

Platform network ties and enterprise innovation performance: The role of network bricolage and platform empowerment



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ABSTRACT

Small and medium-sized enterprises (SMEs) that participate in network platforms can effectively overcome resource bottlenecks and reduce the impact of the coronavirus pandemic of 2019. However, the reasons for this phenomenon remain unclear. To further investigate this issue, we selected 310 Chinese SMEs to examine the relationship between platform network ties, network bricolage, platform empowerment, and enterprise innovation, including both radical and incremental innovation. The empirical results demonstrate that platform network ties can enhance enterprises' innovation performance. Furthermore, the empirical verification of this study's assumptions provides evidence that network bricolage mediates the relationship between network ties and enterprises' innovation performance, while platform empowerment plays a moderating role. The study results could potentially contribute to the more effective management of platform networking ties, empowerment, and bricolage, thus benefiting the management of SMEs.

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Introduction

SMEs are essential engines of economic development (Smallbone et al., 2022; Zafar et al., 2022). While all commercial enterprises face uncertainties in a highly competitive environment, the COVID-19 pandemic presents an especially severe challenge to the survival and growth of SMEs. The pandemic has significantly impacted all sectors and institutions, particularly SMEs (Al Halbusi et al., 2022). SMEs strive to achieve sustainable growth in order to maintain a competitive advantage (Sharif et al., 2022). However, globally, small businesses experience a high failure rate (Latifi et al., 2021); previous literature has shown that nearly 40% of enterprises fail within the first two years of operation (Hashim et al., 2018; Abbas et al., 2019). Additionally, there has been a wave of SME shutdowns due to their inability to withstand the impact of economic instability.

In such challenging times, it is crucial for businesses to adapt and create the necessary conditions for survival (Jabeen et al., 2022; Shah et al., 2023). To compete with larger and more established enterprises, SMEs must have innovative advantages (Dubouloz et al.,

2021; Clauss et al., 2022). Therefore, they must maximize the utilization of their existing resources to thrive in the competitive market (Limaj & Bernroider, 2019; Park et al., 2022). Innovation is the key to overcoming challenges for SMEs (Shkolnykova & Kudic, 2022; Ge et al., 2022). Organizations are increasingly utilizing platforms to discover and develop innovation. Network-based platforms enable users from social and economic enterprises to interact with each other, discuss market opportunities, and stimulate new ideas (Puthusserry et al., 2020). SMEs that leverage platforms have a higher survival rate and stronger innovation capabilities (Jean & Kim, 2020), and many believe that platform-based innovation is the fundamental difference between successful and failed enterprises (Balsalobre-Lorente et al., 2023; Rajala & Hautala-Kankaanpää, 2023).

In recent years, many platforms have focused on empowering participating enterprises, particularly SMEs, from a network perspective (Peng et al., 2022). These platforms provide opportunities for exchange and sharing among SMEs, helping them establish relationships, find high-quality partners, and grow together (Liu et al., 2021). The platform network aims to generate innovation by fostering interactive relationships among different types of participants and organizations. This promotes changes in practices, institutions, and policies, effectively deploying available human and financial resources to

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address challenges, seize opportunities, and overcome weaknesses (Comunello & Mulargia, 2023). The platform network is an indispensable strategic resource that enables SMEs to cope with adverse situations, grow, and develop (Xie et al., 2022).

However, in many aspects, the resources and opportunities provided by platforms may be underestimated or even overlooked, making better utilization of such resources crucial (Cenamor et al., 2019). Despite extensive research, the role of platform networks in facilitating corporate innovation and their link to innovation performance remain unclear. This study investigates the relationship between platform network ties, network bricolage, platform empowerment, and enterprise innovation performance. Specifically, the empirical results reveal how platform networks promote SMEs' innovation and shed light on the impact of network bricolage and platform empowerment in driving SMEs' innovation. These findings may enhance the competitiveness of SMEs and help them overcome development bottlenecks.

Literature review

Network ties and innovation performance

Enterprises that are embedded in networks have various network ties through which they can acquire knowledge and information from their partners to enhance their innovation performance. Granovetter (1973) conducted pioneering research on the strength of network ties, with a focus on the flow of information among individuals. Different types of network ties have varying strengths, resulting in different effects on innovation (Jiakui et al., 2023). According to this theory, a strong network can facilitate the interaction of individuals with knowledge and information, thereby fostering improved innovation performance. On the other hand, bridging ties, which span structural holes as per Burt's (1995) theory of structural holes, provide enterprises separated by such holes with greater access to novel knowledge and more opportunities for innovation compared to those not separated by such holes.

Participants in platforms benefit from mutual exchanges and intensive interactions, utilizing these strong ties to enhance their ability to exchange detailed information (McEvily & Zaheer, 1999; Huggins et al., 2020). Strong network ties facilitate a rich flow of information (Moon et al., 2022). Conversely, those lacking such connections find it more costly to acquire reliable, accurate, and detailed information (Thrassou et al., 2020). Moreover, SMEs in platforms can leverage newly created knowledge to improve their existing products and processes, thereby positively influencing product innovation (Rajala & Hautala-Kankaanpää, 2023; Mu & Di Benedetto, 2012).

