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# How digital platform capability affects the innovation performance of SMEs—Evidence from China

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ABSTRACT

Today, more and more enterprises are achieving co-innovation across borders by joining digital platforms. However, many SMEs face difficulties in developing and benefiting from strong digital platform capability (DPC) due to limited experience, resources, and funds, which hinders innovation opportunities. This study constructs a model to explore how SMEs can enhance their innovation performance (IP) by adopting digital platforms based on resource orchestration theory. We then introduce ecological institutional norms (EIN) as the moderating variable to observe whether effective platform governance impacts enterprises' value co–creation (VCC) and IP. We conduct a questionnaire survey on 346 SMEs in China's manufacturing industry that participate in digital platforms, and the regression analysis and the bootstrap test results indicate that (1) DPC has a significantly positive impact on IP; (2) DPC has a significantly positive impact on VCC; (3) VCC partially mediates DPC and IP; (4) EIN positively moderate the relationship between DPC and VCC and positively moderate the mediating effect of VCC. These findings add to the literature on digital platforms theoretically and fill the gap in research on how participation in digital platforms can enhance enterprises' innovation and development from the perspective of SMEs. Finally, the study has important managerial implications for SMEs to cultivate DPC, carry out VCC, and participate in platform governance.

## 1. Introduction

Innovation is a critical component for enterprises to take the leading edge and occupy a dominant competitive position in the market in the context of information technology development and industrial integration [1,2]. In the digital economy age, digital technology provides infrastructural support for economic development [3–5]. However, most small and medium–sized enterprises (SMEs) in China lack core technologies and the digital divide further increases the resistance to breaking through low–end lock–in. SMEs need to deeply integrate into the digital economy and explore new value growth points through digital process transformation and cross–border integration based on network effects. Therefore, digital platforms and the internal digital business ecosystem (DBE), which can break the boundaries of time, space, and organization with the support of digital technology, are gradually attracting attention [6–8]. Industry leaders such as Ali, Tencent, and Haier are trying to build digital platforms and DBEs to break organizational barriers and achieve technological collaborative innovation [9]. However, most of the current research on digital platforms is centered on large enterprises, with less attention given to SMEs [10,11].

Resource orchestration theory suggests that static enterprise resources cannot meet the needs of enterprise development. Thus, the ability to allocate, integrate, and utilize resources is key to establishing a sustainable competitive advantage [12]. Joining a digital platform does not directly generate benefits: enterprises can only achieve efficient value creation when they actively and spontaneously allocate resources in a digital platform [13–15]. Based on the digital platform scenario, some scholars have pointed out that digital platform capability (DPC) involves combining the resources obtained by enterprises based on information and communication technology (ICT) with other internal and external resources [16]. A stronger DPC can enhance online communication, collaboration, and marketing for efficient and cost–effective resource expansion, which further increases the identification and integration opportunities of critical shared knowledge. It also facilitates

*Abbreviations:* DPC, digital platform capability; VCC, value co–creation; EIN, ecological institutional norms; IP, innovation performance.

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enterprises to reallocate internal and external resources to flexible respond to rapidly shifting market environment [17–19]. However, due to the disadvantages in resources, capital, experience, and other aspects, SMEs' cooperative innovation with other enterprises in the digital platform is often accompanied by risks such as leakage of core resources and misaligned partnerships [20,21]. As a result, many managers of SMEs are resistant and reluctant to join digital platforms. In light of these contradictions, some intriguing questions arise: Can SMEs actually benefit from digital platforms? How does DPC affect the innovation performance (IP) of SMEs?

Nowadays, solo innovation no longer meets the needs of business development [22–24], especially for SMEs with limited resources. These organizations are more inclined to rely on digital platforms to access the required resources and find partners for value co–creation (VCC) and thus co–innovation [25,26]. Their strategies are more flexible, with shorter decision times and faster innovation [27]. Some scholars have recognized that VCC facilitates enterprises' IP in open innovation contexts [28–30], but there is currently a lack of clarity regarding the role that VCC plays in the relationship between DPC and enterprises' IP. Therefore, this study examines how the different constituent dimensions of VCC affect the relationship between DPC and enterprises' IP.

Additionally, effective network governance mechanisms are important in order to avoid potential risks for SMEs in DBEs constituted by digital platforms [31]. Ecological institutional norms (EIN), as the network governance mechanism arising in an ecosystem context, refer to the expectation of acceptable behavior or practice in the institutional environment [32]. In a DBE, well–established EIN can inhibit possible transaction risks and reduce opportunistic behavior to ensure the effective circulation and interaction of resources, which is a necessary background condition for the smooth implementation of VCC activities [33]. Most previous studies have focused on traditional cooperative network governance, such as alliance [34–36], supply chain [37,38], and innovation [39,40] networks. However, limited research focuses on the unique situation of mutualism, which is the interdependence between network subjects in an ecological organization. Therefore, this study focuses on the impact of EIN on VCC activities in a DBE.

This study constructs a relationship model between DPC, VCC, and IP. Based on data collected from 346 manufacturing SMEs in China, this study empirically tests the impact of the interaction between DPC and EIN on VCC and IP using multiple regression analysis and the bootstrap method to clarify the complex process mechanisms involved. The results show that DPC has a significantly positive impact on IP; VCC partially mediates DPC and IP; EIN positively moderate the relationship between DPC and VCC and positively moderate the mediating effect of VCC. Overall, this study broadens the application of resource orchestration theory and responds to Xiao et al.'s [41] call for the need to adopt more new perspectives when studying big data resources and platforms. The study investigates the antecedents of enterprises' IP from a VCC perspective, complements relevant research literature on digital platforms, and provides effective suggestions for SME managers to participate in digital platform innovation activities.

The remaining structure of this study is arranged as follows. The theoretical review is summarized in Section 2, and the research model and hypothesis are also proposed. Then, the research methodology, including the sample and data, is outlined in Section 3. Section 4 reports the empirical analysis, and Section 5 provides a detailed discussion and clarifies the current limitations.

## 2. Theoretical basis and hypothesis

### 2.1. Resource orchestration theory

As a key theory in strategic management research, the core idea of resource orchestration theory is to emphasize the allocation, integration, and utilization of resources, and how the enterprises' resources and capabilities play an essential role in establishing a sustainable competitive advantage [12,42]. This study presents a research framework based on this theory. First of all, the digital platform constitutes the external resource pool of the enterprise. DPC represents the ability of the enterprise to integrate platform resources [16,43], which is conducive to integrating key shared knowledge. By concentrating, displaying, and utilizing the internal information resource flow, organizations can respond more effectively to the rapidly changing market environment and improve the success rate of innovation activities [44,45]. Second, the architecture and technical characteristics of digital platforms provide support for enterprises to restructure resources. The modularization, standardization, and openness of the platform are conducive to the configuration, arrangement, and coordination of platform resources by enterprises with strong DPC [19], helping to build new resource combinations and achieve enterprise innovation. Third, the digital platform creates an organizational environment for flexible collaboration among subjects [46], which is beneficial to enterprise value co–creation [47]. At the same time, value co–creation activates the integration and utilization of platform resources by enterprises, connecting the relationship between DPC and IP. To sum up, based on resource orchestration theory, we believe that DPC is a key factor affecting IP, and that value co–creation plays an important role in this relationship.

