

Dear Editors and Reviewers:

We would like to thank *iCCPMCE2024* for giving us an opportunity to revise our manuscript.

We appreciate very much the editor and reviewers' insightful comments and suggestions. These comments are very helpful for us to revise the paper. We have carried out revisions on the manuscript in accordance to the comments.

The revisions and responses were addressed point by point below.

Thank you for considering our manuscript.

Kind regards,

Authors

Response to Reviewer #1:

General comments

The abstract reads well and falls within the conference themes. Please submit the full paper by 31 May via the Easy Chair submission.

Response:

Thank you for your valuable comments and suggestions.

Response to Reviewer #2:

General comments

The new quality productivity plays a crucial role in constructional sustainability development. this study innovatively outlined some macroscopic factors of an innovation network of new quality productivity in the construction industry, and quantified and explained their linkage mechanisms by using 2016 and 2020's patent data. Based on the rigorous analysis process, it was suggested to be accepted. Significantly, there are still some improvement requirements.

Comment 1:

Some formatting errors should be corrected, including the authors' names and the last inserted reference -the webpage link- in the first paragraph of 'METHODS' section.

Response:

Thank you for your kind comment, we have revised it.

Comment 2:

In the Methods section, it is suggested to use a table to outline the factors of the innovation network system (excluding the Proximity mechanism), including the reasons for their selection, quantification indicators, and reference literature. Additionally, the formulas for the four proximities should be also indicated the reference sources.

Response:

Thank you for your valuable comments. This table originally existed, but the conference paper template was only allowed to have 6 pages, so it was deleted. And there is no space to add. The formulas for the four proximities are cited in the revised manuscript, we have revised it.

(Template FullPaper_iCCPMCE2024 : “Full paper must be in the range of 4 to 6 pages long including tables, figures and list of references.”)

Comment 3:

You should present the reasons for choosing the data only Year 2016 and 2020 for comparison in the empirical study.

Response:

Thank you for your valuable comments. We have revised it. “The reason for choosing these two years is that the development of new quality productivity in the construction industry in 2016 has just started, and the new quality productivity in the construction industry in 2021 is rapidly spreading.”

Comment 4:

In the Results section, you did not analyze the research findings related to the last two factors of the innovation network: Industrial pattern and economic and social factors. Additionally, it is better to use visual figures rather than tables for comparisons here.

Response:

Thank you for your valuable advice. Firstly, on Industrial patterns and economic and social factors. These two points are less important than Proximities and Policy orientation, and generally belong to the control variables. Due to the 6-page limit, it

was deleted. Secondly, there was originally a picture here, but the length of the paper was only allowed to be 6 pages, so it was deleted. Tables provide more accurate numerical information than pictures.

(Template FullPaper_iCCPMCE2024 : “Full paper must be in the range of 4 to 6 pages long including tables, figures and list of references.”)

We have revised the manuscript to explain why Industrial patterns and economic and social factors were not analyzed. “Since Industrial pattern and Economic and social factors are mainly control variables, their analysis is mainly placed in the DISCUSSION section.”

Comment 5:

Grammatically, the research results should be described and discussed using the past tense. Additionally, the readability of the English text should be improved further.

Response:

Thank you for your important advice. We have made revisions to improve the readability of the paper.

Response to Reviewer #3:

General comments

This is an interesting study and plays a typical role in improving quality in construction. The study observes the link between the emergence of new qualitative productivity and the dynamic development of innovation networks.

The author needs to clarify and supplement Table 1 to further strengthen the results and conclusions of the study.

Response:

Thank you for your valuable comments and suggestions. We have further strengthened the results and conclusions of the study. Due to the 6-page limit of the paper, some details could not be elaborated, but we tried our best to strengthen the results and conclusions.

(Template FullPaper_iCCPMCE2024 : “Full paper must be in the range of 4 to 6 pages long including tables, figures and list of references.”)

