.

Source: Authors' elaboration.

**Table 4**  
Model fit results.

Factors	VIF	R <sup>2</sup>	R <sup>2</sup> Adj.	Q <sup>2</sup>	SRMR
Work Productivity	1.534	0.592	0.589	0.238	0.074
Digital Transformation	1.422	0.383	0.378	0.32	–
Innovative Work Behavior	1.534	0.621	0.616	0.441	–
Digital Human Resource Practices	1.329	–	–	–	–
Disruptive Innovation	1.643	–	–	–	–

Notes: VIF = Variance inflation factor, R2 = Coefficient of determination, Q2 = Predictive relevance of the model, SRMR = Standardized Root Mean Square Residual.

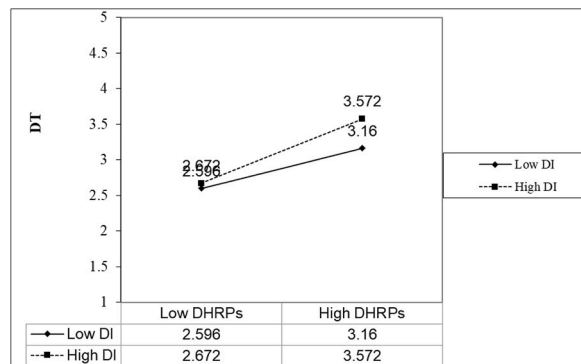
Source: Authors' elaboration.

**Table 5**  
Hypothesis testing.

Hypotheses	$\beta$	STDV.	T-value	P-value	Decision	
<b>Direct relations</b>						
Hypothesis 1a	DHRPs → DT	0.366	0.058	6.291	0.000**	Supported
Hypothesis 1b	DHRPs → IWB	0.282	0.051	5.496	0.000**	Supported
Hypothesis 1c	DHRPs → WP	0.135	0.057	2.323	0.020**	Supported
Hypothesis 2a	DT → IWB	0.503	0.061	8.270	0.000**	Supported
Hypothesis 2b	DT → WP	0.522	0.078	6.717	0.000**	Supported
Hypothesis 3a	IWB → WP	0.207	0.095	2.162	0.031**	Supported
<b>Mediating relations</b>						
Hypothesis 2c	DHRPs → DT → IWB	0.184	0.035	5.232	0.000**	Supported
Hypothesis 3b	DT → IWB → WP	0.104	0.049	2.108	0.035**	Supported
Hypothesis 4	DHRPs → DT → IWB → WP	0.138	0.099	2.969	0.029**	Supported
<b>Moderating relations</b>						
Hypothesis 5a	DI*DHRPs → DT	0.083	0.038	2.181	0.029**	Supported
Hypothesis 5b	DI*DT → IWB	0.054	0.040	1.337	0.181**	Not Supported

Notes:  $\beta$  = path coefficients, STDV = Standard deviation, T-value = parameter estimate, P-value sig at < 0.05 (95 %), DHRPs = Digital human resources practices, DT = Digital transformation, IWB = Innovative work behavior, WP = Work productivity, DI = Disruptive innovation.

Source: Authors' elaboration.



**Fig. 3.** Interaction effects of DI and DHRPs on DT.

Notes: DHRPs = Digital human resources practices, DT = Digital transformation, DI = Disruptive innovation.

Source: Authors' elaboration.

the link between digital human resource practices and digital transformation. The graph indicates two lines, one for low and one for high disruptive innovation. With low disruptive innovation, the link between digital human resource practices and digital transformation is present but weaker. However, the line gets steeper under high disruptive innovation, showing that strong digital human resource practices become even more critical for driving successful digital transformation during disruptive times. At the same time, it did not moderate the connection between digital transformation and innovative work behavior ( $\beta = 0.054$ ,  $t = 1.337$ ), which led to accepting H5a and rejecting H5b. Fig. 4 shows that digital transformation increases innovative work behaviors, but this effect weakens when there's high disruption. In other words, new digital tools boost creativity unless the change is overwhelming.

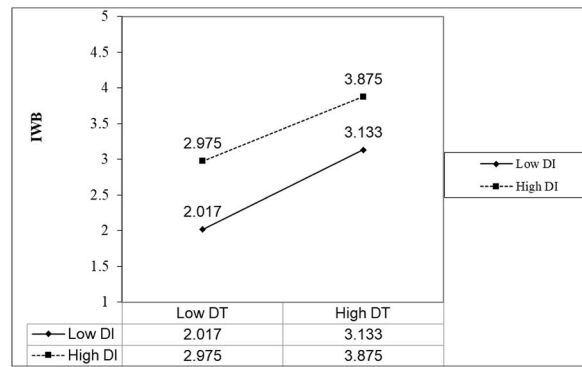


Fig. 4. Interaction effects of DI and DT on IWB.