### 2.2. Digital platform capability

A digital platform can be considered as a technical framework connecting organizations to the platform, which enables organizations to collect, integrate and calculate information in the platform [48]. It has the characteristics of hierarchical modularization, self–growth, and the network effect, which is an effective way for enterprises to achieve rapid information interaction, reduce information asymmetry and uncertainty, and reduce resource search and transaction costs [13,49]. In digital platforms, different subjects (such as upstream and downstream enterprises, universities, scientific research institutions, government departments, intermediaries, consumers, etc.) are in a state of coexistence and symbiosis, forming an economic community and a digital business ecological network, namely DBE. DBE exists based on the platform and enterprise participation in a DBE enables the interactive utilization of resources across boundaries, regions, and time zones. This resource utilization method is especially conducive to the expansion of SMEs' network resources, to avoid being squeezed out of the market by large enterprises, whereby it is even difficult to maintain survival. Nachira et al. [50] believe that the DBE helps SMEs to realize digital sharing and value transmission through the integrated digital platform. It can be said that DBE provides strong information interaction and resource transmission support for enterprise value creation.

The integration of resources is key for different enterprises to obtain a sustainable competitive advantage according to resource orchestration theory [12,51,52]. Especially for SMEs, it is imperative to integrate new resources to cope with fierce competition and to avoid being eliminated. Therefore, scholars propose the concept of DPC, which is deemed essential for each subject to carry out valuable communication with participants from other platforms [16,18,53]. DPC characterizes the subject's ability to combine ICT–based resources with original resources [16]. Helfat and Raubitschek [18] believe that DPC allows enterprises to integrate important shared knowledge and reconfigure both internal and external resources to respond flexibly and quickly to dynamically changing market needs. According to Rai and Tang [17], DPC refers to the ability of enterprises to maintain contact with other interactors through online communication, cooperation, and marketing, and to achieve efficient and low–cost resource expansion. DPC enables enterprises to conduct valuable exchanges with other platform participants at zero marginal cost, thereby improving their own innovation ability [18]. To sum up, DPC is the key strategic capability of enterprises participating in a DBE, which helps enterprises obtain high–quality platform resources and improves the efficiency of resource utilization. Combined with the specific situation, this study defines DPC as a two–dimensional

concept which includes platform integration and reconfiguration [19]. Platform integration represents the enterprise's ability to centralize and integrate the internal information flow of a digital platform [43]. Platform reconfiguration represents the enterprise's ability to reconfigure the platform resources obtained by using its flexible architecture [17].

### 2.3. Digital platform capability and innovation performance

Resource orchestration theory fully explains the importance of resource allocation, combination, and management to enhance the competitive advantage of enterprises. Digital platforms provide channels and technical support for SMEs to obtain resources. Compared with large enterprises, SMEs have greater strategic flexibility and urgent value interaction propositions [54], enabling SMEs to use the architecture and technical characteristics of digital platforms to obtain and integrate key resources. Therefore, with the improvement of DPC, SMEs can more effectively improve their IP through resource interaction using digital platforms. On the one hand, platform integration enables enterprises to integrate massive amounts of information swiftly and efficiently and form multiple resource channels. Enterprises maintain good dynamic ability by extracting critical information and predicting the production information and customer preference trends [55]. Enterprises use internal and external resources to face rapidly changing market environments with effective innovation, which improves the success rate of innovation activities and obtains a sustainable competitive advantage [44,45]. Additionally, enterprises use digital tools on digital platforms to create a community feedback loop, broaden the value chain, and develop integration capability. Thus, the spontaneous value feedback of DBE participants is timely and accurately transmitted to jointly optimize shared data and resources, thus improving enterprises' IP.

On the other hand, based on the characteristics of the layered modular architecture of digital platforms [56], enhanced reconfiguration capability makes the cooperation between enterprises and other platform subjects flexible and diverse, which is conducive to rapid innovation and improving IP. A digital platform's modular architecture helps enterprises create a differentiated product series with minimal incremental work [57], even leading to subversive innovation [58]. In addition, because existing modules are publicly available, these can provide a reference for enterprises when developing new products, shortening the research and development (R&D) cycle and reducing costs [59]. Furthermore, from the perspective of resource orchestration theory, a digital platform's standardized and reserved interface helps enterprises with enhanced reconfiguration capability to build resource combinations, form a competitive advantage, and realize innovation [60,61]. Therefore, we propose the following assumptions:

**H1(a, b).** DPC, including platform integration (a) and reconfiguration (b), has a significantly positive impact on IP.

### 2.4. Digital platform capability and value co–creation

VCC refers to the process in which enterprises break through the original organizational boundary, implement an opening strategy, and interact and cooperate with other subjects [62], including joint planning, joint problem solving, and flexibility to make adjustments [63]. Value co–creation theory provides a theoretical perspective for the value interaction between subjects in a DBE. According to the theory, all stakeholders in the value chain are participants in VCC, and the in–depth interaction between these participants and enterprises brings more value creation potential to enterprises [64,65]. VCC can provide an effective way for enterprises to break through resource barriers and obtain critical and non–redundant resources [66]. SMEs, especially, can respond to changes more quickly and flexibly, meet customer needs, maximize value interaction with various resource owners in the system, create new value growth points, and strengthen their core competitive advantages. With its fuzzy geographical boundary, time boundary, and organizational boundary, the digital platform is conducive to value interaction between subjects [67]. However, these value interactions have the characteristics of interactivity, magnanimity, nonlinearity, and dynamics, which require SMEs to identify the co–creation frequency of each value subject in the system, as well as the elements and laws. An enterprise's DPC can improve its understanding of cooperative activities and objectives, which is conducive to the interconnection between participants, aiding the coordination of resources and capabilities between the enterprise and other subjects [68,69].