Bridging ties between heterogeneous participants with diverse knowledge often stimulate the generation of new ideas (Jin & Li, 2022), and networks enable enterprises to search for, manage, and utilize these bridge connections (Chung et al., 2020). Bridging ties offer the potential for diversity and novelty while reducing knowledge redundancy (Moon et al., 2022). Multiple heterogeneous bridging ties allow enterprises to access extensive expertise among network members without pre-existing connections (Chung et al., 2020). This encourages enterprises to combine knowledge from various sources related to technology, organizational practices, and market trends (Raza et al., 2019; Moon et al., 2022). The inflow of diversified knowledge enhances an enterprise's capacity to assimilate and establish new connections (Crupi et al., 2020), thereby stimulating a wide range of insights and knowledge creation. Based on these considerations, this study proposes the following hypotheses:

H1: Strong ties are positively related to SMEs' (a) radical and (b) incremental innovation performance.

H2: Bridging ties are positively related to SMEs' (a) radical and (b) incremental innovation performance.

Network ties, network bricolage, and innovation performance

Bricolage is first defined by Lévi-Strauss (1966) as "making do with what is at hand" (Konczak et al., 2000). Bricolage practitioners demonstrate creativity by reusing or combining resources to achieve their goals (Baker & Nelson, 2005). "Making do" relies on improvised methods and experimentation, and the trial-and-error process may indicate the absence of a formal analysis. The resources "at hand" encompass physical goods, creative ideas, science and technology, and contacts. These resources are easily accessible as they are often considered obsolete or worthless (Baker & Nelson, 2005).

The outbreak of COVID-19 has severely threatened the development of enterprises (Micah et al., 2023). Surviving the significant downward pressure on the economy has become a critical issue, especially for SMEs (Jaffar, 2020; Li et al., 2022), as resource constraints hinder the transformation of ideas into innovative performance (Yan et al., 2020). Therefore, establishing and expanding network relationships are crucial for enterprise innovation. In a platform environment, the network itself is perceived as a resource. According to Baker et al. (2003), network bricolage in a platform occurs when the enterprise views the existing network within the platform as an available resource (Kwong et al., 2019).

Numerous studies argue that relying on existing resources for network bricolage can enhance SMEs' innovation performance. SMEs can only survive fierce competition by leveraging the availability of resources from different perspectives. First, network bricolage enables the integration of existing network resources. By engaging in network bricolage, enterprises can creatively implement processes to meet their resource needs (Baker & Nelson, 2005; Crupi et al., 2022), thus improving innovation performance. Second, network bricolage emphasizes action and the rapid utilization of available resources to meet needs creatively (Senyard et al., 2014). Bricolage accelerates the aggregation of resources, ultimately contributing to innovation performance (Fu et al., 2020). Third, network bricolage can continuously generate higher-quality services based on existing resources and is more likely to identify new innovation opportunities. Therefore, enterprises that engage in network bricolage are better equipped to develop solutions when they encounter innovation challenges (Senyard et al., 2014). Based on these considerations, we propose the following hypothesis:

H3: Network bricolage is positively related to SMEs' (a) radical and (b) incremental innovation performance.

Contact opportunities and the development of social capital are crucial for growth (Khan et al., 2021). Bricolage can assist companies in utilizing the resources "at hand" to realize innovative ideas, thereby aiding SMEs in overcoming resource constraints and promoting innovation performance (Chen et al., 2022). Strong ties facilitate the identification of opportunities and the exchange of information, particularly tacit knowledge, for enterprises (Li & Gao, 2021). Bridging ties within a platform network also offer benefits to SMEs. Building upon H3, we believe that for SMEs with limited resources, entrepreneurial creativity increases within the platform network, leading to bricolage activities that translate innovative ideas into tangible innovation practices. Consequently, platform network ties enhance platform bricolage, which in turn positively impacts innovation performance. Hence, we propose the following hypothesis:

H4: Network bricolage mediates the positive relationship between platform network ties and SMEs' (a) radical and (b) incremental innovation performance.

Platform empowerment

In 1975, McClelland proposed that empowerment should be defined as enabling. Conger and Kanungo (1988) further argued that

the process of empowerment should not be simply about delegation but about enabling, thereby fostering autonomy and promoting overall creativity through enhanced self-efficacy. We contend that this definition of empowerment is associated with the perception of being enabled. Within the platform network environment, empowerment focuses on improving social relations between organizations and enhancing subjective and endogenous factors such as motivation, trust, intimacy, unity, and identity in the relationships between enterprises (Liu et al., 2021).

The COVID-19 pandemic has hindered the growth of SMEs, and SMEs embedded in platforms could become more viable (Jawad et al., 2023). Empowerment in platform networks is crucial for SMEs' innovation and development (Broekhuizen et al., 2021). Leveraging their core position in the value network and their ability to integrate resources, platforms play a key role in bridging resources, elements, products, and services within bilateral or plurilateral architectures. Platforms in the empowerment process also contribute to empowering their members, which is a dynamic and targeted process (Santos, 2023; Fan et al., 2023). SMEs on the platform establish connections with universities, research institutions, intermediary organizations, government departments, and other entities. Within this intricate network, symbiotic relationships promote "empowerment" through channels, information, funds, and other resources. Consequently, SMEs are supported as "empowerment objects," stimulating value creation (Fan et al., 2023) and fostering the development of the platform's ecological system (Foerderer et al., 2019). Therefore, platform empowerment is an important factor influencing network relationships and aiding SMEs in enhancing their innovative development. The greater the empowerment, the stronger the relationship. Thus, the hypothesis is as follows:

H5: Platform empowerment moderates the positive relationship between platform network ties and SMEs' (a) radical and (b) incremental innovation, such that the impact of platform network ties on innovation performance will be stronger when platform empowerment is higher.

Fig. 1. shows the study's conceptual model.

