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Toward a Circular Path: Integrating Knowledge, Open Innovation, Green HRM, Entrepreneurship, and Digital Orientation in Chinese Fashion Industry

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ABSTRACT

The present study examines the nexus between sustainable digital entrepreneurship, open innovation, green human resource, and circular economy in the context of the Chinese fashion sector. Since fashion brands delve into the adoption of digital technologies, the opportunity to harness such innovation has become more pronounced in order to achieve sustainability. Circular economy, in recent years, has garnered the attention of scholars as they view the concept as a strategic mechanism which helps in achieving sustainable goals through cleaner production. Thus, the research assumes that digital entrepreneurship under the disguise of sustainable principles nurtures open innovation and green HRM practices, shaping circular economic goals. The study also scrutinizes the mediating role of knowledge sharing and digital orientations as they are proven critical enablers of sustainable principles. The researcher has gathered data from the full-time employees in the HRM department of fashion companies in China; these employees included departmental heads, line managers, managers, and employees having good knowledge regarding the observed variables of the study. By employing PLS-SEM, the findings of the study reveal that there is a significant positive association of circular economy with the firm's open innovation and green HRM practices, while it is not related to sustainable digital entrepreneurship. In light of the findings, the study offers a significant contribution by introducing a comprehensive model that fosters sustainability initiatives. However, the study is limited to the Chinese fashion industry, so its findings cannot be generalized. Therefore, future researchers are recommended to study some other industries as well.

1 | Introduction

With recent environmental challenges, business leaders tend to acknowledge the pronounced necessity for fashion industry to embark on a "take-make-use-reuse again and again" journey by embracing a restorative shift toward circular economy (Ki et al. 2023). Under linear system, fashion industry particularly has made a significant contribution toward environmental pollution due to high reliance on natural resource and emissions released during product manufacturing. Although various fashion related businesses have realized the sizeable environmental and societal damaged associated to linear model, however, it is still evident in recent statistics that only 1% of clothing is recycled and 3% of the fashion sector prioritizes 3R (recycle, reuse, remanufacture) principle (Brown 2023). China in particular is considered a largest producer and exporter of clothing at global level, making its position crucial in global fashion value chain. However, with strong position and growth in fashion sector, the

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country experiences significant challenges among which over-reliance on resource consumption and environmental impact are most prominent being a part of linear economic system. A recent report generated by China National Resources Recycling Association posited that around 60 million tons of textile waste was generated by China in 2021 (Ki et al. 2023). In stark contrast, only 4.15 million tons of this vast accumulation was gathered for the potential reprocessing in 2022 (Ki et al. 2023). With government initiatives, although fashion sector has begun adopting circular business models and viewing clothing as service rather than a product (Kristoffersen et al. 2021). In addition to this, other firms adopted circular practices in the form of take-back programs where consumer are benefited from discounts on future purchasing when they tend to recycle their clothes. Regardless of these initiatives, there exists an uncertainty in fashion industry readiness, particular Chinese fashion industry, due to varying capabilities that often push back businesses to fully consider circular economy as their central part of business operation (Kautish and Khare 2022).

In this regard, sustainable digital entrepreneurship has been observed as a great factor in dealing with this problem of pollution. Sustainable digital entrepreneurship is basically the sustainable entrepreneurship practices that are related to technology (Isensee et al. 2022). Different researchers have discussed how sustainable digital entrepreneurship can help the fashion industry reduce waste and pollution (Allal-Chérif et al. 2023). Moreover, a link has been observed between sustainable digital entrepreneurship and the circular economy by different researchers (Agrawal et al. 2022). The reason for this is the fact that sustainable digital entrepreneurship includes such technologies and practices that can help the fashion industry know about the demand so that waste is reduced. Moreover, it helps to provide such practices or processes that can help reduce waste in the fashion industry, such as the recycling process and remanufacturing plants (Allal-Chérif et al. 2023). On the other hand, open innovation also appears to be a powerful mechanism as it promotes shared value creation, an integral part of the circular economy system. Open innovation has also become very popular with the passage of time. This type of innovation provides one of the best solutions and that is to take help in innovation and practices from outside the boundaries of the organization. It allows the organization to have an open experience such as sourcing technology and collaboration (vertical & horizontal) (Anshari and Almunawar 2022). However, the struggle lies in balancing economic gains with sustainable ones, which open innovation can resolve with the help of advanced yet eco-friendly technologies. Similarly, green HRM practices help businesses by nurturing employees to adopt sustainable practices. Green HR policies not only bring behavior change but also help businesses embed sustainability principles in organizational culture. Zhao and Huang (2022) also discussed how different green human resource practices, such as green training and green performance management, can also help reduce the waste and pollution created by the fashion industry in China. The training can help people gain knowledge about green and sustainable practices, their importance, and the consequences of the absence of such practices. In addition to this, digital orientation and knowledge management orientation are two crucial mediators that amplify the effectiveness of green HRM, open innovation, and sustainable digital entrepreneurship toward circular models. Scholars proclaim that digital orientation supports embedded technologies, helping businesses improve their transparency in sustainable production (Kautish and Khare 2022). Knowledge management orientation, on the other hand, facilitates management in building a robust knowledge management system to ensure knowledge is disseminated across all stages of the manufacturing process.

While the current literature specifies the significance of these factors, the collective impact of these factors in the presence of knowledge management orientation and digital orientation warrants further assessment within the context of the Chinese fashion apparel sector. By utilizing absorptive capacity theory, the study proposes a framework to validate the argument that complex changes made within organizations are more likely to produce positive outcomes when firms have enough capacity to recognize, assimilate, and operationalize knowledge and advanced technologies to establish a trajectory of circular business. Thus, drawing on absorptive capacity theory, the study examines the link between sustainable digital entrepreneurship, open innovation, and Green HRM Practices, knowledge management orientation, and digital orientation from stakeholders' perspective, specifically employees, as they offer valuable insights within the circular fashion eco-system. In doing so, the study offers a tailored approach to help organizations embrace transformative change toward the circular economy with appropriate tools and methods.

