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Abstract

Purpose - This study aims to enrich Social Information Processing Theory (SIP) by investigating how external knowledge integration (EKI) influences Chinese small and medium-sized enterprises (SMEs) employee creativity through creative process engagement (CPE) and work-related exhaustion in the digital age. Additionally, we investigate the moderating role of leader encouragement in the mediational pathway from EKI to employee creativity.

Design/methodology/approach - Using a two-wave longitudinal survey with data collected from 212 employees selected from 143 SMEs across various industries in eastern China, we tested our hypothesis using multivariate regression models with bootstrap procedures.

Findings – This research found that EKI has both positive and negative effects on employee creativity, mediated by CPE and work-related exhaustion, respectively. Additionally, leader encouragement of creativity moderates the impact of EKI on CPE and work-related exhaustion, influencing how the positive and negative effects of EKI affect creativity in the digital age.

Originality/value – This paper applies SIP theory to examine the complex relationship between EKI, CPE, work-related exhaustion, and the role of leaders in small and

medium-sized enterprises (SMEs). Our study offers practical implications for SME leaders to leverage external knowledge to improve employee creativity.

Keywords - External knowledge integration, Leader encouragement of creativity, Employee creativity, Exhaustion, Creative process engagement, Digitalization

Paper type Research paper

1. Introduction

Small and medium-sized enterprises (SMEs), as key pillars of economic development, typically exhibit flatter organizational structures, reduced bureaucratic constraints, and lower levels of operational routinization compared to larger corporations (Brunswicker and Vanhaverbeke, 2015). Such qualities enable SMEs to more effectively embrace digital transformation through the adoption of advanced technologies (Soluk et al., 2023; Ardito et al., 2021; Denicolai et al., 2021). Employees are the key force for SMEs' digital transformation, as their ability to integrate diverse knowledge and generate creative solutions directly supports innovation and adaptive change (Schenkel et al., 2019). But what motivates employees in SMEs to engage in the creative activities?

Although the significance of external knowledge networks for SME innovation has been widely acknowledged (Nakandala et al., 2024), much of the extant research remains concentrated at the organizational level, leaving a notable gap regarding individual-level outcomes. Unlike large corporations, SMEs heavily rely on employees' interpersonal interactions to integrate external knowledge, with leaders' personal

networks further facilitating external collaborations (Zhang et al., 2023). While digital technologies such as information and communication technologies (ICT) and AI, enable access to diverse external knowledge sources more easily, they stimulate employees to involve in the novel ideas and improve work efficiency and productivity (Venkataramani and Tang, 2024). On the other hand, it may increase pressure and job-related anxiety on employees be flexible to the new requirements and new routines (Zahoor et al., 2022; Ninaus et al., 2021), and have negative effect on employee creativity. Thus, it is still unclear for the impact between external knowledge integration in digital era with employee creativity for SMEs.

Creative process engagement and work-related exhaustion are viewed as positive and negative effects and provide a link between EKI based on using newer technologies such as social media, virtual reality, and video meeting technologies and employee creativity. There is a general consensus that fostering employee engagement in the creative process enhances creativity (Khan et al., 2022; Zhang and Bartol, 2010). As SMEs in emerging markets face the complexities of acquiring and utilizing external digital technologies (Kumar et al., 2024; de Oliveira Neto, 2025), many are collaborating with various stakeholders and investing efforts in identifying differences and opportunities for joint problem-solving. This collaboration positively relates to the generation of original ideas (Chung and Tan, 2017). However, integrating external knowledge based on digital technologies also has a complex effect on creativity by inducing work-related exhaustion. Employees are required to dedicate extra time to learn, adapt, and apply these digital technologies during working hours. To answer Hill

et al. (2024)'s call for balance the positive and negative effect of digital technologies on employee well-being, this study explored the mediating effect of CPE and work-related exhaustion for the association between EKI and creativity.

Additionally, SIP theory posits that individuals are significantly influenced by their information cues such as values, job requirements and expectations of the social environment, beyond the influence of the social environments (Salancik and Pfeffer, 1978). In the realm of employee creativity, leader's expectations and support act as the pivotal social cues that shaped how employees engage in the creative process (Zhang and Bartol, 2010). Prior research showed that leader encouragement of creativity not only promote access to diverse external knowledge sources for employees, but also create conditions conducive to individual creativity (Zhang et al., 2023). Especially in the digital era, leaders' encouragement could influence the feedback mechanism in remote work or the company's online community communication process, which change employees' investment in external knowledge integration, related creative work, and work pressure (Nguyen et al., 2024). Therefore, leader encouragement of creativity could act as a significant moderating variable in the pathways linking EKI, CPE, exhaustion, and employee creativity within SMEs.

Based on these considerations, this study draws on SIP theory to addresses two fundamental research questions: Q1 How does EKI influence employee creativity in the context of digitalization through CPE and work-related exhaustion, respectively? Q2 How does leader encouragement of creativity moderate the association between

EKI and employee creativity via CPE/ work-related exhaustion?

To empirically validate the proposed model, a two-wave longitudinal survey was conducted involving 212 employees from SMEs located in East China. This study contributes to the literature in several important ways. First, we addressed the need for greater insight into individual-level outcomes of EKI within SMEs (Nakandala et al., 2024; Crupi et al., 2020). Second, the mediating mechanisms of CPE and exhaustion enriches the understanding of creativity in the digital age (Khan and Abbas, 2022). Third, our research expands the findings of Nguyen et al. (2024), indicating that leader encouragement of creativity acts as a boundary condition in the digital era which moderate the influence of EKI on CPE/work-related exhaustion. Through these theoretical advancements and empirical findings, the study offers valuable implications for scholars, practitioners, and policymakers aiming to enhance SME innovation capacities in an era of rapid digital transformation.

The paper is organized as follows: In Section 2, we review the literature on EKI, CPE, work-related exhaustion, leader encouragement, and creativity, and we propose hypotheses. Moreover, in Section 3 and Section 4, we present the methodology, the resulting of hypothesis test and discuss the findings. Finally, in Section 5, we showed the theoretical and practical implications and give some suggestions for future research.

Theoretical background and hypothesis development

2.1 CPE as mediator between EKI and employee creativity

Social Information Processing (SIP) theory suggests that individuals form attitudes and

behaviors by interpreting salient and contextually relevant cues from their environment (Salancik and Pfeffer, 1978; Crick and Dodge, 1994). In organizational settings, such cues often include leadership behaviors, peer interactions, and the configuration of technological systems. Employees rely on these signals to interpret workplace expectations and adjust their actions accordingly (Robinson and O'Leary-Kelly, 1998; Maitlis and Lawrence, 2007).

In the context of digital transformation within SMEs, digital technologies, such as collaborative platforms, knowledge-sharing systems, and AI-enabled tools, serve as conduits that connect external environmental inputs to employee behaviors. These technologies not only enhance access to external knowledge but also shape how employees cognitively process and assign meaning to that information. Within the SIP framework, digital tools operate as embedded social cues that guide employees' interpretations, ultimately shaping their creative involvement or experience of burnout. We thus conceptualize EKI with digital technologies as a behavioral process that mediates the relationship between environmental stimuli and employee outcomes.

In the digital era, EKI encompasses the application of big data analytics and data mining algorithms to integrate and access external knowledge from industry associations, expert communities, and authoritative sources (Radicic and Petković, 2023). In this research, EKI of employees refers to the employees perceived the organizations' knowledge collection activities and their openness to external collaboration. Through insights gathered from customers and suppliers (Tang, 2016),

SMEs can enhance the efficiency for the innovation performance at the organizational level (Ricci et al., 2021), as well as benefit for the development of individuals (Zhang et al., 2023). While, EKI of SMEs largely benefit from individual's interpersonal interactions and relationships with external partners (Zhang et al., 2023). These interactions facilitate employee learning from external practices, help eliminate inefficiencies in their work, and foster the development of creative skills, thus providing a foundation for innovation (Tang, 2016; Venkataramani and Tang, 2024). Moreover, integrating external knowledge from customers, suppliers, and competitors allows for the diverse input of stakeholders in the innovation process (Perry-Smith, 2014; Vakandala et al., 2024) and encourages employee involvement in digital exploration.