Research methodology

Data collection

As the world's largest developing economy, China's emerging economy continues to progress rapidly (Mubeen et al., 2021). China offers an ideal research environment due to its complexity and vitality, which enables enterprises to face the challenges of new competition and the need to enhance their innovation capabilities. Our research focused on the Chinese entrepreneurship platform, which is well-developed and primarily comprises SME participants. The sample consisted of 310 enterprises from 120 entrepreneurial platforms across 24 Chinese provinces (Mu & Di Benedetto, 2012).

Prior to conducting the questionnaire survey, we gathered information through open-ended, semi-structured interviews and telephone conversations, each lasting two to three hours. The interview questions covered the (a) personal information of the interviewees, (b) current production and operations of the companies, (c) network relationships on the entrepreneurial platform, and (d) innovative activities on the platform. The responses obtained from these interviews aided in further refining the questionnaire as needed. Additionally, we invited five professors with expertise in innovation management to review the content, and their feedback was utilized to revise the questionnaire. A preliminary survey was conducted with 15 SME managers who were using the platform. Based on their opinions and suggestions, certain questions in the draft questionnaire were modified (Adam & Alarifi, 2021).

The final questionnaire was divided into three parts, primarily focusing on the innovation behavior of SMEs within platform networks. The first section provided an overview of the enterprises' basic information and characteristics. The second section focused on the relationships and structure of platform networks. The third section addressed the innovation practices among enterprises on these platforms.

Our sample consisted of 310 enterprises, with 33% having fewer than 10 staff members, 59.03% having 10–50 staff members, and 7.74% having 50–100 staff members. In terms of annual revenue, 13.23% of the enterprises had revenue below ¥500,000, 51.94% had revenue between ¥500,000 and ¥1,000,000, 30.65% had revenue between ¥1,000,000 and ¥5,000,000, and 4.19% had revenue between ¥5,000,000 and ¥10,000,000. The majority of these enterprises were from the information transmission industry, accounting for 40%, while the remaining belonged to other industries.

Measures and variables

The hypotheses were tested using a five-point Likert scale ranging from strong disagreement to strong consensus. We translated the questionnaire items from English to Chinese (Behling & Law, 2000). To ensure the readability of the translation, we pre-tested it on five randomly chosen participants and generated a final questionnaire.

Dependent variables

Innovation performance. Existing research divides innovation into radical and incremental improvements. Incremental innovations focus on improving existing product processes, methods, technology, and organizational structures (Lennon, 2022), while radical innovations leap beyond existing technology with the potential to make a significant difference (Ritala & Sainio, 2014; Lennon, 2022). Incremental and radical innovation performance items are formulated based on a theoretical review by Cheng and Shiu (2015).

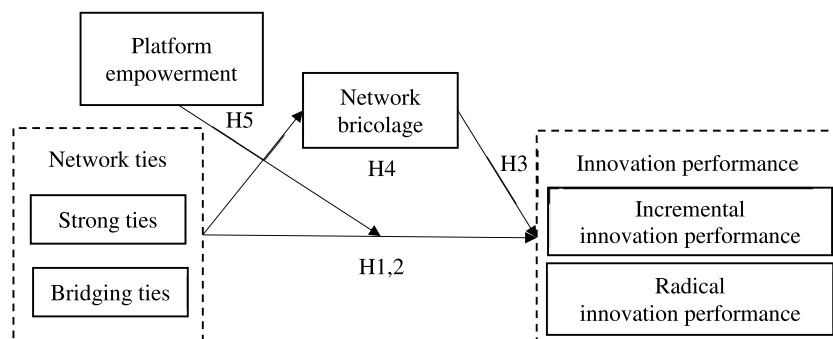


Fig. 1. Research framework.

Table 1
Constructs and measures.

VARIABLES	ITEMS	CRONBACH'S ALPHA	FACTOR LOADING	AVE	CR
Strong ties	We feel indebted to our collaborators for what they have done for us.	0.753	0.595	0.510	0.757
	Our employees share close social relations with the employees of collaborating organizations.		0.640		
	Our relationship with our collaborators can be defined as "mutually gratifying."		0.544		
Bridging ties	Our members and those of our partners vary widely in their areas of expertise.	0.783	0.820	0.553	0.788
	Our members and those of our partners have different backgrounds and experiences.		0.809		
	Our members and those of our partners have skills and abilities that complement each other.		0.755		
Platform empowerment	Mutual aid, sharing, and corporation are important among the members.	0.789	0.734	0.558	0.791
	There is a friendly atmosphere here.		0.682		
Network bricolage	The relationships among the members are close and cozy.	0.891	0.731	0.505	0.891
	We are confident of our ability to find workable solutions to new challenges using our existing resources.		0.634		
	We gladly take on a broader range of challenges with our resources than others are able to do.		0.671		
	We use any existing resource that seems useful in responding to a new problem or opportunity.		0.650		
	We deal with new challenges by applying a combination of our existing resources and other available, inexpensive resources.		0.680		
	When dealing with new problems or opportunities, we take action and assume that we will find a workable solution.		0.717		
	By combining our existing resources, we take on a surprising variety of new challenges.		0.727		
	When we face new challenges, we put together workable solutions from our existing resources.		0.638		
Incremental innovation performance	We combine resources to accomplish new challenges that the resources were not originally intended to accomplish.	0.773	0.660	0.539	0.778
	Our firm introduces new products that result from an incremental improvement in existing products.		0.709		
	Our firm introduces new products that offer more incremental features.		0.772		
	Our firm introduces new products that require more incremental changes in customers' way of using them.		0.674		
Radical innovation performance	Our firm introduces new products that are more radically new to the market.	0.912	0.764	0.776	0.912
	Our firm introduces new products that offer more radical features		0.851		
	Our firm introduces new products that require more radical changes in customers' way of using them.		0.809		

Notes: AVE, average variance extracted; CR, composite reliability.