1.1 | Theoretical Background and Conceptual Framework

The current research has stressed the improvement of the Chinese circular economy with the help of green, sustainable, innovative, and digitalized practices thus incorporated within the Chinese fashion industry. In addition, the researcher has used "absorptive capacity theory (ACT)," which is based on an absorptive capacity model which was first proposed by Cohen and Levinthal (1990). According to this theory, every organization can understand the norms, externally generated knowledge, and its implementation within the company to achieve a particular task. In addition, numerous researchers have also designed their framework based on this theory due to its technical nature (Marrucci et al. 2022). Therefore, it is feasible for the current research because of the orientation of the companies toward knowledge management and digitalization. Innovative practices have also been incorporated based on external knowledge, which enhances the circular economy.

In accordance with the framework, the firm's capacity to recognize, assimilate and operationalize knowledge is paramount as this ability steers the trajectory of firm's sustainability and innovative patterns. In the light of this theoretical argument, it can be postulated that the absorptive capacity of firms catalyzes the amalgamation of novel, sustainable, and digital knowledge which further shapes their strategic predisposition to embrace open innovation and green HRM practices. Notably, open innovation expands the firm's knowledge by encouraging businesses to acquire diverse perspectives that further help in achieving sustainable goals (Chau et al. 2024). Additionally, green HRM practices offer support for innovative development and

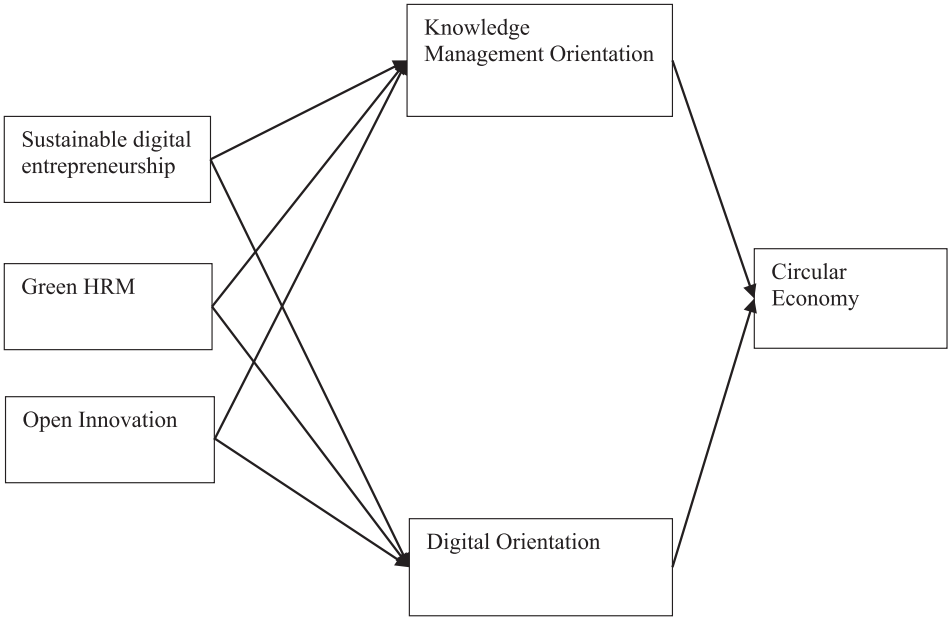

FIGURE 1 | Conceptual framework.

a thriving work environment, further amplifying their adaptability to handle environmental pressure while simultaneously fulfilling requisites of digital transformation imperatives. Thus, the spectrum of these factors enhances organizational ability to continuously innovate while incorporating sustainable practices in challenging circumstances (Muafi and Sugarindra 2023).

The inclusion of knowledge management and digital orientation in the framework further bridges the gap as knowledge management orientation reinforces the organizations to perfectly digest, process, and internalize pertinent sustainable and digital knowledge. This strategic orientation improves firms' ability to make judicious decisions, resulting in novel solutions and improving circular economy performance (Grandinetti 2016). On the other hand, digital orientation harmonizes the digital capabilities of organizations with sustainable practices, allowing businesses to utilize digital tools in order to refine resource productivity, streamline waste reduction, and promote sustainable production (Ardito et al. 2022). Thus, absorptive capacity theory provides a perspective to demonstrate how green HRM practices, open innovation, and sustainable digital entrepreneurship help firms to experience a smooth transition of the circular economy through knowledge management orientation and digital orientation (See Figure 1).

1.2 | Sustainable Digital Entrepreneurship and Circular Economy

Sustainable digital entrepreneurship can be viewed as a central mechanism that concentrates on environmental integrity, communal welfare, and life-sustaining systems in the pursuit of emergent opportunities aimed forthcoming financial and non-financial gains to organizations and society. The view intensifies the dual nature of profitability where environmental and social equilibrium are also maintained during the creation of entrepreneurial ventures. On the other hand, the rise of digital transformation in all aspects of life enforces firms to digitalize their enterprises in order to embrace novelty into business processes, operations and methods. According to Xu et al. (2022), the upward trend in the count of inclusive entrepreneurship embedded with digital technology is considered an effective solution for poverty alleviation and social inequality reduction. Literature also specified that the issues grappling with sustainable entrepreneurship appear due to information asymmetry discerned in the temporal precision of information transmission. However, digital technologies have an edge to crack the market flaw as they equip firms with analytical, connective and intelligent capability which further help businesses to realize the net positive environmental effect (Chau et al. 2024). George et al. (2021) defined digital sustainable entrepreneurship as "organizational activities that seek the sustainable objective of boosting social and environmental value creation by creatively deploying and utilizing digital technology." Thus, it can be argued that sustainable digital entrepreneurship plays an essential role in circular economy performance. The utilization of advanced technologies such as big data analytics and AI into businesses not only improve resource efficiency of systems but also make supply chain mechanism more effective by promoting 3R (reuse, recycle, and reduction) principle. These digital offerings also allow businesses to have smooth transition from linear economic model to circular ones. Recent studies pointed out that sustainable digital entrepreneurship is based on the principle of innovation, hence, not only improves operational efficiency of businesses but also enhance environmental sustainability that is the main agenda of circular economy (Isensee et al. 2022). Studies also argued that the association of sustainable digital entrepreneurship with circular economy is pampered by digital entrepreneurial ecosystems that promote knowledge exchange. With the help of digital entrepreneurial ecosystems, entrepreneurs are able to develop business models that incorporate circular principles such as sustainable consumption (Baranauskas and Raišienė 2022). As evident in empirical literature, the relationship of sustainable digital entrepreneurship and circular economy advances circular supply chain mechanism and accelerates waste management solutions that support long-term environmental growth.