Regional Innovation Networks in Construction Industry and Its Mechanisms: Facing the Formation of New Quality Productivity

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Abstract

The new quality productivity in the construction industry includes construction robots, Human-Machine/Computer Interfaces, new energy construction machinery, etc., which can promote the green and high-quality development of the construction industry. The process of technological innovation in the formation of new quality productivity is highly complex, requiring industrial innovation actors to dynamically respond to various factors in the industry and deeply integrated themselves into the regional innovation network. Based on patent data, this study constructs an innovation network of new quality productivity in the construction industry, using the dynamic capability theory to explain the linkage mechanisms of the innovation network. The negative binomial regression is used for empirical analysis. The results show that: (1) Geographical proximity and institutional proximity always promote cooperative innovation, and the significance of industrial proximity and technological proximity fluctuates. (2) The effect of policy support is relatively significant, while the effect of environmental policy is not significant. (3) The two regions with strong industrial innovation ability tend to collaborate. (4) Social and economic factors all have a certain influence in a certain period of time. This study has implications for regional construction innovation and the formation of new quality productivity.

Keywords: New quality productivity; Regional industrial innovation network; Construction industry; Dynamic capabilities; Industry life cycle

1 INTRODUCTION

In the construction industry, the emergence of new quality productivity is characterized by the integration of construction robots, Human-Machine/Computer Interfaces (HMCIs), and new energy construction machinery, among others. These advancements are instrumental in fostering environmentally sustainable and high-quality growth within the sector. The underpinning technological innovations are inherently complex, necessitating a departure from the conventional closed and linear innovation models that no longer suffice for the demands of groundbreaking technological progress. Innovative entities within the industry confront significant challenges when attempting to achieve their innovation objectives solely through internal resources. The construction industry's innovation networks are intricately linked to its life cycle dynamics (Ani et al., 2020). Technological innovation serves as both the driving force and the catalyst for the industry's growth and renewal. While the journey from research and development to large-scale commercialization is fraught with challenges for emerging technologies, successful breakthroughs can precipitate transformative changes within the industrial system. Concurrently, as the industry matures, a continuous influx of novel innovation agents and resources into the cooperative network occurs, evolving the dynamics of collaborative efforts. Aligned with the tenets of the dynamic capability theory, innovation actors are perpetually recalibrating their processes, positioning, and strategic pathways at various junctures of the industry's life cycle to gain and maintain a competitive edge. Such adjustments are instrumental in propelling the evolution of regional network interlinking mechanisms. This research delves into the mechanisms underpinning the emergence of innovation networks that enhance new quality productivity within the construction sector, thereby fostering sustainable and

high-quality industry development.

The formation of new quality productivity in the construction industry is inextricably linked to the evolution of regional innovation networks, a subject that has garnered substantial attention in the literature. Prior research has introduced models such as the ‘local buzzer-global pipeline’ and the ‘stimulus-response’ model to elucidate the nuances of regional innovation cooperation (Bathelt, 2007, Mao et al., 2023). These studies underscore the multifaceted nature of inter-regional collaborative innovation, which is subject to a myriad of influences (Santamaría et al., 2021, D’Este et al., 2012). Balland et al. (2014) identified proximity factors, particularly geographical proximity, as pivotal in fostering regional cooperation. Villani et al. (2017), in their analysis of an innovation network, revealed that a city’s resource endowment heterogeneity and multidimensional proximity significantly influence network optimality. The recognition of the complex dynamic factors affecting innovation cooperation has led to investigations into the stages of innovation network evolution, with Grimm and Walz (2024) noting that proximity mechanisms exert varying influence at different evolutionary stages. However, there is a gap in the literature regarding the interplay between the industry life cycle and technical cooperation, a correlation that is often overlooked (Yuan and Li, 2021).

From the vantage point of dynamic capabilities, the innovation network's link mechanism within the construction industry is expected to undergo significant changes during the formation of new productivity. The traditional proximity mechanism faces challenges as innovation entities strive to transcend geographical, institutional, technological, and competitive barriers in their quest for innovation. This shift has led to an increase in cross-regional cooperation. Position reconstruction is also a key aspect, where policy orientation changes and industrial pattern shifts prompt local and foreign enterprises with strong innovation capabilities to drive changes within the industry. As industrial growth spurs technological development demands, innovation subjects become more attuned to economic and social factor fluctuations, leveraging regional resource endowments and seizing opportunities for cooperation (Lei et al., 2022). This dynamic interplay is crucial for understanding the mechanisms that underpin the formation of new quality productivity in the construction industry.