Independent variables

Network ties. We developed a network relationship item based on the theoretical reviews of influential social network articles (Desmarchelier et al., 2021; Zhao et al., 2023). Drawing from the study conducted by Mu and Di Benedetto (2012), we measured networking ties using a platform construct consisting of two dimensions: strong ties and bridging ties.

Platform empowerment. Platform empowerment is critical for promoting SME development (Wang et al., 2022; Logue & Grimes, 2022). The platform empowerment items were adapted from Wang et al. (2011). This measure describes the interactions among different enterprises within a platform and reflects their impact on internal enterprises.

Network bricolage. As a mediator, bricolage utilizes existing resources and available tools and materials to create new products (Mai et al., 2023). Our research situates bricolage within the context of platform networks. We designed eight items to capture the essence of Senyard et al.'s (2014) study and used them to measure network bricolage.

Control variables

Control variables were employed to ensure accurate results (Liu et al., 2021; Hafeez et al., 2023). In general, innovation is influenced by the fundamental characteristics of the enterprise (Sattar et al., 2020).

Therefore, we incorporated firm age, staff number, annual revenue, and industry as control variables in the study.

Results

According to the research hypotheses, strong and bridging ties within a platform have a positive impact on SMEs' radical and incremental innovation performance, with network bricolage serving as an intermediary and the platform moderating the influence of network ties on SMEs' innovation performance. Table 1 presents the results of structural reliability and validity testing using SPSS v.21.0. All Cronbach's alpha values exceed 0.7, and all factor loadings are above 0.5, meeting the necessary requirements (An et al., 2018).

The results of the confirmatory factor analysis (CFA) are displayed in Table 2. Model 1 represents a null model, where all indicators are independent. In Model 2, strong and bridging ties are combined into one component, while platform empowerment, network bricolage, and innovation performance are combined into another. Model 3 is a three-factor model that combines platform empowerment and network bricolage, strong and bridging ties, and incremental and radical innovation performance into three separate factors. The baseline six-factor Model 4 treats strong ties, bridging ties, platform empowerment, network bricolage, incremental innovation, and radical innovation performance as six distinct latent variables. Table 2 also illustrates that the six-factor model provides a better fit to the

Table 2
Comparison of the measurement models for the main variables.

Model	χ^2	df	χ^2 / df	RMR	GFI	NFI	IFI	CFI	RMSEA
Model 1	1432.857	231	6.203	0.074	0.676	0.597	0.639	0.636	0.130
Model 2	1244.022	229	5.432	0.055	0.699	0.650	0.695	0.693	0.120
Model 3	1015.219	227	4.472	0.057	0.736	0.715	0.763	0.716	0.106
Model 4	292.905	215	1.362	0.021	0.927	0.918	0.977	0.976	0.034

Table 3
Descriptive statistics of the measured variables.

	MEAN	SD	SQUARED CORRELATION COEFFICIENTS						
			(1)	(2)	(3)	(4)	(5)	(6)	
Strong ties (1)	3.814	0.603	0.714						
Bridging ties (2)	3.644	0.576	0.302**	0.744					
Platform empowerment (3)	3.945	0.583	0.536**	0.304**	0.747				
Network bricolage (4)	3.826	0.512	0.465**	0.363**	0.504**	0.711			
Incremental innovation performance (5)	3.888	0.529	0.435**	0.293**	0.407**	0.508**	0.734		
Radical innovation performance (6)	3.374	0.891	0.335**	0.364**	0.349**	0.576**	0.206**	0.881	

Note: ** means significant at 1% level; * means significant at 5% level.

observed data compared to any alternative model ($\chi^2 = 292.905$, $df = 215$, $\chi^2 / df = 1.362$, $RMR = 0.021$, $GFI = 0.927$, $NFI = 0.918$, $IFI = 0.977$, $CFI = 0.976$, $RMSEA = 0.034$).

The average values of the primary measured variables are presented in Table 3 and range between 3.374 and 3.945. The Pearson correlation coefficient reveals a positive correlation among the variables. Furthermore, the diagonal of the matrix displays the square root of the average variance extraction (AVE) values, which already exceed the correlation between the constructs. Additionally, the Bartlett sphericity test yielded a statistically significant result ($p < 0.01$), and the Kaiser–Meyer–Olkin value for each scale was 0.912. These results suggest that model testing can be conducted using regression analysis procedures (Hair et al., 1998).

SPSS’s PROCESS calculation tool (Hayes, 2013) was used to measure the influence of different variables on innovation performance. Table 4 displays the results for radical innovation performance as the dependent variable. Model 2 demonstrates a significant and positive correlation between network ties and radical innovation performance ($\beta = 0.362$, $p < 0.01$; $\beta = 0.451$, $p < 0.01$), providing strong support for H1a and H2a, respectively. Model 3 shows a strong correlation between network bricolage and innovation performance ($\beta = 0.849$, $p < 0.01$), confirming H3a. In Model 4, there is a statistically significant interaction between strong ties and platform empowerment ($\beta = 0.241$, $p < 0.05$), while Model 5 indicates that the estimated

coefficient of bridging ties is statistically significant ($\beta = 0.259$, $p < 0.05$), supporting H5a.