CPE is defined as employees' involvement in creativity-related activities, such as problem identification, information search and encoding, and idea generation (Gilson et al., 2004; Zhang and Bartol, 2010). From a SIP theory perspective, CPE represents a positive behavioral response to organizational social cues, linking EKI to enhanced creativity (Khan and Abbas, 2022). Employees who are highly engaged in creative processes are better positioned to harness opportunities presented by digital transformation and to contribute novel ideas within cross-functional teams (Ullrich et al., 2023).

Integrating external knowledge fosters a conducive environment for "thinking outside the box," motivating employees to pursue creative problem-solving (Tang, 2016; Zhang and Edgar, 2021). Moreover, the collaborative efforts required for digital

adoption—such as leveraging additive manufacturing technologies and virtual reality tools—enhance employees' technological capabilities and stimulate creative thinking (Ricci et al., 2021; Radicic and Petković, 2023). Investing efforts in accessing external knowledge motivates employees to identify differences and seize opportunities for collaborative problem-solving, which is positively associated with the generation of original ideas (Tang, 2016; Goyal et al., 2020; Venkataramani and Tang, 2024). For SMEs, the relatively unstructured organizational environment further enables employees to engage in creative activities, encouraging risk-taking and the novel application of digital technologies (Chung and Tan, 2017). Consequently, employees become more invested in knowledge search and idea development, thereby enhancing the feasibility and innovativeness of their creative outputs (Khan and Abbas, 2022; Nakandala et al., 2024). Building on this theoretical foundation, we propose the following hypothesis:

H1. CPE positively mediated the relationship between EKI and SME employee creativity.

2.2 Work-related exhaustion as mediator between EKI and employee creativity

Work-related exhaustion refers to the negative personal reaction employees experience when they feel overwhelmed, leading to a deterioration of their emotional and physical resources (Hildenbrand et al., 2018; Chen et al., 2020). It is also related to fatigue, decreased commitment, and a loss of mutual trust (Stein et al., 2021). Drawing on SIP theory, social cues associated with high demands or constraints, which can trigger

psychological strain and adverse behavioral responses among employees (Morrison, 1994; Robinson and O'Leary-Kelly, 1998). The overloaded external ideas, skills and information could cause conflicts related to time and stress for employees, which can lead to negative psychological and behavioral outcomes.

Digital technologies adoption facilitates SMEs to collect and utilize a diverse range of knowledge resources at reduced costs (Denicolai et al., 2021). When large amounts of external knowledge enter the organization, employees are overwhelmed by adapting to and assimilating new digital knowledge applications (Crupi et al., 2020; Denicolai et al., 2021; Zhang et al., 2023), which can lead to mental fatigue and increased work-related stress. Facing with the digitalization, SMEs tend to focus on customer-oriented innovation to meet digital demands, rather than relying on research-driven approaches (Chung & Tan, 2017). The individualized and complex nature of customer information requires employees to invest considerable time and cognitive effort in processing, categorizing, and interpreting it (Valaei et al., 2017; Oh & Kim, 2021).

Furthermore, as artificial intelligence becomes more prevalent, many routine tasks have been automated through digital technologies, showing greater demands on employees to involve in creative and non-standard work (Chung & Tan, 2017; Chen et al., 2020). The expanding and complex knowledge base also adds time pressure, as employees are expected to respond quickly to changing market needs. These intensified workloads, particularly under strict deadlines, often lead to stress and frustration (Li et

al., 2023). When employees experience prolonged exhaustion, they may be less willing to share knowledge with colleagues, which can hinder collaborative learning and reduce overall creativity (Li et al., 2023). Thus, we hypothesize,

H2. EKI has a negative indirect effect on SME employee creativity via work-related exhaustion.

2.3 The moderating role of leader encouragement of creativity

According to SIP theory, leader encouragement of creativity serves as a salient social cue that shapes how employees interpret their work environment and respond to creative tasks (Salancik & Pfeffer, 1978). Prior research has applied SIP theory to explain various workplace behaviors, including organizational citizenship and job satisfaction (Pollock et al., 2000; Zagenczyk & Powell, 2023). Empirical findings consistently show that when leaders actively support creativity, employees are more likely to take initiative, generate original ideas, and implement innovative solutions (Zahoor et al., 2022). Such leadership not only motivates exploration of new approaches, but also reduces perceived risks associated with creative efforts.

In SMEs, leader encouragement is particularly important in helping employees manage uncertainties in the creative process. Employees who feel encouraged are more likely to be open to experimenting with new methods and embracing potential challenges (Zhang et al., 2023). Supportive leadership fosters a climate where individuals are more inclined to search for, develop, and apply novel ideas to solve problems (Nguyen et al., 2024). Conversely, the lack of such encouragement may

undermine employees' confidence, leading to hesitation and a passive or resistant attitude toward engaging with new tasks or initiatives. (Li et al., 2020; Zahoor et al., 2022).

When employees perceive a high level of encouragement from their leaders, they are more likely to integrate external knowledge and digital tools effectively. This enables them to put greater effort into identifying complex problems and collecting diverse information to produce creative outcomes (Li et al., 2020; Nguyen et al., 2024). Consequently, we propose the following hypothesis:

H3. SME leader encouragement of creativity positively moderates the relationship between EKI and CPE.

Previous studies, using both cross-sectional (Syrek et al., 2013) and longitudinal designs (Gregersen et al., 2014), have found that transformational leadership is negatively associated with employee emotional exhaustion. When leaders actively support employee creativity, individuals tend to feel psychologically safe and experience higher levels of well-being. This support allows them to find meaning in their work, pursue shared goals, and engage in continuous learning (Hildenbrand et al., 2018). In such environments, the stress linked to EKI, such as information overload, role ambiguity, and constant adaptation to digital change, is more likely to be reduced.

In contrast, when employees are expected to handle various external knowledge sources without adequate support or recognition, they may face increased stress and emotional fatigue. This can weaken their ability to remain innovative and adaptable under pressure. Leaders in SMEs often attempt to offset these risks by fostering a

psychologically supportive climate and introducing incentives to encourage knowledge sharing and creativity (Masa'deh et al., 2016; Oluwafemi et al., 2020).

Empirical findings further show that leader encouragement helps employees cope with the uncertainties of digital transformation and knowledge integration (Oluwafemi et al., 2020; Stein et al., 2021; Zhang et al., 2023). Employees in SMEs who perceive strong creative support from their leaders report lower levels of exhaustion and are better able to handle the pressures associated with external knowledge demands and digital change (Oluwafemi et al., 2020; Stein et al., 2021). Thus, we hypothesize:

H4. SME leader encouragement of creativity negatively moderates the relationship between EKI and work-related exhaustion.

As described above, a stronger relationship between EKI and CPE is expected to develop, while the link between EKI and work-related exhaustion will weaken when leader encouragement is high. It is reasonable to predict that the indirect effect of EKI on creativity, via CPE, will be stronger when leader encouragement is prominent. Specifically, employees who receive support and opportunities through leader encouragement are more likely to learn about novel technologies such as automation, remote control, and artificial intelligence. These technologies serve as primary sources of creative ideas that enhance creative process engagement and reduce exhaustion (Oluwafemi et al., 2020; Nguyen et al., 2024), ultimately boosting employee creativity. Conversely, when leader encouragement of creativity is low, employees may feel restricted to following established procedures and may be unable to break rules, which

diminishes their engagement in the creative process and increases their levels of exhaustion. Therefore, we hypothesize the following:

Hypothesis 5a: Leader encouragement of creativity positively moderates the indirect relationship between EKI and employee creativity via CPE.

Hypothesis 5b: Leader encouragement of creativity negatively moderates the indirect relationship between EKI and employee creativity via work-related exhaustion.

Based on the above hypotheses, the conceptual framework is shown in Figure 1.