VCC in the ecosystem depends on the harmonious matching of multiple subjects, which involves significant information flow [70]. Platform integration enables enterprises to effectively integrate and manage platform resources and supports VCC activities [71]. Specifically, trust is the basis of VCC activities. The stronger the trust between platform subjects, the greater the degree of value in co–creation [72]. A digital platform's information and data transparency make the platform subjects' reputation visible. Enterprises with enhanced integration capability can effectively use the network effect of a digital platform, gather platform information flow, reduce the cooperation risk between subjects, and improve their willingness to jointly formulate development plans, solve problems, and enhance VCC. Furthermore, a DBE also provides a completely decentralized system. Enterprises can interact with any subject directly through digital platforms, which is convenient for collaborating in terms of information and resources. Therefore, with stronger integration capability, enterprises can master valuable information to flexibly adjust the relationship with partners and quickly conduct value creation activities at any time according to changes in the external environment.

The digital platform architecture includes the device, network, service, and content layers. Resources flow in the same layer and across layers in a complex hierarchical structure [56]. A standardized and universal digital platform architecture allows for rapid transmission and sharing of resources among different derivatives and subsystems. Enterprises with enhanced digital platform reconfiguration capability can optimize the allocation of platform resources and reduce the cost of information coordination with partners to improve the effectiveness of joint planning and problem solving. Furthermore, a digital platform's self–growth provides the technical basis for expanding the number of DBE subjects and the scope of VCC partners [73]. Enterprises with enhanced digital platform reconfiguration capability can identify the best partners, share information resources with subjects on the platform or those in other platforms through an open architecture, prevent technology locking, and facilitate rapid adjustment of partnerships to improve overall value. Therefore, we propose the following assumptions:

**H2(a, b, c).** Platform integration has a significantly positive impact on VCC, including joint planning (a), joint problem solving (b), and flexibility to make adjustments(c).

**H2(d, e, f).** Platform reconfiguration has a significantly positive impact on VCC, including joint planning (d), joint problem solving (e), and flexibility to make adjustments(f).

### 2.5. Digital platform capability, value co–creation, and innovation performance

The unique technical architecture of the digital platform empowers enterprises to integrate and reconfigure resources; thus, they promote value creation behavior between enterprises and other subjects. The greater the cooperation distance between network subjects, the more it will eliminate their enthusiasm for VCC [74,75]. DPC helps enterprises to quickly integrate and reconfigure resources and transmit them to various subjects accurately, shortening the cooperation distance between innovation subjects, facilitating value synergy, and fostering the satisfactory progress of VCC. Then, VCC promotes the continuous transformation of innovative thinking, development of innovative activities, and achievement of competitive advantage. It can be recognized

that VCC plays a connecting role between DPC and enterprise innovation. In fact, many scholars believe that the enterprise's ability to integrate and allocate resources cannot directly improve IP. Wang et al. [76] noted that the enterprise's capability to influence performance is not a one–time process. There are some mechanisms in this stage and the utility of enterprise capability depends on these mechanisms. Similarly, DPC is only one factor, which will not directly affect enterprise innovation or competitive advantage. This capability needs to be "activated" by an "activity" to carry out a "specific behavior" to further affect IP. VCC is both an "activity" to activate capabilities and a "specific behavior" to promote innovation. Lavie [47] pointed out that in any organization with strong interaction and high enthusiasm for cooperation, the progress of VCC will be ideal. Therefore, VCC plays a key role in the process of enterprise innovation and maintaining competitive advantage.

Specifically, joint planning of future strategic deployment and development for the next stage among VCC subjects can continuously adjust and optimize enterprises' strategic decisions, improving the success rate of innovation. Shams and Kaufmann [77] indicated that enterprises could effectively improve innovation benefits by sharing information resources, jointly coping with challenges, and creating value together with stakeholders in strategy formulation and operation. VCC may also lead to the creation of new ideas and innovative inspiration in discussing solutions to problems. Filieri [78] found that informal, point–to–point, and transparent communication methods promote VCC, not only realizing product and service innovation but also triggering process innovation. Additionally, in a turbulent market environment, enterprises can only maintain their competitive advantage by quickly and efficiently integrating resources and adjusting partnerships according to external changes [79,80].

It is worth noting that the VCC of SMEs also has certain risks in the context of a DBE. On the one hand, compared with large enterprises, SMEs do not have resource advantages or a prominent voice in resource interaction, which makes them difficult to obtain the key resources needed for development. The lack of resources hinders equal VCC, thus affecting the improvement of IP [20,21]. On the other hand, digital platforms expand the boundaries of resource flows in DBEs. The more connections SMEs establish with other subjects, the more likely they are to lose their core resources and even their competitive advantage. Some SMEs will take measures that are not conducive to long–term development to protect their current rights and interests, which undermines their stable integration into digital platforms [81]. Although there are some debates about the innovation benefits of the value co–creation behavior of SMEs, this study believes that the relationship between subjects in a DBE is more focused on mutualism, and enterprises pay more attention to the resource complementation between different subjects to enhance the common value creation potential. There is insufficient motivation to destroy the value interaction between them. Therefore, we propose the following assumptions:

**H3(a, b, c).** VCC, including joint planning (a), joint problem solving (b), and flexibility to make adjustments (c), has a mediating effect between platform integration and IP.

**H3(d, e, f).** VCC, including joint planning (d), joint problem solving (e), and flexibility to make adjustments (f), has a mediating effect between platform reconfiguration and IP.

### 2.6. Digital platform capability, value co–creation, and ecological institutional norms

In the context of a DBE, enterprises integrate and restructure system resources through digital platforms, and promote IP through VCC among subjects. However, Schreiner et al. [82] pointed out that due to the inherent distance in physical, cognitive, and cultural factors between enterprises, inappropriate border–crossing mechanisms will cause coordination errors. Moreover, inappropriate information exchange and communication between partners will hinder understanding of each other's resource characteristics, and the establishment of a common cognition of their obligations and rules of participation. For SMEs, this problem is particularly prominent. When conducting value interaction with different subjects, enterprises must weigh the challenges of collaboration and the benefits of VCC for innovation, to ensure better benefits from collaboration. In other words, procedures, rules, and policies are essential to regulate the cooperation between platform subjects and establish an appropriate framework for their continuous interaction [83].

Network governance theory states that an effective governance mechanism ensures the effect of network operation [84]. In the context of DBEs, the emergence of EIN regulates the value interaction behavior between subjects. Through data analysis, Du et al. [85] found that EIN can effectively regulate the interactive process of innovation resources. This study believes trust is critical for effective cooperation in DBEs. EIN can weaken moral hazards and effectively curb opportunistic behaviors, such as technology theft and free–riding. This enables enterprises to reasonably predict partners' behavior and reduce the transaction cost in knowledge and information sharing. EIN also eliminate obstacles to information exchange, reduce the negative impact caused by information asymmetry, dispel the concerns of enterprises about cooperation, and provide assurances for using large amounts of resource information that is integrated and reconfigured through digital platforms. Thus, EIN enable deeper interaction and interconnections between cooperating subjects and improve the efficiency and effects of VCC activities [86]. Therefore, we propose the following assumptions:

H4 (a, b). EIN positively moderate the impact of DPC, including platform integration (a) and reconfiguration (b), on VCC.

