The Impact of Relational Governance in Innovation Network on Innovation Performance: The Mediating Role of Knowledge Flows

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Abstract. This study is based on the theory of relationship exchange and knowledge management, and explains how the governance of innovation network relationships affects innovation performance. Specifically, this study divides the governance of innovation network relationships into two dimensions: joint planning and joint problem solving, and explores their impact on innovation performance; At the same time, the mediating role of knowledge flows was explored. The research conclusion has important reference value for enterprises to gain innovation advantages and improve innovation performance through scientific and reasonable network relational governance and knowledge management.

Keywords: Innovation network; Relational governance; Knowledge flows; Innovation performance

1 Introduction

The 2022 Global Innovation Index shows that China's innovation connectivity index ranks 30th globally, indicating a low level of collaborative innovation. Therefore, the construction of innovation network has become the inevitable choice of enterprises. For enterprises, embedding innovation networks, concentrating the resources of network members (universities, research institutes, etc.), and collaborating can help break the dilemma of insufficient innovation capability of a single entity and achieve improvement in innovation performance.Due to the diversified distribution of network members, enterprises need to regulate the behavioral boundaries of actors in the network through relational governance. It is precisely because of the heterogeneity of actors within the network that there are risks that cannot be ignored in the relational governance of innovation network[1].

From the perspective of knowledge management, a large number of studies have discussed the mechanism of knowledge sharing, transfer, creation and flow in the enterprise innovation network. Scholars have gradually realized that capturing their prior knowledge from the relationship with partners is an important way to supplement their own knowledge gap, and they believe that relationship governance can effectively promote knowledge flow[2]. This lays a foundation for using knowledge management theory to explain the internal role of relational governance of innovation network. However, the relational governance of innovation network

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is a complex process of multi-party collaboration, and joint actions with network members often require the flows of knowledge, personnel, and other elements, which has the drawbacks of knowledge leakage[3].

Given the above practical and theoretical background, this study explores the impact of relational governance in innovation networks on innovation performance from the perspective of knowledge flows.

2 literature review and hypothesis development

2.1 The impact of relational governance on innovation performance

This study divides relational governance in innovation network into two dimensions: joint planning and joint problem solving[4]. Joint planning helps to strengthen the expectations of enterprises for cooperation and take proactive actions to achieve them, overcome the shortcomings of contractual governance in dealing with environmental changes, and effectively curb opportunistic behavior, thereby improving innovation performance of enterprises[5]. Joint problem solving can improve the efficiency of collaborative innovation in network, but as the degree of joint problem solving deepens, frequent interactions among network members have led to knowledge leakage, resulting in impaired innovation performance [6]. Therefore, this study proposes the following assumptions:

H1a: Joint planning has a positive impact on innovation performance.

H1b: Joint problem solving has an inverted U-shaped impact on innovation performance.

2.2 The impact of relational governance on knowledge flows

The knowledge flows in innovation networks is the process of knowledge dissemination and diffusion among different innovation entities. This study suggests that strengthening connections among network members creates possibilities for knowledge flows. Under the influence of joint problem solving, all parties can take concerted action, forming collaborative power between organizations, which helps to reduce opportunistic behavior in the process of knowledge flows[7]. However, excessive joint problem solving increases the cost of network cooperation[8].Therefore, this study proposes the following assumptions:

H2a: Joint planning has a positive impact on knowledge flows.

H2b: Joint problem solving has an inverted U-shaped effect on knowledge flows.

2.3 The impact of knowledge flows on innovation performance

Enterprises enrich their knowledge base by acquiring knowledge within the network through knowledge flows, and integrate external static knowledge resources into the knowledge base to enhance the depth and breadth of knowledge, and add value, create, and empower innovation activities, thereby improving the innovation ability and performance of enterprises[9]. In addition, knowledge flows can break through the constraints of knowledge rigidity and improve the openness of enterprises, undoubtedly helping to improve innovation performance of enterprises[10].Therefore, this study proposes the following assumptions:

H3: Knowledge flows has a positive impact on innovation performance.

2.4 The mediating role of knowledge flows

The governance of innovative network relationships has built a good innovation ecological environment for enterprise innovation activities. Relational governance strengthens the nodal connections between network entities, shortens the cognitive distance between network members, and has a significant effect on knowledge flows, thereby promoting the improvement of innovation performance. Moderate joint problem solving effectively avoids the risk of "rigid collaboration". When exceeding the limit, excessive dependence on network members induces factional behavior, leading to knowledge only flowsing within factions[11]. This statement echoes the "highly intimate paradox" from an economic perspective. Therefore, this study proposes the following assumptions:

H4a: Knowledge flows plays a mediating role between joint planning and innovation performance.

H4b: Knowledge flows plays a mediating role in the inverted U-shaped relationship between joint problem solving and innovation performance.

Figure 1 illustrates the proposed model.

