

Article

Research on the Governance Mechanism of Independent Innovation Network in the Core Area of Silk Road Economic Belt

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Abstract: The increasing competition in global scientific and technological innovation and the continuous promotion of the “Belt and Road initiatives” have created new opportunities for the improvement in innovation capabilities in the core area of the Silk Road Economic Belt but have also brought new challenges. This paper first starts from the market and government perspective and sorts out the formation mechanism of an innovation network. Subsequently, based on the development practice of the innovation network in the core area of the Silk Road Economic Belt, we applied the grounded theory to reveal the development constraints of the innovation network in the core area and explore the corresponding network governance mechanism. Subsequently, we applied a survey study to test our conceptual model. We empirically found the innovation network structure governance and innovation relation governance impacting mechanism in a market-led and government guidance context. The study found that: first, the market-led environment and government guidance jointly impact the formation of an innovation network. Second, the network structure governance and network relation governance of the innovation network can address the development constraints faced by the current innovation network to a certain extent, thereby improving the firm’s innovation performance. Finally, it is found that both the market-led environment and government guidance play a positive role in regulating the impact of network structure governance and network relation governance on the firm’s innovation performance. The above conclusions expand the application scenarios of innovation network governance theory in underdeveloped areas and, at the same time, provide new theoretical knowledge increments for the formation mechanism of innovation networks and also provide corresponding theoretical guidance for the improvement of the firm’s innovation performance in the core area.

Keywords: Silk Road Economic Belt Core Zone; innovation network; development constraints; network governance mechanism



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1. Introduction

While economies worldwide continue to engage in science and technology innovation, uncertainty in the science and technology innovation environment continues to rise as global trade frictions intensify and the competition between science and technology innovation becomes more complex. As a result, China’s innovation model has to shift from “import–imitate–digest–reimport” to independent innovation. As critical dependencies for enhancing science and innovation capabilities, regional innovation networks may be driven by their objectives and adopt behaviours that do not match the overall goals.

For instance, the government-led innovation network system may be more concerned with social welfare, while the enterprises focus on economic returns. Therefore, it poses new requirements for the current innovation networks and their governance mechanisms.

The concept of innovation networks originates from social network theory [1], consisting of systematic institutional arrangements and cooperative relations. The innovation network includes various science and innovation actors (enterprises, universities/research institutes, government, financial institutions, and intermediaries, etc.) that continuously learn and progress through social interaction. Simultaneously, they break through common technological barriers and thus enhance their independent innovation capabilities [2,3]. The interactive complementary characteristics of resources, structures, and functions among innovation agents give them great potential to combine and collaborate. Therefore, innovation networks effectively enhance innovation performance as a vehicle for cooperation among heterogeneous governmental, economic, and scientific organisations.

However, the innovation network composed of enterprises, universities/research institutes, governments, financial institutions, and intermediaries will inevitably hinder the improvement of innovation ability in the development process due to the inconsistency of goals between organisations and the relative fixity of their structure. As a relationship arrangement between various innovative entities with the inter-organisational institutional arrangement as the core, the governance of the innovation network plays an essential role in coordinating the relations between various innovative subjects and establishing inter-organisational ties.

As the Belt and Road Initiative continues to advance regional integration [4,5], linking China with Central Asia, Europe, the Middle East, and Africa [6,7], the core area of the Silk Road Economic Belt (specifically “Xinjiang, China”, hereinafter referred to as the “core area”) serves as the hub of scientific and technological exchanges and cooperation between China and Central Asian countries, and its independent innovation system in China, the core area of the Silk Road Economic Belt (specifically referred to as “Xinjiang, China”, hereinafter referred to as the “core area”), serves as the hub of scientific and technological exchanges and cooperation between China and Central Asian countries. The core area plays a significant role in China’s independent innovation system.

China’s independent innovation system is an innovation network system composed of public and private institutions. The innovation system is an institutional framework and social network composed of integrated innovation elements. It is also an institutional arrangement to improve the ability of independent innovation. China’s independent innovation system is a kind of innovation network. The core area has formed three clusters of industrial alliances, built seven offshore incubators, and landed twenty-two major innovation and entrepreneurship projects since 2018 in response to the national innovation-driven development strategy and the opportunity of the national construction of “Belt and Road Initiatives” (the data come from <https://baijiahao.baidu.com/s?id=1626951133955254302&wfr=spider&for=pc> (accessed on 15 February 2022)). The core area has become an essential spatial carrier for science and technology innovation in the western region and a convergence point for economic corridors. As a hub for science and technology exchanges and cooperation between China and Central Asian countries, its construction is essential in building a new pattern of international opening and collaboration with the West. Thus, as a critical innovation space carrier in the western region, the core area bears the crucial responsibility of demonstrating, leading, and driving regional science and innovation capabilities and reducing the gap in innovation capabilities between the developed regions on the mainland. However, the number of firm patents per 10,000 people in the western region has consistently ranked lower than other regions from 2014 to 2020, as shown in Figure 1.

The continuous low science and innovation capacity of the core area result from the following:

In practice, patents are closer to the commercial application of innovation and provide more comprehensive information on inventions and innovation in each region [8], so this paper applies the number of inventions granted per 10,000 people to demonstrate regional science and innovation performance. What reasons limit the development of the innovation network in the core area? What kind of network governance mechanism can

break the shackles of the moment? There are limited research papers covering the topic of the innovation network in the core area. This paper will apply the grounded theory method to investigate the development constraints faced by the innovation network in the core area, explore the governance mechanism to break through the corresponding constraints, and empirically test the network governance mechanism. Subsequently, we constructed a network governance mechanism to break through the limitations and improve the firm's innovation performance.

The grounded theory found that innovation development constraints and government management bottlenecks are the main challenges faced by the development of innovation networks in the core area. In contrast, network structure governance and network relation governance are essential ways to break through the current constraints and improve the firm's innovation performance. According to the empirical results, we found that network structure governance and network relation governance significantly positively impact the firm's innovation performance. Meanwhile, the market-led environment and government guidance both positively regulate the governance of the network structure and the collaborative governance of network relations and the firm's innovation performance. This study provides a powerful practical path for improving the innovation performance of enterprises in the core area. Moreover, it provides suggestions for China to achieve the innovation-driven development strategy of joining the ranks of innovative countries.

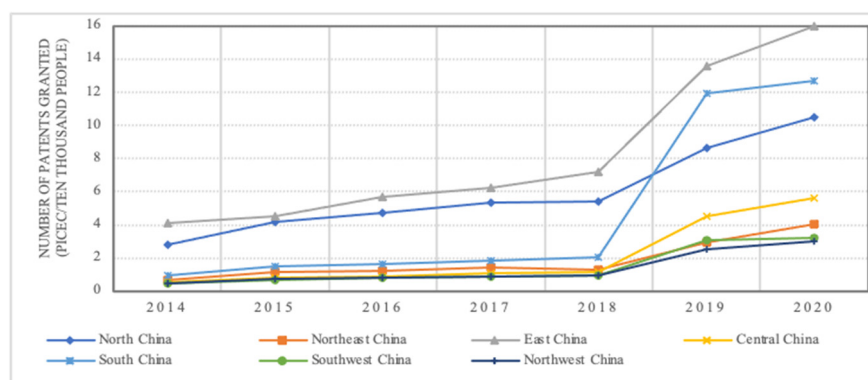


Figure 1. Comparison of regional science and innovation capacity data. Data source: China statistic Yearbook 2014–2021. <http://www.stats.gov.cn/tjsj/ndsj/2014-2021/indexch.htm> (accessed on 17 February 2022).