H1. *Sustainable digital entrepreneurship significantly and positively impacts the circular economy.*

1.3 | Green HRM and Circular Economy

According to Ren et al. (2018), human resource management contextualized within the environmental paradigm is called green HRM. On the other hand, Renwick et al. (2008) conceptualized green HRM as the streamline process that aligns HRM strategies and practices with sustainability goals, employee empowerment, and organizational culture. Thus, it can be argued that successful implementation of effective sustainable practices relies on effective GHRM practices (Yusliza et al. 2017). In this context, Vázquez-Brust et al. (2023) emphasized the association between green HRM and circular economy practices by highlighting the critical role of recycle, reuse, and remanufacture in consumption and production systems. Marrucci et al. (2023) also identified the strong association between constructs by explaining that green HRM can be an elitist action that accelerates performance outcomes based on circular principles. Studies such as Marrucci et al. (2022) also highlight the positive association between green HRM and circular economy and claim that the relationship between these two constructs is systematic. Another study pointed out that the circular economy is a self-sustaining framework used by manufacturing firms to hand post-consumption cycle (Chau et al. 2024). The study highlights the critical connection between green HRM and circular economy practices by explaining that the effectiveness of CE practices depends on human activities. In other words, organizations capable of incorporating green human resource management practices play a crucial role in enhancing the organization's sustainability, which also generates profitable business and proves feasible for modifying the circular economy model of various countries (Yong et al. 2020). In addition, green human resource management practices and policies can considerably facilitate the transformation of an organization toward an environment-friendly organizational environment (Jabbour et al. 2019). Therefore, green human resource management practices positively contribute to implementing the principles of the circular economy within various business organizations.

H2. *Green HRM significantly and positively impacts the circular economy.*

1.4 | Open Innovation and Circular Economy

Scholarly discourse conceptualizes open innovation as a tool that empowers organizations to leverage both internal and external creative thoughts to enhance innovation processes and transfer knowledge and technological readiness into external markets (Khare et al. 2023). Since innovation processes are dynamic in nature, scholars argue that they should be incorporated into business models to change and adapt in response to new challenges and technologies (Chesbrough 2017). In parallel, the circular economy is another promising concept that also represents a paradigm of change management (Jesus and Jugend 2023). As argued by Anderson and Huge Brodin (2005), the circular economy stems from industrial ecology that anticipates material symbiosis within production processes and promotes the sustainable use of natural resources and advanced technologies. Scholars also argue that the implementation of 3R principles is an integral part of the circular economy; therefore, innovation plays a key role in the circular economy transition (De Jesus and Mendonça 2018; Pieroni et al. 2019). In reference to the circular economy, the need for innovation is both at the manufacturing and consumer sides (Kristensen and Mosgaard 2020). This implies that open innovation is a significant factor that makes the circular economy transition possible. It is because it promotes the flow of knowledge and speeds up the manufacturing process to meet consumer demand (Brown et al. 2021). For instance, the study of Hu et al. (2017) argued that acquiring external technologies helps organizations to meet environmental mandates. Recent literature also postulates that pairing with external actors is a vital pillar of circular economy adoption (Brown et al. 2021). Similarly, Bogers et al. (2019) present the case of open innovation in an ecological sense and proclaim that collaboration with external partners helps businesses to improve their ability to innovate for sustainability. Another piece of evidence presented by Zucchella and Previtali (Zucchella et al. 2022) discloses that cross-sector collaborations are crucial for the successful implementation of the circular economy because they allow businesses to share expertise, knowledge, and technologies to improve current practices to achieve collective goals. This evidence confirms that open innovation is capable of enhancing circular economy performance by lowering technological obstacles and reducing knowledge barriers (De Jesus and Mendonça 2018). It also explains that open innovation extends organizational limits by empowering firms to collaborate with external actors, leading to the successful implementation of projects based on circular principles.

H3. *Open innovation significantly and positively influences the circular economy.*

1.5 | Mediating Role of Knowledge Management Orientation

Knowledge management orientation is viewed as an organizational capability to build effective learning environment and promote knowledge sharing culture (Farooq and Vij 2018). Lin (2015) defined knowledge management orientation as "the relative propensity of an organization to share, assimilate and be receptive to new knowledge," whereas Wang et al. (2009) viewed it as organizational propensity that firms build to share and assimilate knowledge in order to achieve new wisdom. Empirical studies proclaim that knowledge management orientation emphasizes on knowledge acquiring and sharing which is an integral part of sustainable digital entrepreneurship. Together these factors help firms to achieve circular goals. Studies also argued that although sustainable digital entrepreneurship leverages on digital tools and innovative methods to address environmental issues, however, its connection with circular economy relies on organizational capacity to implement effective knowledge management. With knowledge management orientation, firms' capacity can be enhanced which allow them to gain benefit from digital technologies to achieve circularity. Studies have suggested that organizations

with effective knowledge management system are successful in implementing sustainable production and developing circular models (Chaudhuri et al. 2022). Empirical literature also highlights that knowledge management orientation promotes innovation that help business to make informed decisions on information asymmetries as they are vital elements in CE frameworks (Chizaryfard et al. 2021).

