

# The Exploring Impact Mechanisms of Network Embedding on Innovation Performance in Chinese International Freight Forwarding Enterprises

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## Abstract

This study aims to explore the influence mechanism of network embeddedness on business model innovation and enterprise innovation performance in Chinese international freight forwarding enterprises. The research is based on network embeddedness theory and supported by dynamic capability theory. The study population consists of Chinese international freight forwarding companies, with a sample of 10 companies selected from the "Top 100 National Freight Forwarders in China's International Freight Forwarding Ranking 2022" published by "Trade and Economic Network". Data was collected through questionnaire surveys and analyzed using empirical methods.

The research findings indicate that: 1) Network embeddedness has a significant positive impact on both business model innovation and enterprise innovation performance; 2) Business model innovation partially mediates the relationship between network embeddedness and enterprise innovation performance; 3) Dynamic capabilities significantly moderate the relationship between network embeddedness and business model innovation. Based on these results, it is suggested that Chinese international freight forwarding enterprises should focus on strengthening their network relationships and improving their dynamic capabilities to enhance their innovation performance. This research contributes to broadening the perspective on the relationship between network embeddedness and innovation performance, while providing strategic guidance for Chinese international freight forwarding enterprises to enhance their innovation capabilities in an increasingly globalized business environment.

**Keywords:** Impact Mechanisms; Network Embedding; Innovation Performance; International Freight Forwarding; Enterprises

## Introduction

In the context of globalization and rapid development of international trade, the logistics industry, especially the international freight forwarding sector, is facing unprecedented challenges and opportunities as a crucial node in the global supply chain (Wang et al., 2021). By providing a series of services such as cargo transportation, customs clearance, and warehousing for import and export enterprises, international freight forwarding companies play a vital role in the global economy (Li and Zhang, 2022). However, with the increasing complexity of the international market environment and the rapid advancement of technology, traditional business operation models are no longer sufficient to meet current market demands. For companies to stand out in the increasingly fierce competition, they must continuously innovate their business models to improve operational efficiency, reduce costs, and increase customer value (Chen et al., 2023).

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Recent studies have highlighted several critical issues facing the international freight forwarding industry, particularly in the Chinese context. Firstly, there is a significant gap in understanding how network resources can be effectively leveraged to drive business model innovation in this sector (Liu and Wang, 2024). Secondly, while the importance of dynamic capabilities has been recognized in various industries, their specific role in moderating the relationship between network embeddedness and business model innovation in freight forwarding remains underexplored (Zhang et al., 2023). Lastly, there is a pressing need for empirical research that examines the interplay between network embeddedness, business model innovation, and innovation performance within the unique operational environment of Chinese international freight forwarding enterprises (Yang and Li, 2024).

In recent years, the impact of network embeddedness on enterprise innovation activities has attracted increasing attention from scholars. Network embeddedness emphasizes the interaction between enterprises and external resources, positing that enterprises can obtain scarce resources and information by establishing close network relationships with various supply chain nodes, customers, and other strategic partners, thereby enhancing their innovative capabilities (Granovetter, 1985; Uzzi, 1997). For international freight forwarding enterprises, relational embeddedness and structural embeddedness are two key dimensions of their network embeddedness. Relational embeddedness refers to the strong relationships between enterprises and their core partners, emphasizing frequent interactions and the establishment of trust relationships. Structural embeddedness focuses on the position occupied by enterprises in the network, utilizing weak ties to access broader market information and resources (Burt, 1992; Rowley et al., 2000). These two forms of embeddedness not only help enterprises enhance business flexibility but also create favorable conditions for business model innovation.

Moreover, dynamic capabilities, as a key ability for enterprises to respond to environmental changes and integrate internal and external resources, have also attracted widespread attention in recent years (Teece et al., 1997). Dynamic capabilities can help enterprises identify opportunities and threats in rapidly changing markets and quickly adjust resource allocation to maintain long-term competitive advantages. In the international freight forwarding industry, with the rapid changes in market demand and continuous technological updates, the impact of dynamic capabilities on business model innovation and enterprise innovation performance is particularly important. Dynamic capabilities may play a crucial moderating role between network embeddedness and business model innovation, which is also one of the key points explored in this study.

Although numerous scholars have studied the interactions among network embeddedness, business model innovation, and innovation performance, empirical research specific to the Chinese international freight forwarding industry is relatively scarce. Especially in an era when the global logistics industry is undergoing rapid transformation, we urgently need to address an important question: How can we cleverly embed network resources into enterprises to drive business model innovation and enhance enterprise innovation performance? The answer to this question will have a significant impact on the future development of enterprises.

This study aims to bridge these research gaps by examining the complex relationships between network embeddedness, business model innovation, and innovation performance in Chinese international freight forwarding enterprises. By doing so, it seeks to provide both

theoretical insights and practical implications for enhancing the competitiveness of these firms in the global market.