Similar results for radical innovation performance as an independent variable are presented in Table 5. According to H1 and H2, network ties have a positive effect on incremental innovation performance. Model 7 demonstrates that the coefficient ($\beta = 0.337$, $p < 0.01$; $\beta = 0.166$, $p < 0.01$) is both positive and significant, strongly supporting H1b and H2b. H3b proposes a positive association between bricolage and incremental innovation performance. Model 8 confirms a strong positive correlation between network bricolage and incremental innovation performance ($\beta = 0.385$, $p < 0.01$), thereby supporting H3b. H4 examines the impact of platform empowerment on incremental innovation performance and network interactions. In Model 9, the interaction between strong ties and platform empowerment is not significant, while in Model 10, the estimated interaction coefficient of bridging ties is negatively significant ($\beta = 0.158$, $p < 0.05$).

To further test the mediating effect, an additional analysis was conducted. Table 6 demonstrates that the confidence interval of the indirect effect does not include zero, indicating the significance of the mediating role played by network bricolage and supporting H4. However, since the confidence intervals of their direct effects contain zero, the direct impacts of strong ties on radical innovation performance and bridging ties on incremental innovation performance are

Table 4
Results of the hierarchical linear regression analysis – Radical innovation performance.

VARIABLE NAME	MODEL 1	MODEL 2	MODEL 3	MODEL 4	MODEL 5
<i>Control variables</i>					
Firm age	0.039 (0.047)	0.058 (0.043)	0.055 (0.038)	0.057 (0.038)	0.051 (0.038)
Staff number	-0.106 (0.096)	-0.021 (0.088)	0.005 (0.078)	-0.008 (0.078)	-0.003 (0.078)
Annual revenue	0.132 (0.076)	-0.016 (0.071)	-0.060 (0.064)	-0.061 (0.063)	-0.058 (0.063)
Industry	-0.030 (0.020)	-0.019 (0.018)	-0.013 (0.016)	-0.013 (0.016)	-0.013 (0.016)
<i>Main effects</i>					
Strong ties		0.362** (0.080)	0.086 (0.078)	0.065 (0.084)	0.052 (0.084)
Bridging ties		0.451** (0.086)	0.278** (0.079)	0.265** (0.079)	0.275** (0.079)
Network bricolage			0.849** (0.094)	0.815** (0.098)	0.837** (0.098)
<i>Interaction effect</i>					
Platform empowerment				0.090 (0.090)	0.072 (0.089)
Strong ties*platform empowerment				0.241* (0.117)	
Bridging ties*platform empowerment					0.259* (0.128)
R ²	0.021	0.196	0.368	0.378	0.378
F	1.643	12.280	25.130	20.274	20.240

Dependent variable: radical innovation performance.

Note: ** means significant at 1% level; * means significant at 5% level.

Table 5
Results of the hierarchical linear regression analysis – Incremental innovation performance.

VARIABLE NAME	MODEL 6	MODEL 7	MODEL 8	MODEL 9	MODEL 10
<i>Control variables</i>					
Firm age	-0.055* (0.028)	-0.047 (0.025)	-0.049* (0.023)	-0.048* (0.023)	-0.045 (0.023)
Staff number	0.027 (0.057)	0.067 (0.051)	0.078 (0.048)	0.074 (0.048)	0.081 (0.047)
Annual revenue	0.068 (0.045)	-0.016 (0.042)	-0.036 (0.039)	-0.038 (0.039)	-0.041 (0.039)
Industry	-0.007 (0.012)	0.000 (0.011)	0.002 (0.010)	-0.000 (0.010)	-0.002 (0.010)
<i>Main effects</i>					
Strong ties		0.337** (0.047)	0.212** (0.047)	0.177** (0.051)	0.181** (0.051)
Bridging ties		0.166** (0.050)	0.088 (0.048)	0.078 (0.048)	0.078 (0.048)
Network bricolage			0.385** (0.057)	0.347** (0.060)	0.342** (0.060)
<i>Interaction effect</i>					
Platform empowerment				0.106 (0.055)	0.099 (0.054)
Strong ties*platform empowerment				0.056 (0.071)	
Bridging ties*platform empowerment					-0.158* (0.078)
R ²	0.020	0.230	0.330	0.339	0.346
F	1.532	15.059	21.243	17.075	17.659

Dependent variable: incremental innovation performance.
Note: ** means significant at 1% level; * means significant at 5% level.

not significant. Thus, network bricolage partially mediates the relationship between bridging ties and radical innovation performance, as well as between strong ties and incremental innovation performance. Bricolage also acts as a complete mediator between strong ties and radical innovation performance and bridging ties and incremental innovation performance.

Fig. 2 illustrates that the impact of strong ties on radical innovation is greater when platform empowerment is high than when it is low.

Fig. 3 shows that the positive effect of bridge relationships on radical innovation is stronger when platform empowerment is high than when it is low.

Fig. 4 shows that when platform empowerment is low compared to high, bridging ties have a more positive impact on incremental innovation.

Table 7 lists the results of the study's hypothesis testing.

Discussion

There is a relative scarcity of studies on SME innovation, particularly in the context of platform networks. To address this gap, the primary objective of this study is to examine the variables that influence SMEs' innovation performance within platform networks. Specifically, the study aims to build a comprehensive knowledge system regarding platform and enterprise management and to establish and validate an integrated theoretical model encompassing platform

network ties, bricolage, empowerment, and innovation performance. The quantitative analysis conducted in this study confirms our expectations, demonstrating that platform network ties can effectively enhance SMEs' innovation performance, with network bricolage serving as a mediating factor and platform empowerment playing a moderating role to some extent.