2 METHODS

Innovation networks within the construction industry are predominantly founded on patent data, encompassing comprehensive patent information and collaborative patent data. The prevalent strategies for acquiring patents in this sector involve keyword searches and searches based on International Patent Classification (IPC) codes. In the context of this research, the patent count pertaining to new quality productivity in the construction industry across 60 Chinese cities was ascertained through keyword-based searches. The keywords utilized were targeted towards construction robots, Human-Machine/Computer Interfaces (HMCIs), new energy construction machinery, and similar innovations. The patent data were sourced from the incoPat database, an extensive and reliable global patent repository.

For the purposes of this study, a focus is placed on geographical, institutional, technological, and industrial proximities, which are deemed more appropriate for macro-regional research endeavors. Geographical proximity (Ren et al., 2024) is measured as follows:

$$\text{Geoproximity} = 1 - \ln (d_{ij}/\max d_{ij}) \quad (1)$$

d_{ij} is the distance between the geometric centers of city i and city j , $\max d_{ij}$ is the maximum distance of all cities. Institutional proximity (Marchesani et al., 2023) is measured as follows:

$$\text{Insproximity} = \begin{cases} 3 & \text{Both cities } i \text{ and } j \text{ are sub - provincial cities} \\ 1 & \text{City } i \text{ or City } j \text{ is a sub - provincial city} \\ 0 & \text{Neither City } i \text{ nor City } j \text{ are sub - provincial cities} \end{cases} \quad (2)$$

Technology proximity (Ren et al., 2024) is measured by the Jaff index:

$$\text{Tecproximity} = \frac{\sum_{m=1}^8 (PAT_{im} + PAT_{jm})}{\sqrt{\sum_{m=1}^8 PAT_{im}^2} \sqrt{\sum_{m=1}^8 PAT_{jm}^2}} \quad (3)$$

Where, PAT_{im} and PAT_{jm} represent the total number of patent applications in the m (8 in total)

patent categories of city i and city j , respectively.

Industrial proximity (Feng et al., 2022) is measured by the similarity of the proportion of each part of the industry:

$$Indproximity = \frac{\sum_{k=1}^n (s_{ik} + s_{jk})}{\sqrt{\sum_{k=1}^n s_{ik}^2} \sqrt{\sum_{k=1}^n s_{jk}^2}} \quad (4)$$

Where, s_{ik} and s_{jk} respectively represent the proportion of the output value of the k th industry in the three industries of city i and city j in the current year to the gross urban product.

To capture the intensity of policy support, this study utilizes the count of newly registered enterprises within the regional construction industry chain (Cattaneo et al., 2022). Moreover, considering the construction industry's frequent inclusion in green development initiatives by governments at various levels and its significant exposure to environmental policies, the emission of pollutants serves as a standard metric for gauging the impact of environmental policies (Ren et al., 2024). Accordingly, this research adopts the measure of industrial sulfur dioxide emissions per unit of industrial output value. In the realm of industrial patterns, the construction industry's innovation capacity in each city is gauged by the total number of patent applications, a metric widely recognized in the field (Feng et al., 2022). Additionally, recognizing that foreign enterprises can disrupt the industrial structure, the number of newly established foreign-funded enterprises is used as an indicator to measure the competitive impact of foreign enterprises, directly reflecting the regional market's openness to foreign businesses and investments. Economic and social factors are also critical in shaping the landscape of regional innovation. The vibrancy of the regional consumer market, indicative of economic activity levels conducive to innovation, is assessed through the lens of total retail sales of consumer goods (Zhang et al., 2023). Social governance, reflecting the societal investment in public governance, is seen as a contributor to a favorable environment for cooperative innovation, and is quantified by expenditures from the general budget of local finance (Lei et al., 2022). Furthermore, regional science and technology funding, which mirrors the region's commitment to and support for innovation, is crucial for nurturing innovation networks and is measured by research funding expenditure (Marchesani et al., 2023). To encapsulate the independent variable as the inter-city relationship, the literature addresses influence indicators beyond the proximity mechanism from two distinct vantage points: one is the total city connection perspective, which posits that city connections stem from the data magnitude of each indicator between two cities (Zhou et al., 2021); the other is the urban similarity connection view, which suggests that urban connections arise from the similarities and differences between cities (Zhang et al., 2023). This study will concurrently consider both perspectives, employing the following calculation methods:

$$Connection_{total} = \ln (X_i + X_j) \quad (5)$$

$$Connection_{similarity} = \frac{2 \cdot \min (X_i, X_j)}{(X_i + X_j)} \quad (6)$$