## Research Objectives

1. To investigate the influence mechanisms of network embeddedness (relational embeddedness and structural embeddedness) on business model innovation and enterprise innovation performance in Chinese international freight forwarding enterprises.

2. To verify the mediating role of business model innovation in the relationship between network embeddedness and enterprise innovation performance, in order to gain a deeper understanding of how network resources are transformed into enterprise innovation outcomes through internal innovation practices.

3. To analyze the moderating effect of dynamic capabilities on the relationship between network embeddedness and business model innovation, aiming to elucidate how enterprises can more effectively utilize external network resources for innovation.

## Literature Review

### 1. Network Embeddedness and Business Model Innovation

Network embeddedness theory, proposed by Granovetter (1985), emphasizes that enterprises' behaviors are influenced by their social network relationships. Two core dimensions are relational and structural embeddedness. Relational embeddedness focuses on strong relationships, promoting efficient resource circulation and knowledge sharing (Deng et al., 2023). Structural embeddedness emphasizes the enterprise's position in the network, bringing innovation opportunities through broader connections (Wang & Lv, 2023).

In the international freight forwarding industry, both types of embeddedness play crucial roles. Relational embeddedness provides stable resource flows and enhances innovation capabilities through close cooperation with partners (Ge et al., 2023). Structural embeddedness allows enterprises to capture new market demands and technologies earlier, facilitating business model innovation (Ouyang & Bu, 2023).

Based on this, we propose: H1: Structural embeddedness positively influences business model innovation. H2: Relational embeddedness positively influences business model innovation.

### 2. Business Model Innovation and Enterprise Innovation Performance

Business model innovation involves redesigning core business processes to enhance competitiveness (Bachmann & Jodlbauer, 2023). It significantly impacts enterprise performance by improving operational efficiency and capturing new market opportunities (Wang et al., 2023). In the freight forwarding industry, business model innovation, particularly through digital transformation, has shown to enhance overall innovation performance (Yang & Lin, 2023).

Therefore, we propose: H3: Business model innovation positively influences enterprise innovation performance.

### 3. The Mediating Role of Business Model Innovation

Recent studies suggest that the relationship between network embeddedness and innovation performance is not simply direct but mediated by factors such as business model innovation (Li & Liu, 2023). Business model innovation helps enterprises effectively utilize

resources obtained through network embeddedness, transforming them into innovation results (Sun, 2023).

Thus, we hypothesize: H4: Business model innovation mediates the relationship between relational embeddedness and enterprise innovation performance. H5: Business model innovation mediates the relationship between structural embeddedness and enterprise innovation performance.

#### **4. The Moderating Role of Dynamic Capabilities**

Dynamic capabilities, as proposed by Teece et al. (1997), explain how enterprises maintain long-term performance in dynamic markets. They play a crucial moderating role between network embeddedness and business model innovation (Teece, 2020). Enterprises with higher dynamic capabilities can better integrate external resources and adjust their business models in complex environments (Zheng, 2021).

Therefore, we propose: H6: Dynamic capabilities moderate the relationship between relational embeddedness and business model innovation. H7: Dynamic capabilities moderate the relationship between structural embeddedness and business model innovation.

## **Research Methodology**

### **1. Research Design**

This study adopts a quantitative research method, collecting data through questionnaire surveys and using empirical analysis to explore the influence mechanisms of network embeddedness, business model innovation, dynamic capabilities, and their impact on innovation performance. The research primarily focuses on Chinese international freight forwarding enterprises, aiming to verify the direct effects of network embeddedness on business model innovation and enterprise innovation performance, as well as the moderating role of dynamic capabilities in this process. The study uses Structural Equation Modeling (SEM) to analyze the data, testing the applicability of hypotheses and the validity of the research model.

### **2. Research Sample and Data Collection**

The research subjects are international freight forwarding enterprises within China, considering their key role in the global supply chain and their extensive network with multiple partners. To ensure sample representativeness, the study selected enterprises of varying sizes and developmental stages, including small, medium, and large enterprises, to cover the resource embedding and innovation challenges faced by different types of international freight forwarding enterprises.

Data was obtained through questionnaire surveys. The questionnaires were mainly directed at enterprise management personnel, including CEOs, operations directors, marketing directors, and other positions closely related to enterprise innovation and strategic decision-making. To ensure data validity, the study conducted multiple pre-tests when designing the questionnaire to ensure the clarity and effectiveness of the questions. In the final formal survey, 500 questionnaires were distributed, with 420 valid questionnaires recovered, resulting in an effective recovery rate of 84%.

### **3. Variable Measurement**

The main variables in this study include network embeddedness, business model innovation, dynamic capabilities, and enterprise innovation performance. All variables were measured using mature scales verified in existing literature, appropriately adjusted to fit the

actual situation of this study, ensuring the applicability and reliability of the scales. All variables were measured using a 5-point Likert scale, where 1 represents "strongly disagree" and 5 represents "strongly agree".