## 3. Methodology

### 3.1. Research design and data statistics

We constructed a moderated mediating model based on the above assumptions, as shown in Fig. 1. We hired a professional research organization to identify a list of target enterprises in China that meet the sample criteria for this study, selected enterprises from the list using a random sampling method, and administered the questionnaire to them. The reason for choosing China's enterprises as the sample is that China's market environment provides a suitable background for such research. China is the nation with the most Internet users worldwide, and its digital market and digital technologies are developing rapidly, and the importance of digital platforms is gaining attention [87]. How SMEs can use digital platforms to gain competitive advantage has become a pressing issue [19], but the theory currently lags far behind the needs in practice. In addition, China shares the same characteristics as other developing countries, which provides room for the replication of research findings. The respondents were mainly middle and senior management employees who have all worked in the enterprise for at least three years. They have a comprehensive understanding of the enterprise's overall development strategy and the development of innovation activities that meet the requirements of this study. SMEs from the manufacturing sector were selected because manufacturing enterprises produce tangible products and have a clear and standardized innovation process; therefore, the sector's features are consistent with the study's purposes. The classification of SMEs is based on the latest criteria set by the National Bureau of Statistics of the People's Republic of China in 2011, that is, fewer than 1000 employees or less than 400 million CNY in business revenue, and they are required to join one or more digital platforms.

From January to March 2020, data collection was conducted in two stages. First, to ensure the questionnaire's reliability and validity, we carried out a pre–survey, recovered 49 valid questionnaires, and performed reliability analyses and exploratory factor analyses. The results show that all indicators of the data meet the critical value criteria, demonstrating that the scale has good reliability and validity. We, then,

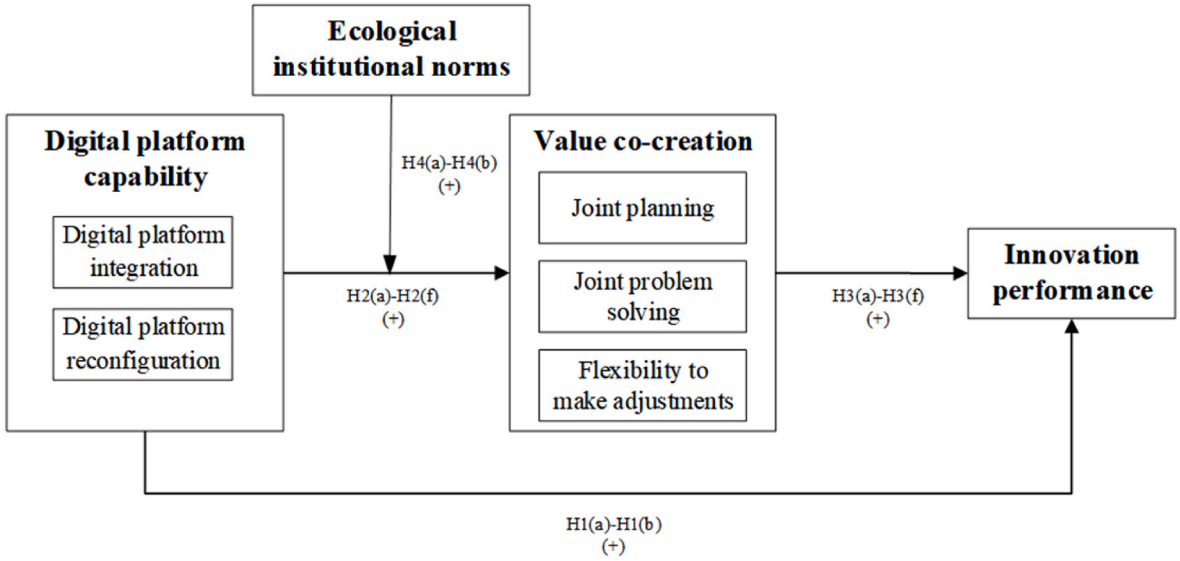


**Fig. 1.** Research model.

conducted a formal survey by combining online and offline methods and recovered 473 questionnaires in total. We excluded questionnaires with the following characteristics: (1) filling time less than 100 s; (2) key information missing; (3) apparent regularity of answers; and (4) enterprises with more than 1000 employees and more than 400 million CNY in business revenue. The remaining valid questionnaires totaled 346, with a return rate of 73.2%. Table 1 presents an overview of the research sample.

**Table 1**
Descriptive statistics of the sample.

| Characteristic | Classification | Number | Proportion |
|---|---|---|---|
| Position | Senior management (chairman, CEO, etc.) | 20 | 5.8% |
| | Middle and senior management of the R&D department | 117 | 33.8% |
| | Middle and senior management of the Marketing department | 88 | 25.4% |
| | Middle and senior management of the Sales department | 53 | 15.3% |
| | Middle and senior management of other departments | 68 | 19.7% |
| Enterprise nature | State–owned enterprise | 58 | 16.8% |
| | Private enterprise | 247 | 71.4% |
| | Joint venture enterprise | 24 | 6.9% |
| | Foreign capital enterprise | 17 | 4.9% |
| Enterprise age | Less than 1 year | 0 | 0% |
| | 1–3 years | 6 | 1.7% |
| | 4–10 years | 95 | 27.5% |
| | 11–20 years | 175 | 50.6% |
| | Over 20 years | 70 | 20.2% |
| Enterprise scale (number of employees) (ES) | <20 | 0 | 0% |
| | 20–299 | 106 | 30.6% |
| | 300–999 | 174 | 50.3% |
| | >1000 | 66 | 19.1% |
| Enterprise annual revenue from main business (million CNY) | <3 | 5 | 1.4% |
| | 3–199 | 82 | 23.7% |
| | 200–400 | 232 | 67.1% |
| | >400 | 27 | 7.8% |

Note: EN = enterprise nature, EA = enterprise age, ES = enterprise scale.

### 3.2. Measurement

Our scale was designed to measure DPC, VCC, EIN, and IP, and included 27 items. We adopted a 5–point Likert scale, ranging from 1 to 5, to indicate complete non–compliance to full compliance.