The results reveal a positive correlation between platform network ties and SMEs' innovation performance, indicating that both strong and bridging ties contribute to improving innovation performance. These findings align with previous research (Fu et al., 2022; Iorember et al., 2022; Zhao et al., 2023). Strong and bridging network ties are considered advantageous as they facilitate innovation by promoting resource acquisition and optimizing resource allocation within the platform network (Zhang et al., 2022; Zhao et al., 2023). These findings support H1, which posits a positive relationship between network ties and SMEs' innovation performance.

Moreover, the study highlights the crucial role of network bricolage, suggesting that higher network bricolage ability corresponds to better innovation performance. Network bricolage also mediates the impact of network ties on innovation performance. Specifically, network bricolage acts as a complete mediator between bridging ties and incremental innovation performance, as well as between strong ties and radical innovation performance. The influence of strong ties on incremental innovation and the impact of bridging ties on radical innovation are both mediated by network bricolage. While bridging ties have an insignificant impact on incremental innovation when network bricolage is included as a mediating component, strong ties can facilitate the effective utilization of existing resources. These findings align with the notion that incremental innovation primarily involves leveraging existing knowledge and resources (Moon et al., 2022). However, radical innovation requires new resources and powerful network ties may inhibit the generation of new ideas (Chirico et al., 2022). Thus, while bridging ties directly and positively affect radical innovation, network bricolage plays a more influential role in shaping strong network relationships. Therefore, H3 and H4 are supported.

Regarding the moderating effects of platform empowerment on innovation, the study finds a negative and significant moderating effect on incremental innovation. This suggests that among the influences of network relationships, strong ties have a stronger impact on incremental innovation, while bridging ties tend to counteract the effect of platform empowerment, resulting in a decline in innovation performance. This may be because incremental innovation focuses more on integrating and utilizing existing resources (Gui et al., 2022), where strong network ties play a more prominent role. Alternatively, platform empowerment positively moderates radical innovation. Platform empowerment primarily focuses on

Table 6
Mediating analysis.

	Direct effect			Indirect effect		
	Effect	LLCI	ULCI	Effect	LLCI	ULCI
Strong ties→network bricolage→radical innovation performance	0.065	-0.099	0.230	0.265	0.183	0.367
Bridging ties→network bricolage→radical innovation performance	0.2746	0.120	0.430	0.170	0.089	0.0280
Strong ties→network bricolage→incremental innovation performance	0.177	0.076	0.278	0.113	0.066	0.179
Bridging ties→network bricolage→incremental innovation performance	0.078	-0.017	0.172	0.070	0.036	0.121

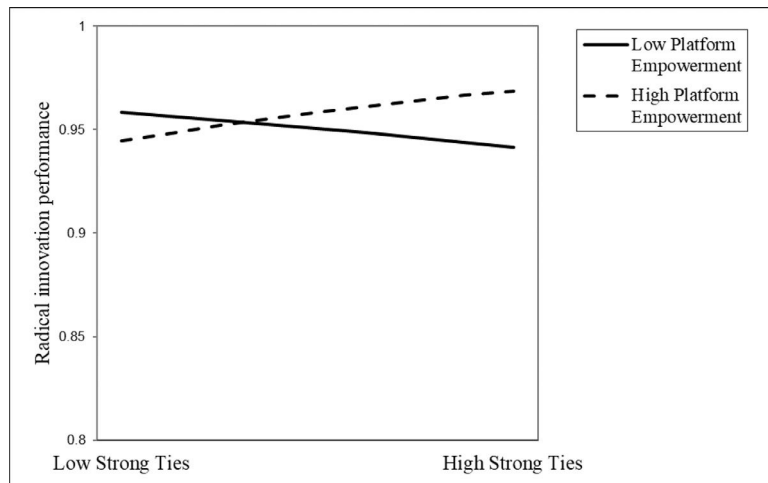


Fig. 2. Moderating effect of platform empowerment on the relationship between strong ties and radical innovation performance.

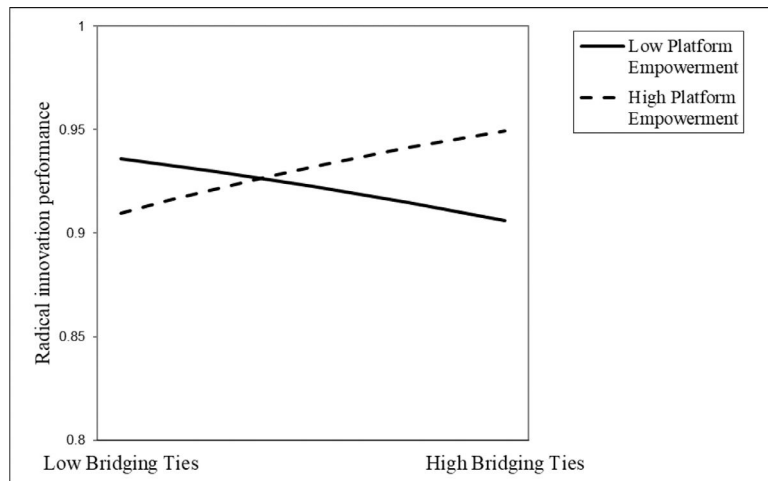


Fig. 3. Moderating effect of platform empowerment on the relationship between bridging ties and radical innovation performance.

improving organizational social relations, enhancing endogenous motivation, and fostering subjective feelings such as mutual trust, intimacy, solidarity, and identity, which contribute to building a network of relationships and bonds within the platform network (Yu et al., 2022). This enables enterprises to leverage innovation resources

within the platform network and enhance their performance in radical innovation (Zhuang et al., 2022; Comunello & Mulargia, 2023). These findings partially support H5, which suggests that platform empowerment moderates the association between platform network ties and both radical and incremental innovation in SMEs.