According to Shahzad et al. (2020), the knowledge management process is also responsible for incorporating advanced technologies within organizations because digital technologies are the most important resources that could develop a sustainable and competitive organizational process by formulating and enhancing the quality of the circular economic model. Despite this, knowledge management orientation is also responsible for mediating the connection between green human resource management practices and the circular economy because green HRM thrives when it has support in the form of a robust knowledge management system. Although green HRM significantly contributes to circular economy principles, however, its effectiveness increases when firms have a strong knowledge management orientation (Ul-Durar et al. 2023). Knowledge management orientation promotes a seamless flow of knowledge, which further allows firms to collaborate with stakeholders to ensure effective implementation of CE strategies. Evidence also disclosed that organizations with higher knowledge management orientation are capable of aligning green HR policies with circular objectives (Al Halbusi et al. 2024). Studies also suggest that knowledge management orientation has the potential to overcome challenges such as information asymmetry while empowering firms to embrace change and embed circular principles into their business operations (Xu et al. 2022).

Further to discussion, open innovation also allows organizations to outsource ideas and technical ability from external partners to advance their circular practices; however, with knowledge management orientation, firms often fail to translate these inputs into actionable strategies (Perotti et al. 2024). Knowledge management orientation helps firms to integrate the external knowledge into their internal operations to create closed loop processes. Since knowledge management orientation addresses barrier gaps such as technology, it becomes easier for firms to develop circular models such as material recovery. To summarize the debate, it can be postulated that knowledge management orientation serves as a critical mediator that intensifies the effectiveness of open innovation, green HRM, and sustainable digital entrepreneurship toward circular practices by enabling knowledge sharing and an innovative culture.

H4. *Knowledge management orientation significantly mediates the relationship between sustainable digital entrepreneurship and circular economy.*

H5. *Knowledge management orientation significantly mediates the relationship between green HRM and circular economy.*

H6. *The relationship between open innovation and circular economy is significantly mediated by knowledge management orientation.*

1.6 | Mediating Role of Digital Orientation

In this modern era, with the increasing demand for digitalization for the preservation of social and environmental resources, it is necessary for organizations thus working in numerous developed and developing countries to work in a manner that they can prove themselves in this competition for sustainability by formulating an effective circular economy model based on sustainable digital entrepreneurship, green human resource practices, and open innovation. Digital orientation within the business market is a business model more oriented toward implementing digital technologies and services, such as mobile applications and digitized processes (igi-global.com 2023). Moreover, it enables a business firm to generate new revenue and innovations, leading toward introducing the company in the digital market (Mishra et al. 2024). Therefore, the researcher has focused on the mediating role of digital orientation between sustainable digital entrepreneurship, green human resource management practices, open innovation, and circular economy.

Digital orientation may also be characterized as technological orientation, which refers to applying and incorporating various technological innovations within organizations. Moreover, technological innovations are encapsulated in the open innovation process and are characterized as the learning process regarding the technological innovations necessary for the organization to achieve a sustainable and competitive advantage (Mubarak and Petraite 2020). In addition, such innovations are necessary for various business organizations to acquire technological knowledge and adopt and implement innovative technologies to achieve organizational success. Therefore, it is necessary for business organizations operating in various developed and developing countries to be digitally oriented toward incorporating digital technology based on preserving social and environmental damages (Chavez et al. 2023).

Within the context of the Chinese fashion industries that have been starving for the modification of their circular economy model because it is a crucial aspect for the conservation of the natural and environmental resources that are necessary for operating the Chinese fashion industry and making it different from the other fashion industries in the global business market. Therefore, the researcher believes that all Chinese fashion organizations should focus on implementing digital technologies because it will be crucial to devising a sustainable and eco-friendly circular economy model. In other words, they should be digitally oriented. Moreover, digital orientation will significantly mediate the nexus between green HRM, sustainable digital entrepreneurship, open innovation, and circular economy, which is the focal point of this study.

H7. *Digital orientation plays a significant mediating role in the relationship between sustainable digital entrepreneurship and circular economy.*

H8. *The relationship between green HRM and circular economy is significantly mediated by digital orientation.*

H9. *Digital orientation significantly mediates the relationship between open innovation and circular economy.*

2 | Methodology

2.1 | Study Design

The current study is grounded in the philosophical view of positivism and utilizes a survey-based strategy. As per the research framework formed in the research, the researcher intended to provide an understanding of the causal association between the variables understudy, signifying the explanatory nature of the research (Creswell and Creswell 2017). Additionally, in line with the positivist stance, the researcher has depended on deductive reasoning to propose the research model along with the formulation of the hypotheses. The positivist approach is also suitable for the study as it helps in producing findings that can be generalized. Moreover, the positivist paradigm is well-suited for quantitative data, which the study collected through a large-scale instrument.

2.2 | Sampling and Participants

The sample population comprised managerial employees in companies in the Chinese fashion industry. A non-random sampling technique, convenience sampling, was utilized to select the participants (Thompson 2012). With the use of convenience sampling, data can be collected from the relevant population on the basis of their availability and willingness to take part in the study, which is also advocated by previous scholars (Iftikar et al. 2022). The target population consisted of full-time employees in the human resource department of fashion companies. The full-time employees included managers, line managers, and departmental heads, as they would have sufficient knowledge regarding the variables under study.

2.3 | Data Collection

The current study utilized a survey questionnaire to gather the required data. Data on firms was obtained from social media and company websites. The researcher contacted the potential participants through the mail and social media platforms and informed them regarding the research purpose before sharing the survey. The questionnaire was distributed among 350 full-time managerial-level employees and departmental heads in the fashion sector through online survey links and e-mail. Voluntary participation was ensured. Moreover, the researcher ensured the participants that the information obtained was solely for research purposes and that the confidentiality of their personal data would be kept. A total of 298 participants took part in the survey; however, only 284 were valid, as the rest consisted of missing information and values.