DPC's scale, developed by Cenamor et al. [19], is a measurement scale with two dimensions and eight items. The scale of VCC is based primarily on Claro and Claro's [63] work, classifying VCC into three dimensions—joint planning, joint problem solving, and flexibility to make adjustments—with eleven items. EIN's scale is based on the research of Wong and Boon [32], and it consists of four items. To establish the scale for IP, we referred to the research of Hagedoorn and Cloodt [88] and Kleinknecht et al. [89]; it primarily examines new technology development, new patent applications, and new product sales and comprises four items. Furthermore, our statistical model includes various controls to prevent potential endogeneity problems [90]. In particular, we identified controls to avoid incorrect findings about the impact of DPC on IP. First, we use enterprise size to represent enterprise innovation and resource acquisition capabilities, which means that each research sample has a similar basis for innovation [91]. Similarly, we also use the nature of the enterprise, which may have an impact on both DPC and IP, as the control variable to avoid the problems of reverse causality and omitted variable bias. Finally, we take the enterprise age as a control variable to control the hierarchical structure of the data, and capture the unobserved heterogeneity along these dimensions [92] to further alleviate the potential endogeneity problems.

### 3.3. Common method bias

Podsakoff et al. [93] suggested that self–reporting data may have a common method bias (CMB). It is a systematic error because of same respondents, survey setting, question context, and other factors that can trigger artificial covariation and largely affect the accuracy of study results. Therefore, we adopted Harman's single–factor test to verify the data's CMB. Through principal component factor analysis without rotation, seven factors were extracted to explain the total variation of 72.178%. The total variation explained by the first factor is 35.731% < 50%. The above results indicate that there is no obvious CMB [94].

## 4. Empirical analyses

### 4.1. Reliability and validity test

We used SPSS 23.0 to test the reliability of the sample data, and Table 2 presents the results. The Cronbach's α of each scale was above the critical value of 0.7, indicating good reliability [95].

We then tested the sample's validity using Amos 24.0, including convergent and discriminant validity. The results of the convergent validity test showed that the factor loadings >0.7, composite reliability (CR) > 0.7, and average variance extracted (AVE) > 0.5 met the critical value requirement, indicating good convergent validity between variables [96]. The results of the discriminant validity test showed that the square root of AVE of any variable was greater than the absolute value of the correlation coefficient between that variable and all other variables, indicating good discriminant validity between variables [97]. Table 3 shows the test results.

Additionally, we tested the fit of the theoretical model using fit indicators. The results were as follows: $X^2/df = 1.104 < 3$, goodness of fit index (GFI) = 0.933 > 0.9, incremental fit index (IFI) = 0.994 > 0.9, comparative fit index (CFI) = 0.994 > 0.9, and the root mean square error of approximation (RMSEA) = 0.017 < 0.08. The results of all indicators satisfied the ideal state [98], indicating that the sample data and the model match well. Additionally, we judged whether there was a multicollinearity problem among the variables by observing the variance inflation factor (VIF), and the results showed that VIF<5 [99], i.e., there was no multicollinearity problem.

### 4.2. Hypotheses tests

#### 4.2.1. Direct effect

We constructed Model 1 to test the relationship between DPC (platform integration and reconfiguration) and IP. The regression results are shown in Table 4. Platform integration and reconfiguration have a significantly positive impact on IP (β = 0.462, p < 0.001, β = 0.172, p < 0.01), supporting H1(a) and H1(b). To test the relationship between DPC and VCC, we constructed Models 2–4. The regression results show that platform integration has a significant positive effect on joint planning, joint problem solving, and flexibility to make adjustments (β = 0.201, p < 0.001; β = 0.335, p < 0.001; β = 0.326, p < 0.001). Further, platform reconfiguration has a similar positive effect (β = 0.462, p < 0.001; β = 0.236, p < 0.001; β = 0.262, p < 0.001). Therefore, hypotheses H2(a)–H2(f) are supported.

**Table 2**
Reliability and validity analysis.

| Variable | Items | Loadings | AVE | CR | Cronbach's α |
|---|---|---|---|---|---|
| Platform integration | PI1 | 0.779 | 0.569 | 0.840 | 0.839 |
| | PI2 | 0.736 | | | |
| | PI3 | 0.692 | | | |
| | PI4 | 0.805 | | | |
| Platform reconfiguration | PR1 | 0.763 | 0.627 | 0.870 | 0.868 |
| | PR2 | 0.792 | | | |
| | PR3 | 0.750 | | | |
| | PR4 | 0.858 | | | |
| Joint planning | JP1 | 0.876 | 0.688 | 0.898 | 0.897 |
| | JP2 | 0.820 | | | |
| | JP3 | 0.731 | | | |
| | JP4 | 0.881 | | | |
| Joint problem solving | JPS1 | 0.815 | 0.612 | 0.863 | 0.862 |
| | JPS2 | 0.742 | | | |
| | JPS3 | 0.743 | | | |
| | JPS4 | 0.824 | | | |
| Flexibility to make adjustments | FMA1 | 0.857 | 0.670 | 0.858 | 0.857 |
| | FMA2 | 0.829 | | | |
| | FMA3 | 0.766 | | | |
| Ecological institutional norms | EIN1 | 0.795 | 0.560 | 0.836 | 0.835 |
| | EIN2 | 0.717 | | | |
| | EIN3 | 0.737 | | | |
| | EIN4 | 0.743 | | | |
| Innovation performance | IP1 | 0.825 | 0.620 | 0.867 | 0.866 |
| | IP2 | 0.749 | | | |
| | IP3 | 0.763 | | | |
| | IP4 | 0.810 | | | |

Note: PI = platform integration, PR = platform reconfiguration, JP = joint planning, JPS = joint problem solving, FMA = flexibility to make adjustments, EIN = ecological institutional norms, IP = innovation performance.

#### 4.2.2. Indirect effect

We examined the mediating effect of VCC using the bootstrap method. Table 5 presents the results. The indirect impact of platform integration on IP through VCC (joint planning, joint problem solving, and flexibility to make adjustments) is significant (Boot 95% CI = [0.0749, 0.1937]; Boot 95% CI = [0.1091, 0.2288]; Boot 95% CI = [0.1241, 0.2561]). The indirect impact of platform reconfiguration on IP through VCC (joint planning, joint problem solving, and flexibility to make adjustments) is also significant (Boot 95% CI = [0.1447, 0.3311]; Boot 95% CI = [0.1215, 0.2472]; Boot 95% CI = [0.1436, 0.2928]). Therefore, hypotheses H3(a)–H3(f) are supported.

#### 4.2.3. Moderation

To test the moderating effect of EIN between DPC (platform integration and reconfiguration) and VCC, we constructed Models 5 and 6. Table 6 presents the results, indicating that EIN have a positive moderating effect on the relationship between DPC (platform integration and reconfiguration) and VCC (β = 0.155, p < 0.01; β = 0.095, p < 0.05). Therefore, hypotheses H4(a) and H4(b) are supported.