2. Literature Review and Research Pathways

An innovation network is an open, dynamic, and complex network system formed by high-tech enterprises, universities/research institutes, relevant government departments, and financial and intermediary service institutions in a specific region [9]. The key to network governance is to accurately sort out the formation mechanism of the innovation network and identify the science and innovation actors and their positioning to reveal the development constraints faced by the innovation network in the core area, as well as to explore the multi-subject governance mechanism suitable for the innovation network in the core area to improve the network governance level and break the current development constraints. Therefore, this paper will review three aspects: the formation mechanism of innovation networks, the subjects of innovation networks and their positioning, and the network governance mechanism.

2.1. Analysis of the Mechanism of the Formation of the Innovation Network

It should be noted that market-led and government policies jointly affect the formation of an innovation network.

2.1.1. The Market-Led Factors Include Resources, Returns, Risks, and Competition

Resource elements in the network are the key to determining innovation performance, and the innovation network is the primary channel to obtain external resources and knowledge. Specifically, innovation resources, such as science and innovation talents, science and innovation funds, science and innovation venues, science and innovation facilities, and information, are the basis for the collaborative creation of multiple subjects, and, the richer the resource base, the more conducive to enhancing innovation performance [10]. However, with the deepening division of labour in society, most innovation organisations only possess some of the critical resources to carry out innovation activities, making it difficult for a single organisation to carry out science and innovation activities today. At this stage, the large and diversified market-led environment for innovation has forced all science and innovation players to actively seek external organisations with heterogeneous innovation resources (e.g., heterogeneous knowledge, heterogeneous capabilities, etc.) for innovation cooperation [3]. Second, in terms of sharing innovation risks, in addition to the complexity, dynamism, and uncertainty of innovation activities [11], science and innovation actors also need to face the risk of low innovation efficiency [12]. The construction of innovation networks enables science and innovation actors to be linked together through various contractual mechanisms. Thus, achieving the construction of an innovation network can help all science and innovation players connect through different contractual means.

Therefore, this achieves risk-sharing and benefit-sharing, thus reducing the risks associated with science and innovation activities. The network centrality, structure holes, and density enable science and innovation actors to occupy core positions to obtain more diversified information [13]. The non-core positioned science and innovation actors can acquire heterogeneous knowledge through weak network relations to enhance organisational learning ability and innovation capacity [14].

2.1.2. Government Policy Guidance Factors

First, the government introduces policies to optimise the regional science and innovation environment and promote the formation of innovation networks. Specifically: complete infrastructure development helps to improve the cooperation between science and innovation actors and ensures the efficient operation of science and innovation activities by enriching the resource base required for science and innovation [15]; the business environment has a particular impact on the ability of enterprises to imitate and learn in sales and competition [16], which, in turn, promotes the policy environment and provides policy guarantees for cooperation among multiple subjects, guiding orderly collaboration between various science and innovation actors to form a mutual coexistence and symbiosis [17]; the business environment can attract more high-quality talent and science and innovation organisations, thus enriching the science and innovation resources in the region and thus promoting the formation of innovation networks. Secondly, the government has introduced policies and measures on the open sharing and guidance of science and technology devices, facilitating the formation of innovation networks. For instance: the State Council, the Ministry of Education, and the Ministry of Science and Technology have all issued policies and guidelines on the open sharing of large-scale scientific devices, requiring localities to establish specialised science and technology service organisations represented by science and innovation service platforms to provide strong support for the market transformation of various scientific and technological achievements.

2.2. The Governance Mechanism of Innovation Networks

The concept of governance originates from many control and coordination arrangements made by micro-enterprises to improve the efficiency of organisational operations. Therefore, it is generally considered that corporate governance is the first field to apply governance theory to management practice. The networked form of the innovation environment faced by companies today is becoming increasingly complex, and the factors affecting innovation are becoming more complex and diverse. In the face of complex and

various networked organisational models, corporate governance theory remains the basis for the continuous improvement of network governance systems.

The innovation network governance is crucial in coordinating and improving the allocation of resources for science and innovation. The object of innovation network governance is an innovation network organisation, which is an essential part of innovation network research. The innovation network governance has the following classifications: external governance and internal governance [18], network relation governance and network structure governance [19], classified governance and collaborative governance [20].

It is a relation arrangement among the participants, with institutional arrangements among science and innovation actors as the core [21], with the goal of collaborative cooperation and optimisation of resource elements, enhancing the organisation's adaptability to the external environment [19], unifying the action goals of each member so as to achieve collaborative and adaptive innovation, and thus consolidate transactional relations among participants and eventually reach a balance of interests, ultimately promoting innovation to achieve the goal of sustainable development [22]; the design of network governance mechanisms can effectively optimise the allocation of resources, maintain the overall efficacy of the network, its operational functions, the distribution of benefits among participating actors, and improve the efficiency of the market in innovation pilot zones. Thereby, the design of network governance mechanisms can effectively optimise the allocation of resources, maintain the overall efficacy of the network, its functioning, the distribution of benefits among participating actors, and improve the efficiency of the market in the innovation pilot area, thereby achieving collaborative innovation and shared value creation. Scholars have pointed out that network governance is an essential tool for balancing the relationship between democratic participation, efficiency and effectiveness in policymaking [23], encouraging public participation [24], and thus influencing the institutional landscape of policy formation and implementation [25]. As the promulgator and implementer of various science and innovation policies and innovation network governance, the government can influence the institutional landscape of policy formation and implementation by motivating subjects' participation. Social relations and credibility, among others, play an essential role in the cooperation between subjects within a network.

2.3. Research Gap Analysis

In summary, despite some differences in their research backgrounds, methodological approaches, and central research questions, scholars across related literature broadly discussed the following topics: (1) the meaning of innovation network governance and the innovation governance model [26,27]; (2) the role of innovation subjects in terms of innovation network governance [28]; and (3) the role of the innovation network governance mechanism on innovation performance and behaviour [29,30]. However, some research questions remained unanswered, which have drawn our attention: (1) the current research of scholars mainly focuses on the research of innovation networks in developed countries or regions and pays little attention to developing and underdeveloped regions. (2) In terms of research methods, the existing literature mainly applied qualitative analysis, such as case analysis without sufficient data. There is a lack of a combination of qualitative and quantitative analysis to enhance the preciseness of the research result. With the degradation of the innovation environment, the organisation model has become consistently complex, which raised new challenges for the innovation network governance. Meanwhile, the core area is underdeveloped compared to the developed area, the network infrastructure, resource endowment conditions, and location disadvantages, and it is difficult to learn from the relevant research conclusions of the innovation network and its governance mechanism in developed regions. The possible marginal contributions of this paper are as follows: (1) this study starts from both market and government perspectives and concludes the existing literature, exploring the formation mechanism of the innovation network. By doing this, we complement the research gap of innovation network formation. (2) This research applies grounded theory to sort out the development constraints of the innovation

network and its corresponding governance mechanisms in the core area. Therefore, we extend the application scenario of innovation network mechanisms in the underdeveloped area and provide the theoretical basis for enhancing the innovation capability of the core area. (3) The paper empirically tested the impact of network structure governance and network relationship governance on the firm's innovation performance in market-led and government guidance scenarios and supplemented the existing literature. The research path is shown in Figure 2.

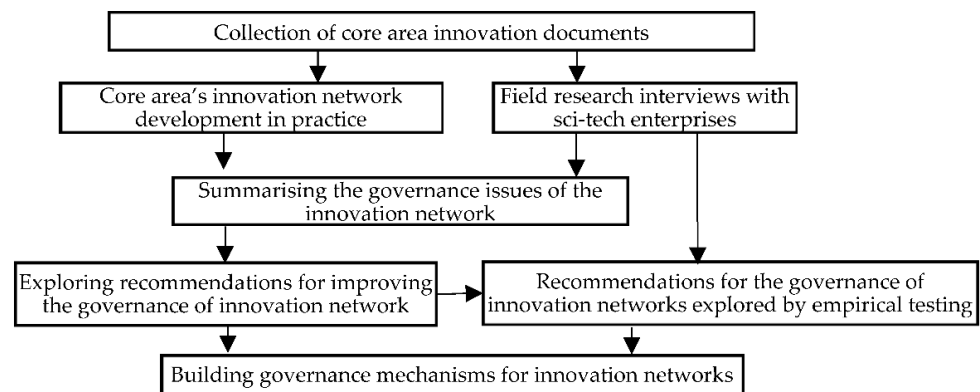


Figure 2. Research pathway.