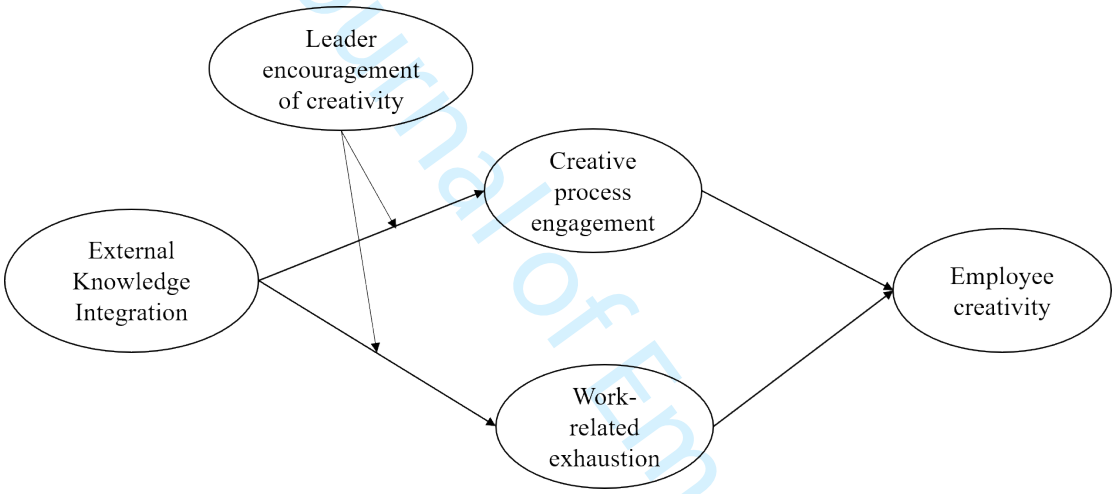

Figure.1 Research Model

3. Data and methods

3.1 Data collection procedure and participants

We employed a two-wave, time-lagged research design to collect data from employees of Chinese SMEs between June 2022 and January 2023. Most survey items were adapted from established and validated scales. To ensure linguistic and conceptual equivalence, the original English items were translated into Chinese and subsequently subjected to a rigorous back-translation procedure. Prior to the main data collection, a

pilot test was conducted with 25 MBA students—frontline employees with experience in digital technology applications—to assess the clarity and validity of the survey instruments.

Given the eastern region's leading role in China's digital economy, characterized by rapid technological advancements and strong policy support for digital transformation, we focused our sampling on SMEs located in this area. A professional data collection agency assisted in randomly selecting 600 SMEs from provinces including Jiangsu, Zhejiang, Shanghai, and Shandong. These regions represent economically advanced areas where SME digital transformation is particularly prominent. The sampled SMEs covered a variety of industries. Regarding firm size, the participating SMEs had fewer than 300 employees and annual revenues below 100 million RMB, consistent with the official classification of SMEs in China.

To minimize common method bias (CMB), the questionnaire was divided into two sections. Section A focused on middle managers of the SMEs, who provided information related to EKI and leader encouragement of creativity. Section B targeted employees, who reported on their basic information, Coping with CPE, work-related exhaustion, and employee creativity.

An introductory message explaining the research objectives was sent to selected SMEs via email. To incentivize participation, respondents were offered a small gift certificate. Confidentiality assurances were provided to reduce potential social desirability bias. Eligibility criteria required participants to be full-time employees working in technology-related departments with a minimum of three years of work

experience, ensuring sufficient exposure to external collaborations and digitalization practices within their organizations. A total of 212 usable responses were obtained from 143 SMEs out of the 600 initially contacted, yielding a response rate of 23.83%.

Data collection occurred in two stages. The first wave (T1) was conducted in June 2022. Each firm received five questionnaires, and 389 valid responses were collected, corresponding to a validity rate of 54.41%. Following the methodology of Rodríguez-Muñoz et al. (2009), the second wave (T2) was carried out six months later in January 2023, focusing specifically on employee creativity among those who had participated in T1. After excluding incomplete or unmatched questionnaires, the final sample comprised 212 employees, resulting in a validity rate of 35.33%.

In second round, the average age of the participants ranged from 31 to 40 years. The gender distribution was relatively balanced, with 48.58% male and 51.42% female respondents. The industry distribution was as follows: 8 participants from furniture, handicrafts, and toys; 12 from wholesale and retail; 18 from education and training; 18 from communications and telecommunications; 18 from catering, entertainment, and tourism; 26 from finance, real estate, and professional and scientific services; 53 from manufacturing; and 77 from IT, software, and hardware services. The respondents reported an average job tenure of 7.764 years (SD = 3.241 years).

To assess potential non-response bias, we compared early and late respondents based on the quarterly division of response waves, as suggested by Armstrong and Overton (1977). A Multiple Group Analysis (MGA) using PLS-SEM was conducted to examine whether there were significant differences in the path coefficients across early

and late respondent groups. The results showed that none of the relationships between key constructs differed significantly (all p-values > 0.05), indicating that non-response bias was not a substantial concern in this study.

3.2 Measures

The variables in our research were measured based on validated and established scales (as Table 1) are the specific measures along with Cronbach's alpha coefficients calculated for each measure:

External knowledge Integration. A four-item scale provided by Zahra et al. (2007) was used to measure EKI (Cronbach's α=0.875). We developed this scale in digital context and conducted reliability and validity analyses. This measure was assessed on a 5-point scale, ranging from "1(not at all)" to "5(always do that)".

Creative process engagement. CPE was measured using Zhang and Bartol (2010) 11-item scale (Cronbach's α=0.961). Respondents rated their agreement on a 5-point scale ranging from "1 (not at all)" to "5 (always do that)".

Work-related Exhaustion. Using a three-item scale (Cronbach's α=0.943) adapted from Schaufeli and Van Dierendonck (1995), participants expressed their level of agreement regarding work-related exhaustion on a 5-point scale from 1 (not at all) to 5 (always do that).

Leader encouragements of creativity. We adopted a six-item scale (Cronbach's α=0.932) based on Scott and Bruce (1994), to evaluate the degree to which leaders encourage creativity. Ratings were on a five-point scale from 1 (not at all) to 5 (always

do that).

Employee Creativity. We assessed employee self-related creativity with 13-item scales (Cronbach's α = 0.963) adapted from Zhang and Bartol (2010). Participants indicated their agreement on a 5-point scale ranging from "1 (not at all)" to "5 (always do that)".

Control variables. We included several control variables in our analysis to evaluate factors related to employee creativity. These variables are age (using the natural logarithm), gender (coded as 1 for male and 2 for female), and job experience (measured by job tenure), following the methodologies proposed by Dias et al. (2022) and Sonnentag (2003). While, as stated by Wasim et al. (2024), industry type may determine employees' external interaction and business characteristics. Therefore, we also included industry type as a control variable. To address potential reverse causality, we controlled for creativity measured at Time 1 (T1) in our analysis.

Table1 and Table 2

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4. Results

4.1 Measurement model

For all latent variables (see Table 1), the factor loadings were greater than 0.70, indicating strong convergent validity. The construct reliability (CR) for each variable exceeded 0.80, and the average variance extracted (AVE) was greater than 0.50 for all variables, further supporting their convergent validity. Additionally, the square root of

the AVE for each variable was higher than any inter-variable correlation, demonstrating satisfactory discriminant validity.

To evaluate both the convergent and discriminant validity of the five-factor model, we conducted confirmatory factor analysis (CFA) and compared our initial model against four alternative models. We utilized chi-square difference tests along with various model fit indices, as recommended by Anderson and Gerbing (1988), to identify the most suitable model. As detailed in Table 3, comparisons showed that the initial model significantly outperformed the other models based on the chi-square difference tests and model fit indices, indicating that the baseline five-factor model was a robust fit ($\chi 2$ = 849.141, df = 619, RMSEA =0.042, IFI = 0.968, TLI = 0.965, and CFI = 0.967).

Table3

To analyze common method bias in our dataset, we used Harman's single-factor test. This test evaluates whether combining measures from a single source could influence the results. The results indicated that the first factor accounted for less than 40% of the total variance, which is consistent with the conclusions of Podsakoff et al. (2003) and suggests that there is no significant common method variance in our data.

To further strengthen our assessment, we applied a marker variable technique as recommended for self-reported data (Healey et al., 2015). Specifically, we included a theoretically unrelated item, perceived industry growth, as a marker variable. This item was not conceptually related to any focal constructs in our model (i.e., EKI, CPE, work-

related exhaustion, or employee creativity). We incorporated the marker variable into our regression models as an additional control (Table 6). After adjusting for the marker variable, the coefficients for our key hypothesized relationships remained statistically significant and directionally consistent, suggesting that the results are robust and not driven by common method variance.

Descriptive statistics and correlations were shown in Table 4. According to Henseler et al. (2015), we used the Heterotrait-Monotrait Ratio (HTMT) test the discriminant validity. The highest value of HTMT radio of collections was 0.398 (showed in Table 5), which is lower than the cut-off value of 0.85.