Additionally, we examined the moderated mediating effect of VCC using the bootstrap method. Table 6 presents the results. When EIN are imperfect, the mediating effect of VCC between platform integration and IP (Boot 95% CI = [0.0875, 0.2412]) and between platform reconfiguration and IP (Boot 95% CI = [0.1768, 0.3775]) is significant. When EIN are relatively perfect, the mediating effect of VCC between platform integration and IP (Boot 95% CI = [0.2032, 0.4102]) and between platform reconfiguration and IP (Boot 95% CI = [0.2648, 0.5282]) is equally significant; however, the coefficient increased. The above results show that VCC has a positive moderated mediating effect—that is, the interaction of DPC (platform integration and reconfiguration) and EIN can indirectly and positively influence IP through VCC.

## 5. Discussion

This study proposes a moderated mediating model to explore the relationship between DPC and IP and how governance mechanisms in the DBE environment impact the above relationship. Focusing on SMEs, we collected 346 valid questionnaires, tested the theoretical assumptions using empirical analysis, and found some interesting conclusions.

First, DPC has a significantly positive impact on SMEs' IP. The result is consistent with resource orchestration theory, which proposes that the orchestration, combination, and flexible allocation of heterogeneous resources can help enterprises maintain their long–term competitive advantage [100]. This suggests that stronger digital platform integration capability enables SMEs to quickly access the large amount of heterogeneous resources aggregated in digital platforms [18] and to accelerate the speed of value feedback between subjects through digital channels [50], continuously optimizing the information quality on the platform. At the same time, we found that DPC positively influences VCC. Stronger digital platform integration capability can effectively monitor and evaluate data elements and strengthen the quality of plans developed jointly between subjects [72]; it can reduce the cooperation risk [71] and effectively promote the willingness of subjects to engage in joint problem solving; it can provide more critical information and promote the flexibility of SMEs to adjust their relationships with partners [16]. Stronger digital platform reconfiguration capability can reduce the cooperation cost [57] and enhance the willingness to engage in joint

**Table 3**
Correlation and reliability analysis.

| Variable | Mean | SD | EN | EA | ES | PI | PR | JP | JPS | FMA | EIN | IP |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| EN | 2.000 | 0.659 | 1 | | | | | | | | | |
| EA | 2.890 | 0.732 | 0.042 | 1 | | | | | | | | |
| ES | 1.880 | 0.697 | 0.107* | 0.271** | 1 | | | | | | | |
| PI | 3.672 | 0.808 | 0.020 | −0.079 | −0.012 | (0.754) | | | | | | |
| PR | 3.821 | 0.811 | −0.005 | −0.063 | −0.051 | 0.390** | (0.792) | | | | | |
| JP | 3.851 | 0.837 | 0.014 | −0.009 | −0.013 | 0.379** | 0.538** | (0.829) | | | | |
| JPS | 3.499 | 0.974 | 0.025 | 0.011 | −0.023 | 0.425** | 0.365** | 0.402** | (0.782) | | | |
| FMA | 3.715 | 0.879 | 0.003 | 0.076 | 0.004 | 0.423** | 0.388** | 0.463** | 0.563** | (0.819) | | |
| EIN | 3.704 | 0.898 | 0.055 | 0.046 | 0.067 | 0.379** | 0.181** | 0.221** | 0.340** | 0.393** | (0.748) | |
| IP | 3.807 | 0.938 | 0.002 | 0.045 | 0.011 | 0.521** | 0.344** | 0.452** | 0.496** | 0.528** | 0.465** | (0.787) |

Notes: n = 346; *p < 0.05, and **p < 0.01. The numbers in brackets represent the square roots of the AVE.
EN = enterprise nature, EA = enterprise age, ES = enterprise scale, PI = platform integration, PR = platform reconfiguration, JP = joint planning, JPS = joint problem solving, FMA = flexibility to make adjustments, EIN = ecological institutional norms, IP = innovation performance.

**Table 4**
Regression analysis results.

| Variable | Model 1 IP | | Model 2 JP | | Model 3 JPS | | Model 4 FMA | |
|---|---|---|---|---|---|---|---|---|
| | β | p | β | p | β | p | β | p |
| EN (State–owned enterprises as the reference) | | | | | | | | |
| Private enterprise | −0.026 | 0.653 | 0.034 | 0.545 | −0.032 | 0.593 | −0.013 | 0.822 |
| Joint venture enterprise | 0.029 | 0.586 | 0.006 | 0.902 | 0.008 | 0.889 | −0.067 | 0.216 |
| Foreign capital enterprise | −0.031 | 0.540 | 0.011 | 0.820 | 0.025 | 0.635 | 0.032 | 0.543 |
| EA | 0.083 | 0.089 | 0.041 | 0.396 | 0.049 | 0.340 | 0.127 | 0.012 |
| ES | 0.000 | 0.997 | 0.006 | 0.897 | −0.032 | 0.528 | −0.014 | 0.783 |
| PI | 0.462 | 0.000 | 0.201 | 0.000 | 0.335 | 0.000 | 0.326 | 0.000 |
| PR | 0.172 | 0.001 | 0.462 | 0.000 | 0.236 | 0.000 | 0.262 | 0.000 |

Note: EN = enterprise nature, EA = enterprise age, ES = enterprise scale, PI = platform integration, PR = platform reconfiguration.

**Table 5**
Results of mediation effects.

| Path | Indirect effect | Boot SE | LLCI | ULCI |
|---|---|---|---|---|
| H3(a) : PI→JP→IP | 0.1316 | 0.0311 | 0.0749 | 0.1937 |
| H3(b) : PI→JPS→IP | 0.1647 | 0.0306 | 0.1091 | 0.2288 |
| H3(c) : PI→FMA→IP | 0.1869 | 0.0337 | 0.1241 | 0.2561 |
| H3(d) : PR→JP→IP | 0.2347 | 0.0475 | 0.1447 | 0.3311 |
| H3(e) : PR→JPS→IP | 0.1802 | 0.0322 | 0.1215 | 0.2472 |
| H3(f) : PR→FMA→IP | 0.2109 | 0.0384 | 0.1436 | 0.2928 |

Note: PI = platform integration, PR = platform reconfiguration, JP = joint planning, JPS = joint problem solving, FMA = flexibility to make adjustments, IP = innovation performance.

planning among platform subjects; it can optimize the allocation of platform resources [13] and improve the efficiency of cooperating subjects in joint problem solving; it can make platform subjects behave in a loosely coupled state [60] and promote enterprises' flexibility and mobility to adjust existing cooperative relationships.