3. Grounded Analysis of the Governance Mechanism of Innovation Networks

The current research on innovation networks' development constraints in the core area and their governance mechanisms is still in the exploratory stage.

The research on the development constraints and governance mechanisms faced by the innovation network in the core area is still in the exploratory stage. We collected the data through interviews and surveys combined with the grounded theory. We explore the development constraints by constructing the corresponding governance mechanism based on this adapted to the research of the theoretical exploration stage. Glaser and Strauss [31] first proposed the grounded theory, which is an essential tool in the management field. There are three schools of grounded theories: classical grounded theory, procedural grounded theory, and constructivism grounded theory. In this study, we applied procedural grounded theory (hereinafter grounded theory). Grounded theory is different from other research methods, and it is a continuous process of iteration, recursion, and interaction, which makes its research conclusions have a rigorous scientific nature. Therefore, grounded theory has unique advantages in defining core concepts, exploring the internal relationship between concepts, and forming a theoretical framework. The clarity and normativity of its research process make it highly operable, especially suitable for explaining management phenomena that are not clearly defined or difficult to identify and explain with existing theories. Grounded theory collects data around research questions through "open coding–spindle coding–selective coding". We collated and analysed it by a three-level coding program. Compared with positivism, the collection, collation, and analysis of grounded theoretical data is a continuous iterative process. The results produced by each step will be repeatedly compared and tested with the deepening of research to form a theory with a higher degree of match with the actual situation and then provide a corresponding theoretical basis for explaining the research problem. The development constraints faced by the innovation network in the core area explored by using interview surveys combined with the grounded theory research method are more applicable, and the network governance mechanism constructed is more scientific.

3.1. Selection of Material

3.1.1. Selection of Target Parks

The research object is the national industrial parks in the core area. Compared with the case of "park within a park" ("Park within a Park" is a small park that combines the same

type of enterprises in a national industrial park. For example, in the Urumqi High-tech Industrial Park, there are software parks, biomedical industrial parks, and innovative small and micro enterprise parks), the science and innovation actors in national parks are more abundant and conducive to enhancing the integrity and science of the analysis. We consider the availability of data and the representativeness of the park. This paper selects the scientific and technological innovation practices of the two most representative parks in “Five Places and Seven Parks” of the core area (as shown in Figure 3), namely “Urumqi High-tech Industrial Park” and “Urumqi Economic and Technological Development Zone”, as case studies. The two contribute the most to the development of the core area in terms of economic benefits and innovation capabilities compared with the other five parks in the core area. The case parks are described in Table 1.

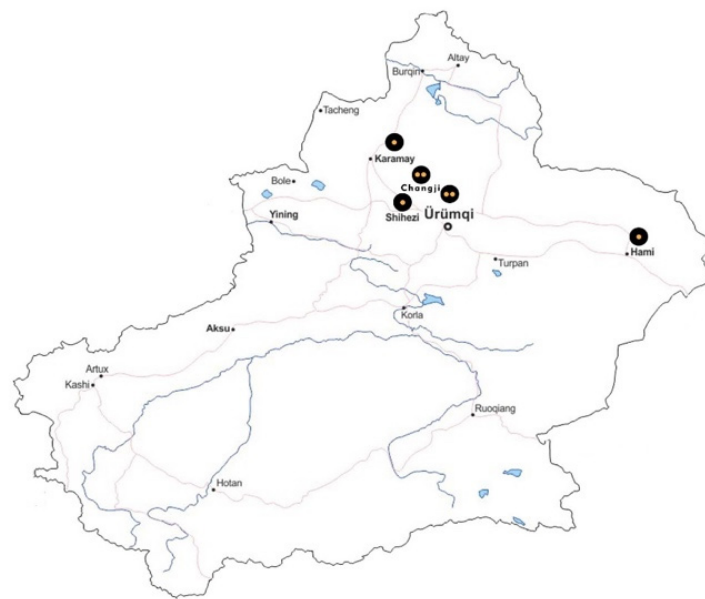


Figure 3. Map of “Five Places and Seven Parks”. Notes: black dots represent places; orange dots represent parks.

Table 1. Case park profile.

Park Name	Established Date	Park Features
High-tech Industrial Development Zone	August 1992	The new energy, new materials, equipment manufacturing, biomedicine, coal petrochemical, and modern service industries are the primary pillar industries of the high-tech zone and have taken shape. In recent years, the high-tech zone has been recognised as an international-level innovation base for science and technology, a high-tech industrialisation base for photovoltaic power generation equipment, a modern service industry industrialisation base, a new industrialisation demonstration base, and an e-commerce demonstration base, and it is the first national-level intellectual property pilot park in Xinjiang.
Economic and Technological Development Zone	August 1994	With advanced manufacturing and modern services as the primary pillar industries, the economic development zone has focused on developing the real industrial economy and has introduced and cultivated hundreds of vital industrial projects, such as Goldwind Technology, SAIC Volkswagen, and GAC Group. It has formed a relatively complete advanced manufacturing system supported by wind power equipment, automobile manufacturing, intelligent terminals, rail equipment, engineering, and agricultural machinery manufacturing, etc., filling several gaps in the manufacturing sector in the capital and even in the whole territory. The first passenger car, the first tunnel equipment, the first underground train, and the first intelligent terminal were all launched in the region.

Data source: www.uhdz.gov.cn (accessed on 1 March 2022), www.uetd.gov.cn (accessed on 1 March 2022).

3.1.2. Data Collection

Semi-structured interviews were conducted with various subjects within the innovation network of the targeted park to obtain primary data around this paper's research objectives and design, with a total research period of 2020–2022 and in-depth interviews ranging from 30 to 150 min. Firstly, we enhance the study's validity by reliable, complete, and representative secondary sources, including policy documents, which can provide a more systematic and comprehensive response. Secondly, master's thesis/journal literature, mainly selected from the domestic and international literature on innovation networks and their governance. Thirdly, official reports, including the official websites of high-tech and economic development zones, mainstream media reports on innovation efficiency and networks, etc. The research team conducted a review of the different sources. The research team triangulated the information from various sources to ensure the information's reliability and the study's scientific validity. The data collection was mainly dynamic, and, when we identified problems in the study, the data were collected again with a problem-oriented approach. The data analysis and collection were crossed. The details are shown in Table 2.

Table 2. Sources and content of information.

Data Type	Data Sources	Interview Data Content				
		Parks	Interviewees	Number of people	Duration (minutes)	Representative interview content
First-hand data	Interviews (semi-structured)	Economic and technological development zone	High technology enterprise (T1)	9	680	The status of role positioning, closeness to other nodes, and status of cooperation models; the status of innovative resource holdings, problems in each node, and measures to improve the status quo
			Government departments (G1)	2	155	Role positioning situation, network operation, problems at each node, measures to improve the situation
			Research institute (R)	4	170	Role positioning situation, network operation, problems at each node, measures to improve the situation
		High-tech industrial development zone	Colleges (C)	6	420	Role positioning situation, network operation, problems at each node, measures to improve the situation
			High-tech enterprises (T2)	11	775	Positioning of roles, closeness to other nodes, the status of innovative resource holdings
			Government departments (G2)	4	223	Role positioning situation, network operation, problems at each node, measures to improve the situation
		Expert scholar (E)	3	172	What factors contribute to the inefficiency of science and innovation in the core area? How can the core area be scientifically and creatively capable?	
Secondary data	Policy documents (P)	150 examples of relevant policy documents available on the core's official data site				
	Theoretical literature (L)	89 journal articles and master's theses through Web of Science and CNKI				
	Official website reports (M)	Access to data on the high-technology and economic development zone government websites and mainstream media in the core area				

Source: compiled by the author.