Table 4

Table 5

We conducted hypothesis testing using multivariate regression models. Additionally, we performed a bootstrap analysis to calculate confidence intervals (CIs) for mediation tests (Efron and Tibshirani, 1993). Hypothesis testing results can be found in Tables 5 and 6. We also addressed potential collinearity issues in our analytical model by grand-mean centering the predictors.

4.2 Hypotheses tests

Hypothesis 1 proposed that integrating external knowledge would positively influence employee creativity through CPE. The results in Table 6 confirmed this, indicating a

significant positive relationship between EKI and CPE (B = 0.183, p < 0.05, Model 1). Additionally, CPE was positively associated with employee creativity (B = 0.265, p < 0.001, Model 10). Furthermore, as presented in Table 7, the indirect effect of EKI on employee creativity via CPE was significant (B = 0.071, SE = 0.034; 95% CI 0.032, 0.133), thus supporting Hypothesis 1.

Hypothesis 2 suggested a negative indirect effect of EKI on employee creativity via work-related exhaustion. The data in Table 6 reveals a positive and significant direct relationship between EKI and work-related exhaustion (B = 0.227, p < 0.05, Model 6). Moreover, employee work-related exhaustion is negatively correlated with employee creativity (B = -0.131, p < 0.01, Model 11). As shown in Table 7, the indirect relationship between EKI and creativity via work-related exhaustion was found to be negative and significant (B = -0.02, SE = 0.022; 95% CI: -0.054, -0.013), thereby supporting Hypothesis 2.

Hypothesis 3 predicted that the positive relationship between EKI and CPE would strengthen with a higher level of leadership encouragement. According to Table 6, the interaction effect was significant for CPE (B = 0.164, p < 0.001, Model 4). Figure 2 illustrates that EKI is significantly and positively related to CPE when leadership encouragement of creativity is high (B = 0.451, p < 0.001), but this relationship is not significant when leadership encouragement is low (B = 0.080, p > 0.05). This suggests that in digitally transforming SMEs, where employees are expected to adopt and utilize new digital tools, platforms, and data streams, leader encouragement serves as a crucial social cue that frames EKI as a resource rather than a burden. Drawing on SIP theory,

when leaders signal psychological safety and support for creativity, employees are more likely to interpret the influx of complex external knowledge (often facilitated by digital technologies) as an opportunity to explore novel ideas, rather than as an uncertain or risky endeavor.

Figure 2

Hypothesis 4 proposed that the positive relationship between EKI and work-related exhaustion would be weaker when leader encouragement is high. As indicated in Table 7, the interaction effect was significant regarding work-related exhaustion (B = -0.231, $p < 0.001$, Model 8). Figure 3 illustrates that the relationship between EKI and work-related exhaustion is significant and positive when leader encouragement is low (B = 0.421, $p < 0.001$). Conversely, this relationship is insignificant when leader encouragement is high (B = -0.113, $p > 0.05$). Therefore, these findings support Hypothesis 4. However, when leaders actively encourage creative engagement, they provide emotional reassurance, help prioritize tasks, and legitimize exploratory learning, which collectively buffer employees from experiencing exhaustion. The asymmetry in these moderation effects highlights the dual role of leader encouragement, it not only activates the motivational pathway (via CPE) but also neutralizes the strain pathway (via exhaustion). In the context of digitalization, where external knowledge is both abundant and cognitively demanding, leadership support becomes a pivotal organizational lever for shaping how employees internalize and respond to knowledge integration pressures.

Figure 3

Finally, the indirect relationship between EKI of SMEs and employee creativity via CPE was reveals in Table 7. For cases with high leadership encouragement, the indirect effect on creativity was positive and significant (B = 0.123, SE = 0.044; 95% CI: 0.042, 0.221). In contrast, under low leadership encouragement, this effect was not significant (B = 0.021, SE = 0.022; 95% CI: -0.023, 0.072). This context also showed a significant moderated mediation effect (B = 0.036, SE = 0.022; 95% CI: 0.010, 0.085), thus supporting Hypothesis 5a. This implies that in the absence of leadership encouragement, employees may perceive the demands associated with EKI, such as rapidly changing digital workflows, unclear expectations, and knowledge overload, leading to psychological strain.

Furthermore, the indirect effect of EKI on employee creativity, mediated by work-related exhaustion, was significantly negative with low leadership encouragement (B = -0.052, SE = 0.023; 95% CI: -0.111, -0.014). However, this effect was not significant under high leadership encouragement (B = 0.011, SE = 0.027; 95% CI: -0.028, 0.067). Additionally, the index of moderated mediation was significant (index = 0.03, SE = 0.023; 95% CI: -0.001, 0.069), thereby supporting Hypothesis 5b.

Table 6

Table 7

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5. Discussion and conclusions

Building on SIP theory, the present two-wave longitudinal investigation shows the dual role of EKI in shaping employee creativity. Empirical findings indicate that EKI contributes positively by broadening employees' cognitive reservoirs through interactions with external actors, thereby facilitating deeper engagement in creative endeavors. The indirect effect of EKI on employee creativity via CPE was significant (B = 0.071, SE = 0.034; 95% CI 0.032, 0.133). This suggests that even modest enhancements in digital-enabled external knowledge acquisition, such as participation in virtual expert forums, use of cloud-based knowledge repositories, or adoption of AI-powered customer feedback analysis, can yield substantial gains in employees' involvement with creative tasks. This is particularly vital for SMEs striving to innovate under escalating digital complexity and resource constraints.

Conversely, the investigation results shows that EKI exerts a significant positive influence on work-related exhaustion (B = 0.227, $p < 0.05$, Model 6) in some extent, which, in turn, decrease employee creativity. In the digital era, SME employees are often overwhelmed by the need to continuously adapt to external changes and decode vast volumes of data, especially when engaging with unstructured or unfamiliar digital platforms. This digital overload, often exacerbated by the always-connected culture and real-time communication tools (e.g., Slack, Zoom, Microsoft Teams), can create cognitive fatigue. Consistent with Ferasso and Grenier (2021), our results further suggest that interpersonal linkages with larger enterprises substantially enhance EKI, especially via technically competent employees. These individuals often serve as early

adopters of platform-based innovation ecosystems such as GitHub, Alibaba Cloud, or open R&D communities, who translate external digital advancements into internal creative practice.

Leadership encouragement of creativity emerged as a pivotal contextual factor moderating the influence of EKI. Specifically, it strengthened the positive association between EKI and CPE ($B = 0.164$, $p < 0.001$, Model 4) and simultaneously mitigated the detrimental link between EKI and work-related exhaustion ($B = -0.231$, $p < 0.001$, Model 8). These results emphasize that leadership support is not merely symbolic but provides digital psychological safety, by framing external digital knowledge as an opportunity rather than a threat. Supportive leadership empowers employees, instilling confidence and humility (Zhang and Bartol, 2010; Li et al., 2020; Nguyen et al., 2024). When leaders endorse experimentation with new digital tools or publicly recognize efforts to engage external partners via online platforms, employees are more willing to navigate uncertainty and embrace creative risk-taking.

Moreover, moderated mediation analyses reveal that leadership encouragement significantly influences the indirect effects of EKI on employee creativity via both CPE and exhaustion. The conditional indirect effect sizes suggest that these mechanisms are statistically significant, which are also substantively meaningful for SME digitalization. Similarly, Nguyen et al. (2024) found that creative encouragement from leaders can reduce the pressure on employees as they manage their daily tasks. These results highlight that even incremental shifts in managerial behavior, such as expressing support for creative experimentation, can translate into measurable enhancements in

creative outcomes and reductions in employee strain. These findings underscore the need for SME leaders to act not only as knowledge facilitators but also as interpretive agents who shape the psychological meaning of EKI for their employees.

Taken together, the observed effect sizes across the direct, indirect, and moderated pathways underscore the practical relevance of this study's findings. For Chinese SMEs navigating the challenges of digital transformation, it is not sufficient to merely increase exposure to external knowledge sources. The impact of EKI is contingent upon contextual conditions within the organization, with leadership support for creativity emerging as a key determinant of whether such integration facilitates innovation or exacerbates employee exhaustion.