2.4 | Questionnaire and Pre-Test

The researcher selected items from the literature to develop the questionnaire in which questions regarding the respondents' age, position, and work experience were included in the first section. Multiple items were adopted for each construct in the study, and a 5-point Likert scale was utilized. To measure the construct of sustainable digital entrepreneurship, the researcher utilized the work of Xu et al. (2022) and adopted six items for the questionnaire. Scale items adopted from Xu et al. (2022) were based on the studies of Baranauskas and Raišienė (2022) and Shepherd and Patzelt (2011). Open innovation was measured with six items, adopted from the scale developed by Al-Belushi et al. (2018). Green HRM Practices were gauged utilizing a set of thirteen items from Singh et al. (2020), which were adapted from the works of Sun et al. (2007) and Renwick et al. (2008). The scale items comprised three components, namely green ability, opportunity, and motivation. Four items were used to measure circular economy from the adapted scale by Singh et al. (2018) based on existing studies (Han et al. 2010; Zhang et al. 2013). Knowledge management orientation was based on a five-item scale previously used in Habib et al. (2021) and Attia and Essam Eldin (2018). The scale represents organizational practices for circulation of product, process, and innovation-related knowledge among all concerned stakeholders. In the present study, digital orientation was incorporated into the model as a mediator, and four items were utilized from the study of Khin and Ho (2018), originally drawing on the works of Zhou et al. (2005) along with the study by Gatignon and Xuereb (1997). The detailed measurement items are shown in Appendix A.

To determine content validity, the researcher took feedback from six experts by sharing the survey with them, including three managers in the human resource field and three professors specializing in human resource management. Slight modifications were made to the instrument on the basis of their feedback and suggestions. Furthermore, to make sure the survey was easily understandable and clear, the questionnaire was distributed to 30 respondents to gather their feedback in the pilot study. No revisions were needed based on the pilot study results. Furthermore, the internal consistency was determined using reliability analysis.

2.5 | Data Collection

The present study employs smart PLS, a statistical instrument which is widely used by researchers to assess complex frameworks. The study's rationale for selecting the said approach relies on the characteristics of data along with the need to perform mediation and moderation techniques. Besides, the methodology has already garnered specific significance in management studies. According to Mateos-Aparicio (2011), PLS-SEM is well-suited to predict a group of equations for the proposed model at the same time. Thus, the study considers PLS-SEM, a validated approach to perform robust analysis. Structural equation modeling is considered an appropriate approach to assess direct and indirect path coefficients of a model. The PLS methodology consists of two steps: measurement model and structural model. In the first step, which is assessing the measurement model, the reliability and validity of the model are exposed through discriminant and convergent validity to establish the consistency of the model. The structural model, the later phase of the PLS-SEM, is being assessed to test formulated hypotheses. The research framework developed in the current research was also evaluated using SPSS software for descriptive statistics.

3 | Results

3.1 | Demographical Information

The collection of data entry study has resulted in 330 total responses, which have been utilized for the analysis of the data and analyze the demographical characteristics of the respondents, which are presented in Table 1 below. Out of the sample of 330, 54.8% were male, and 45.2% were female. Additionally, it was found that 14.8% of the respondents were between the age bracket of 21 to 25 years old, 24.8% were between the ages of 26 to 30 years old, and 21.8% were between 31 to 35 years old. It was found that most respondents were over 35 years old, which is 38.5%. The researcher asked the participants about the number of years of their job experience, and it was found that 7.3% had experienced between 0 to 1 year, 24.8% had the experience of 1 to 3 years,18.8% had job experience between 3 to 5 years, 19.7% for having job experience between 5 to 10 years, and the majority of the respondents, that is, 29.4% were having job experience of more than 10 years.

3.2 | Preliminary Assessment

Prior to analyzing the measurement model and structural equation modeling, a preliminary assessment was conducted to ensure the data was free of bias. For instance, common method bias is essential as survey-based research is prone to affect the bias. Current research created a dummy variable to examine the common method bias through measured latent market variable (MLMV). Based on the results of the comparison between inclusion and exclusion of the marker variable, there is no significant difference and thus, this research is safe to be considered as free from common method bias. The present research also examined the VIF values to scrutinize the indicator collinearity. It is worth noting that all the VIF values are within the recommended values of below 3.3 (Kock 2015).

TABLE 1 | Demographical characteristics.

	Frequency	Percent
Gender		
Male	181	54.8
Female	149	45.2
Age		
21–25 years	49	14.8
26–30 years	82	24.8
31–35 years	72	21.8
More than 35 years	127	38.5
Experience		
0–1 years	24	7.3
1–3 years	82	24.8
3–5 years	62	18.8
5–10 years	65	19.7
More than 10 years	97	29.4

3.3 | Measurement Model Assessment

The measurement model was analyzed by using partial least square structural equation modeling (PLS-SEM) to ensure validity and reliability. We have analyzed the convergent validity, reliability, and discriminant validity as shown in Tables 2 and 3. All of the convergent validity values (AVE) have exceeded the recommended values of 0.5, while the reliability of composite reliability and Cronbach alpha also has a value of more than 0.7 (Hair et al. 2016). This indicates that this measurement model has no reliability and validity issues. Furthermore, the discriminant validity analysis employed the HTMT ratio to determine the presence of high collinearity between variables. As shown in Table 3, all the values are below the threshold of 0.85 (Henseler et al. 2015) and thus it is confident to confirm there are no issues of discriminant validity.

3.4 | Structural Equational Modeling (SEM)

SEM is a multivariate and widely recognized statistical method to explore the structural associations between the variables of the study (Zhang 2022). The researcher employed partial least square structural equation modeling (PLS-SEM) to test the formulated study's hypotheses. The structural associations between the variables can be examined to determine their underlying direct and indirect effects (Hair et al. 2010). The results of the direct hypotheses are shown in Table 4 below. The association between OP and CE is significant at a *p*-value of 0.009, and GHR and CE are also significant at a *p*-value of 0.039, while the association between SDE and CE is also significant at a *p*-value of 0.008, above the threshold values (see Figure 2). This implies that when firms tend to show acceptance toward open innovation by collaborating with external stakeholders, they are likely to achieve success in implementing circular practices. The positive relationship between open innovation and circular economy indicates that open innovation prepares firms to capitalize on an advanced set of technologies, external resources, and relevant knowledge. Hence, firms can formulate more effective strategies that allow them to improve product lifecycle management. On the other hand, making investments in green HRM practices means firms are more capable of adopting circular economy practices, which further help them to minimize wastages and recycle materials. In addition to this, findings also suggest that digital entrepreneurs aiming at focusing on sustainable business models may likely show devotion toward circular economy principles. Hence, such businesses shaped by sustainable digital entrepreneurs get an opportunity to benefit from digital technologies to offer creative solutions related to the sustainable use of resources. The path coefficient between SDE and CE also highlights a significant role of sustainable digital entrepreneurship in economic business models as it promotes economic growth and social and environmental well-being simultaneously.