Where, X_i and X_j represent the influence indicators of city i and city j . $Connection_{total}$ is the sum of an index of two cities, and $Connection_{similarity}$ measures the similarity of an index of two cities. The value range is (0,1), the larger the similarity is. Within the scope of independent variables, the counts of newly established enterprises in the construction sector and the entities with foreign investment are extracted from the annual query outcomes available on the enterprise verification platform (www.qcc.com). The remaining data sets are sourced from the respective yearly editions of the Chinese Urban Statistical Yearbook.

3 RESULTS

This study pinpointed the years 2016 and 2021 as critical junctures in the emergence of new quality productivity within the construction industry and conducted a detailed comparative analysis of the link mechanisms operative during these periods. The reason for choosing these two years is that the development of new quality productivity in the construction industry in 2016 has just started, and

the new quality productivity in the construction industry in 2021 is rapidly spreading. To bolster the empirical robustness, the study initiated a regression analysis focusing on the proximity mechanism, policy orientation, and industrial patterns, which are intimately linked to innovation collaboration, followed by the incorporation of a more comprehensive array of economic and societal variables. Table 1 delineates the empirical findings pertaining to the innovation network link mechanisms within the construction industry for the years 2021 and 2016. With respect to proximity, the data from 2021 reveal that, akin to 2016, both geographical and institutional proximities continued to significantly foster innovation collaboration. This trend underscores that cities are inclined to maintain cooperative efforts with adjacent cities and those at analogous administrative strata. Such a pattern indicates a limited dynamic responsiveness of innovation entities to inherently persistent environmental factors, such as geographical separation and systemic regional attributes. Concurrently, there was a notable shift in the impact of technological and industrial proximities on innovation cooperation—technological proximity's significance in hindering cooperation escalates, while that of industrial proximity diminished. This could be ascribed to the constrained market space, where the advantages derived from segmented technological advancements are curtailed, thus rendering innovation collaboration predominantly aligned with overarching regional industrial development strategies. Regarding policy orientation, the empirical evidence indicated a discernible shift in 2021. When analyzed from both the total volume and similarity perspectives, environmental policies transitioned from a state of insignificance to a position of promoting innovation cooperation at the 0.1 significance level. Conversely, their role evolved from a significant inhibitor to one of irrelevance when considering the similarity perspective. This transformation suggests that while macro-environmental policies may play a role in facilitating the transition from traditional to new quality productivity, they concurrently imposed compliance costs on innovation entities. Consequently, these entities may prioritize regional cooperation that is distinct from stringent environmental regulations and seeks to circumvent green costs. Moreover, once a certain threshold was surpassed, the policy dividends accrued by the industry appeared to offset the costs associated with adhering to policy standards, thereby diminishing the industry's sensitivity to environmental policy considerations. Since Industrial pattern and Economic and social factors are mainly control variables, their analysis is mainly placed in the DISCUSSION AND CONCLUSIONS section.

Table 1. Comparison of regression results of innovation network link mechanism

Linkage mechanism	Total perspective		Similar perspective		
	Year 2016	Year 2021	Year 2016	Year 2021	
Proximity mechanism	Geographical proximity	1.684*** (12.17)	1.932*** (7.81)	1.492*** (11.65)	1.733*** (7.43)
	Institutional proximity	0.741*** (5.75)	0.518** (2.74)	0.613*** (8.51)	0.425*** (6.81)
	Technological proximity	-0.864* (-1.77)	-0.086 (-0.13)	-1.207** (-2.18)	-0.871* (-1.90)
	Industrial proximity	-1.116* (-1.79)	-2.143* (-1.82)	-0.162 (-0.11)	-4.257*** (-3.15)
	Policy support	1.721* (1.71)	0.133 (0.70)	0.354*** (3.28)	-0.162 (-0.17)
	Environmental policy	0.053 (0.34)	0.241 (0.68)	-0.133 (-1.17)	-0.815*** (-2.76)
Industrial pattern	Innovation ability	0.544*** (3.52)	1.155*** (2.87)	-0.461 (-1.51)	1.587 (1.14)
	Foreign companies	-0.053 (0.571)	0.648 (1.52)	-0.014 (-0.09)	-1.31 (-1.07)
Economic and social factors	Economic activity	0.467* (1.80)	0.232 (0.89)	-0.114 (-0.34)	1.185 (1.56)
	Social governance	-0.514*** (-3.74)	-2.012*** (-4.14)	-1.157** (-2.15)	-2.307*** (-4.68)
	Science fund	0.113 (0.47)	0.314 (0.97)	0.655*** (3.17)	-0.008 (-0.02)