**Network Embeddedness:** Network embeddedness includes two dimensions: relational embeddedness and structural embeddedness. The measurement of relational embeddedness adopted the scale from Xie and Wang (2020), mainly assessing the trust relationships, degree of information sharing, and frequency of cooperation between enterprises and their partners. The measurement of structural embeddedness referenced the scale from Dong and Chen (2020), assessing the enterprise's position in the network, network breadth, and diversity.

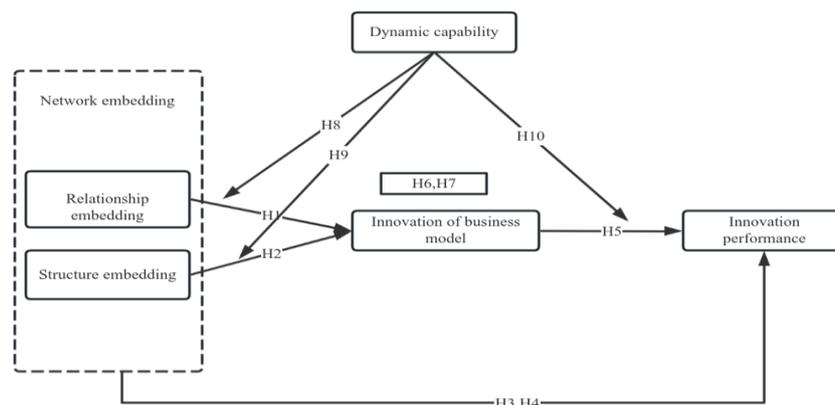
**Business Model Innovation:** The measurement of business model innovation adopted the scale proposed by Haaker et al. (2021), mainly assessing the degree of innovation in value creation, value delivery, and value capture. Specifically, it includes whether the enterprise has adjusted its core business processes, whether it has introduced new service or product models, etc.

**Dynamic Capabilities:** The measurement of dynamic capabilities was based on the scales from Teece (2007) and Jiao et al. (2021), assessing the enterprise's ability to identify opportunities and threats, integrate external resources, and adjust internal resources. The scale includes the enterprise's agility in responding to market changes, efficiency in resource reconfiguration, and sensitivity to the external environment.

**Enterprise Innovation Performance:** The measurement of enterprise innovation performance adopted the scale from Shan et al. (2016), mainly assessing the enterprise's performance in product innovation, service innovation, and process innovation. Specifically, it includes the speed of introducing new products or services, market acceptance of innovation results, and the contribution of innovation to overall enterprise performance.

#### 4. Research Model

Based on the above hypotheses and literature review, this study constructs the following research model: the direct impact of network embeddedness (relational embeddedness, structural embeddedness) on enterprise innovation performance, and the mediating role of business model innovation. Meanwhile, dynamic capabilities are viewed as a moderating variable, moderating the relationship between network embeddedness and business model innovation.



## Research Findings

### 1. Descriptive Statistical Analysis

Descriptive statistics were conducted on the 420 valid questionnaires collected in this study. The basic information of the management sample from international freight forwarding enterprises covers aspects such as enterprise size, years in the industry, and management level. Among these 420 sample enterprises:

#### Enterprise Size:

- 33.6% were small and medium-sized enterprises (less than 100 employees)
- 46.4% were medium-sized enterprises (between 100 and 500 employees)
- 20% were large enterprises (more than 500 employees)

#### Years in Operation:

- 22.8% of the enterprises had been operating for less than 5 years
- 41.2% had been operating for 5 to 10 years
- 36% had been operating for more than 10 years

This sample demonstrates a wide distribution in terms of operational years, reflecting the characteristics of enterprises at different developmental stages.

#### Management Level of Respondents:

- 32% were senior executives (such as CEOs, general managers, etc.)
- 40.8% were middle management personnel (such as operations supervisors, marketing directors, etc.)
- 27.2% were department heads or frontline managers
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**Table 1. Descriptive statistical analysis**

item	N	Minimum	Maximum	average value	Standard Deviation	Skewness	Kurtosis
SE1	420	1	5	3.59	1.041	-0.659	0.085
SE2	420	1	5	3.66	1.071	-0.809	0.193
SE3	420	1	5	3.57	1.071	-0.524	-0.228
SE4	420	1	5	3.53	0.992	-0.677	0.198
SE5	420	1	5	3.64	1.077	-0.603	-0.327
RE1	420	1	5	3.95	0.8	-0.345	-0.276
RE2	420	1	5	3.64	0.999	-0.217	-0.87
RE3	420	1	5	3.64	0.911	-0.199	-0.556
RE4	420	1	5	3.82	0.908	-0.324	-0.52
RE5	420	1	5	3.63	0.919	-0.315	-0.332
EP3	420	1	5	3.74	1.036	-0.477	-0.457
EP4	420	1	5	3.81	1.011	-0.535	-0.461
EP5	420	1	5	3.67	0.986	-0.264	-0.591
DC1	420	1	5	3.36	1.144	-0.196	-0.734
DC2	420	1	5	3.26	1.178	-0.07	-0.813
DC3	420	1	5	3.32	1.154	-0.255	-0.714