The results of the indirect effect of the hypotheses are given in Table 5 below. In this study, there were a total of 6 hypotheses; all of them were accepted. From Table 5, it can be seen that knowledge management orientation and digital orientation proved to be potential mediators. From findings, it is apparent

TABLE 2 | Measurement model.

Variables	Item	Loading	Cronbach's alpha	CR	AVE
Sustainable digital entrepreneurship	SDE1	0.822	0.864	0.907	0.709
	SDE2	0.807			
	SDE3	0.864			
	SDE4	0.874			
Green HRM	GHR1	0.800	0.928	0.938	0.557
	GHR2	0.780			
	GHR3	0.738			
	GHR4	0.725			
	GHR5	0.736			
	GHR6	0.735			
	GHR7	0.766			
	GHR8	0.701			
	GHR9	0.708			
	GHR10	0.775			
	GHR11	0.719			
	GHR12	0.768			
Open innovation	OP1	0.869	0.892	0.917	0.650
	OP2	0.745			
	OP3	0.765			
	OP4	0.818			
	OP5	0.839			
	OP6	0.796			
Knowledge management orientation	KMO1	0.869	0.903	0.932	0.774
	KMO2	0.890			
	KMO3	0.897			
	KMO4	0.864			
Digital orientation	DO1	0.870	0.768	0.855	0.601
	DO2	0.802			
	DO3	0.831			
	DO4	0.561			
Circular economy	CE1	0.896	0.913	0.939	0.792
	CE2	0.875			
	CE3	0.899			
	CE4	0.890			

that knowledge management orientation mediates the relationship between green HRM, sustainable digital entrepreneurship, open innovation, and circular economy. This implies that organizations having strong knowledge management orientation better learn to integrate technologies and external resources into their business operations, leading to effective implementation of the circular agenda. Besides, effective management of knowledge orientation also allows entrepreneurs to utilize digital technologies in a more subtle manner, especially if their agenda is to achieve sustainable goals. Also, the

relationship between GHRM and CE is strengthened in the presence of effective knowledge management. It helps firms to translate sustainable HR practices into circular benefits.

4 | Discussion

Due to the growing sustainability issues in the global fashion industry, the principles of circular economy are found to be an appropriate solution to product and service management in fashion companies. The contemporary fashion industry of China covers a wide range of unsustainable products, which are becoming a primary cause for the development of sustainable digital alternatives that can reduce textile wastage. The researcher examined the impact of sustainable digital entrepreneurship, green HRM, and open innovation on the circular economy.

Moreover, the mediating role of knowledge management orientation and digital orientation was also analyzed in the relationship between SDE, GHRM, open innovation, and circular economy.

TABLE 3 | HTMT.

Construct	1	2	3	4	5
1. DO	0.677				
2. GHR	0.516	0.615			
3. OP	0.562	0.653	0.532		
4. KMO	0.543	0.651	0.488	0.601	
5. SDE	0.523	0.588	0.670	0.521	0.502

To analyze the association between variables in the context of the Chinese fashion industry, nine hypotheses were formed. Firstly, the results mark that the SDE holds a significant impact on the circular economy. Since SDE backs up digital innovations and aids in eliminating unnecessary and unwanted industrial wastes, the circular economy of the fashion industry found SDE relevant in achieving the sustainable cause. Consistent with literature, it is confirmed that digital technologies improve the supply chain mechanism of firms due to which they are able to track their product and material lifecycle in a more profound manner. Since sustainable digital entrepreneurship advocates the amalgamation of technology and sustainability, hence entrepreneurs belonging to said domain are more capable of optimizing resources with the help of digital technologies that are aimed at promoting the sharing economy agenda. Sustainable digital entrepreneurship also shapes the innovative abilities of firms that are supposed to be well-aligned with circular economy principles.

Secondly, as per the results, the linkage between green HRM and the circular economy is found to be significant. It implies that green HRM practices positively impact sustainable growth and help the industry keep up with the circular economy principles. The results are in accordance with the findings of Jabbour et al. (2019). Adopting a circular economy at the organizational level is possible due to green HRM practices. Including GHRM proposes strategies suitable for sustainable merits and thus growing business sustainably. The results of the third hypothesis declared it acceptable, indicating a significant association between open innovation and the circular economy. The present results findings are supported by the findings of (Köhler et al. 2022). For advancing the circular economy in the fashion industry, open innovation can be taken as a strong determinant

TABLE 4 | Direct Hypotheses.

Direct path	Estimate	Std dev	*t*-Value	*p*	CI-lower limit	CI-upper limit
OP → CE	0.145	0.055	2.622	0.009	0.038	0.255
SDE → CE	0.126	0.048	2.635	0.008	0.033	0.221
GHR → CE	0.106	0.051	2.068	0.039	0.008	0.211

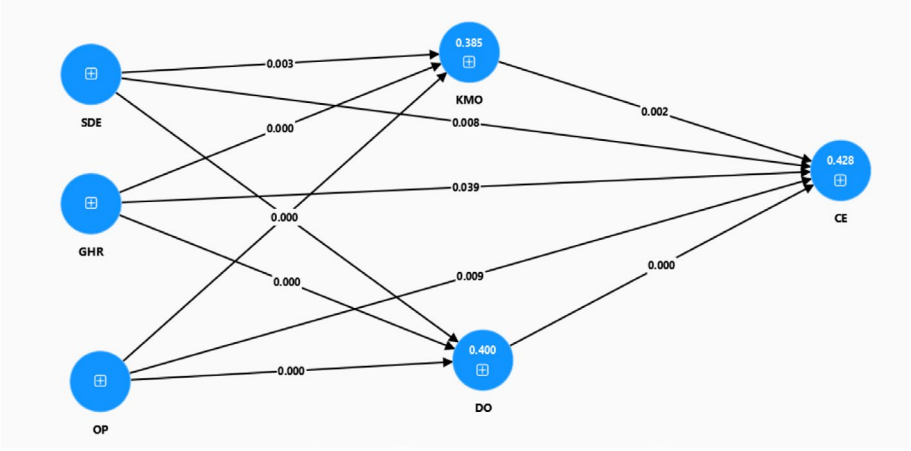

FIGURE 2 | SEM analysis.