3.2. Grounded Theory and Analysis

A three-level procedural grounded theory coding procedure was applied to code the collected primary and secondary data with the support of Nvivo12 software (QSR International USA, Burlington, MA, USA). To ensure the reliability and validity of the coding, three professors in the social sciences led the postgraduate students to collate and code the data in a back-to-back manner. If disagreements arose during the coding process, two professors agreed first, and, if they could not be resolved, the third professor determined. After the data processing and coding process described above, the final coding results showed strong consistency. The data processing and coding procedures are included.

3.2.1. Open Coding

The research team led by the three professors was divided into three groups to carry out a back-to-back process of labelling, conceptualising, and categorising the interview data, policy documents, etc.

Following the open coding process steps to remove the duplicate, only once occurring and uncategorisable first-level codes while retaining two team-level principles as far as possible, resulting in 31 sub-categories. This is shown in Table 3.

Table 3. Open (associative) coding data structure.

Conceptualisation	Category	Main Category	Conceptualisation	Category	Main Category
Low investment	Insufficient resource allocation	Innovation development constraints	Role-modelling policy	Poor policy effect	Government management bottleneck
Insufficient talent investment			Lack of fault tolerance mechanism		
Financing difficulties			Imperfect technology trading rules		
Old equipment			Insufficient support for innovation coupons	Slow policy response	
Low investment enthusiasm	Lack of technical personnel	Innovation development constraints	Insufficient financial and tax support	Difficult policy implementation	Government management bottleneck
Low talent introduction rate			The long time limit for policy implementation		
Talent outflow			Lack of institution implementation		
Poor talent training effect			Lack of policy implementation		
Information asymmetry	Uncoordinated innovation chain	Innovation development constraints	Many similar enterprises	Serious homogenisation	Government management bottleneck
Lack of local cooperation partner			Lack of industrial chain complementation		
Imperfect cooperation mechanism			Lack of supporting services	Low industrial energy level	
Competition is larger than cooperation			Insufficient investment in production capacity		

Table 3. Cont.

Conceptualisation	Category	Main Category	Conceptualisation	Category	Main Category
Strengthen leading enterprises	Network position centrality		Multiparty collaborative innovation	Relation strength	
Leading enterprises			Multiparty cooperative transformation		
Multi-subject cooperation			Common technology breakthrough		
Information portal hub			Mutual trust of innovation subjects		
Multiparty direct connection	Network structure hole	Network structure governance mechanism	Innovative technology into the stake	Relational contract	Network relation governance mechanism
Multiparty transmission connection			Sharing innovation risks		
Information accumulation and sharing			Benefit-driven investment		
Network scale expansion			Sharing cooperation results		
Network cooperation frequency	Network density		Shared investment cost	Collaborative cooperation	
Network resource allocation			Innovation equipment sharing		
Network resource integration			Regional cooperation of innovation		
Quality competition	Competition response	Market-led	Follow news	Policy concern	Government guidance
Price competition			Focus on government documents		
Demand survey	Demand response		Mechanism reform	Policy response	
User feedback			Differentiated development		
Patent application	Innovation capability	Innovation vitality	New product sales revenue	Innovation efficiency	Innovation output
Patent authorisation			Number of new product development projects		
Patent conversion rate	Conversion efficiency		Industrial-scale	Industrial practice	
Patent transaction volume			Absorb employment		

3.2.2. Associative Coding

After open-ended coding, we obtained an array of conceptualisations and categorisations with operational definitions. We followed by an analysis of the relations and choruses between the categorisations to establish meaningful links.

In this process, we explore the intrinsic links between the categorisations. The intrinsic links between the categorisations are phenomenological according to the causal conditions, phenomena, chakras, strategies of action/interaction, and outcomes of the phenomena

analysed. The project team found an intrinsic logic between the 20 categorisations obtained in the open coding process of the primary axis coding. Ultimately, we summarised eight main categories. Based on the above analysis, we explained the categories in the grounded theory part. The definitions of the main categories are shown in Table 4.

Table 4. The definition of the main categories.

Main Category	Definition
Innovation and development constraints	Development constraints refer to the problems faced by the core area innovation network in the development process, such as insufficient resource allocation, lack of technical talents, and non-coordination of the innovation chain, forming the development constraints faced by the core area innovation network.
Bottlenecks in government management	The bottleneck of government management refers to the fact that, when the government supervises and manages the innovation network, it is affected by some subjective and objective factors, resulting in the difficulty and poor effect of the policies promulgated by the government. The slow response of the approach to the demand for innovation so that the government's management has reached a bottleneck in the current period.
Network structure governance mechanism	Network structure governance mechanism refers to the different network characteristics of the core area innovation network, such as "network structure hole, network density and network location centrality". The specific operation is to strengthen the park's leading enterprises and improve their network location's centrality. It supports establishing direct/indirect links between innovative entities to enrich the number of holes in the network structure. It fosters collaboration between innovations, increases collaboration frequency, and increases overall network density.
Network relations governance mechanism	Network relation governance refers to the collaborative governance of the relation characteristics of each innovative subject in the core area of the innovation network, such as "relation strength, relation contract and collaborative cooperation". The specific operation is that the park guides enterprises to carry out mutual innovation and equity investment to enhance the strength of the relation between enterprises. It guides enterprises to establish cooperation contracts for risk, benefit, and innovative facilities sharing to achieve synergy and cooperation between enterprises.
Market-led	Market orientation refers to the organisation of innovation activities by each innovation entity guided by market demand
Government guidance	Government guidance refers to the government guiding innovative activities through leading innovative organisations.
Innovative vitality	Innovation vitality refers to the innovation ability of each innovative entity, which is reflected in the patent application volume, transaction volume, and other indicators of each innovative entity.
Innovative output value	Innovation output value refers to the economic benefits generated by the innovative activities organised by each innovative entity.

3.2.3. Coding Categorisation Check

After the first round of open and spindle coding by the coding team, we obtained 134 labels and extracted 62 conceptualisations and 20 categorisations. We combined and discussed 20 conceptualisations at a conceptual level. We formed eight main categories by applying the paradigm model: innovation development constraints, government management bottlenecks, network structure governance, network relations governance, government guidance, market-led, innovation output, and innovation dynamism.

In the second round, we divided six judges into three groups and re-categorised 62 conceptualisations into eight main categories. In this process, we divided six researchers into three groups, three of whom were PhD students, two of whom were PhD supervisors, and one of whom was a university teacher in the same field of study working in a government department. The study result is more consistent with the second round of categorisation. Among the 62 conceptualisations, only four were categorised as having three completely different groups. Of the remaining 58 conceptualisations, 49 were classified as having three identical groups and were categorised directly. In contrast, the other nine had two identical groups and were categorised according to the “majority rule”.

We thoroughly discussed the four conceptualisations with completely different categorisation results. The external experts were consulted before the inconsistently categorised conceptualisations were assigned to their respective categories. After discussion and consultation, one of the four conceptualisations with completely different categorisations was attributed to government management bottlenecks. One belongs to network relation governance, innovation output, and network structure governance. The consistent results of the second round of categorisation are shown in Table 5.

Table 5. Summary of consistency in the second round of categorisation.