Notes: DT = Digital transformation, IWB = Innovative work behavior, DI = Disruptive innovation.

Source: Authors' elaboration.

## 5. Discussion

### 5.1. Theoretical implications

This study assessed the influence of digital HR practices on work productivity in Chinese SMEs, considering the serial mediation of digital transformation and innovative work behavior, along with the moderating role of disruptive innovation. This section elaborates on the findings related to each hypothesis, the theoretical framework, and the implications for both theory and practice. By providing a nuanced understanding of these relationships, the study contributes to the growing body of literature on digital transformation and its multifaceted impact on organizational performance. The results of this study present several significant theoretical implications.

First, our findings demonstrate that digital HR practices positively influence digital transformation, innovative work behavior, and productivity. The results support the hypotheses, showing that SMEs adopting digital HR practices are more likely to experience digital transformation, foster innovative work behavior among their employees, and enhance productivity. This corroborates literature emphasizing the importance of digitizing HR practices to boost organizational outcomes [1]. Moreover, it underscores the role of digital HR practices as a foundational element that can drive broader organizational changes and improvements. The study further theorizes that digital transformation positively impacts innovative work behavior and productivity. The findings confirm these relationships, indicating that as SMEs embrace digital transformation, they cultivate an environment conducive to innovative work behavior among employees, thereby positively affecting work productivity. This finding highlights the need for SMEs to invest in digital capabilities to remain competitive and innovative. This underscores the transformative power of digital technologies in reshaping organizational procedures and behaviors [33,35].

Second, the study hypothesizes that digital transformation mediates the relationship between digital HR practices and innovative work behavior. The results validate this mediation effect, suggesting that digital transformation serves as an intermediary through which digital HR practices can foster innovative work behavior. This highlights the role of digital HR practices in driving broader organizational transformations [34]. This mediation effect reveals the importance of a phased approach to digital transformation, where initial digital HR initiatives lay the groundwork for subsequent innovative behaviors. Additionally, the study proposes that innovative work behavior impacts work productivity. These results support the importance of nurturing a culture of innovation within SMEs to enhance work productivity [40]. Creating a supportive environment for innovation can lead to sustainable productivity gains and long-term organizational success.

Third, the study posits that innovative work behavior mediates the relationship between digital transformation and work productivity. The findings confirm this mediation effect, indicating that innovative work behavior is a crucial pathway through which digital transformation influences work productivity. This underscores the significance of innovative behavior as a predictor of productivity improvements in the digital age [33]. Furthermore, the results suggest that both digital transformation and innovative work behavior mediate the relationship between digital HR practices and work productivity. This complex mediation indicates that digital HR practices initiate a chain reaction: they trigger the digital transformation, which, in turn, fosters innovative work behavior, ultimately leading to enhanced work productivity. This complex mediation underscores the transformative potential of digitally driven HR strategies [60].

Fourth, the study conjectures that disruptive innovation moderates the relationships between digital HR practices and digital transformation and between digital transformation and innovative work behavior. These findings confirm the moderating effect of disruptive innovation on the relationships between digital HR practices and digital transformation. However, the moderating effect of disruptive innovation on the relationship between digital transformation and innovative work behavior is insignificant, leading to the rejection of hypothesis H5b. This suggests that disruptive innovation plays a more significant role in facilitating the adoption of digital technologies and practices within HR functions and in the initial phases of digital transformation [60]. Once digital transformation is underway, the effect of disruptive innovation on employees' innovative work behavior diminishes. This may imply that while disruptive innovation facilitates organizational change, its influence on employees' behaviors and innovative tendencies becomes less

pronounced once the initial technological disruption is integrated. This finding supports the notion that the impact of disruptive innovations can be context-dependent and change over time [85].

### 5.2. Practical implications

The outcomes of this study have several practical and managerial implications for SMEs regarding digital transformation and HR management.

First, distinguishing the pivotal role of digital HR practices in nurturing digital transformation, innovative work behavior, and enhancing work productivity is crucial. SMEs should digitize their HR processes, including recruitment, training, and performance management to connect the benefits of efficient operations and enhanced workforce productivity. This transition not only streamlines HR functions but also enables a more agile and responsive workforce, ready to meet the demands of a dynamic business environment.