Second, the empirical results verify that VCC partially mediates the relationship between all dimensions of DPC and IP. That is, joint planning, joint problem solving, and flexibility to make adjustments play a partially mediating role between digital platform integration capability and IP, and between digital platform reconfiguration capability and IP. SMEs with strong digital platform capability can effectively use the vast amount of resources aggregated by the platform to address the negative impact of insufficient enterprise resources [20]. Additionally, the fact that SMEs maintain open interactions and collaborations in a dynamically changing environment through a flexible platform architecture can facilitate VCC. The mutual embedding between value co–creators allows both to access the resources they need in a shorter time and at a lower cost [101]. The increased efficiency of knowledge transfer helps to improve the speed of new product development and take advantage of market first entry, thus enhancing IP. At the same time, the cooperation model of the digital ecosystem emphasizes that enterprises can achieve high IP by grafting and sticking to the heterogeneous resources of other ecological units, while taking into account the value proposition of multilateral subjects. The subjects are in a "mutually beneficial and symbiotic" cooperation model, which effectively solves the risks of leaking core resources and issues of unequal relationships, further enhancing the willingness of SMEs to co–create value and carry out innovation activities.

Additionally, the environmental variable of EIN moderates the relationship between DPC and VCC, confirming the importance of governance mechanisms for stable ecosystem development [102,103]. Robust EIN lead to a stable environment for the whole ecosystem [33], resulting in a more positive cooperative attitude and a stronger desire for value sharing among subjects [86], thus facilitating VCC. Furthermore, EIN can, to a certain extent, promote the mediating role of VCC; the more advanced the EIN, the lower the concern that SMEs cannot protect their own interests by participating in digital platforms [81], and the SMEs can realize VCC more effectively through enhanced DPC. They can then indirectly improve IP through extensive and in–depth VCC.

### 5.1. Theoretical implications

This study has essential theoretical innovation value. First, we follow the trend of cross–border research on resource orchestration theory [104–106] and extend the theoretical boundary. We use resource orchestration theory to analyze resource integration and allocation in digital platforms, verifying the applicability of this theory in the specific context of digital platforms. Based on this, we construct a theoretical model of "DPC–VCC–IP," which provides a valuable theoretical framework to unveil the "black box" of DPC affecting IP. Although the positive effect of DPC on IP has been identified in previous studies [107–109], the process and mechanism of the effect are not yet clear. Our empirical results validate the positive relationship between the variables and provide a reasonable explanation for the impact relationship. Additionally, rather than viewing VCC as a broad concept, we consider it a three–dimensional structure that encompasses joint planning, joint

**Table 6**
Results of moderating effect.

| Variable | Model 5 | | | Model 6 | | |
|---|---|---|---|---|---|---|
| | β | t | P | β | t | P |
| EN (State–owned enterprises as the reference) | | | | | | |
| Private enterprise | 0.016 | 0.294 | 0.769 | 0.027 | 0.507 | 0.612 |
| Joint venture enterprise | −0.022 | −0.424 | 0.672 | −0.012 | −0.245 | 0.806 |
| Foreign capital enterprise | 0.022 | 0.443 | 0.658 | 0.022 | 0.461 | 0.645 |
| EA | 0.059 | 1.222 | 0.223 | 0.057 | 1.237 | 0.217 |
| ES | −0.036 | −0.771 | 0.441 | −0.022 | −0.490 | 0.625 |
| PI | 0.439 | 8.987 | 0.000 | | | |
| PR | | | | 0.487 | 11.086 | 0.000 |
| EIN | 0.271 | 5.361 | 0.000 | 0.323 | 7.179 | 0.000 |
| PI × EIN | 0.155 | 3.268 | 0.001 | | | |
| PR × EIN | | | | 0.095 | 2.150 | 0.032 |

| Route | Moderated mediation | Effect | Boot SE | BootLLCI | BootULCI |
|---|---|---|---|---|---|
| PI→VCC→IP | eff1 (M–1SD) | 0.1672 | 0.0388 | 0.0875 | 0.2412 |
| | eff2(M) | 0.2349 | 0.0401 | 0.1588 | 0.3151 |
| | eff3 (M + 1SD) | 0.3027 | 0.0532 | 0.2032 | 0.4102 |
| PR→VCC→IP | eff1 (M–1SD) | 0.2764 | 0.0512 | 0.1768 | 0.3775 |
| | eff2(M) | 0.3337 | 0.0518 | 0.2351 | 0.4390 |
| | eff3 (M + 1SD) | 0.3911 | 0.0677 | 0.2648 | 0.5282 |

Note: LLCI = Lower value of 95% confidence interval; ULCI = Upper value of 95% confidence interval.
EN = enterprise nature, EA = enterprise age, ES = enterprise scale, PI = platform integration, PR = platform reconfiguration, EIN = ecological institutional norms, IP = innovation performance.

problem solving, and flexibility to make adjustments. This perspective provides a more nuanced understanding of the relationship between DPC and IP, and contributes to the emerging literature on digital platforms.

Second, we introduce EIN as the moderating variable to enrich understanding about the sustainability of digital platforms. We analyze the characteristics of digital platforms from the perspective of ecosystems. We, then, explain the subject relationships in platforms and the flow of resources within them, answering the call for a new perspective to study big data resources in digital platforms [41]. EIN are essential in ensuring the smooth operation of ecosystems [33], yet they are often underestimated in digital platform research. As the crucial factor influencing the effect of VCC among platform subjects, we explore the role of EIN with different degrees of perfection in platform growth, further revealing the complex mechanism of DPC to VCC.

Finally, we conducted a study related to DPC based on the perspective of SMEs. Previous studies have focused on how large firms use DPC [10] and lacked exploration of SMEs. Our study confirms how SMEs use DPC to drive VCC activities and thus enhance IP, broadening the boundary of the impact of DPC on IP. In this way, our work adds to the literature on SMEs' participation in digital platforms. Although there are existing case studies on large enterprises building or participating in digital platforms, we validate the relationship between related variables by combining data from an extensive sample of empirical research, so as to analyze the mechanism's role in a more scientific and rigorous manner.

### 5.2. Practical implications

This study provides a few management insights for the sustainability of SMEs. First, SME managers should establish a clear perception of digital platforms. In the absence of a unified vision and goal for participation in digital platforms, the cognitive inertia that exists within the enterprise is likely to hinder the development of DPC [110,111]. SMEs that are limited by capital and resources must use digital platforms (e.g., finance, data, and sales platforms) to achieve a competitive advantage in the market. These platforms offer many new opportunities for SMEs, including new markets, resource channels, and value propositions [112–114]. Therefore, we encourage enterprises to actively participate in digital platforms and to continuously nurture, develop, and enhance their DPC. Since the outbreak of Covid–19 epidemic, digital transformation practices in China have developed rapidly, and the ability to leverage digital technologies characterized by big data, cloud computing, and artificial intelligence is a key element for organizations to enhance their core competitive advantage. Cultivating and building DPC through continuous learning can help enterprises to absorb resources from multiple platform participants, create greater new value, and build long–term competitive advantage.