Categorisation	Summary of the Second Round of Independent Categorisation		Summary of Categorisation after Discussion and Adjustment	
	Number of Labels	Percentage	Number of Labels	Percentage
Completely different	4	6.45%	0	0.00%
Same for both groups	9	14.52%	11	17.74%
Exactly the same	49	79.03%	51	82.26%
Total	62	100%	62	100%

After detailed discussion, the final 62 conceptualisation labels were categorised as 12 for innovation development constraints, 12 for government management bottlenecks, 11 for network structure, 11 for network relations, 4 for market-led, 4 for government guidance, 4 for innovation output, and 4 for innovation dynamism. The categorisation results are shown in Table 6.

Table 6. Results of the second round of categorisation tests.

Main Category	Three Sets of Independent Categorisation Results	Categorisation after the Three Groups' Discussions
Innovation development constraints	12	12
Government management bottlenecks	11	12
Network structure governance	10	11
Network relation governance	10	11
Market-led	4	4
Government guidance	4	4
Innovative performance	3	4
Innovation capacity	4	4
Total	58	62

The third round of reliability analysis is essential to the content analysis process. By reliability analysis, we mean whether the categories and units of analysis resulting from the content analysis can be grouped into the same categories by different researchers and whether the conclusions obtained are consistent. Thus, reliability directly affects the results of content analysis. The content analysis must be subjected to a rigorous reliability analysis to improve accuracy, and the formula for calculating the reliability of content analysis is as follows.

$$\text{Reliability} = \frac{n * (\text{mutual agreement})}{1 + [(n - 1) * \text{mutual agreement}]}$$

where n = number of coding groups, mutual agreement = M/N , where M represents the number of consensuses, and N represents the total conceptualisation of the category. According to the reliability analysis Table 7 of coding and classification, the reliability is $\in [88.89\%, 100\%]$. In terms of the test standard of questionnaire reliability, all coding and classification reliability pass the reliability test.

Table 7. Reliability analysis of classification test.

Main Category	Total Entries	Number of Consensuses	Mutual Agreement	Reliability
Innovation and development constraints	12	9	75.00%	90.00%
Government management bottleneck	12	9	75.00%	90.00%
Network structure governance	11	10	90.91%	96.77%
Network relation governance	11	8	72.73%	88.89%
Market-led	4	3	75.00%	90.00%
Government guidance	4	4	100.00%	100.00%
Innovation performance	4	3	75.00%	90.00%
Innovation ability	4	3	75.00%	90.00%

3.2.4. Selective Coding

Through multiple rounds of in-depth comparative analysis of the eight main categories and repeated listening to the interview recordings, we clarified the storyline of grounded research. The government management bottlenecks, such as the lack of technical talents and insufficient resource allocation efficiency faced by the core area innovation network, such as the lack of technical personnel and inadequate resource allocation efficiency, and the slow response to policies and the difficulty of policy implementation, are the key factors hindering the improvement of the current core area science and technology innovation capability. The network relation governance and structure governance in the market-led and government-guided environment are effective measures to solve the current network development constraints and improve the firms' innovation vitality and innovation output. Through the above analysis, we finally formed the three core categories of innovation network development constraints, innovation network governance mechanism, and enterprise innovation performance, as shown in Figure 4.

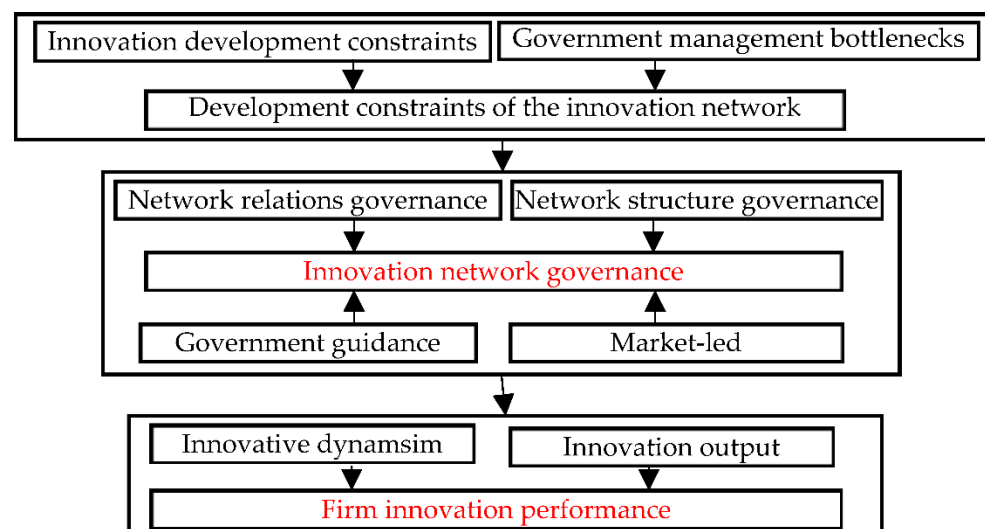


Figure 4. Schematic representation of selective coding results.

3.2.5. Theoretical Saturation Test

After completing the coding process, the project team applied the remaining 30% of the data material to test the results for theoretical saturation following the coding process described above. There are no new conceptualisations, new categories, or new dimensions that emerged during the test. Therefore, we consider the theory saturated.

4. Empirical Test of the Mechanism of the Role of Science and Innovation Performance

4.1. A Conceptual Model of Performance Governance Mechanisms in Science and Innovation

The establishment of independent innovation demonstration zones is conducive to the embedding of innovation networks, and network embedding is generally divided into structural embedding and relational embedding. When the innovation network is embedded, due to the constraints of innovation and development and the constraints of government management bottlenecks, it is necessary to govern the network to further enhance its role in promoting the firm's innovation performance. Combined with the above grounded analysis results and the existing literature, it can be seen that network structure governance affects the network capabilities of enterprises by improving the location centrality of core enterprise networks, increasing network density, and enriching network structure holes [32], thereby increasing the number of enterprises controlling and utilising resources [33,34], which, in turn, improves the firm's innovation performance.

Network relation governance, on the other hand, strengthens inter-organisational relations through the establishment of relation contracts to enable inter-organisational cooperation and constrain the behaviour of both parties, thereby safeguarding the legitimate rights and interests of both parties [35] so that their cooperation produces synergistic effects, thereby improving the firm's innovation performance. However, further testing is still needed. Therefore, this article proposes the assumption that:

Hypothesis 1. *Network structure governance is conducive to improving the firm's innovation performance.*

Hypothesis 2. *Network relation governance is conducive to improving the firm's innovation performance.*

According to the results of the grounded analysis, the core area innovation network faces the constraints of innovation and development by two parts: innovation and development constraints and government management bottlenecks. In the market-led innovation network environment, enterprises are attracted by huge market profits and will actively carry out innovative activities [36]; in order to achieve the success of innovation activities, enterprises increase their ability to control resources by improving the proximity of their network location, the number of structural holes in the network, and the strength of partners' relations [37], thereby strengthening the effectiveness of network structure governance and network relation governance. In the environment of the government-led innovation network, the government has changed the previous management mode, provided policy and financial support for enterprise innovation through policies and topics [38], guided enterprise innovation activities, and enhanced the innovation enthusiasm of enterprises; in order to reduce the risk of innovation activities, enterprises increase their ability to control resources by improving their network location near the centre, the number of structural holes in which they are located, and the strength of partners' relations, thus strengthening the effect of network structure governance and network relation governance. Based on the above analysis, this paper proposes Hypotheses 3a, 3b, 4a, and 4b:

Hypothesis 3a. *Market-led positively moderates the relation between network structure governance and firm innovation performance.*

Hypothesis 3b. Market-led positively moderates the relation between network relation governance and firm innovation performance.