Second, it emphasizes the importance of cultivating a culture of innovation among SMEs. Assuring employees to think creatively, produce novel ideas, and accept innovative work behaviors increases productivity. SMEs should substitute for an environment that standards and rewards innovation, offering employees autonomy and the tools to discover new ways of doing things. Creating innovation hubs or dedicated time for creative thinking can further embed a culture of continuous improvement and inventive problem-solving.

Third, this study demonstrates the moderating role of disruptive innovation. SMEs should remain attentive and adaptive to disruptive technological progress in their industries. Embracing disruptive innovations can facilitate the transition to digital HR practices and improve the overall transformation process. SMEs should continuously scan the technological landscape for opportunities to adopt disruptive innovations that provide a competitive advantage. Establishing an innovation task force or leveraging external innovation consultants can help SMEs stay ahead of technological trends and implement cutting-edge solutions effectively. Practically, SMEs should consider allocating resources to upskill their workforce and prepare employees with the technical and soft skills necessary to thrive in a digitally transformed environment. Training programs in software design, data analytics, and critical thinking can authorize employees to contribute vigorously to digital transformation. Investing in continuous learning platforms and partnerships with educational institutions can ensure ongoing skill development aligned with industry needs.

Fourth, SMEs can benefit from strategic planning that incorporates digital transformation as a central pillar of their business strategy. By aligning digital initiatives with overall organizational goals, SMEs can ensure a smoother transition and a more critically significant impact on work productivity. Integrating digital transformation into the core strategic vision and establishing clear milestones and metrics for digital initiatives can drive focused and sustained progress.

In summary, this study offers valuable insights for SMEs seeking to navigate the digital age effectively. Implementing digital HR practices, fostering innovation, remaining in agreement with disruptive technologies, and capitalizing on employee skill development can position SMEs to improve work productivity and competitiveness in an increasingly digital business environment. By adopting these strategic and practical measures, SMEs can transform challenges into opportunities, ensuring long-term success and resilience in the digital era.

### 5.3. Academic implications

Despite its ongoing rapid growth, China's digital economy has encountered challenges. Compared with industrialized economies, the penetration of the digital economy in China remains relatively low. The China Academy of Information and Communications Technology (CAICT) estimates that China will have digitalization rates in the primary, manufacturing, and tertiary sectors of 8.9 %, 21.0 %, and 40.7 %, respectively, in 2020 compared with 23.1 %, 45.3 %, and 60.4 %, in Germany in 2019 [86]. Additionally, China's economic digitalization is unevenly spread across industries, with service-related industries exhibiting a higher level of digitalization than industrial and agricultural businesses. Geographic imbalances hamper the growth of the sector, causing a digital gap across China. Compared to the central and western provinces and rural areas, the digital economy is more prevalent in the eastern provinces and major cities, such as Beijing, Shanghai, Guangdong, Jiangsu, and Zhejiang [86].

By contrast, headwinds have emerged following 20 years of persistent lax policy. Before the rapid growth of large tech companies raised concerns about the monopolistic power in the industry, as exemplified by BAT, support for information technology and the Internet economy had long been the focus of China's economic policies. The recent regulatory crackdown on Internet companies such as Alibaba, Tencent, and Didi indicates a shift in its digital regulations, profoundly impacting the digital economy sector in China [86]. Furthermore, as China seeks to increase its global influence in digital technologies, the sector has also become a focal point in the technological competition between China and the US. Therefore, when navigating the Chinese digital economy, businesses should be mindful of the challenges and consider avoiding high-risk regions while identifying opportunities in specific fields, such as cross-border e-commerce, digital services trade, and fintech [87].

Based on the outcomes of this study, SMEs should consider several approaches to connect the benefits of digital transformation, innovative work behavior, and better work productivity. These suggestions can assist SMEs in their strategic methods for HR management and technology acceptance.

- *Digital HR Integration:* SMEs should develop a comprehensive policy that integrates digital HR practices across all functions. This policy should outline steps and plans to digitize recruitment, training, performance management, and other related process. Highlighting the adoption of AI tools, online platforms, and data analytics can streamline HR operations and enhance efficiency.