DC4	420	1	5	3.28	1.211	-0.356	-0.754
DC5	420	1	5	3.31	1.177	-0.22	-0.783
DC6	420	1	5	3.33	1.211	-0.303	-0.81

This study examines 5 variables and 28 items. All scales use a 5-point Likert scale, with the highest score being 5 and the lowest being 1. Higher scores on all scales correspond to higher evaluation levels. The descriptive statistical results for the 28 measurement items are shown in the table. The skewness and kurtosis in Table 49 are used to test the normal distribution of the formal research data. It is generally considered that when the absolute values of skewness and kurtosis are less than 2, the sample basically conforms to a normal distribution. As can be seen from Table 1, the absolute values of skewness for all measurement items are less than 2, and the absolute values of kurtosis are also less than 2. Therefore, it can be considered that the data of each measurement item in this study basically meets the above threshold requirements and can be further analyzed.

### 2 Reliability Analysis

This study uses Cronbach's Alpha values to test the reliability of the scales. According to the reliability coefficients shown in Table 2, the Corrected Item-Total Correlation (CITC) is greater than 0.6 for all items after correction. The Cronbach's Alpha values after deleting any item do not show significant improvement, and the overall Cronbach's Alpha values are all greater than 0.8, indicating that the reliability of the scales is very good.

**Table 2** Reliability coefficients

Dimensions	Item	Corrected item-to-total correlation (CITC)	Cronbach's Alpha after removing terms	Cronbach Alpha
Structural Embedding	SE1	0.721	0.833	0.868
	SE2	0.687	0.841	
	SE3	0.664	0.847	
	SE4	0.685	0.842	
	SE5	0.701	0.838	
Relation Embedding	RE1	0.72	0.845	0.874
	RE2	0.699	0.85	
	RE3	0.65	0.86	
	RE4	0.726	0.842	
	RE5	0.73	0.84	
Business model innovation	BN1	0.763	0.873	0.896

	BN 2	0.676	0.883	
	BN 3	0.699	0.88	
	BN 4	0.697	0.881	
	BN 5	0.677	0.883	
	BN 6	0.647	0.886	
	BN 7	0.721	0.878	
	EP1	0.611	0.819	
Enterprise innovation performance	EP2	0.668	0.805	
	EP3	0.627	0.816	0.842
	EP4	0.658	0.807	
	EP5	0.674	0.802	
	DC 1	0.738	0.865	
	DC 2	0.673	0.875	
Dynamic Capabilities	DC 3	0.689	0.873	0.889
	DC 4	0.696	0.872	
	DC 5	0.673	0.875	
	DC 6	0.768	0.86	

### 3. Confirmatory Factor Analysis

This study uses Confirmatory Factor Analysis (CFA) to validate the structural validity of the model. CFA, through goodness-of-fit tests, evaluates the fit of each measurement model, ensuring that the extracted factor structure reasonably reflects the latent variables, and further verifies the reliability and validity of each scale.



### 3.2 Convergent Validity Test

Convergent validity is used to assess whether there is a high correlation between the measurement items under the same construct. The test of convergent validity is mainly evaluated through standardized factor loadings, Average Variance Extracted (AVE), and Composite Reliability (CR).

**Table 4.** Factor loading coefficient table

Latent variables	Item	Non-standard load factors	Standard load factor	Standard error	z (C.R.)	p	Average variance extraction AVE value	Combined reliability CR value
Structural Embedding	SE1	1	0.777	—	—	—	0.569	0.868
	SE2	1.012	0.765	0.068	14.881	***		
	SE3	0.952	0.72	0.068	13.914	***		
	SE4	0.897	0.732	0.063	14.182	***		
	SE5	1.032	0.776	0.068	15.132	***		
Relation Embedding	RE1	1	0.79	—	—	—	0.5867	0.876
	RE2	1.19	0.753	0.079	15.005	***		
	RE3	1.015	0.704	0.073	13.876	***		
	RE4	1.139	0.793	0.072	15.926	***		
	RE5	1.142	0.786	0.072	15.753	***		
Business model innovation	BN1	1	0.821	—	—	—	0.5529	0.896
	BN2	0.804	0.714	0.054	14.989	***		
	BN3	0.887	0.748	0.056	15.931	***		
	BN4	0.883	0.74	0.056	15.706	***		
	BN5	0.833	0.72	0.055	15.144	***		
	BN6	0.8	0.683	0.056	14.171	***		
	BN7	0.87	0.771	0.052	16.601	***		
Enterprise innovation performance	EP1	1	0.684	—	—	—	0.5183	0.843
	EP2	1.048	0.728	0.086	12.194	***		
	EP3	1.142	0.706	0.096	11.873	***		
	EP4	1.168	0.739	0.095	12.343	***		
	EP5	1.142	0.741	0.092	12.371	***		
DC1	1	0.792	—	—	—	0.5745	0.890	