5.1 Theoretical contributions

Our study has several theoretical implications. First, by examining the complex impact of EKI on employee creativity, we contribute to the ongoing debate in the context of digital transformation. By demonstrating that employees use digital collaboration tools (e.g., Google Workspace, Trello, Miro boards) and knowledge sharing platforms to acquire and apply external insights, we contribute to a richer understanding of how digital technologies reshape the social information landscape within SMEs (Kumar et al., 2024).

Previous research has revealed the benefits of external knowledge for organizations, including strategic effectiveness, operational effectiveness, creativity, and innovative behavior (Brunswicker and Vanhaverbeke, 2015; Tang, 2016; Nakandala et al., 2024). However, we expand on the model proposed by Venkataramani

and Tang (2024) by illustrating both the positive and negative effects of Chinese SME employees' sourcing of external knowledge. While this integration can enhance creativity, it can also lead to time pressure and poor task execution (Li et al., 2022). In thus, work-related exhaustion among employees could have the negative impact on their creativity.

Our research emphasizes the need for a balanced and nuanced understanding of EKI of SMEs. These findings are consistent with the SIP theory, indicating that external knowledge serves as social cues that influence employees' reactions and behaviors. Our study enhances SIP theory within a digital context by demonstrating how SMEs located in emerging markets integrate external knowledge using digital technology tools (Kumar et al., 2024; de Oliveira Neto, 2025). This integration develops the traditional knowledge base and enables employees to develop skills relevant to creativity, providing crucial background knowledge necessary for innovative thinking (Rajalo and Vadi, 2021; Venkataramani and Tang, 2024).

Second, we focused on the mediating roles of CPE and work-related exhaustion, exploring the different cognitive and behavioral mechanisms that explain the mixed effects of EKI on creativity. Previous research has examined the mediating effect of CPE in the relationships between leadership style, individual characteristics, and creativity (Zhang and Bartol, 2010; Henker et al., 2015; da Costa et al., 2018; Ferasso and Grenier, 2021). Extending the work of Khan and Abbas (2022), this study finds CPE represents a proactive cognitive response to external digital cues, exhaustion reflects a depletion of emotional and attentional resources due to information saturation

and digital multitasking.

The SIP theory primarily focuses on how individuals receive, interpret, store, and utilize environmental cues, it tends to underemphasize the role of complex psychological mechanisms, such as emotions and intrinsic motivation. However, it overlooks the influence of complex psychological factors such as emotions and motivations. Based on SIP theory, our research uniquely explains how employees cognitively interpret EKI as a social cue shaping their proactive (CPE) and reactive (exhaustion) responses. We emphasize in the revised manuscript that our dual-path model extends SIP by integrating both motivational and affective pathways within SME digital contexts. Addressing the call by Venkataramani and Tang (2024) for longitudinal approaches, this study strengthens the causal interpretation of the relationship between EKI and individual outcomes. By showing that EKI can both foster and constrain creativity via creative process engagement and work-related exhaustion, our findings offer nuanced insights into how EKI shapes employee creativity in the digital era.

Third, our study contributes to SIP theory at the individual level by demonstrating how leader encouragement serves as a boundary condition that determines the extent to which employees can convert EKI to creative outputs. Previous research suggests that leader encouragement or expectations can enhance subordinates' creativity and values (Oluwafemi et al., 2020; Nguyen et al., 2024). These studies primarily focus on the mediating role of creative self-efficacy (Jiang and Gu, 2017) and

adaptive or flexible behavior (Oluwafemi et al., 2020). Leadership is vital for determining whether SMEs successfully adopt external knowledge in the digital age (Oluwafemi et al., 2020) and for promoting innovation among employees as they face the challenges of integrating digital technologies (Ardito et al., 2021).

Based on the notion that leader encouragement of creativity can help build trust and creatively manage work-related stress (Oluwafemi et al., 2020; Li et al., 2020; Stein et al., 2021), leaders act as digital sensemakers, guiding employees in filtering relevant knowledge from the digital noise and reinforcing productive engagement. Therefore, our study supports the findings of Nguyen et al. (2024) that leader encouragement of creativity is a dynamic process that enhances employee engagement and reduces work-related exhaustion across various creative tasks.

5.2 Managerial implications

Our study also has several practical implications. First, leaders of SMEs can create an open environment that fosters mutual learning and sharing. This environment enables employees to engage in external collaboration activities and facilitates the assimilation of external knowledge. For instance, to maximize the use of external knowledge, the emerging markets' SME leaders can identify potential collaborations in the digial era (Kumar et al., 2024; de Oliveira Neto, 2025) and encourage employees to work with universities, R&D teams, and cooperative organizations to address common challenges associated with digital transformation (Tang, 2016). Additionally, SME leaders of emerging market could enhance their informal relationships by leveraging past work

experiences to promote collaboration with vendors and customers, ultimately driving innovation among employees.

Our research indicates that creativity is fostered in SMEs when employees are willing to invest time and effort in identifying work problems during the integration of external knowledge. However, if employees are overwhelmed with their workload and must adapt their routines to incorporate external skills and ideas, it can negatively impact creativity. To address this, SMEs in emerging market, such as China, India, Brazil and Eastern Europe, should implement tailored strategies and training programs aimed at encouraging specific employee actions to overcome limitations related to resources and heavy workloads (Kumar et al., 2024; de Oliveira Neto, 2025). Furthermore, SME leaders can guide employees on how to recognize and seize opportunities that arise from external interactions, while also supporting them in searching for relevant information (Zhang et al., 2023). This approach could stimulate a variety of ideas to effectively solve task-related problems.

Third, leader encouragement of creativity is a crucial factor in determining employees' job performance. It is essential for leaders of SMEs located in emerging markets to establish norms that support employees' personal growth and to create regulations that incentivize employees to invest their efforts in completing work tasks (Oluwafemi et al., 2020; Cai et al., 2023). Additionally, leaders should enhance their understanding of advanced digital technologies and align their management practices to facilitate the adoption of these technologies. Moreover, leaders should provide timely and constructive feedback to motivate employees to embrace trial and error, which can

help build their confidence and inspire them to put more effort into their creative roles (Nguyen et al., 2024). This type of feedback is likely to enhance employees' ability to navigate work uncertainties during a digital transformation.

Institutions and policymakers of emerging markets should create incentives to encourage SMEs to become more flexible and innovative by integrating both external and internal knowledge through the adoption of digital technology. At the same time, they can enhance employee productivity and commitment by fostering creativity. Institutions can support these firms by establishing online platforms that facilitate cooperation among SMEs, enabling the exchange of information and resources while ensuring that these activities are legitimate.

5.3 Limitations and directions for future research

Our study makes important contributions but also has several limitations that highlight potential directions for future research. First, the integration of external knowledge based on digital technology may influence how organizations demonstrate openness and their access to various knowledge sources (Brunswicker and Vanhaverbeke, 2015; Ferasso and Grenier, 2021). While external knowledge can be viewed as social information through digital technology for organizations, it is important to note that not all types of external knowledge may be equally accepted by employees. It would be beneficial to investigate which types of external knowledge are most impactful in enhancing or hindering employee creativity (Tang, 2016; Tang et al., 2020). Accordingly, future research could develop a more comprehensive model to analyze

the effects of different types of EKI on employee creativity.

Second, our research model conducts CPE and work-related exhaustion as two psychological mediators to explain the association between EKI and employee creativity. However, it lacks consideration of dynamic feedback loops or cross-path effects (e.g., CPE reducing exhaustion). Incorporating such dynamic feedback loops in future models could provide a more comprehensive understanding of how employees internalize external stimuli during digital transformation.

Third, although we examine leader encouragement of creativity as a moderating variable, our analysis does not account for other important individual-level boundary conditions. For example, personality traits (e.g., openness to experience), job involvement, and job autonomy could moderate employees' reactions to external knowledge and influence their creative outputs and emotional responses. Future research should explore these individual characteristics to better understand employee heterogeneity in the context of EKI.

Fourth, we used self-reported measures of employee creativity. While self-assessments capture individuals' internal perceptions and motivations, they may be subject to self-report bias and common method variance. Future studies should incorporate multi-source data, such as supervisor or peer evaluations, to validate these results and provide a more objective assessment of employee creativity.