- *Innovation Cultivation*: SMEs should adopt innovation as a core organizational value. A dedicated policy can encourage a culture of innovation by rewarding employees for developing novel ideas and rewarding innovative contributions. This policy should provide guidelines to identifying and nurture innovative work behavior in the workforce.
- *Disruptive Technology Adoption*: Considering the moderating role of disruptive innovation, SMEs should develop policies that emphasize the monitoring of emerging technologies relevant to their industry. This policy should assist decision-making in adopting disruptive technologies to improve HR practices and overall business processes. This should comprise mechanisms for incessant technology assessment and adaptation.
- *Skills Development and Training*: Considering the importance of employee skills in the digital age, SMEs should devise policies for persistent skills development and training. This policy should provide detailed strategies for enhancing the workforce, including programming, data analytics, critical thinking, and digital learning. They should assign resources and incentivize employees to attain and apply these skills effectively.
- *Strategic Digital Transformation*: SMEs should develop a strategic digital transformation policy that supports digital initiatives with a broader organizational strategy. This policy should describe the objectives, timelines, and key transformation activities. They should also assign responsibilities and resources for successful implementation.
- *Monitoring and Evaluation*: To confirm the efficiency of their policies, SMEs should monitor and assess their digital HR practices, innovation outcomes, and work productivity continuously. Steady assessments can help to classify areas for improvement and lead to adjustments in policies and strategies.
- *Data Privacy and Security*: With their increasing reliance on digital tools and data-led HR practices, SMEs should order data privacy and security. A vigorous policy should discuss data protection measures, agreements with relevant regulations, and employee training on data management best practices.
- *Collaboration and Knowledge Sharing*: SMEs can benefit from fostering employee collaboration and knowledge distribution. A policy that includes cross-functional collaboration, thinking sessions, and the sharing of best practices can improve innovative work behavior and productivity.
- *Supplier and Technology Partners*: SMEs should develop policies for selecting and cooperating with technology suppliers and partners. These policies should include criteria for evaluating technology suppliers, negotiating contracts, and guaranteeing ongoing support and updates.
- *Risk Management*: SMEs should develop risk management policies to alleviate the potential risks associated with digital transformation and disruptive innovations. This policy should outline strategies for classifying, measuring, and mitigating risks related to technology adoption, data security, and business stability.

Integrating these policy implications into their organizational models will help SMEs navigate the challenges and opportunities presented by the digital era. These policies should be customized to each SME's specific needs and resources, offering a roadmap for sustainable growth and competitiveness in an increasingly digital business environment.

#### 5.4. Limitations and future research directions

This study has some limitations. First, the data came from a particular province in China, which may limit the applicability of our conclusions to SMEs in other nations or locations. Future research should attempt to broaden the geographical area covered by the data collection for a more thorough understanding. Second, the use of time-lagged data in this study limited the longitudinal implications. A more comprehensive understanding of the phenomena under study could be obtained through longitudinal research, which could offer deeper insights into the dynamics of innovation and digital transformation in SMEs as they change over time. Third, organizational stakeholders may find useful information by planning intervention studies to assess the efficacy of tactics targeted at advancing digital HR practices, encouraging innovative behaviors, and raising productivity in SMEs. Future industry-specific studies should investigate how the relationships among digital HR practices, digital transformation, innovation behavior, and work productivity vary across industry sectors.

#### 5.5. Conclusion

With a major focus on work productivity, we thoroughly investigated the complex relationships among digital HR practices, digital transformation, innovative work behavior, and disruptive innovation within the framework of Chinese SMEs. Utilizing a rigorous research design and empirical analysis, we aimed to make a meaningful contribution to the current corpus of knowledge in this field, benefiting researchers and practitioners alike. Several important findings advance our knowledge of these links. First, we conducted an empirical study to confirm the beneficial effects of digital HR practices on innovative work practices, digital transformation, and productivity in SMEs. The results highlight the importance of digital initiatives in driving productivity gains and organizational changes in the current digital era.

Our research also supports the notion that innovative work practices and digital transformation mediate the association between work productivity and digital HR practices. The results underscore how innovation and digitalization practices enhance productivity outcomes in SMEs. They also demonstrated the significance of cultivating an innovative culture using digital HR initiatives. We also examined the moderating role of disruptive innovation and found that it greatly influences the adoption of digital technology by HR departments. Although disruptive innovation helps adopters of digital HR practices, as digital transformation advances, its impact on employee behavior decreases. The contextual and temporal aspects of disruptive innovations and their implications for organizational



change are highlighted from this sophisticated perspective.

Our study expands on existing theoretical frameworks and empirical data, providing factual support for important claims and presenting fresh perspectives on the dynamics of digitalization and HR management in SMEs. This study adds to the literature on digital transformation and HR management by providing empirical support for theoretical claims and clarifying the underlying processes of productivity gain. Our study highlights the significance of adopting digital HR practices, encouraging innovation, and managing disruptive development to improve work efficiency within SMEs. Our research has practical implications for SMEs looking to prosper and survive in the digital age by emphasizing the need for a thorough digital HR strategy and innovative digital initiatives. Future research should continue to examine the intricacies of digitalization and HR management in various corporate situations to deepen our understanding of these important phenomena.