Intercept	-12.191*** (-8.65)	-13.759*** (-9.32)	-0.253 (-0.07)	9.112*** (2.99)
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Note: 1) *, **, *** means passing 10%, 5%, 1% significance level test respectively; 2) Values in parentheses are Z-values.

4 DISCUSSION AND CONCLUSIONS

Drawing from the aforementioned investigation, it is evident that the construction industry's innovation network link mechanism has experienced significant transformation. This observation substantiates the connection between the emergence of new quality productivity and the dynamic evolution of the innovation network, as posited by the dynamic capability theory underpinning this study's framework.

First, examining the process of change, it is apparent that the proximity mechanism continues to exert a significant influence. Notably, the suppressive impacts of industrial and technological proximity are observed to diminish and intensify, respectively. This phenomenon, which has been corroborated by multiple studies, can be ascribed to the complementary demands of local protectionist tendencies and the technological (industrial) structural configurations (Zhao et al., 2024, Broekel and Boschma, 2011). This research further discerns a sequential pattern between these two effects, with the burgeoning demand for technological expansion invigorating the influence of technological proximity (Ben Letaifa and Rabeau, 2013), while the advent of industrial convergence mitigates the impact of industrial proximity.

Second, from the perspective of potential reconstruction, the analysis of the industrial pattern indicates that regions with robust industrial innovation capabilities are more prone to engage in "strong-strong" collaborations. This outcome further substantiates the preferential linkage mechanism observed within regional innovation networks (Caragliu and Nijkamp, 2015), and also elucidates the prevalence of patent cooperation primarily between pivotal cities in China. Moreover, the study observes a constrained impact from the activities of foreign companies, corroborating the notion that China's construction industry has been progressively achieving a position of technological leadership, with core technology areas largely under domestic control (Ahmad and Hall, 2017). Regarding policy orientation, the catalytic effect of policy support becomes markedly significant following a critical transition point, while the influence of environmental policies wanes progressively. This finding aligns with existing research, which suggests that policy tools are dynamically adjusted in accordance with industrial development. The impact of macro-environmental policies is diminished by the benefits derived from industrial growth, whereas enabling policies that promote technology dissemination predominantly exert their influence during the construction industry's transition phase post-2018.

Third, considering the creation of innovative pathways, economic and social factors exert variable influences over specific temporal intervals, with their effects displaying a lack of consistency and undergoing shifts in significance over time. These oscillations may be ascribed to the dynamic strategic selections made by enterprises and the occurrence of 'industrial shocks' (Chen et al., 2022). It becomes imperative for governing bodies to implement tailored measures to foster a stable environment for regional collaborative innovation efforts. Such actions are essential in safeguarding the cooperative innovation processes that are instrumental in catalyzing the emergence of new quality productivity.

REFERENCES

- AHMAD, M. & HALL, S. G. 2017. Economic growth and convergence: Do institutional proximity and spillovers matter? *Journal of Policy Modeling*, 39, 1065-1085.
- ANI, M., JENNIFER, K., FABIAN, L., VASANTH, K., MUNTEANU, V., ALEXANDER SCHMIDT, J. & BLEISCHWITZ, R. 2020. Integrated Urban Mobility Policies in Metropolitan Areas: A System Dynamics Approach for the Rhine-Ruhr metropolitan region in Germany. *Sustain Cities Soc*, 102358.
- BALLAND, P.-A., BOSCHMA, R. & FRENKEN, K. 2014. Proximity and Innovation: From Statics to Dynamics. *Regional Studies*, 49, 907-920.