Hypothesis 4a. Government guidance positively moderates the relation between network structure governance and firm innovation performance.

Hypothesis 4b. Government guidance positively moderates the relation between network structure governance and firm innovation performance.

The conceptual model is shown in Figure 5.

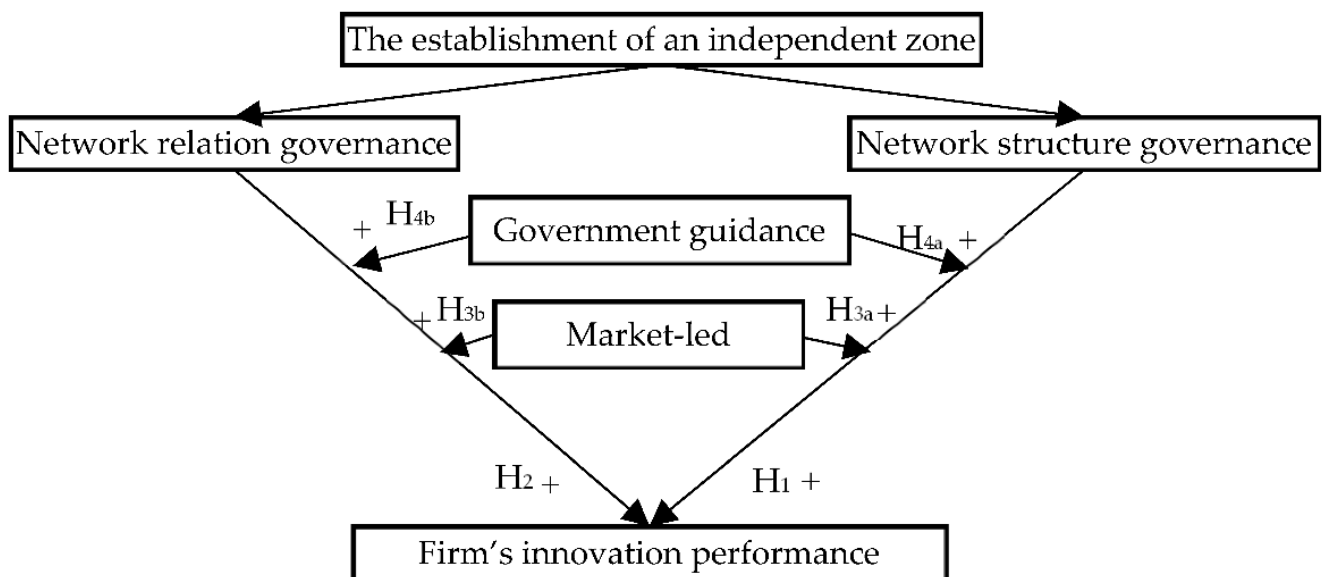


Figure 5. A conceptual model of the mechanisms at play in science and innovation performance.

4.2. Sample Selection and Data Collection

High-tech enterprises in the core area of “Five Places and Seven Parks” (specifically referring to seven industrial parks located in five places: Urumqi, Shihezi, Hami, Karamay, and Changji) were selected as the respondents for the surveys. This paper studies the enterprises in the core area in the five innovation networks. Study survey data are mainly obtained in two ways: firstly, the geographically close respondents were contacted by telephone/email and then visited on-site to conduct the survey research. Secondly, for respondents in a remote area, data were collected by electronic questionnaires through channels such as email and WeChat. We enhanced the questionnaire quality by providing explanations for each of the variables. The training was given to the survey distributors before the survey distribution so that they could effectively collect and address the feedback from the respondents.

The formal research period for the survey data collection lasted almost six months, from late October 2021 to mid-April 2022. A total of 412 questionnaires were distributed, of which 162 were distributed on-site and 154 were returned, resulting in 150 valid questionnaires; 250 electronic questionnaires were distributed via the internet and 245 were returned, resulting in 200 valid surveys. A total of 350 valid surveys were distributed, with a valid return rate of 84.95%. Further analysis of the industry distribution, regional distribution, and the nature of property rights of the research enterprises.

First, industry distribution: there were 381 firms in total, including 109 electronic information enterprises, accounting for 28.61%; 46 biomedical enterprises, accounting for 12.07%; 82 new energy enterprises, accounting for 21.52%; 76 intelligent equipment manufacturing enterprises, accounting for 19.95%; 53 new materials, 13.91%, and 15 other types of enterprises, accounting for 3.94%. Secondly, regional distribution. 32.39% of the

sample enterprises were located in Urumqi, 22.54% in Shihezi, 11.28% in Changji, 14.11% in Karamay, 14.11% in Hami, and 5.63% in other regions. Finally, in terms of ownership, 62.46% were privately owned; 15.49% were state-owned; 20.74% were joint ventures; and 1.41% were other types. It can be seen that the sample data are highly representative, and the basic statistics are shown in Table 8.

Table 8. Sample statistics.

Dimension	Sub-Indicators	Numbers	%
Regional distribution	Urumqi	123	32.39%
	Shihezi	86	22.54%
	Changji	43	11.28%
	Hami	54	14.11%
	Karamay	54	14.11%
	Other regions	21	5.63%
Nature of property	Private equity	238	62.46%
	State capital	59	15.49%
	Joint ventures	79	20.74%
	Others	5	1.41%
Industry distribution	Electronic information	109	28.61%
	Biomedical	46	12.07%
	New energy	82	21.52%
	Intelligent equipment manufacturing	76	19.95%
	New materials	53	13.91%
	Other types	15	3.94%
Firm size	1–99 people	56	14.70%
	100–499 people	144	37.8%
	500–999 people	97	25.46%
	1000+	84	22.04%

4.3. Variable Measurement

According to the results of the grounded analysis, the hypotheses are put forward in combination with the literature combing, and the questions measuring each variable are designed by drawing on the relevant literature, as shown in Table 9. This article sets the firm age and firm size as the control variables. Among them, the firm age = the year of the questionnaire distributed (2022)—the year of firm establishment; the size of the innovation body is measured by the number of employees and divided into four levels, of which 1 represents less than 100 people and 2 represents 100–499 people, while 3 represents 500–1000 people, and 4 represents more than 1000 people.

The measurement problems of the above variables are based on the existing research literature. The related questions are revised around the content of this paper's grounded analysis results and network governance, as well as the respondents' feedback in the questionnaire distribution process. In addition, to the control variables, the other variables were designed using the Linkert five-point scale, of which 1 expressed strong disagreement, 2 disagreed, 3 expressed neutrality, 4 expressed agreement, and 5 expressed full agreement.

Table 9. Variables and question items of the conceptual model of the mechanism of action of science and innovation performance.

Variable Type	Latent Variable	Measured Variables			Reference	
		Symbols	Name	Question Items		
Independent variable	Network relation governance	RG1	Relationship strength	We trust our key innovation partners.	Park & Bae (2004) [39], Zhou et al. (2010) [40], Manev & Stevenson (2001) [41]	
		RG2	Relationship contract	Our cooperation with our innovative partners is a win-win relationship.		
		RG3	Collaboration	Innovative partners share their knowledge to help other members find solutions to problems.		
	Network structure governance	SG1	Network structure hole	We act as a bridge/intermediary between innovative partners.		Bruyaka (2008) [42], Chuang et al. (2016) [43], Jackson et al. (2006) [44], Hippel & Krogh (2003) [45], Falci & McNeely (2009) [46]
		SG2	Network density	We have a high degree of aggregation among partners.		
		SG3	Network centrality	The knowledge/technology is shared between partners through us.		
Moderating variables	Market-led	ML1	Competitive response	We respond quickly to the actions of our competitors.	Narver & Slater (2004) [47], Li (2005) [48]	
		ML2	Demand response	Our functions all respond effectively to user needs.		
	Government guidance	GG1	Policy concerns	We pay close attention to the various policies issued by the government.		
		GG2	Policy response	We strictly enforce government policy.		
Dependent variable	Firm's innovation performance	INP1	Sci-tech Efficiency	We are often the first in the industry to introduce new products/services.	Bell (2005) [50], Thomas & Ritter (2004) [51]	
		INP2	Patent conversion rate	We are often the first in the industry to apply new technologies.		
		INP3	New product value	After product improvement, we earned high sales.		
		INP4	New technology output	Our products include state-of-the-art technology and techniques.		