### Data availability statement

Data will be made available on request.

### Ethical approval

The study was conducted according to the guidelines of the Declaration of Helsinki. The review board of Jiangsu University exempted the research from ethical approval, as it is a survey-based study. The study obtained the consent of the employees working in the SMEs and they filled the questionnaires willingly.

### Consent to participate

All the participants of the study willingly participated and gave full consent to participate in this study.

### Consent to publish

I hereby provide consent for the publication of the manuscript detailed above, including any accompanying images or data contained within the manuscript that may directly or indirectly disclose the authors' identity or that of any disclosed firms.

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### CRediT authorship contribution statement

**Ying Zhang:** Funding acquisition, Formal analysis, Data curation. **Shuja Iqbal:** Writing – original draft, Formal analysis. **Hongyun Tian:** Supervision, Funding acquisition, Conceptualization. **Shamim Akhtar:** Writing – review & editing, Software.

### Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

### References

- [1] S. Strohmeier, Digital human resource management: a conceptual clarification, *German Journal of Human Resource Management* 34 (3) (2020) 345–365.
- [2] I. Pantelidis, Digital human resource management, in: *Human Resource Management in the Hospitality Industry*, Routledge, 2019, pp. 337–352.
- [3] A. Marcysiak, Ż. Pleskacz, Determinants of digitization in SMEs, *Entrepreneurship and Sustainability Issues* 9 (1) (2021) 300.
- [4] T.S.A. Essa, This is the secret of the most successful small businesses, Available from: <https://www.weforum.org/agenda/2018/01/this-is-the-secret-of-the-most-successful-small-businesses/>, 2018.
- [5] B. Lin, J. Zhu, Determinants of renewable energy technological innovation in China under CO2 emissions constraint, *J. Environ. Manag.* 247 (1) (2019) 662–671.
- [6] D. Castro, M. McLaughlin, E. Chivot, Who is winning the AI race: China, the EU or the United States, *Center for data innovation* 19 (2019).
- [7] D. Nguyen, Growth, productivity and digitalisation in China, Available from: <https://www.niesr.ac.uk/wp-content/uploads/2021/10/Growth-productivity-and-digitalisation-in-China-Full-box-analysis-4.pdf>, 2020.
- [8] X. Gu, et al., How do firms respond to COVID-19? First evidence from Suzhou, China, in: *Research on Pandemics*, Routledge, 2021, pp. 49–65.
- [9] L. Lu, et al., Perceived impact of the Covid-19 crisis on SMEs in different industry sectors: evidence from Sichuan, China, *Int. J. Disaster Risk Reduc.* 55 (2021) 102085.
- [10] Á. Nicolás-Agustín, D. Jiménez-Jiménez, F. Maeso-Fernandez, The role of human resource practices in the implementation of digital transformation, *Int. J. Manpow.* 43 (2) (2022) 395–410.
- [11] A.S. Bharadwaj, A resource-based perspective on information technology capability and firm performance: an empirical investigation, *MIS Q.* 24 (1) (2000) 169–196.
- [12] S. Bag, et al., Sustainable electronic human resource management systems and firm performance: an empirical study, *Int. J. Manpow.* 43 (1) (2022) 32–51.
- [13] S. Bag, et al., Role of institutional pressures and resources in the adoption of big data analytics powered artificial intelligence, sustainable manufacturing practices and circular economy capabilities, *Technol. Forecast. Soc. Change* 163 (1) (2021) 1–14.
- [14] A. Jerman, M. Pejić Bach, A. Aleksić, Transformation towards smart factory system: examining new job profiles and competencies, *Syst. Res. Behav. Sci.* 37 (2020) 388–402.