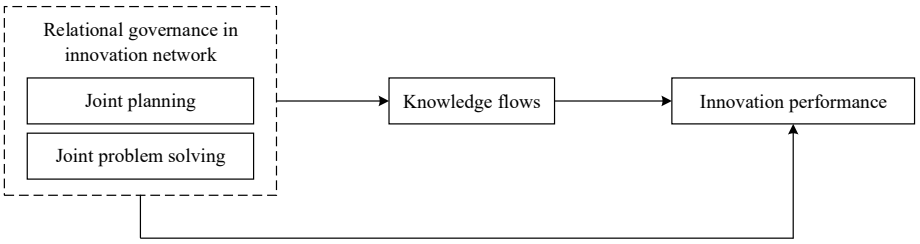

Fig. 1. Proposed model

3 Methodology

3.1 Sample and data collection

This study used a questionnaire survey to collect data. Considering that the research content of this study involves strategic decisions such as the innovation network and knowledge flow within the enterprise, the questionnaire is mainly distributed to middle and senior management personnel of the enterprise. This study used a combination of paper and electronic questionnaires for distribution. A total of 434 questionnaires were distributed, and 335 were collected, with a recovery rate of 77.2%. Then, the collected questionnaires were screened based on the completeness of the responses and the time taken. Finally, 254 valid questionnaires were obtained, with an effective rate of 75.8%.

3.2 Measurement

Measurement is based on the results of a scale established by scholars. Using years, scale, and industry category as control variables. Each project used a five point Likert scale, with 1

indicating 'strongly disagree' and 5 indicating 'strongly agree'. The scale of this study is shown in **Table 1**.

Table 1. Measurement model.

	Standardized factor loading	Cronbach's α	AVE
Joint planning (JP)		0.828	0.552
Our company and network members have a clear understanding of future cooperation	0.753		
Our company will discuss with network members when changing business	0.813		
Network members are willing to make further plans with our company after business changes	0.701		
Our company and network members can predict the evolution trend of cooperative relationships	0.828		
Joint problem solving (JPS)		0.870	0.626
Our company and network members will work together to address issues arising from our cooperative relationship	0.819		
Our company and network members can adopt improvement measures that can promote cooperative relationships as a whole	0.806		
In cooperation, all responsibilities are shared by network members and our company	0.789		
Our company and network members can achieve mutually satisfactory solutions	0.822		
Knowledge flows (KF)		0.851	0.660
Our company often shares new technologies and knowledge with network members	0.813		
Our company often exchanges research and development experience and tips with network members	0.799		
Our company often obtains new knowledge and ideas from innovation networks	0.803		
Innovation performance (IP)		0.924	0.605
Compared to our peers, our company has a higher profit growth rate	0.786		
Compared to our peers, our company has a larger market share	0.783		
Compared to our peers, our company's product improvement and innovation have had a very good market response	0.767		
Compared to our peers, our company is the first in the industry to apply new technologies	0.742		
Compared to our peers, our company often takes the lead in launching new products/services within the industry	0.790		
Compared to our peers, our innovative products include top-notch technology and craftsmanship	0.757		
Compared to our peers, our company has a higher success rate in innovation projects	0.776		

Compared to our peers, our company's management system has been continuously optimized and improved	0.806

3.3 Construct reliability and validity

This study collected data using a questionnaire survey method. Firstly, a review and organization of relevant literature and theoretical research results on innovation networks, relationship governance, and knowledge flow in the academic community were conducted. Based on this, the initial scale of the questionnaire was designed; Secondly, after repeated discussions with relevant experts in the industry, the questionnaire was revised multiple times and finally determined. The questionnaire and reliability and validity tests of this study are shown in **Table 1**.

In addition, **Table 2** shows the correlation analysis results between various variables. Among them, the diagonal value represents the average extracted variance, and the square roots of the five AVEs are greater than the correlation coefficient, indicating good discriminant validity among the variables.

Table 2. Discriminant validity.

	JP	JPS	KF	IP
JP	0.743			
JPS	0.302**	0.791		
KF	0.366**	0.438**	0.812	
IP	0.423**	0.393**	0.457**	0.778

*** p < 0.01. ** p < 0.05. * p < 0.1.

4Analysis and results

This study uses the hierarchical regression method to test the research hypotheses proposed earlier, and the hypothesis testing is shown in **Table 3**. Model 1 and Model 7 respectively show the regression results of the control variables of the establishment time of the enterprise, enterprise size, and industry of the enterprise on the dependent variable of innovation performance and the intermediary variable of knowledge flows, indicating that the influence of the control variable is not significant.

Table 3. Results of regression analysis.