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Table1 Results of measurement assessment-first order

Variables	Items	Factor loading	Cronbach's alpha	AVE	CR
EKID	EKID1	0.852	0.877	0.730	0.915
	EKID2	0.843			
	EKID3	0.857			
	EKID4	0.866			
PI	PI1	0.818	0.883	0.728	0.889
	PI2	0.871			
	PI3	0.870			
ISE	ISE1	0.889	0.896	0.747	0.899
	ISE2	0.839			
	ISE3	0.864			
IG	IG1	0.864	0.919	0.703	0.922
	IG2	0.822			
	IG3	0.841			
	IG4	0.828			
	IG5	0.837			
EX	EX1	0.937	0.938	0.889	0.96
	EX2	0.948			
	EX3	0.943			
LEC	LEC1	0.828	0.910	0.686	0.929
	LEC2	0.863			
	LEC3	0.762			
	LEC4	0.863			
	LEC5	0.831			
	LEC6	0.818			
EC	EC1	0.838	0.973	0.754	0.975
	EC2	0.873			

	EC3	0.823
	EC4	0.883
	EC5	0.885
	EC6	0.897
	EC7	0.877
	EC8	0.874
	EC9	0.900
	EC10	0.883
	EC11	0.852
	EC12	0.849
	EC13	0.851

Table 2 Results of measurement assessment-second order

Variables	Items	Cronbach's alpha	AVE	CR
CPE	PI ISE IG	0.961	0.722	0.966

Table 3 Comparison of measurement models for variables

	χ2	Df	χ2/df	RMSEA	IFI	TLI	CFI
Baseline five-factor model	849.141***	619	1.372	0.042	0.968	0.965	0.967
Four-factor model	1270.375***	623	2.039	0.070	0.828	0.902	0.908
Three-factor model	1839.445***	626	2.938	0.096	0.872	0.816	0.827
Two-factor model	2592.705***	628	4.129	0.122	0.722	0.704	0.721
One-factor model	4455.591***	629	7.084	0.170	0.459	0.424	0.456

Note: four-factor model: external knowledge integration and CPE combined into one factor; three-factor model: external knowledge integration and CPE combined into one factor, employee creativity and employee work-related exhaustion combined into one factor; two-factor model: external knowledge integration, CPE and leader encouragement of creativity combined into one factor; one-factor model: all variables combined into one factor.

****p<0.001; two-tailed tests.*

Table 4 Correlations and Descriptive Statistics of Research Variables

Measures	Means	SD	1	2	3	4	5	6	7	8	9	10
1. Gender	1.510	0.501	1									
2. Age	3.480	0.857	-0.204**	1								
3. Job experience	7.764	3.241	-0.123	0.212**	1							
4. Industry	8.755	6.925	-0.010	-0.006	0.025	1						
5. Employee creativity (T1)	3.628	0.976	0.138*	0.052	0.034	0.058	1					
6. External knowledge integration	3.487	1.034	-0.001	0.016	-0.008	-0.105	0.315**	**0.788**				
7. Creative process engagement	3.632	0.952	0.062	0.043	-0.020	-0.018	0.271**	0.264**	**0.821**			
8. Work-related exhaustion	2.717	1.287	-0.038	-0.087	-0.062	-0.045	-0.012	0.167*	-0.244**	**0.909**		
9. Leader encouragement of creativity	2.734	1.128	0.037	0.011	0.092	0.037	0.201**	0.238**	0.014	-0.074	**0.856**	
10. Employee creativity (T2)	3.852	0.814	0.024	0.040	-0.030	-0.108	0.186**	0.347**	0.385**	-0.145*	0.046	**0.813**

Note: $^{*}p < 0.05$; $^{**}p < 0.01$

Table 5 Discriminant validity ——HTMT

	External knowledge integration	Creative process engagement	Work-related exhaustion	Leader encouragement of creativity	Employee creativity
External knowledge integration					
Creative process engagement	0.314				
Work-related exhaustion	0.342	0.365			
Leader encouragement	0.071	0.068	0.141		

of creativity				
Employee creativity	0.398	0.274	0.262	0.187

Table 6 Results of hierarchical regression analysis

Variables	Creative process engagement				Work-related exhaustion				Employee creativity (T2)			
	Model 1	Model2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8	Model 9	Model 10	Model11	Model12
Control variables												
Gender	0.54	0.074	0.078	0.087	-0.163	-0.139	-0.131	-0.144	0.024	0.004	0.006	-0.002
Age	0.046	0.048	0.047	0.048	-0.134*	-0.132	-0.134	-0.135	0.038*	0.025*	0.021*	0.011
Job experience	-0.010	-0.009	-0.006	-0.005	-0.020	-0.018*	-0.014*	-0.017*	-0.009	-0.007	-0.011	-0.030
Industry	-0.004	-0.001	0.000	0.000	-0.008	-0.004	-0.003	-0.004	-0.009	-0.009	-0.010	-0.080
Creativity(T1)	0.262***	0.198**	0.207**	0.176*	0.008	-0.071*	-0.053*	-0.009*	0.075*	0.023*	0.066*	0.027*
Independent variables												
EKID		0.183*	0.198**	0.268***		0.227*	0.255**	0.152	0.244***	0.195***	0.273***	0.270***
Moderator												
LEC			-0.067	-0.064			-0.123	-0.124				
Interaction												
EKID*LEC				0.164***				-0.231***				
Mediator												
CPE										0.265***		0.272***
Work-related exhaustion											-0.131**	-0.128*
Marker variable												
Perceived industry growth												0.590
R^2	0.078	0.112	0.118	0.156	0.016	0.053	0.068	0.098	0.136	0.221	0.177	0.237
AdjustedR^2	0.055**	0.086***	0.088**	0.123***	-0.008	0.025***	0.036*	0.062*	0.111***	0.194***	0.148**	0.203**
F	3.462	4.325***	3.903**	4.692***	0.656	1.918	2.134*	2.749**	5.371***	8.252***	6.255***	6.964***

Note: $^{*}p < 0.05$; $^{**}p < 0.01$; $^{***}p < 0.001$

Table 7 Results of the mediated moderation path analysis

Relationships	B	SE	95% bias-corrected CI
External knowledge integration →CPE →Employee creativity			
Indirect relationship	0.071	0.034	[0.032, 0.133]
Conditional indirect relationships			
Low leader encouragement (-1 s.d.)	0.021	0.022	[-0.023, 0.072]
High leader encouragement (+1 s.d.)	0.123	0.044	[0.042, 0.221]
Difference	0.064	0.034	[0.012, 0.161]
Index of moderated mediation			
Leader encouragement	0.036	0.022	[0.010, 0.085]
External knowledge integration →Employee work-related exhaustion →Employee creativity			
Indirect relationship	-0.02	0.022	[-0.054, -0.013]
Conditional indirect relationships			
Low leader encouragement (-1 s.d.)	-0.052	0.023	[-0.111, -0.014]
High leader encouragement (+1 s.d.)	0.011	0.027	[-0.028, 0.067]
Difference	0.073	0.051	[0.012, 0.231]
Index of moderated mediation			
Leader encouragement	0.031	0.023	[0.001, 0.069]

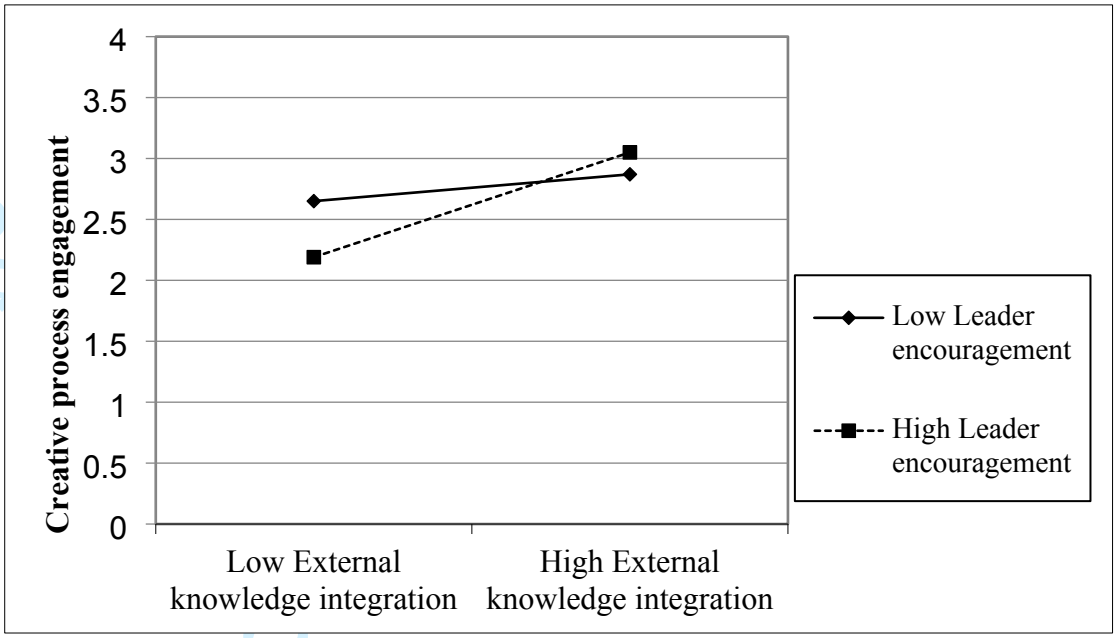

Figure 2. Leadership encouragement of creativity as a moderator for the relationship between external knowledge integration and CPE