- [15] K. Szczepańska-Woszczynna, The importance of organizational culture for innovation in the company, in: *Forum Scientiae Oeconomia*, 2014.
- [16] B. Nadeak, L. Naibaho, M. Silalahi, COVID-19 and students' anxiety management, *International Journal of Innovation, Creativity and Change* 13 (7) (2020) 1574–1587.
- [17] B. Logvinenko, Study of artificial intelligence tools in the management of the behavior of economic agents in the digital space at enterprises, *The Journal of VN Karazin Kharkiv National University. Series: International Relations. Economics. Country Studies. Tourism* (15) (2022) 45–53.
- [18] A. Zirar, Can artificial intelligence's limitations drive innovative work behaviour? *Review of Managerial Science* (2023) 1–30.
- [19] S. Si, H. Chen, A literature review of disruptive innovation: what it is, how it works and where it goes, *J. Eng. Technol. Manag.* 56 (1) (2020) 101568.
- [20] M. Sharma, et al., Analysing the impact of sustainable human resource management practices and industry 4.0 technologies adoption on employability skills, *Int. J. Manpow.* 43 (2) (2022) 463–485.
- [21] A.A. Kharlamov, G. Parry, The impact of servitization and digitization on productivity and profitability of the firm: a systematic approach, *Prod. Plann. Control* 32 (3) (2021) 185–197.
- [22] T. Jeske, M. Würfels, F. Lennings, Development of digitalization in production industry—Impact on productivity, management and human work, *Proc. Comput. Sci.* 180 (2021) 371–380.
- [23] C.-C. Lee, Z.-W. He, Z. Yuan, A pathway to sustainable development: digitization and green productivity, *Energy Econ.* 124 (1) (2023) 106772.
- [24] R. Mostaghel, et al., Digitalization driven retail business model innovation: evaluation of past and avenues for future research trends, *J. Bus. Res.* 146 (1) (2022) 134–145.
- [25] F. Kitsios, M. Kamariotou, Service innovation process digitization: areas for exploitation and exploration, *Journal of Hospitality and Tourism Technology* 12 (1) (2021) 4–18.
- [26] H. Endres, S. Huesig, R. Resch, Digital innovation management for entrepreneurial ecosystems: services and functionalities as drivers of innovation management software adoption, *Review of Managerial Science* 1 (1) (2022) 1–22.
- [27] S. Kraus, N. Roig-Tierno, R.B. Bouncken, Digital innovation and venturing: an introduction into the digitalization of entrepreneurship, *Review of Managerial Science* 13 (3) (2019) 519–528.
- [28] J. Benitez, et al., Impact of digital leadership capability on innovation performance: the role of platform digitization capability, *Inf. Manag.* 59 (2) (2022) 103590.
- [29] J.B. Barney, Resource-based theories of competitive advantage: a ten-year retrospective on the resource-based view, *J. Manag.* 27 (6) (2001) 643–650.
- [30] A. AlHamad, et al., The effect of electronic human resources management on organizational health of telecommunications companies in Jordan, *International Journal of Data and Network Science* 6 (2) (2022) 429–438.
- [31] R.C. Sangaji, A.N.A. Setyaning, E.G. Marsasi, A literature review on digital human resources management towards digital skills and employee performance, in: *International Conference on Business and Technology*, Springer, 2022.
- [32] T. Blom, H. Kazeroony, Y. Du Plessis, The role of electronic human resource management in diverse workforce efficiency, *SA J. Hum. Resour. Manag.* 17 (1) (2019) 1–12.
- [33] A. Purwanto, et al., The Role of Transformational Leadership, Organizational Citizenship Behaviour, Innovative Work Behaviour, Quality Work Life, Digital Transformation and Leader Member Exchange on Universities Performance, *Linguistica Antverpiensia*, 2021.
- [34] A. Pilav-Velić, et al., Digital or innovative: understanding “digital literacy–practice–innovative work behavior” chain, *S. East Eur. J. Econ. Bus.* 16 (1) (2021) 107–119.
- [35] T. Erhan, H.H. Uzunbacak, E. Aydin, From conventional to digital leadership: exploring digitalization of leadership and innovative work behavior, *Management Research Review* 45 (11) (2022) 1524–1543.
- [36] X. Xing, et al., Digital transformation and innovation performance of China's manufacturers? A configurational approach, *Technol. Soc.* 75 (1) (2023) 102356.
- [37] P.J. Guinan, S. Parise, N. Langowitz, Creating an innovative digital project team: levers to enable digital transformation, *Bus. Horiz.* 62 (6) (2019) 717–727.
- [38] Y. Curzi, et al., Performance appraisal and innovative behavior in the digital era, *Front. Psychol.* 10 (1) (2019) 1659.