4.4. Reliability and Validity Tests

We conducted the reliability and validity of the questionnaire, reliability analysis, and factor analysis of the following variables: Network structure governance, Network relation governance, market-led, government guidance, and firm's innovation performance (see Table 10), and the results showed that the KMO values of the variables (0.712, 0.921) met the requirement of greater than 0.700 critical value; Bartlett's sphere test.

Table 10. Results of reliability validity tests for variables.

Variables	Item	Load	KMO	Cronbach's α	AVE	CR
Network relation governance	RG1	0.785	0.712	0.709	0.657	0.793
	RG2	0.835				
	RG3	0.742				
Network structure governance	SG1	0.887	0.921	0.954	0.766	0.908
	SG2	0.859				
	SG3	0.880				
Market-led	ML1	0.772	0.798	0.773	0.610	0.824
	ML2	0.760				
	ML3	0.810				
Government guidance	GG1	0.850	0.718	0.741	0.568	0.839
	GG2	0.762				
Firm's innovation performance	INP1	0.749	0.740	0.709	0.626	0.869
	INP2	0.859				
	INP3	0.836				
	INP4	0.711				

The results are significantly different from 0, and it can be seen that the conditions of factor analysis are satisfied. The Cronbach's α coefficient of each variable is (0.709, 0.954); meanwhile, the combined reliability (CR) value of each variable is (0.793, 0.908), which meets the requirement of greater than or equal to 0.700, which indicates that the reliability level of this study is within the acceptable range. The factor loading values for each question item (0.711, 0.887), which met the criterion of greater than 0.500, indicated that the scale had a good convergence. The average extractive variance (AVE) values (0.568, 0.766), which met the requirement of being close to and more significant than the critical value of 0.500, indicated that the scale had significant discriminant validity. It can be seen that the scale used in this study passed with high validity and credibility.

4.5. Empirical Testing

4.5.1. Correlation Test

We applied SPSS 19.0 software (IBM, New York, NY, USA) to analyse the collected data. We showed the variance and Pearson correlation of the variables and the test results in Table 11. From the data in the table, the Pearson correlation coefficients between the variables are less than 0.6, which is in the acceptable range. This result shows no serious correlation between the independent, dependent, moderating, and control variables.

Table 11. Matrix of correlation coefficients for descriptive statistical variables.

Variables	Mean	Std.	NS	NR	MO	GO	INP	Age	Size
NS	23.72	4.64	1.000						
NR	21.44	2.27	0.392 ***	1.000					
MO	25.60	3.14	0.339 ***	0.584 ***	1.000				
GO	22.54	1.97	0.292 ***	0.326 ***	0.452 ***	1.000			
INP	20.52	2.55	0.384 ***	0.457 ***	0.558 ***	0.393 ***	1.000		
Age	15.43	11.78	−0.146	−0.161	−0.111	−0.289 ***	−0.176	1.000	
Size	2.55	0.996	−0.021	0.216	0.174	0.106	0.372 ***	0.221 **	1.000

Notes: ** represents $p < 0.05$, *** represents $p < 0.01$.

4.5.2. The Main Effect, Moderating Effect Test

The regression model is used to test the relationship between network structure governance, network relation governance, and enterprise innovation performance, as well as the results of market-led and government-led regulation effects, as shown in Table 12. Model 1 examines the impact of control variables on the innovation performance of enterprises. Model 2 examines the impact of network structure governance on the innovation performance of enterprises. Model 3 is to incorporate the interaction terms of network structure governance, market leadership, network structure governance, and market leadership into the model at the same time to test the market-led regulatory effect. Model 4 is to incorporate the interaction terms of network structure governance, government guidance, network structure governance, and government guidance into the model at the same time to test the regulatory effect of government guidance. Model 5 examines the impact of network relation governance on firm's innovation performance. Model 6 is to incorporate the interaction terms of network relation governance, market-led, network relation governance, and market-led into the model simultaneously to test the market-led regulatory effect. Model 7 is to simultaneously incorporate the interaction terms of network relation governance, government guidance, network relation governance, and government guidance into the model to test the moderating effect of government guidance. The results show that the D-W values of the variables in models 1–7 are close to 2, and the VIF values are lower than 3, indicating that the test results are not affected by the multicollinearity and autocorrelation of the variables. Models 2 and 5 verify that both network structure governance and network relation governance positively impact enterprise innovation performance at a significance level of 0.01, i.e., assume H1 and H2 are established. Model 3 verifies that market-led environment plays a positive role in regulating the relationship between network structure

governance and enterprise innovation performance at the significance level of 0.05. Model 4 verifies that government guidance positively moderates the relations between network structure governance and a firm's innovation performance at the significance level of 0.01. Model 6 verifies that market dominance positively moderates the relationship between network relation governance and a firm's innovation performance at the significance level of 0.1. Model 7 verifies that government guidance positively moderates network relation governance and a firm's innovation performance at a significance level of 0.1, i.e., assuming H3a, H3b, H4a, and H4b was established. In summary, the innovation network governance mechanism constructed in this paper can better help the innovation network in the core area to break through the current shackles and improve the firm's innovation performance.

Table 12. Results of hierarchical regression analysis.

Variables	Sci-Tech Network Performance						
	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7
Firm age	−0.124 **	−0.086 *	−0.008	−0.045	−0.081	−0.064	−0.043
Firm size	0.222 ***	0.208 ***	0.120 **	0.076	0.172 ***	0.151 ***	0.107 **
Network structure governance		0.190 ***	0.392 **	0.961 ***			
Network relations governance					0.468 ***	0.402 ***	0.928 ***
Market-led			−0.954 ***			−0.055	
Government guidance				0.549 ***			−0.222 *
Network structure governance * Market-led			0.136 **				
Network structure governance * Government guidance				0.160 ***			
Network relation governance * Market-led						0.020 *	
Network relation governance * Government guidance							0.022 *
R2	0.197	0.292	0.462	0.662	0.311	0.336	0.426
Adjusted R2	0.177	0.264	0.427	0.639	0.284	0.292	0.388
F-value	9.705	10.704	13.067	29.727	11.729	7.688	11.264

Notes: * represents $p < 0.1$, ** represents $p < 0.05$, *** represents $p < 0.01$.

5. Conclusions

As essential support for enhancing the science and technology innovation capacity in the core area, the innovation network is a crucial carrier for the core area to realise the innovation-driven development strategy. This paper analyses the innovation practices of innovation networks in the core area and explores the development constraints faced by the core area's innovation networks. It explores corresponding governance measures to build a network governance mechanism that breaks through the shackles and seeks an adequate development path for the core area's innovation networks. It also contributes to realising China's innovation-driven development strategy in the core area.

5.1. Research Conclusions

This paper firstly compares the formation mechanism of innovation networks. We applied grounded theory to analyse the development practice of innovation networks in the core area and found constraints faced by various subjects in the network. Then, we explored the innovation network governance mechanism to break through the shackles. We come to the following conclusions.