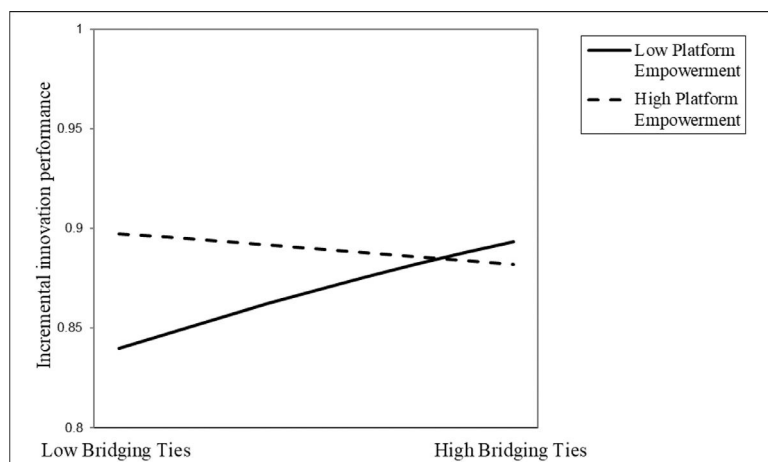


Fig. 4. Moderating effect of platform empowerment on the relationship between bridging ties and incremental innovation performance.

Table 7
Research hypotheses test results.

Hypothesis	Impact path	Result
H1a	Strong ties are positively related to SMEs' radical innovation performance.	Supported
H1b	Strong ties are positively related to SMEs' incremental innovation performance.	Supported
H2a	Bridging ties are positively related to SMEs' radical innovation performance.	Supported
H2b	Bridging ties are positively related to SMEs' incremental innovation performance.	Supported
H3a	Network bricolage is positively related to SMEs' radical innovation performance.	Supported
H3b	Network bricolage is positively related to SMEs' incremental innovation performance.	Supported
H4a	Network bricolage mediates the positive relationship between platform network ties and SMEs' radical innovation performance.	Supported
H4b	Network bricolage mediates the positive relationship between platform network ties and SMEs' incremental innovation performance.	Supported
H5a	Platform empowerment moderates the positive relationship between platform network ties and SMEs' radical innovation performance.	Supported
H5b	Platform empowerment moderates the positive relationship between platform network ties and SMEs' incremental innovation performance.	Not Supported

Implications

Theoretical implications

Previous studies have recognized the effectiveness of social networks in promoting enterprise innovation (Chung et al., 2020; Fu et al., 2022; Moon et al., 2022). However, the connections between network ties, network bricolage, and innovation performance in platform networks remain largely unexplored. This study contributes to the existing knowledge in multiple ways, specifically in the context of platform networks, bricolage, and the empowerment and innovation performance of SMEs.

First, this study expands the research on innovation by exploring a new stream of research that integrates network theory into platform analysis. It also enhances our understanding of innovation performance. A platform network comprises various SMEs that have continuous access to and share information and resources within the platform networks (Abbas et al., 2019). This dynamic and intangible resource enhances the efficiency of SMEs. Strong ties and bridging relationships are beneficial for entrepreneurs, and SMEs can benefit from business networking; for example, they provide access to up-to-date information and enhance credibility. There was little research on the invention of SMEs at the platform level prior to this study, and even fewer studies on the differentiation of different network relationships and innovation categories. This study empirically demonstrates the significance of platform networks in firm innovation using empirical data.

Second, this study is among the first to theoretically investigate network bricolage and empirically demonstrate that SMEs in platform networks can search for new knowledge leading to radical innovation while leveraging existing knowledge for incremental innovation using available resources. This study enhances the scientific literature on the role and impacts of network bricolage. The findings illustrate that network bricolage serves as a mediator between network ties and innovation performance. Additionally, the focus on bricolage in this study is crucial as it is particularly relevant for SMEs.

Prior research has predominantly focused on the impact of firm-level factors on innovation, with limited attention given to the platform level and analyses of the platform network.

Lastly, this study addresses the research gap regarding the impact of platform empowerment on enterprise innovation. Previous analyses have primarily examined the influence of social networks and firm capabilities on innovation performance. Our model extends previous research by providing a comprehensive view of the moderating effects of platform empowerment on the relationship between network ties and innovation performance. These findings indicate that the impact of network ties on innovation performance is moderated by platform empowerment, which is a relationship not previously documented. This study fills this gap by elucidating the specific mechanisms through which platform empowerment affects different types of innovation performance.

Practical implications

Based on the findings, we have identified practical implications that can benefit Chinese firms' innovation performance through platform network ties. This study highlights the significance of platform networks in SMEs' innovation performance, which should be considered a primary goal for firm survival and development in today's competitive marketplace. These implications not only focus on enhancing enterprises' network bricolage ability but also on leveraging the platform to aid SMEs in growth and innovation.