- [39] T. Yidong, L. Xinxin, How ethical leadership influence employees' innovative work behavior: a perspective of intrinsic motivation, *J. Bus. Ethics* 116 (2013) 441–455.
- [40] N. Jankelová, Z. Joniaková, J. Mišún, Innovative work behavior—a key factor in business performance? The role of team cognitive diversity and teamwork climate in this relationship, *J. Risk Financ. Manag.* 14 (4) (2021) 1–16.
- [41] R. Sanz-Valle, D. Jiménez-Jiménez, HRM and product innovation: does innovative work behaviour mediate that relationship? *Manag. Decis.* 56 (6) (2018) 1417–1429.
- [42] K. Afridi, et al., Impact of digital communications on project efficiency through ease of use and top management support, *Heliyon* 9 (7) (2023) e17941.
- [43] K. Sanders, et al., Performance-based rewards and innovative behaviors, *Hum. Resour. Manag.* 57 (6) (2018) 1455–1468.
- [44] P.C. Verhoef, et al., Digital transformation: a multidisciplinary reflection and research agenda, *J. Bus. Res.* 122 (1) (2021) 889–901.
- [45] J. Bérubé, C. Demers, Creative organizations: when management fosters creative work, *Creativ. Ind. J.* 12 (3) (2019) 314–340.
- [46] A. Purwanto, Tourist satisfaction and performance of tourism industries: how the role of innovative work behaviour, organizational citizenship behaviour? *Journal of Industrial Engineering & Management Research* 3 (1) (2022) 1–12.
- [47] M. Hajhashem, A. Khorasani, Demystifying the dynamic of disruptive innovations in markets with complex adoption networks: from encroachment to disruption, *Int. J. Innovat. Technol. Manag.* 12 (5) (2015) 1550022.
- [48] S. Si, H. Chen, A literature review of disruptive innovation: what it is, how it works and where it goes, *J. Eng. Technol. Manag.* 56 (2020) 101568.
- [49] D. Majumdar, P.K. Banerji, S. Chakrabarti, Disruptive technology and disruptive innovation: ignore at your peril, *Technol. Anal. Strat. Manag.* 30 (11) (2018) 1247–1255.
- [50] C. Millar, M. Lockett, T. Ladd, Disruption: technology, innovation and society, *Technol. Forecast. Soc. Change* 129 (2018) 254–260.
- [51] K. Tomičić-Pupek, et al., Disruptive business model innovation and digital transformation, *Bus. Syst. Res.: International journal of the Society for Advancing Innovation and Research in Economy* 14 (1) (2023) 1–25.
- [52] V. Roblek, et al., The role and meaning of the digital transformation as a disruptive innovation on small and medium manufacturing enterprises, *Front. Psychol.* 12 (2021) 592528.
- [53] X. Hou, W. Li, Q. Yuan, Frontline disruptive leadership and new generation employees' innovative behaviour in China: the moderating role of emotional intelligence, *Asia Pac. Bus. Rev.* 24 (4) (2018) 459–471.
- [54] M. Enis Bulak, A. Turkyilmaz, Performance assessment of manufacturing SMEs: a frontier approach, *Ind. Manag. Data Syst.* 114 (5) (2014) 797–816.
- [55] T.Y. Chang, et al., The effect of pollution on worker productivity: evidence from call center workers in China, *Am. Econ. J. Appl. Econ.* 11 (1) (2019) 151–172.
- [56] T.D. Street, S.J. Lacey, K. Somoray, Employee stress, reduced productivity, and interest in a workplace health program: a case study from the Australian mining industry, *Int. J. Environ. Res. Publ. Health* 16 (1) (2019) 94.
- [57] M. Newmann-Godful, Distraction as a Mediator of Productivity: Measuring the Role of the Internet, University of Phoenix, 2013, pp. 2–24.
- [58] S. Khan, P.S.U. Sabri, N. Nasir, Cost of workplace bullying for employees: an anti-bullying policy through introduction of workplace spirituality in higher education sector of Lahore, Pakistan, *Sci. Int.* 28 (1) (2016) 541–549.
- [59] J.E. Mathieu, M.A. Wolfson, S. Park, The evolution of work team research since Hawthorne, *Am. Psychol.* 73 (4) (2018) 308.
- [60] A.M. Faisal, et al., Behavioral ambidexterity: the impact of incentive schemes on productivity, motivation, and performance of employees in commercial banks, *Hum. Resour. Manag.* 54 (S1) (2015) s45–s62.
- [61] M.L. Shier, et al., Preventing workplace violence in human services workplaces: organizational dynamics to support positive interpersonal interactions among colleagues, *Human Service Organizations: Management, Leadership & Governance* 42 (1) (2018) 4–18.
- [62] D. Russo, et al., Predictors of well-being and productivity among software professionals during the COVID-19 pandemic—a longitudinal study, *Empir. Software Eng.* 26 (4) (2021) 62.
- [63] F. Suhariadi, et al., Work from home: a behavioral model of Indonesian education workers' productivity during Covid-19, *Heliyon* 9 (3) (2023) e14082.