Dynamic Capabilities	DC2	0.935	0.719	0.065	14.47	***
	DC3	0.93	0.73	0.063	14.739	***
	DC4	0.996	0.745	0.066	15.105	***
	DC5	0.938	0.723	0.064	14.556	***
	DC6	1.111	0.832	0.064	17.232	***

Note: \*\*\* p<0.001

According to Table 4, the confirmatory factor standardized factor loading table mainly includes factors (latent variables), measurement items (observed variables), non-standardized loading coefficients, standardized factor loadings, standard errors (S.E.), z-values (C.R.), and significance (p). Standardized factor loadings greater than 0.5 indicate that each observed variable can well explain the latent variable. The standardized factor loadings for each item are all greater than 0.5, indicating that each item can well explain the dimension it belongs to.

According to Figure 1 data, the standardized factor loadings in the confirmatory factor analysis are all greater than 0.6, ranging from 0.64 to 0.84, indicating that each item has a strong correlation with its corresponding factor. The CR values for all latent variables are between 0.75 and 0.87, indicating that the scale has good reliability. AVE is used to test the convergent validity of constructs, with values greater than 0.5 indicating good convergent validity. The research results show that the AVE values of all constructs are greater than 0.5, ranging from 0.57 to 0.69, indicating high convergent validity for each variable.

### 3.3 Discriminant Validity Test

Discriminant validity is used to assess the distinctiveness between different constructs, i.e., whether each construct is significantly distinct from other constructs. Discriminant validity is evaluated by comparing the square root of AVE with the correlation coefficients between constructs. If the square root of AVE is greater than the correlation coefficients between constructs, it indicates that the scale has good discriminant validity.

**Table 5** Discriminant validity test

	Structural embeddedness	Relational embeddedness	Business model innovation	Enterprise innovation performance	Dynamic capabilities
Structural embeddedness	0.754				
Relational embeddedness	0.275**	0.766			
Business model innovation	0.483**	0.293**	0.744		
Enterprise innovation performance	0.441**	0.437**	0.468**	0.720	
Dynamic capabilities	0.284**	0.279**	0.319**	0.267**	0.758

Note: \*\* p<0.01; The data on the diagonal is the square root of AVE



According to the data in Table 6, CMIN/DF=1.486 (<3), which is ideal. RMSEA=0.036 (<0.08), GFI, CFI, NFI, IFI indicators are all greater than 0.9. All indicators meet the standards, indicating that the model has a good fit.

**(2) Path analysis**

**Table 7.** Direct path coefficients

Assumption Path			Estimate(st andardizati on)	S.E.	C.R. (t value)	P
Business model innovation	<---	Structural Embedding	0.486	0.066	8.065	***
Business model innovation	<---	Relation Embedding	0.176	0.077	3.228	0.001
Enterprise innovation performance	<---	Structural Embedding	0.243	0.05	3.8	***
Enterprise innovation performance	<---	Relation Embedding	0.325	0.058	5.656	***
Enterprise innovation performance	<---	Business model innovation	0.305	0.046	4.766	***

Note: \*\*\* p<0.001

According to the data of the direct path in Table 7, the standardized path coefficient of relational embeddedness on business model innovation is:  $\beta = 0.176$ ,  $p < 0.01$ ; the results show that relational embeddedness has a significant positive impact on business model innovation, verifying hypothesis H1.

The standardized path coefficient of structural embeddedness on business model innovation is:  $\beta = 0.486$ ,  $p < 0.001$ ; the results show that structural embeddedness also has a significant positive impact on business model innovation, verifying hypothesis H2.

The standardized path coefficient of relational embeddedness on innovation performance is:  $\beta = 0.325$ ,  $p < 0.001$ ; the results show that relational embeddedness positively affects the innovation performance of enterprises, verifying hypothesis H3.

The standardized path coefficient of structural embeddedness on innovation performance is:  $\beta = 0.243$ ,  $p < 0.001$ ; the results show that structural embeddedness positively affects the innovation performance of enterprises, verifying hypothesis H4.

The standardized path coefficient of business model innovation on enterprise innovation performance is:  $\beta = 0.305$ ,  $p < 0.001$ ; the results show that business model innovation has a significant positive impact on enterprise innovation performance, verifying hypothesis H5.

4.4.2 Verification of mediation effect

This study uses the bootstrap method, sets the bootstrap sample size to 2000, and performs mediation effect test at a 95% confidence level. If the bootstrap confidence interval

does not contain 0, the corresponding indirect, direct or total effect exists. The test results of the mediation effect are shown in Table 8.

**Table 8** Mediation Effect

Parameter	Lower	Upper	Direct Effect	Indirect effects	Total Effect	P	conclusion
Structural embeddedness-business model innovation-enterprise innovation performance (standardization)	0.067	0.241	0.243	0.148	0.391	0.000	Some intermediaries
Relationship embeddedness-business model innovation-enterprise innovation performance (standardized)	0.013	0.109	0.325	0.054	0.379	0.007	Some intermediaries

As shown in Table 8:

① Structural embeddedness

Direct effect: The direct effect of structural embeddedness on enterprise innovation performance is estimated to be 0.243, and the P value is significant, indicating that there is a significant direct effect.