First, executives need to consider the demands of firm innovation and fully utilize network ties within enterprise platforms. The platform network comprises various market participants (such as social enterprises, enterprises, micro-entrepreneurs, and SMEs) and non-market participants (including governments, universities, and non-governmental organizations). It can serve as a source of new information and a catalyst for innovation. One approach to achieve this is by facilitating information flow through the establishment of high-density network connections. Enterprises facing innovation bottlenecks may lack technology, products, services, and distribution channels (Shkolnykova & Kudic, 2022). Another solution is to establish lightweight connection network-platform relationships that can resolve coordination failures and facilitate the exchange of information within platform networks. SMEs can act as "brokers" to control information flow within the network and ridge the gap between "structural holes" (Burt, 1995). This enables networks and "brokering" enterprises to enhance knowledge transfer and innovation promotion capabilities.

Second, this study offers practical recommendations for managers and decision-makers in SMEs, particularly startups. The findings indicate that network ties enhance SMEs' innovation performance by activating network bricolage. Resource-driven thinking often dominates the research agenda, with innovation believed to occur only when significant resources are invested. Therefore, entrepreneurs should recognize that bricolage can help them maximize their limited resources and creatively reconfigure them. Additionally, they should explore the utilization of their platform networks to gain competitive advantages (Kwong et al., 2019). This approach can significantly enhance innovation performance in resource-constrained situations.

Furthermore, this study expands on previous knowledge of platform management practices and recommends that platform empowerment provides enterprises with new development opportunities. These opportunities include value-added services, knowledge sharing, accurate supply-demand matching, and improved innovation performance. Therefore, to realize the transformation from platform empowerment to enterprise innovation performance, enterprises operating on the platform should also focus on establishing a positive symbiotic relationship with the platform and forming a community of interest that promotes consistent and effective value co-creation.

Limitations and future research

This study has several limitations. First, when examining the impact of network ties on innovation platforms, the study only focused on the effects of strong and bridging ties within the platform. Other network-related variables, such as network structure, quality, and breadth, have not been thoroughly investigated. Future studies should aim to explore these variables to gain a more comprehensive understanding of the underlying mechanisms.

The second limitation pertains to the sample used in the study, which primarily consists of entrepreneurial platforms. However, there are various types of platforms across different industries. Although valuable insights have been gained from this research which can be applied to a variety of industries, it is important to expand the scope and include platforms from diverse industries with different network structures and relationships in future research.

Lastly, this study primarily focuses on Chinese SMEs and entrepreneurial platforms due to their significance. However, it is worth noting that country-specific conditions may have influenced the findings. Therefore, conducting comparative analyses between countries could be a fruitful direction for future research to explore potential differences.

Policy recommendations

The empirical results of this study lead to profound conclusions and important policy recommendations. First, it provides decision-makers with insights into the network behavior of SMEs and the contribution of various actors in the platform network. In order to make informed decisions, it is crucial to understand the characteristics of the platform network and the network behavior of SMEs. The research findings highlight the need for further development of localized network platforms, such as local incubation network platforms for innovation collaborations. From a policy formulation perspective, the government can promote the establishment of intermediary economic services or agent organizations to facilitate the formation of platform networks involving research centers, universities, government initiatives, or funding agencies. This would enable SMEs to receive assistance when encountering challenges in finding partners and potential customers (Salehi et al., 2022).

Second, for policymakers, this study reveals the effectiveness of developing network bricolage among SMEs, especially when they face resource constraints. Policymakers need to recognize that bricolage, as an informal business strategy, is a valuable approach for under-resourced SMEs to seize opportunities by creatively reconfiguring their resources before competitors do. Furthermore, the government should continue exploring ways to leverage its pre-established networks to offer SMEs alternative competitive advantages (Kwong et al., 2019).

Third, in the context of the COVID-19 pandemic, SMEs are facing challenges in terms of survival and development. Governments and local authorities can support SMEs in overcoming these difficulties by enhancing platform management mechanisms, promoting platform-enterprise cooperation and sharing, and establishing an open, shared, and efficient platform innovation management system. This includes improving preferential policies for collaborative innovation network construction, deepening platform innovation cooperation, recognizing the guiding and service functions of government departments in enabling platform and collaborative innovation between enterprises, and successfully facilitating firm innovation cooperation projects. Additionally, the government can establish a management system with platform sharing at its core, breaking the cycle of independent and segmented innovation resources through platform empowerment, pooling resources to serve the enterprise platform, and promoting enterprise innovation and upgrading.

Conclusion

Due to the importance of innovation in maintaining competitiveness in today's globalized market, especially in the context of the COVID-19 pandemic, it has become a critical factor for economic development. However, many enterprises still lack sufficient innovation capabilities and exhibit low innovation performance. For instance, a survey of European companies revealed that a significant proportion (approximately 80%) do not adopt any modes of innovation (Parrilli et al., 2023). Consequently, this study aims to investigate the impact of network ties, network bricolage, and platform empowerment on radical and incremental innovation performance. By examining 310 enterprises operating on 120 entrepreneurial platforms across 24 Chinese provinces, this study demonstrates that both strong and bridging network ties significantly and positively influence the sustainability of innovation performance. Moreover, network bricolage can assist businesses in enhancing their innovation performance and mediating the effects of platform network ties on innovation performance. The study also reveals that improved network empowerment has a positive impact on network ties, ultimately enhancing radical innovation performance.

Additionally, this study provides valuable insights into platform management practices that effectively enhance the innovation capabilities of SMEs. It establishes a systematic research framework on platform and enterprise innovation to elucidate the role of platform networks and empowerment in SME innovation management practices. Furthermore, the findings of this study offer valuable guidance for the future development of SMEs in the face of the challenges posed by the COVID-19 pandemic.

Declarations of Competing Interest

None.

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