- [64] A.A. Vara-Horna, et al., Direct and indirect effects of workplace sexual harassment on the productivity of victims and witnesses: the preventive role of equitable management, *Heliyon* 9 (11) (2023) e21096.
- [65] A. Xie, F.C. Leh, N. Rambeli, Perfunctory or faithful: the impact of self-professional identity on labor productivity of front-line employees in hotels, *Heliyon* 9 (8) (2023) e19133.
- [66] L. Ngwenya, C. Aigbavboa, Improvement of productivity and employee performance through an efficient human resource management practices, in: *Advances in Human Factors, Business Management, Training and Education: Proceedings of the AHFE 2016 International Conference on Human Factors, Business Management and Society*, July 27-31, 2016, Walt Disney World®, Springer, Florida, USA, 2017.
- [67] R.R. Ahmed, et al., The role of green innovation on environmental and organizational performance: moderation of human resource practices and management commitment, *Heliyon* 9 (1) (2023) e12679.
- [68] J.W. Creswell, J.D. Creswell, *Research Design: Qualitative, Quantitative, and Mixed Methods Approaches*, Sage publications, 2017.
- [69] A. Bryman, Barriers to integrating quantitative and qualitative research, *J. Mix. Methods Res.* 1 (1) (2007) 8–22.
- [70] Hktdc, *Jiangsu: Market Profile, 2022*. Available from: <https://research.hktdc.com/en/data-and-profiles/mcpc/provinces/jiangsu>.
- [71] R. Kline, *Principles and Practice of Structural Equation Modeling*, 4th Editio, Guilford publications, New York, 2015, p. 494.
- [72] P.M. Podsakoff, et al., Common method biases in behavioral research: a critical review of the literature and recommended remedies, *J. Appl. Psychol.* 88 (5) (2003) 879.
- [73] G. Dash, J. Paul, CB-SEM vs PLS-SEM methods for research in social sciences and technology forecasting, *Technol. Forecast. Soc. Change* 173 (1) (2021) 1–11.
- [74] Hair, et al., When to use and how to report the results of PLS-SEM, *Eur. Bus. Rev.* 31 (1) (2019) 2–24.
- [75] M. Tavakol, R. Dennick, Making sense of Cronbach's alpha, *Int. J. Med. Educ.* 2 (1) (2011) 53–55.
- [76] C. Fornell, D.F. Larcker, Evaluating structural equation models with unobservable variables and measurement error, *J. Market. Res.* 18 (1) (1981) 39–50.
- [77] J. Henseler, C.M. Ringle, M. Sarstedt, A new criterion for assessing discriminant validity in variance-based structural equation modeling, *J. Acad. Market. Sci.* 43 (2015) 115–135.
- [78] L.S. Aiken, S.G. West, R.R. Reno, *Multiple Regression: Testing and Interpreting Interactions*, sage, 1991.
- [79] J. Hair, A. Alamer, Partial Least Squares Structural Equation Modeling (PLS-SEM) in second language and education research: guidelines using an applied example, *Research Methods in Applied Linguistics* 1 (3) (2022) 100027.
- [80] G. Cho, et al., Cutoff criteria for overall model fit indexes in generalized structured component analysis, *Journal of Marketing Analytics* 8 (4) (2020) 189–202.
- [81] W.W. Chin, The partial least squares approach to structural equation modeling, *Modern methods for business research* 295 (2) (1998) 295–336.
- [82] R.F. Falk, N.B. Miller, *A Primer for Soft Modeling*, University of Akron Press, 1992.
- [83] C.M. Fuller, et al., Common methods variance detection in business research, *J. Bus. Res.* 69 (8) (2016) 3192–3198.
- [84] W.W. Chin, et al., Controlling for common method variance in PLS analysis: the measured latent marker variable approach, in: *New Perspectives in Partial Least Squares and Related Methods*, Springer, 2013.
- [85] A. Kumaraswamy, R. Garud, S. Ansari, Perspectives on disruptive innovations, *J. Manag. Stud.* 55 (7) (2018) 1025–1042.
- [86] S. Sun, China, Digital Economy, Development, Impacts and Policies, University of Alberta, 2022. China Institute.
- [87] S. Jiao, Q. Sun, Digital economic development and its impact on economic growth in China: research based on the perspective of sustainability, *Sustainability* 13 (18) (2021) 10245.