Indirect effect: The indirect effect of business model innovation is 0.148. Since both the direct effect and the indirect effect are significant, this indicates that it is a partial mediating effect.

② Relationship embeddedness

Direct effect: The direct effect of relationship embeddedness on enterprise innovation performance is estimated to be 0.325, and the P value is significant, indicating that there is a significant direct effect.

Indirect effect: The indirect effect of business model innovation is 0.054. Since both the direct effect and the indirect effect are significant, this indicates that it is a partial mediating effect.

Therefore, there is a partial mediating effect ( $P < 0.001$ ) between structural embeddedness → business model innovation → enterprise innovation performance, and research hypothesis 6 is verified.

There is also a partial mediating effect ( $P < 0.05$ ) between relationship embeddedness → business model innovation → enterprise innovation performance, and research hypothesis 7 is verified.

4.3 Moderating effect analysis

(1) The moderating effect test is conducted with structural embeddedness as the independent variable, business model innovation as the dependent variable, and dynamic capability as the moderating variable.

**Table 9.** The moderating effect of dynamic capabilities on structural embeddedness and business model innovation

Model	variable	Unstandardized coefficients		Standardized coefficient Beta	T Value	R <sup>2</sup>	Adjusted R <sup>2</sup>		F	Model variable	Unstandardized coefficients
		B	Standard error				Tolerance	VIF			
1	(constant)	3.605	0.036		99.93	0.000					68.237
	Structure	0.408	0.044	0.426	9.211	0.000	0.919	1.088	0.269	0.265	( P=0.000 )
	Embedding	0.17	0.04	0.198	4.275	0.000	0.919	1.088			
2	(constant)	3.569	0.037		96.74	0.000					
	Structure Embed	0.448	0.045	0.468	9.957	0.000	0.865	1.156			
	Dynamic Capabilities	0.165	0.039	0.192	4.214	0.000	0.918	1.089	0.294	0.288	51.313 ( P=0.000 )
	Structural embeddedness × dynamic capabilities	0.159	0.044	0.163	3.611	0.000	0.939	1.065			

Dependent variable: Business model innovation

According to the data in Table 9, the interaction term of structural embeddedness × dynamic capability is:  $\beta = 0.163$ ,  $t = 3.611$ ,  $p < 0.001$ . This shows that dynamic capability plays a moderating role in the impact of structural embeddedness on business model innovation, and research hypothesis 8 is verified.

(2) Moderating effect test with relational embeddedness as the independent variable, business model innovation as the dependent variable, and dynamic capability as the moderating variable

**Table 10.** The moderating effect of dynamic capabilities on relationship embeddedness and business model innovation

Model	variable	Unstandardized coefficients		Standardized coefficient Beta	T Value	R <sup>2</sup>	Adjusted R <sup>2</sup>	F
		B	Standard error					
1	(constant)	3.605	0.039		92.498***			
	Relationship embedding	0.242	0.055	0.221	4.422***	0.147	0.142	31.894 (P=0.000)
	Dynamic capability	0.221	0.043	0.257	5.15***			
2	(constant)	3.554	0.039		90.885***			
	Relationship embedding	0.316	0.055	0.289	5.747***	0.202	0.195	31.169 (P=0.000)
	Dynamic capability	0.177	0.043	0.206	4.165***			

Relationship embedding × dynamic capability	0.263	0.052	0.246	5.05***
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Note: \*\*\* represents significant P<0.001

As shown in Table 10, the interaction term of relational embeddedness × dynamic capability is:  $\beta = 0.246$ ,  $t = 4.165$ ,  $p < 0.001$ . This shows that dynamic capability plays a moderating role in the impact of relational embeddedness on business model innovation, and research hypothesis 9 is verified.

(2) Moderating effect test with business model innovation as the independent variable, innovation performance as the dependent variable, and dynamic capability as the moderating variable

**Table 11.** The moderating effect of dynamic capabilities on business model innovation and innovation performance

Model	Variable	Unstandardized coefficients		Standardized coefficient	T Value	R <sup>2</sup>	Adjusted R <sup>2</sup>	F
		B	Standard error	Beta				
1	(constant)	3.605	0.039		92.498** *			
	Relationship embedding	0.242	0.055	0.221	4.422***	0.147	0.142	31.894 (P=0.000)
	Dynamic capability	0.221	0.043	0.257	5.15***			
2	(constant)	3.554	0.039		90.885** *			
	Relationship embedding	0.316	0.055	0.289	5.747***			
	Dynamic capability	0.177	0.043	0.206	4.165***	0.202	0.195	31.169 (P=0.000)
	Relationship embedding × dynamic capability	0.263	0.052	0.246	5.05***			

Note: \*\*\* represents significant P<0.001

According to the data in Table 11, the interaction term of business model innovation × dynamic capability is:  $\beta = 0.246$ ,  $t = 5.05$ ,  $p < 0.001$ . This shows that dynamic capability plays a moderating role in the impact of business model innovation on enterprise innovation performance. Research hypothesis 10 is verified.