TABLE 5 | Indirect hypotheses.

Indirect path	Estimate	Std dev	*t*-Value	*p*	CI-lower limit	CI-upper limit
GHR → KMO → CE	0.038	0.015	2.549	0.011	0.013	0.072
GHR → DO → CE	0.075	0.021	3.638	0.000	0.040	0.122
SDE → KMO → CE	0.027	0.013	2.010	0.044	0.007	0.060
SDE → DO → CE	0.048	0.018	2.702	0.007	0.020	0.090
OP → KMO → CE	0.061	0.022	2.793	0.005	0.021	0.107
OP → DO → CE	0.098	0.023	4.207	0.000	0.057	0.149

in regulating sustainable influence on the industry's resources and products. As findings are backed up by previous evidences, it can be implied that organizations indulging in open innovation practices have more opportunities to leverage technologies and embrace innovative ideas that may help them promote resource-efficient practices. In other words, open innovation makes it easier for organizations to shift to circular economic principles by implementing ideas gathered from external resources. In essence, open innovation gathers different types of stakeholders on a single platform, which allows organizations to implement circular practices effectively.

The knowledge management orientation (KMOW) is the key to achieving knowledge organization, management, and execution. The results indicate that the knowledge management orientation has a significant mediating role in the relationship between SDE and the circular economy. The results are aligned with the findings of De Guimaraes et al. (2018) which emphasize that sustainable digital entrepreneurs heavily depend on digital technologies such as blockchain, artificial intelligence, and other platforms, due to which they are able to handle vast amounts of data. This information educates them to strategize sustainable actions. With effective knowledge management, they are not only able to optimize product designs in a sustainable manner but also transform tacit knowledge into explicit knowledge. The entrepreneurial orientation and knowledge management orientation give a sustainable competitive edge in terms of clean and green production, supported by circular economy principles. Consistent with prior literature, findings highlight the crucial role of digital technologies in formulating circular strategies, as these advanced tools facilitate firms to close and narrow resource loops. KMO has a significant mediating role in the relationship between GHRM and the circular economy. The results are in alignment with the findings by Cvijović (2023) which highlight that green HRM practices are crucial for environmental sustainability. With the fusion of environment and HR, organizations can promote green behavior that is instrumental for CE practices. For instance, the study of Chau et al. (2024) explained that green HRM positively affect circular economy performance specifically in the presence of green innovation. The mediating role of KMO in the relationship between Open innovation and the circular economy is also found to be significant. The results are supported by the findings of Pereira et al. (2021). In the context of CE, open innovation empowers organizations to gain access to a diverse pool of knowledge to achieve sustainable goals. In line with the literature, findings illustrate how open innovation enhances CE performance by giving access to external resources, highlighting the critical role of knowledge management orientation.

The mediating role of digital orientation is also found to be significant in the case of green HRM, SDE, and open innovation. The mediation effect suggests that digital tools amplify the effectiveness of green HRM that further shapes circular economy strategies (Obeidat et al. 2023). Findings also highlight that digital orientation represents the propensity of organizations specifically in terms of digital technologies. The significant path in both cases explains that organizations committed to open innovation and sustainable digital entrepreneurship tend to adopt digital technologies to enhance their circular economy strategies. With digital orientation, firms are not only able to improve their resource efficiency and waste management systems but also leverage external knowledge to drive innovation. The study of Jesus and Jugend (2023) endorsed the findings by highlighting that open innovation brings technological maturity and diversity that further bridges the innovation with CE adoption practices.

4.1 | Theoretical Implications

The study offers a significant theoretical contribution by highlighting that open innovation, green HRM, and sustainable digital entrepreneurship positively influence circular economy performance. The study extends its knowledge on absorptive capacity theory by explaining that although open innovation, green HRM, and sustainable digital entrepreneurship are drivers of circular economic models knowledge management orientation and digital orientation extend organizational capacity to turn the benefits into actionable circular economy strategies. The study advances the application of absorptive capacity theory by highlighting that knowledge and technology are two essential facilitators that create a seamless integration between open innovation, SDE, green HRM, and circular economy practices. The theoretical understanding of the study provides critical insights into the association between digital factors, innovative culture, and knowledge management and how the circular economy can be boosted by focusing on these factors. The global fashion industry is more open to sustainable innovations, which places the Chinese industry on a competitive ground to advance the circular economy. The information can be utilized to assess the position of the Chinese fashion industry under a research background in fashion and textiles.

4.2 | Practical Implications

On practical grounds, the study has implications for digital management authorities. The findings provide an in-depth analysis of the digital orientation, green HRM, and open innovation in advancing the circular economy in the fashion industry. The HR managers can utilize the study to evaluate the knowledge management abilities and open culture that nurture the sustainable culture. The working actors in the fashion industry can avail themselves of this information to understand the circular economy and the room for sustainability it provides in the contemporary fashion world.

The study assists fashion companies and houses in understanding the value of circular economy models in the present day. The right use of materials and methods can be made possible by following circular economy principles. The stakeholders can also utilize this data to upgrade the business models to the circular economy level in order to ensure clean and green production with minimal waste. By promoting sustainable collection, companies can educate their employees and working actors to adhere to sustainable merits.