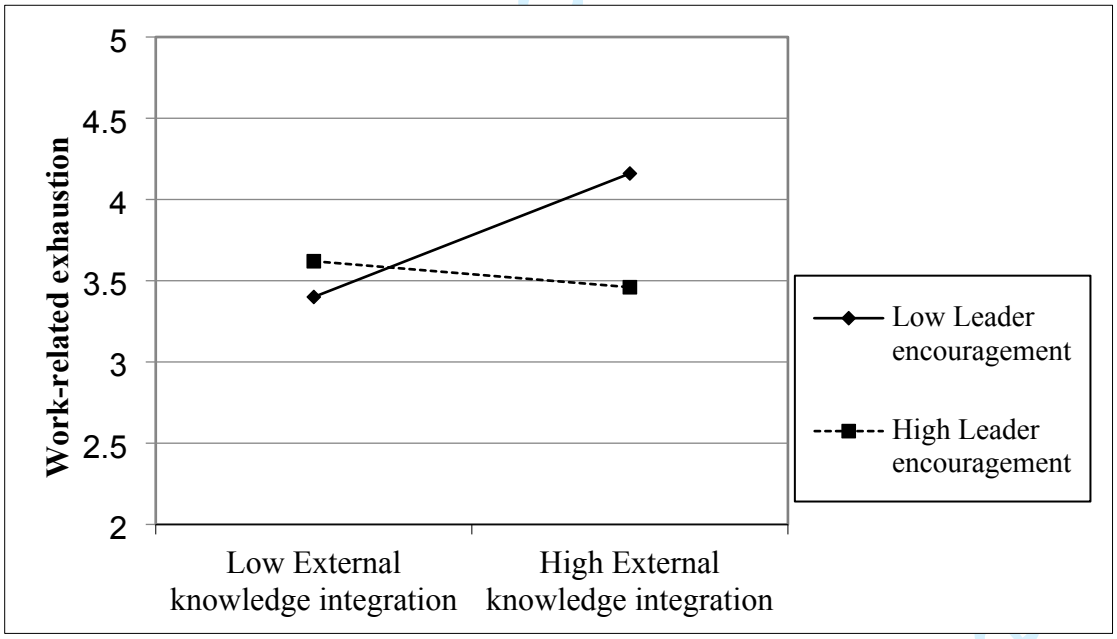

Figure 3. Leader encouragement of creativity as a moderator for the relationship between external knowledge integration and employee work-related exhaustion

Appendix

Table A1. Instrument development

Comstruct	Factors	Items
EKID		Our firm and employees can absorb the partner's knowledge by using digital technology, such as Generative AI, big data, data access system, digital platform
		Our firm and employees can assimilate the partner's knowledge by using digital technology into new products, such as Generative AI, big data, data access system, digital platform
		Our firm and employees can incorporate the partners' knowledge by using digital technology into new products, such as Generative AI, big data, data access system, digital platform
		Our firm and employees can apply the partners' different skills by using digital technology to develop new products, such as Generative AI, big data, data access system, digital platform
CPE	PI	I spend considerable time trying to understand the nature of the problem
		I think about the problem from multiple perspectives
		I decompose a difficult problem/assignment into parts to obtain greater understanding
	ISE	I consult a wide variety of information
		I search for information from multiple sources (e.g., personal memories, others' experience, documentation, Internet, etc.)
		I retain large amounts of detailed information in my area of expertise for future use
	IG	I consider diverse sources of information in generating new ideas
		I look for connections with solutions used in seeming diverse areas
		I generate a significant number of alternatives to the same problem before I choose the final solution
		I try to devise potential solutions that move away from established ways of doing things
EX		I spend considerable time shifting through information that helps to generate new ideas
		I feel emotionally drained from my work
		I feel emotionally fatigued because of the demands of my job
		I feel burned out from my work

LEC	My leader encourages and emphasizes or reinforces creativity by employees
	My leader respects employees' ability to function creatively
	My leader allows employees to try to solve the same problems in different ways
	My leader expects employees to deal with problems in different ways
	My leader will reward employees who are creative in doing their job
	My leader will publicly recognize those who are creative
EC	Suggests new ways to achieve goals or objectives
	Comes up with new and practical ideas to improve performance
	Searches out new technologies, process, techniques and/or product ideas
	Suggests new ways to increase quality
	Is a good source of creative ideas
	Is not afraid to take risks
	Promotes and champions ideas to others
	Exhibits creativity on the job when given the opportunity to
	Develops adequate plans and schedules for the implementation of new ideas
	Often has new and innovative ideas.
	Comes up with creative solutions to problems
	Often has a fresh approach to problems
	Suggests new ways of performing work tasks

Dear Editor and Reviewers,

We sincerely thank you for your constructive and insightful feedback on our manuscript titled " How does external knowledge integration influence SME employee creativity in the Digital Age?", We have carefully considered all comments and revised the manuscript accordingly. Below, we provide a detailed point-by-point response to each comment. Changes in the manuscript are highlighted and page/paragraph numbers are indicated where appropriate.

Response to Reviewer 1

Reviewer Comments

1. While you adopt Social Information Processing (SIP) theory as the central lens, the manuscript does not adequately justify its unique relevance in this context. SIP has been widely applied in organizational research, and your application lacks specificity regarding what theoretical novelty it brings to understanding external knowledge integration (EKI) in SMEs undergoing digital transformation.

Author responses:

We appreciate this comment and have revised the part of literature review and theoretical contribution to clarify the distinctive contribution of SIP theory. Compared with JD-R and COR theories, SIP uniquely explains how employees cognitively used digital technology to interpret EKI as a social cue shaping their proactive (CPE) and reactive (exhaustion) responses.

- In the part of literature review, we mentioned that "*Social Information Processing (SIP) theory suggests that individuals form attitudes and behaviors by interpreting salient and contextually relevant cues from their environment (Salancik and Pfeffer, 1978; Crick and Dodge, 1994). In organizational settings, such cues often include leadership behaviors, peer interactions, and the configuration of technological systems. Employees rely on these signals to interpret workplace expectations and adjust their actions accordingly (Robinson and O'Leary-Kelly, 1998; Maitlis and Lawrence, 2007). ……Within the SIP framework, digital tools operate as embedded social cues that guide employees' interpretations, ultimately shaping their creative involvement or experience of burnout. We thus conceptualize EKI with digital technologies as a behavioral process that mediates the relationship*

between environmental stimuli and employee outcomes." (Page 5-Page 6).

- In the theoretical contribution part, we emphasize in the revised manuscript that our dual-path model extends SIP by integrating both motivational and affective pathways within SME digital contexts. Such as "*Based on SIP theory, our research uniquely explains how employees cognitively interpret EKI as a social cue shaping their proactive (CPE) and reactive (exhaustion) responses. We emphasize in the revised manuscript that our dual-path model extends SIP by integrating both motivational and affective pathways within SME digital contexts.*" (Page 26-Page 27).

Reviewer Comments

2. Your framework simplifies the relationships between EKI, mediators (CPE and exhaustion), and creativity. It lacks consideration of dynamic feedback loops or cross-path effects (e.g., CPE reducing exhaustion).

Maybe you should consider extending the model to reflect more realistic employee responses, such as potential reciprocal effects. You may also consider modeling the digitalization context explicitly rather than treating it as background.