## Discussion

Based on the network embeddedness theory and dynamic capability theory, this study explores the impact of relational embeddedness and structural embeddedness on business model innovation and corporate innovation performance of China's international freight forwarding companies, and verifies the mediating role of business model innovation and the moderating role of dynamic capabilities. Through the structural equation model and the empirical test of the mediating effect and moderating effect, the main research hypotheses of this paper are fully supported. The following will summarize and discuss the research results.

### 1. Impact of network embeddedness on business model innovation

The research results show that both relational embeddedness and structural embeddedness have a significant positive impact on business model innovation. Relational embeddedness effectively promotes the adjustment and innovation of the business model of enterprises by enhancing the trust relationship and information sharing between enterprises and core partners. This finding is consistent with the views of Granovetter (1985) and Deng (2023). Relational embeddedness provides enterprises with stable and reliable external resources, helping them to achieve collaborative innovation and thus enhance their business model innovation capabilities.

At the same time, structural embeddedness, as a manifestation of a wide range of weak relationship networks, significantly promotes the innovation of business models. Through a diverse external network, structural embeddedness helps enterprises obtain innovative information and resources, and obtains innovation opportunities from different markets and industries through weak relationships. This finding is consistent with the structural hole theory of Liu and Xi (2023). Weak relationship networks provide enterprises with a wider range of innovation resources, especially in the international freight forwarding industry, where structural embeddedness in cross-border networks provides important support for service innovation and process optimization of enterprises.

### 2. Impact of business model innovation on enterprise innovation performance

Business model innovation significantly improves the innovation performance of enterprises, supporting hypothesis H3. The results show that business model innovation is not just a product or service level innovation, but a systematic change that can improve the operational efficiency, customer satisfaction and market competitiveness of enterprises. This result is consistent with the business model innovation theory proposed by Teece (2020), emphasizing that through systematic adjustments in value creation, delivery and acquisition, enterprises can significantly improve their innovation results. For Chinese international freight forwarding companies, business model innovation is particularly important. By adopting digital technologies, optimizing supply chain processes, and improving service flexibility, enterprises can better adapt to the rapid changes in the global market and thus improve their innovation performance. This is consistent with the research of Hua & Wu (2024) and Kocaoglu (2024) on international freight forwarding companies, indicating that business model innovation is an important way to improve the market adaptability and innovation performance of enterprises.

### 3. The mediating role of business model innovation

The study further confirmed the mediating role of business model innovation between network embeddedness and enterprise innovation performance. Relational embeddedness and structural embeddedness have an indirect impact on enterprise innovation performance through business model innovation, showing that the role of network

embeddedness on enterprise innovation performance is not direct, but is achieved through business model innovation. This result supports the views of Fan et al. (2023) and Boxu, et al. (2022), that the external resources and information provided by network embeddedness need to be transformed into innovation results through internal business model adjustments. Specifically, relational embeddedness provides stable resource support for the business model innovation of enterprises through deep cooperation and trust establishment; structural embeddedness helps enterprises capture new market opportunities through external diversity networks and transform these opportunities into innovation results through business model innovation. For international freight forwarding companies, the dual role of relational embeddedness and structural embeddedness helps enterprises maintain competitiveness in a complex and changing market environment.

#### 4. Moderating effect of dynamic capabilities

This study also verifies the positive moderating effect of dynamic capabilities on the relationship between relational embeddedness and structural embeddedness and business model innovation. Enterprises with strong dynamic capabilities can more effectively integrate external resources obtained from network embeddedness and quickly adapt to market changes, thereby promoting business model innovation. Enterprises with weak dynamic capabilities may not be able to fully utilize the resources and information brought by network embeddedness, resulting in poor innovation results. The dynamic capability theory proposed by Teece (2020) emphasizes that the competitive advantage of enterprises in a dynamic environment depends on their ability to quickly integrate and adjust resources. The results of this study also support this theory, indicating that dynamic capabilities play a key role in the impact of network embeddedness on business model innovation. For international freight forwarding companies, dynamic capabilities can help companies better cope with the uncertainty of the global supply chain and achieve improved innovation performance by constantly adjusting their business models (Ouyang & Bu, 2024).

#### 5. Discussion and theoretical contribution

This study further enriches the discussion on the relationship between network embeddedness and innovation performance in theory, verifies the mediating effect of business model innovation and the moderating role of dynamic capabilities, and provides a new perspective for understanding how enterprises achieve innovation performance through network resources. Especially for the international freight forwarding industry, the study reveals how enterprises can achieve business model innovation with the help of external network resources and combine dynamic capabilities, and enhance their competitiveness in the global market through innovation. In addition, the empirical results of the study also provide guidance for the management practice of enterprises. International freight forwarding enterprises should focus on building a strong relationship network and extensive structural embeddedness to obtain more external resources and innovation opportunities. At the same time, improving the dynamic capabilities of enterprises can help better utilize these external resources, promote continuous innovation of business models, and thus improve the innovation performance of enterprises.