Firstly, the formation of an innovation network is jointly influenced by two main factors: on the one hand, the innovation network is influenced by the market-led environment, which directly contributes to the formation of innovation networks because of the market-led scenario for access to innovation resources and advantages, benefit-sharing, and risk-sharing among science and innovation actors in the network. On the other hand, it is influenced by government policies. The government has introduced policies to optimise

the regional innovation environment and a series of science and innovation policies to guide the formation of innovation networks.

Secondly, the study found that the constraints faced by the core area's innovation network are: the imperfect upstream and downstream supply chains of high-tech enterprises, the lack of science and innovation capabilities and the lack of science and innovation resources in universities/research institutes and their incomplete embedding in the innovation network, the low efficiency of government departments in formulating policies and implementing them, as well as their strong dominant power in the innovation network.

Lastly, based on the perspective of innovation network governance, combined with the suggestions given by each science and innovation actor and the empirical test results, we found that the construction of structure and relation governance mechanisms is an important way to break through the constraints of the firm's innovation performance in the core area at present.

5.2. Relation between Subjects of the Innovation Network after Governing

This is part of the ideal state of the core area innovation network after the governance of network structure and network relationship governance under market-led and government guidance.

Network structure and network relation governance optimise direct/indirect links between the various innovation network actors. Specifically, based on the role of the market mechanism, the government establishes laws, regulations, and codes of conduct for the behavioural choices of each innovation agent through top-level design. At the same time, when problems arise in the relation between the agents, the government intervenes to coordinate the relationship between them, thus ensuring the regular operation of the innovation network. In addition, the government has set up a venture capital department and cooperated with financial institutions to expand the pool of funds and collaborate with intermediaries to provide financial support to high-tech enterprises' scientific and technological activities, thus alleviating their external financing constraints. Universities/research institutes also play an essential role in the innovation network. On the one hand, universities/research institutes cultivate and provide high-quality human capital for the technological innovation of the innovation agents in the network.

On the other hand, universities/research institutes develop some high-quality basic scientific research results and original innovation results to support the basic effects of the innovation agents in the network. Financial institutions provide corresponding financial support and financing services for the science and innovation activities in the network. In addition, the supply chain financing services are capable of new technologies, linking multiple entities, such as enterprises, universities, and financial institutions, to realise the combination of industry and finance and jointly promote technological progress. As an essential part of the regional innovation network, intermediaries provide specialized services, such as technology assessment, innovation resource allocation, and management consultancy, to all the innovation agents in the network. As the most critical innovation agents in the innovation network, firms share the benefits with other innovation agents in the network and also provide a place for the talents trained by universities/research institutes to practice. In addition, firms conducting science and innovation enclaves share the benefits with the resident innovation network. The government restricts the fund to an ethical and legal framework, and the fund operates the entire innovation network based on the market-led environment. Then, the innovation network in the core area is gradually embedded in innovation society. The innovation network after optimization is shown in Figure 6.

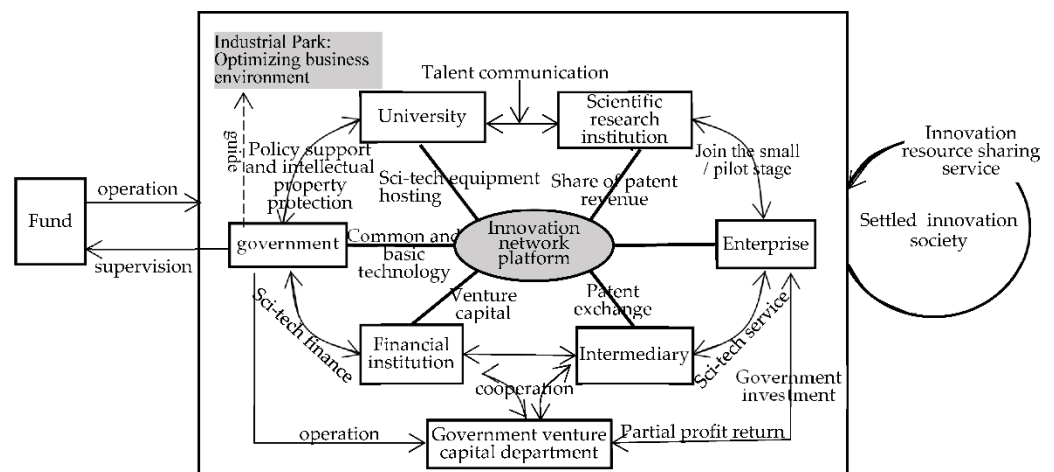


Figure 6. Relations between the subjects of the innovation network in the Silk Road Economic Belt core area.

5.3. Theoretical Insights

Firstly, scholars mainly focused on the group preferences [52], knowledge diffusion mechanism [53], internal independent mechanism [54], and other micro-level innovation network theories. Few pieces of literature discuss innovation network formation from a macro perspective. Therefore, the paper starts from a market and government perspective and is based on conclusions from the existing literature, and we explored the innovation network formation mechanism, which filled the research gap of innovation network formation.

Secondly, few papers focused on innovation network governance and mainly studied developed countries and/or developed regions' innovation network governance [55]. There is a lack of studies that focus on developing and underdeveloped innovation network governance. Therefore, this study takes the core area of the innovation network as the research subject and applies grounded theory to explore the shackles of the innovation network at present and corresponding innovation network governance. As such, we extended the application scenario of the innovation network governance mechanism in underdeveloped regions and provided the theoretical basis for enhancing the innovation capability of the core area.

Finally, although the existing literature has discussed the impact of innovation network structure governance or innovation network relation governance on the firm's innovation performance of under the mechanisms of trust [56], reputation, etc., the impact of network structure governance and network relation governance on the firm's innovation performance under the different orientations of the market/government has not been discussed. Therefore, through empirical analysis, we examine the impact of network structure governance and network relationship governance on the firm's innovation performance under the market-led scenario and government guidance and theoretically supplement the existing literature.

5.4. Management Insights

Firstly, the government should focus on developing leading enterprises through promulgating policies to enhance their networks' centrality, thereby promoting their leading role in small- and medium-sized enterprises. At the same time, the government should help the innovation entities in the core area of the innovation network to establish direct/indirect connections to enrich the number of structural holes in the network. Finally, it should also help promote cooperation between various innovative subjects, thereby increasing the frequency of collaboration and enriching innovation networks' density.

Secondly, the government should guide enterprises to strengthen the relationship between enterprises through cross-shareholding. At the same time, we will guide firms

to establish cooperation contracts for risk- and benefit-sharing and realize collaborative cooperation between enterprises through innovative facilities sharing. In addition, the park government should also re-identify its positioning, carry out the service-oriented transformation, and change from leading the affairs of the park to guiding the transformation to play the role of the market in the resource allocation of the core area innovation network.

Thirdly, enterprise innovation activity should respond to the market-led environment to the greatest extent. Still, due to the strong leading ability of the core district government to the innovation network and the particularity of its location, enterprises should actively respond to the government's call and maintain a good relationship with it. This not only helps to improve the political legitimacy of enterprises and the positive image of enterprises but also brings some indirect support to enterprises so that enterprises can obtain relevant information on changes in government innovation industry policies and innovation strategies on time to quickly carry out their innovation activities and maximize the use of policy preferences/opportunities provided by the government, thereby minimizing the unpredictability of risks.

5.5. Research Perspectives

Future research can enhance the field in the following aspects. Firstly, this study is mainly based on innovation development theory and network governance theory and is conducted using the grounded research method and empirical questionnaire method.

Future research should combine the qualitative research method with the dynamic simulation method. Secondly, innovation practices within the core area are in the process of continuous development and evolution. This study only taps into the development constraints the innovation network faces in the core area and explores governance measures to break through the shackles based on this. However, as time goes by, the development constraints faced by innovation networks in the core area may change, and the corresponding governance mechanisms may also change. Therefore, it requires further research investigation.

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