Author responses:

- Thanks for your advice. The dynamic feedback loops and cross-path effects is really import for the associate for the external knowledge integration to employee creativity. This manuscript used two-wave lagged analysis and try to answer the association between these variables. We will do the deep research of this dynamic feedback loops and cross-path effects in the future and mention the limitation of these mediation effect in the limitation part (Page 30). As "*Second, our research model conducts CPE and work-related exhaustion as two psychological mediators to explain the association between EKI and employee creativity. However, it lacks consideration of dynamic feedback loops or cross-path effects (e.g., CPE reducing exhaustion). Incorporating such dynamic feedback loops in future models could provide a more comprehensive understanding of how employees internalize external stimuli during digital transformation.*"

Reviewer Comments

3. The construct of EKI, as perceived by employees, is not clearly defined—whether it refers to their own engagement, their leaders' practices, or firm-wide strategies. Additionally, creativity is entirely self-reported.

You should specify and clarify the level and content of EKI measurement. Justify reliance on self-rated creativity or suggest, in limitations, the need for supervisor ratings in future research.

Author response:

- Thanks for your promising advice. Base on Zahra et al.' (2007) research, we have revised the literature review section (Page 6) to clarify that "*We conceptualize EKI with digital technologies as a behavioral process that mediates the relationship between environmental stimuli and employee outcomes.*"
- We have also added a statement in the Limitations section (Page 31) to acknowledge the reliance on self-rated creativity and suggest that future research incorporate supervisor ratings to enhance objectivity. The revised part as that "*Fourth, we used self-reported measures of employee creativity. While self-assessments capture individuals' internal perceptions and motivations, they may be subject to self-report bias and common method variance. Future studies should incorporate multi-source data, such as supervisor or peer evaluations, to validate these results and provide a more objective assessment of employee creativity.*" (Page 31)

Reviewer Comments

4. Despite being framed as a study on digital transformation, no variables relating to digital technology use or exposure are modeled, controlled, or examined.

So, either introduce a measurable variable related to digitalization or revise the framing to avoid overstating this context. At minimum, provide deeper discussion in the findings regarding digital tools and practices that may intensify EKI.

Author response:

- Thank you for your reminding. We have significantly expanded the Discussion section (Page 22-Page 24) to incorporate a detailed analysis of digital tools and practices, such as ERP systems, cloud-based knowledge-sharing platforms, AI-driven customer analytics, and digital crowdsourcing platforms, that intensify EKI. We now explain how these digital practices both enable and challenge employees'

creative engagement, addressing the reviewer's concern directly. As showed in the discussion section "*This suggests that even modest enhancements in digital-enabled external knowledge acquisition, such as participation in virtual expert forums, use of cloud-based knowledge repositories, or adoption of AI-powered customer feedback analysis, can yield substantial gains in employees' involvement with creative tasks. This is particularly vital for SMEs striving to innovate under escalating digital complexity and resource constraints.*" (Page 22-Page 23)

Reviewer Comments

5. In terms of CMB, while a two-wave design is used, all focal variables (predictors, mediators, and outcome) are self-reported, and Harman's one-factor test is no longer considered adequate by current standards.

I advise to consider more robust CMB diagnostics. Also clarify the time lag between variables and confirm whether cross-source data collection was implemented to some extent.

Author response:

- Many thanks for your advice. Thank you for this helpful suggestion. In addition to Harman's test, we now apply a marker variable technique following Healey et al. (2015). Specifically, we included a theoretically unrelated item, perceived industry growth, as a marker variable. This item was not conceptually related to any focal constructs in our model (i.e., EKI, CPE, work-related exhaustion, or employee creativity). We incorporated the marker variable into our regression models as an additional control (Table 6). After adjusting for the marker variable, the coefficients of our main relationships remained significant, suggesting that our findings are robust and not attributable to common method variance (In the 4.1 Measurement model, page 18).

  Reference: Healey, M. P., Hodgkinson, G. P., Whittington, R. and Johnson, G. (2015), "Off to plan or out to lunch? Relationships between design characteristics and outcomes of strategy workshops", British Journal of Management, Vol. 26 No. 3, pp. 507-528.

Reviewer Comments

6. The manuscript contains frequent grammatical errors, awkward constructions, and inconsistent terminology (e.g., "have" vs. "has," "involvement in involvement," inconsistent references to leader support).

Author response:

- We appreciate this thoughtful recommendation. We have conducted a comprehensive language edit to ensure grammatical accuracy, consistency of terminology (e.g., "leader encouragement" vs. "leadership support"), and clarity of expression throughout the manuscript.

Reviewer Comments

7. While your manuscript cites many sources, the review lacks critical synthesis. Several paragraphs read as citation lists rather than argumentative development of your hypotheses. Please streamline the literature review by focusing on thematic argumentation. Clearly distinguish the theoretical rationale behind each mediator and the moderator. Consider using a gap map or summary table to improve structure.

Author response:

- We feel great thanks for your professional review work on our article. We have restructured the Literature Review (Page 6-Page 12) into three thematic streams (positive pathway, negative pathway, and leadership moderation). We also added a Literature Summary Table in the appendix to visually present the research streams, theoretical gaps, and the study's positioning. This revision clarifies the rationale for including CPE, exhaustion, and leader encouragement as focal constructs.

Stream	Focus	Representative Studies	Main Findings	Identified Gaps
Positive Pathway: EKI → CPE → Creativity	External knowledge as a resource for creative engagement	Tang (2016); Ricci et al. (2021); Zhang et al. (2023); Khan & Abbas (2022)	EKI facilitates creative engagement by expanding knowledge base, external exposure, and motivation to innovate	Few studies integrate CPE as a mediator under SIP theory; Lack of analysis on how digital context shapes CPE
Negative Pathway: EKI → Exhaustion → Creativity	EKI as a potential stressor causing cognitive overload and fatigue	Crupi et al. (2020); Denicolai et al. (2021); Hildenbrand et al. (2018); Li et al. (2023)	EKI can increase time pressure, task ambiguity, and stress, especially in digital settings	Absence of dual-pathway models; Little focus on how exhaustion interacts with innovation routines
Moderating Role of Leader Encouragement of Creativity	Leadership as a contextual signal influencing EKI interpretation	Zahoor et al. (2022); Nguyen et al. (2024); Zhang et al. (2023)	Leader encouragement buffers stress and promotes proactive innovation; strengthens positive responses to EKI	Most studies explore main effects only; Moderated mediation is under-examined; Unclear how leadership affects dual outcomes differently

Reviewer Comments

8. Although your statistical support for moderated mediation is solid, the implications of these findings (especially asymmetries across levels of leader encouragement) are not deeply explored.

Please. extend your interpretation of Figures 2 and 3. Discuss why leader encouragement may reduce the negative path (exhaustion) but enhance the positive path (CPE), and what this means for leadership practices in SMEs.

Author response:

We thank the reviewer for the insightful and constructive suggestions. We have expanded the discussion of Figure 2 and 3 (Page 20-Page 21). The revised text explains how leader encouragement of creativity serves as a critical interpretive cue under SIP theory. Leader encouragement of creativity helps employees reframe EKI as a challenge rather than a threat, thus amplifying CPE and mitigating exhaustion. We also discuss practical implications for SME leaders managing digital knowledge flows.

For the Figure 2, we give more discussion on this part, as "*This suggests that in digitally transforming SMEs, where employees are expected to adopt and utilize new digital tools, platforms, and data streams, leader encouragement serves as a crucial social cue that frames EKI as a resource rather than a burden. Drawing on SIP theory, when leaders signal psychological safety and support for creativity, employees are more likely to interpret the influx of complex external knowledge (often facilitated by digital technologies) as an opportunity to explore novel ideas, rather than as an uncertain or risky endeavor.*"

For the Figure 3, we also added more discussion on this part, as "*However, when leaders actively encourage creative engagement, they provide emotional reassurance, help prioritize tasks, and legitimize exploratory learning, which collectively buffer employees from experiencing exhaustion. The asymmetry in these moderation effects highlights the dual role of leader encouragement, it not only activates the motivational pathway (via CPE) but also neutralizes the strain pathway (via exhaustion). In the context of digitalization, where external knowledge is both abundant and cognitively demanding, leadership support becomes a pivotal organizational lever for shaping how employees internalize and respond to knowledge integration pressures.*"

We believe these revisions significantly improve the clarity, structure, and theoretical consistency of the manuscript and more directly address the reviewer's concerns.