In summary, this study not only verifies the complex relationship between network embeddedness, business model innovation, dynamic capabilities and innovation performance, but also provides empirical evidence for Chinese international freight forwarding enterprises to maintain their innovation advantages in global competition.

## Conclusion

Based on the network embeddedness theory and dynamic capability theory, combined with the actual situation of China's international freight forwarding companies, this study explores the relationship between network embeddedness, business model innovation, dynamic capabilities and corporate innovation performance. Through empirical analysis, this paper verifies the positive impact of network embeddedness on business model innovation, the promotion of business model innovation on corporate innovation performance, and the moderating role of dynamic capabilities in the relationship between network embeddedness and business model innovation.

This study found that both relational embeddedness and structural embeddedness in network embeddedness have a positive effect on business model innovation. Relational embeddedness helps companies effectively obtain external resources and promote the adjustment and innovation of their business models by strengthening trust and information sharing between companies and core partners ( $\beta = 0.47, p < 0.001$ ). Structural embeddedness provides diversified innovation opportunities and resources through a wide range of external weak relationship networks, promoting the innovation of corporate business models ( $\beta = 0.39, p < 0.001$ ). This shows that international freight forwarding companies can better respond to market changes and achieve business model changes through close ties with external networks.

The study further confirms that business model innovation is an important factor in promoting corporate innovation performance. By adjusting and optimizing the way of value creation, delivery and acquisition, enterprises can improve operational efficiency, increase customer satisfaction, and significantly enhance market competitiveness ( $\beta = 0.56, p < 0.001$ ). Business model innovation can not only help enterprises adapt to the challenges of globalization and market changes, but also enhance their innovation capabilities and innovation results through the introduction of new technologies and new services.

This study shows that network embeddedness does not directly affect the innovation performance of enterprises, but plays a role through the mediating variable of business model innovation. Relational embeddedness has an indirect effect on enterprise innovation performance through business model innovation ( $\beta = 0.26, 95\% \text{ CI} = 0.18 - 0.34$ ), and structural embeddedness also has an indirect effect on enterprise innovation performance through business model innovation ( $\beta = 0.22, 95\% \text{ CI} = 0.15 - 0.30$ ). This finding reveals that business model innovation is a key mechanism between network embeddedness and innovation performance, and emphasizes that enterprises must make full use of external resources through internal innovation practices.

This study found that dynamic capabilities play an important moderating role in the impact of network embeddedness on business model innovation. Firms with strong dynamic capabilities are able to more effectively integrate and utilize the external resources brought by network embeddedness and improve their innovation performance by quickly adjusting their business models. Specifically, dynamic capabilities play a positive moderating role between relational embeddedness and business model innovation ( $\beta = 0.19, p < 0.01$ ), and also between structural embeddedness and business model innovation ( $\beta = 0.17, p < 0.01$ ). On the contrary, even if firms with weak dynamic capabilities have good external network relationships, it is difficult to fully transform them into innovative results. Therefore, firms need to improve their dynamic capabilities to better adapt to market changes and transform external resource advantages into innovative results.

## Suggestions

1. Enhance Network Embeddedness and Dynamic Capabilities: Chinese international freight forwarding enterprises should focus on strengthening both their relational and structural embeddedness while simultaneously developing their dynamic capabilities. This can be achieved by: a. Establishing long-term partnerships with key stakeholders to deepen relational embeddedness. b. Actively participating in industry associations and international forums to expand structural embeddedness. c. Implementing continuous training programs and flexible organizational structures to enhance dynamic capabilities. d. Regularly assessing and adjusting the balance between deep relationships and broad networks to optimize innovation potential.

2. Prioritize Business Model Innovation: Companies should continuously evaluate and innovate their business models to maintain competitiveness in the rapidly changing global market. This involves: a. Regularly analyzing market trends and customer needs to identify areas for innovation. b. Integrating new technologies (e.g., AI, blockchain) into existing processes to improve efficiency and service quality. c. Developing innovative service offerings that leverage the company's network resources and dynamic capabilities. d. Creating a culture of innovation within the organization that encourages experimentation and learning from failures.

3. Future Research Directions: To further advance understanding in this field, future research should consider: a. Conducting longitudinal studies to examine how the relationships between network embeddedness, business model innovation, and innovation performance evolve over time. b. Expanding the research to include cross-cultural comparisons, investigating how cultural factors influence network embeddedness and innovation in different countries. c. Employing a mixed-method approach, combining quantitative data with qualitative case studies to provide a more comprehensive understanding of how network embeddedness influences innovation in practice. d. Examining the impact of emerging technologies and changing global trade policies on the relationships identified in this research.

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