Second, we encourage enterprises that have joined the digital platform to actively seek cooperation and VCC. The biggest advantage of China's market over most other countries is the sheer number of users, suppliers, and peers in the market. Digital platforms can effectively aggregate and virtualize such a large number of resources, allowing enterprises to achieve VCC through communication and interaction, and thus improve their competitive advantage. We found that the three dimensions of VCC (joint planning, joint problem solving, and flexibility to make adjustments) can positively impact enterprise innovation. Therefore, SMEs should focus on VCC activities by strengthening strategic dialogue with partners, building trust mechanisms, designing risk–-sharing mechanisms, and appropriately increasing the relationship's flexibility.

Third, platform owners and core participants should pay attention to the development of platform governance schemes. Digital platforms in China have emerged later than in other countries, and the institutional and market environments are unique [115]. Although China's government has formulated a "Digital China" strategy, most platforms in China are still in the wild growth stage, lacking effective construction and management paths. Our findings suggest that effective EIN positively enhance SMEs' IP. Therefore, platform leaders can attract more SMEs to their digital platforms by building a sound governance scheme, including general rules for platform subjects' interactions, for punishing opportunistic behavior, for rewarding innovative activities, and for regulating data. As important participating members in the digital platform, SMEs should also pay attention to the fairness, perfection, and comprehensiveness of the platform's governance scheme, so that they can obtain more innovative benefits through the digital platform.

### 5.3. Limitations and future research

Although this study makes certain valid theoretical and practical contributions, it still has some research limitations, which should be addressed in the future.

First, our research object is SMEs. We analyze the mechanism of the role of SMEs' DPC on IP through a large sample questionnaire study. However, there are not only SMEs in digital platforms: most of the digital platforms rely on large enterprises to establish, take large enterprises as the core, and have rules set by large enterprises, such as the Haier HOPE platform and Alibaba platform. So, can the DPC of large enterprises have an impact on the whole digital platform? At the same time, will the DPC of large enterprises further influence the operation mechanism of SMEs within the platform? Considering the scarcity of large enterprises, we suggest that the interaction mechanism between large enterprises and SMEs within digital platforms can be further explored in the future using a case study approach. Second, with regard to research on enhancing IP through DPC, this study only examines the role of VCC from the enterprises' level, which is relatively limited. Future research can combine psychological theories and explore the role of influencing factors such as employees'/executives' attitudes, intentions, and behaviors through cross–level analysis at the individual and enterprise levels [116,117] to more comprehensively reveal the impact of DPC on IP and enhance the applicability of research findings. Third, because of the particularity of China's market and institutional environment, the construction and governance of digital platforms have specific characteristics. Future researchers can collect data from enterprises participating in digital platforms in multiple countries to verify the rationality of the model in a multi–country context. Meanwhile, it is interesting to analyze and compare the impact of governance mechanisms on digital platforms in different contexts, policies, and cultures. Finally, although this study has avoided the endogeneity problem by some means, such as designing the model to avoid bilateral causality and selecting multiple important control variables to avoid omitting variables, there may still be problems such as omitting unobservable variables and sample measurement errors. These problems should be further addressed by finding appropriate instrumental variables and adding more control variables to ensure the robustness of the conclusions.

## Authors statements

Hong Jiang: Conceptualization, Methodology, Formal analysis, Funding acquisition, Writing−Writing – original draft. Jingxuan Yang: Conceptualization, Formal analysis, Investigation, Writing−Writing – original draft. Jinlong Gai: Investigation, Writing−review, Language editing.

## Declaration of competing interest

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

## Data availability

Data will be made available on request.

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## Appendix

Digital platform integration.

- The platform on which your enterprise is located can easily access the data of the cooperative enterprises' IT system.
- The platform on which your enterprise is located enables seamless connectivity between cooperative enterprises' IT systems and your own IT systems (e.g., forecasting, production, manufacturing, shipping, etc.).
- The platform on which your enterprise is located allows for real–time information exchange with cooperative enterprises.
- The platform on which your enterprise is located can easily integrate relevant information (e.g., operational information, business customer performance, cost information, etc.) from cooperative enterprises' databases.

*Digital platform reconfiguration*

- The platform on which your enterprise is located can easily adapt to new cooperative enterprises.
- The platform on which your enterprise is located can easily be extended to accommodate new IT applications or functionality.
- The platform on which your enterprise is located uses standards that most existing and potential cooperative enterprises accept.
- The platform on which your enterprise is located consists of modular software components, most of which can be reused in other business applications.

*Joint planning*

- Your enterprise and cooperative enterprises jointly plan the product volume requirements for the next quarter.
- Your enterprise and cooperative enterprises jointly plan new product development requirements for the next quarter.
- Your enterprise and cooperative enterprises share product sales forecasts.
- Your enterprise and cooperative enterprises share long–term plans for products.

*Joint problem solving*

- Your enterprise and cooperative enterprises work together to deal with problems in cooperation.
- Your enterprise and cooperative enterprises are willing to help each other.
- Your enterprise and cooperative enterprises share most of the work rather than working independently.
- Your enterprise and cooperative enterprises are committed to improving the quality of your relationship.

Flexibility to make adjustments.

- Your enterprise is flexible in responding to changes in the relationship with cooperative enterprises.
- Cooperative enterprises make adjustments by themselves to maintain the relationship with your enterprise.
- When unexpected circumstances arise, your enterprise and cooperative enterprises adjust to a new relationship in time (different from the original cooperation mode or cooperation conditions, etc.).

*Ecological institutional norms*

- Sound formal rules are followed in the platform on which your enterprise is located.
- There are good coordination and information mechanisms in the platform on which your enterprise is located.
- Some common knowledge (including product, technical, process, and management knowledge) exists among the members of the platform on which your enterprise is located.
- There is a commonly recognized certification system in the platform on which your enterprise is located.

*Innovation performance*

- In the past three years, your enterprise has had a large amount of new equipment, materials, and technologies compared to your peers.
- In the past three years, your enterprise's labor productivity has been high compared to your peers.
- In the past three years, your enterprise's patent growth rate has been high compared to your peers.
- In the past three years, your enterprise's new product output value accounts for a high proportion of the total output value compared to your peers.

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