	IP					KF			
	1	2	3	4	5	6	7	8	9
Control variable									
Age	-0.14	-0.08	-0.053	-0.038	-0.036	-0.083	-0.124	-0.07	-0.01
Size	0.056	0.02	0.008	0.026	0.018	0.027	0.065	0.034	0.029
Industry	0.01	0.013	0.003	0.02	0.01	-0.001	0.025	0.027	0.035
Independent variable									

JP		0.409***	0.287***					0.352***	
JPS				0.258***	0.180**				0.275***
JPS^2				-0.280***	-0.180**				-0.360***
Mediating variable									
KF			0.344***		0.284***	0.444***			
R^2	0.024	0.185	0.287	0.224	0.28	0.217	0.021	0.141	0.301
ΔR^2		0.161	0.263	0.2	0.256	0.193		0.12	0.28
F	2.014	14.140***	19.949	14.300***	16.023***	17.227***	1.801	10.230***	21.341***

*** $p < 0.01$. ** $p < 0.05$. * $p < 0.1$.

Model 2 display, JP ($\beta = 0.409$, $p < 0.001$)significantly positively affects IP, and H1a is supported; Model 4 display, JPS ($\beta = 0.258$, $p < 0.001$) significantly positive impact on IP, JPS^2 ($\beta = -0.280$, $p < 0.001$) significantly negatively affects IP, and H1b is supported; Model 8 display, JP ($\beta = 0.352$, $p < 0.001$)significantly positively affects KF, and H2a is supported; Model 9 display, JPS ($\beta = 0.275$, $p < 0.001$) significantly positively affects KF, JPS^2 ($\beta = -0.360$, $p < 0.001$)significantly positively affects KF, and H2b is supported; Model 6 display, KF ($\beta = 0.444$, $p < 0.001$) significantly positively affects IP, and H3 is supported.

Model 3 shows KF ($\beta = 0.344$, $p < 0.001$) significantly positively affects IP, while JP ($\beta = 0.287$, $p < 0.001$) still has a significant positive impact on IP, and H4a is supported. Model 5 shows that after adding KF to the regression equation of JP and JPS^2 for IP, KF ($\beta = 0.284$, $p < 0.001$) significantly positively affects IP, while the inverted U-shaped relationship between JPS and IP still holds, and H4b is supported.

5 Discussion

The empirical results show that assuming both H1a and H1b are valid, joint planning has a positive impact on innovation performance, but there is an inverted U-shaped effect between joint problem solving and innovation performance. This leads to a different conclusion from Claro's research. The main reason is that Claro et al. (2003) explored the relational governance between retailers and suppliers, and there is no collaboration between the two in terms of product or technological innovation. In this study, relational governance in innovation network is a manifestation of collaborative innovation between enterprises and network members, which can have such adverse effects. In addition, empirical research has also found that knowledge flows plays a partial mediating role in the inverted U-shaped relationship between joint planning and innovation performance, as well as joint problem solving and innovation performance.

6 Conclusion and implications

This study mainly explores the impact of different dimensions of relational governance in innovation network (joint planning and joint problem solving) on innovation performance, and introduces knowledge flows as an intermediary variable to construct an empirical model to depict the path of its impact on innovation performance. The following conclusion is drawn: joint planning positively affects innovation performance, while joint problem solving has an inverted U-shaped impact on innovation performance; Secondly, knowledge flows plays a partial mediating role between the governance of innovation network relationships and innovation performance.

This study has two contributions. Firstly, it contributes to the theory of relationship exchange and promotes boundary convergence and theoretical construction in the field of innovative network relational governance research. In addition, the research responds to scholars' call to expand the mechanism of innovation network governance. The various inspirations obtained during the empirical process, such as the different impacts of joint planning and joint solving on innovation performance, can provide some supplement to existing research on innovation performance and promote the development of relationship exchange theory to a certain extent. Secondly, it contributes to the theory of knowledge management and deepens the research on the mechanism of relational governance in innovation network on the innovation performance. This study further expands the research conclusions of scholars on the contribution of knowledge flow to improving innovation performance of enterprises, thereby promoting the integration of knowledge management research and innovation management research, promoting the development of knowledge flow theory in depth, and further promoting in-depth research on knowledge management and innovation networks.

This study has important management significance for network management and knowledge management. Firstly, in the process of joint action by network members, enterprises should dynamically view relational governance issues and correctly grasp the limits of joint problem solving. In the process of joint action with network members, enterprises should take precautions against such behavior in advance, mainly by continuously deepening the identification of the true behavioral intentions of network members to protect their core technology and innovative knowledge, and ultimately "safeguard" the innovation achievements of the enterprise. Secondly, enterprises should attach importance to the role of knowledge flows as a bridge between relational governance in innovation network and innovation performance, and enhance the knowledge sharing atmosphere within the innovation network. Maintaining close contact with cooperating enterprises and taking appropriate joint actions can have a good effect on mutual communication and cooperation.

There are also shortcomings in this study. Firstly, this study only discusses from the perspective of knowledge flows, and in the future, research on relational governance in innovation network can be further enriched from other knowledge management perspectives such as knowledge coupling. Secondly, this study uses the collected cross-sectional data as the basis for empirical validation analysis, and may consider using long panel data in the future. In addition, the research object is the focus enterprise and there is a lack of measurement of its network members. The existence of asymmetric cognition among network members is an area that has been highly studied but lacks empirical evidence, and can be improved in the future.

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