The large fashion industries can invest in sustainable digital initiatives to nurture the environment where green HRM practices align with knowledge maturity. The research draws attention to the ways digital abilities can be polished and improved by taking minimal innovative and digital steps per sustainable and circular economic standards. The economic policymakers, therefore, get help from academic findings to draw conclusions and devise strategic economic plans.

4.3 | Limitations and Future Direction

The study has some limitations that allow future researchers to cover these gaps. For the present study, the data is collected from selected fashion companies' employees, limiting the findings. Furthermore, the study limits itself to the Chinese fashion industry. The study was also limited from a theoretical perspective; other determinants and theoretical aspects of the circular economy can be added to get deeper insights. The study also relies on cross-sectional data only, which limits its ability to assess causality and long-term effects of these factors. Longitudinal models can be used by future scholars to observe how these intertwined relationships of these factors evolve over time toward circular economy outcomes. The exclusive focus on knowledge management orientation and digital orientation also limits the study in the context of absorptive capacity theory. There are other mediators as well, such as organizational culture and ethical leadership styles, that may play a bigger role in shaping circular economy practices. In addition to this, the growing trends such as corporate social responsibility or environmental management should also be included in the model to observe their interaction with circular business models. Scholars may explore whether CSR or EM commitments encourage the adoption of open innovation and green HRM. This would help in developing a more holistic approach to identify the success of circular business models.

As the fashion industry has numerous working units, the information regarding the selected variables can be obtained from the managerial authorities, HRM department, and digital management groups in the fashion industry. The data from these sources can provide a broader perspective on the issues undertaken by the researcher. Additionally, the qualitative method can be employed to get a subjective in-depth opinion of the relevant actors in the circular economy in the fashion industry. The debate can be expanded to the leading global fashion industry and how they can be made more sustainable by adopting circular economy models. Future researchers can also include the related variables, i.e., digital/sustainable capacity, economic structure, and sustainable fashion trends, to understand the significance of circular economy principles in the modern fashion industry.

5 | Conclusion

The study covers sustainable fashion growth and circular economy from various dimensions. Due to its empirical findings, the study contributes to the current research stream on the circular economy in the fashion industry. The study findings are valuable in adding knowledge to the previous literature on sustainable fashion trends and practices. The study drew a conceptual framework from the sustainable business models, which implies that the study holds novelty. The study can effectively assist future researchers regarding circular economy principles and the digital sustainability they support in the fashion industry. The empirical findings have an academic impact that encourages future studies to expand this knowledge to numerous research dimensions.

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Appendix A

Item no.	Item	Adapted from	Literature Source
	Circular economy		
1	"My firm promotes the design of products for reuse, recycle, recovery of material and component parts"	Singh et al. (2018)	Han et al. (2010), Zhang et al. (2013)
2	"My firm encourages establishing a recycling system for used and defective products"		
3	"My firm increases the content of reused parts or recycled/renewable materials in the manufacturing process"		
4	"My firm increases the demand for products by reducing production costs and minimizing lifecycle environmental impacts"		
	Sustainable digital entrepreneurship		
1	"Strip several businesses that go against the integration of digital technology with social and environmental value creation"	Xu et al. (2022)	Baranauskas and Raišienė (2022), Shepherd and Patzelt (2011)
2	"Change the competition approach of business departments to achieve the goal of digital capability supporting social and environmental value creation"		
3	"Launch multiple digital transformation programs that can boost the productivity of social and environmental value creation of business departments"		
4	"The company is utilizing digital technology to improve its profitability for a better financial condition under sustainability"		
5	"The company usually uses digital technology to improve customer loyalty and image"		
6	"The company usually utilizes digital technology and takes measures beneficial to the environmental and resource protection"		
	Open innovation		
1	"New opportunities as new products and/or services/ process"	Al-Belushi et al. (2018).	
2	"We have been able to create more value because the new products and services jointly developed by us have opened up new market opportunities and expanded our customer base"		
3	"We thoroughly collect industry information and new technologies"		
4	"Our firm has used the new ideas and skills acquired from the partner to create value by improving its products and services"		
5	"Our firm has used the knowledge gained about technology from the alliance experience to improve our technology"		
6	"Within the alliance boundary, this alliance has led to more efficient deployment and utilization of resources leading to continuous improvement of quality of products"		

Item no.	Item	Adapted from	Literature Source
	Green HRM practices		
1	"Great effort goes in to select the right person"	Singh et al. (2020)	Renwick et al. (2008), Sun et al. (2007)
2	"Hiring only those who possess environmental values"		
3	"Considerable importance is given to the green staffing process"		
4	"Every employee undergoes mandatory environmental training"		
5	"Environmental training is designed to enhance employees' environmental skills & knowledge"		
6	"Employees to use environmental training in their jobs"		
7	"Performance appraisal records environmental performance"		
8	"Performance appraisal includes environmental incidents, responsibilities, concerns, and policy"		
9	"Employee gets reward for environmental management"		
10	"Employee gets reward for acquiring specific environmental competencies"		
11	"Employees are involved to become environmentally friendly"		
12	"Using team-work for resolving environmental issues"		
13	"Employees to discuss environmental issues in team meetings"		
	Knowledge management orientation		
1	"We have clear rules for categorizing product knowledge"	Attia and Essam Eldin (2018), Habib et al. (2021)	Attia and Essam Eldin (2018), Zhou and Li (2012)
2	"We have clear rules for categorizing process knowledge"		
3	"Employees of our organization always use technology to cooperate"		
4	"Our organization inspires us to exchange knowledge across functional boundaries"		
5	"Our organization has the opportunity to communicate with its judgment also other departments"		
	Digital orientation		
1	"We are committed to use digital technologies in developing our new solutions"	Khin and Ho (2018)	Gatignon and Xuereb (1997), Zhou et al. (2005)
2	"Our solutions have superior digital technology"		
3	"New digital technology is readily accepted in our organization"		
4	"We always look out for opportunities to use digital technology in our innovation"		