- BATHELT, H. 2007. Buzz-and-Pipeline Dynamics: Towards a Knowledge-Based Multiplier Model of Clusters. *Geography Compass*, 1, 1282-1298.
- BEN LETAIFA, S. & RABEAU, Y. 2013. Too close to collaborate? How geographic proximity could impede entrepreneurship and innovation. *Journal of Business Research*, 66, 2071-2078.
- BROEKEL, T. & BOSCHMA, R. 2011. Knowledge networks in the Dutch aviation industry: the proximity paradox. *Journal of Economic Geography*, 12, 409-433.
- CARAGLIU, A. & NIJKAMP, P. 2015. Space and knowledge spillovers in European regions: the impact of different forms of proximity on spatial knowledge diffusion. *Journal of Economic Geography*, 16, 749-774.
- CATTANEO, A., ADUKIA, A., BROWN, D. L., CHRISTIAENSEN, L., EVANS, D. K., HAAKENSTAD, A., MCMENOMY, T., PARTRIDGE, M., VAZ, S. & WEISS, D. J. 2022. Economic and social development along the urban–rural continuum: New opportunities to inform policy. *World Development*, 157.
- CHEN, Y., NI, L. & LIU, K. 2022. Innovation efficiency and technology heterogeneity within China's new energy vehicle industry: A two-stage NSBM approach embedded in a three-hierarchy meta-frontier framework. *Energy Policy*, 161.
- D'ESTE, P., GUY, F. & IAMMARINO, S. 2012. Shaping the formation of university-industry research collaborations: what type of proximity does really matter? *Journal of Economic Geography*, 13, 537-558.
- FENG, Z. J., CAI, H. C., CHEN, Z. N. & ZHOU, W. 2022. Influence of an interurban innovation network on the innovation capacity of China: A multiplex network perspective. *Technological Forecasting and Social Change*, 180.
- GRIMM, A. & WALZ, R. 2024. Current and future roles of the automotive and ICT sectoral systems in autonomous driving - Using the innovation system approach to assess value chain transformation. *Technological Forecasting and Social Change*, 198, 122990.
- LEI, W., JIAO, L., XU, Z., XU, G., ZHOU, Z. & LUO, X. 2022. Effects of local, network and systemic dependence on urban development. *Sustainable Cities and Society*, 86.
- MAO, B., GU, J. & LU, Q. 2023. A pipeline for urban knowledge spillover: Based on the internal linkage of cross-regional multilocation enterprises. *Cities*, 143, 104585.
- MARCHESANI, F., MASCIARELLI, F. & BIKFALVI, A. 2023. Smart city as a hub for talent and innovative companies: Exploring the (dis) advantages of digital technology implementation in cities. *Technological Forecasting and Social Change*, 193, 122636.
- REN, M., ZHOU, T. & WANG, C. 2024. New energy vehicle innovation network, innovation resources agglomeration externalities and energy efficiency: Navigating industry chain innovation. *Technological Forecasting and Social Change*, 200.
- SANTAMARÍA, L., NIETO, M. J. & RODRÍGUEZ, A. 2021. Failed and successful innovations: The role of geographic proximity and international diversity of partners in technological collaboration. *Technological Forecasting and Social Change*, 166, 120575.
- VILLANI, E., RASMUSSEN, E. & GRIMALDI, R. 2017. How intermediary organizations facilitate university–industry technology transfer: A proximity approach. *Technological Forecasting and Social Change*, 114, 86-102.
- YUAN, X. & LI, X. 2021. Mapping the technology diffusion of battery electric vehicle based on patent analysis: A perspective of global innovation systems. *Energy*, 222.
- ZHANG, Y., WANG, T., REN, C., WANG, L., ZHANG, K. & SONG, R. 2023. Heterogeneous impacts and spillover effects of green innovation network and environmental regulation on water use efficiency: A spatiotemporal perspective from 269 cities in China. *Sustainable Cities and Society*, 90.
- ZHAO, S., WANG, J., JI, J. & VINCENT EKOW, A. 2024. Proximity or alienation? Can knowledge type influence the relationship between proximity and enterprise innovation performance? *Technological Forecasting and Social Change*, 202, 123314.
- ZHOU, R., QIU, Y. & HU, Y. 2021. Characteristics, Evolution and Mechanism of Inter-city Innovation Network in China: From a Perspective of Multi-dimensional Proximity. *Economic Geography*, 41.