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Research Article

A Method for Enterprise Network Innovation Performance Management Based on Deep Learning and Internet of Things

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In the Internet era, traditional performance management has failed to satisfy the modern enterprise development; therefore, enterprises must achieve timely innovation and improvement of performance management. The application of performance management in state-owned firms promotes employee motivation and skill development, as well as the development of innovative thinking. Performance effect, therefore, on the role of management in the state-owned enterprise development is bigger, especially because of the influence of traditional human resources performance management mode. The further development of state-owned enterprise resource management work affected the operation and management of state-owned enterprises. Therefore, state-owned enterprises must further optimize the path of performance management, to achieve its fine development. In view of this, this paper deeply analyzes the problems existing in the current performance management of state-owned enterprises and puts forward optimization methods for the problems, aiming at providing help for the optimization of the performance management of state-owned enterprises. In essence, a value network is a value symbiosis system between firms that involves resource sharing, value cocreation, risk sharing, and benefit win-win situations. The formation and development of value network not only extremely change the industrial structure and mode of production, but also have an important impact on enterprise innovation mechanism. Enterprise innovation under the value network system has become the focus of academic and business circles. With the rapid development of machine learning and internet of things (IOT) technologies, as well as China's urbanization, China's agriculture is embracing new development opportunities. Using artificial intelligence (AI) technology to effectively mine agricultural big data and realize effective control and management of intelligent agriculture has become a research hotspot and difficulty. Based on recurrent neural network (RNN) and IOT technology, this paper proposes an enterprise network innovation performance management path optimization system.

1. Introduction

With the continuous and in-depth application of the internet model in enterprises, it has brought a huge impact on the whole development of enterprises, making the market competition pressure become huge, and judging the market situation becomes gradually difficult. Nowadays, no enterprise dares to blindly carry out enterprise expansion and market invasion. For the continuous development of internet enterprises, the most important thing is to maintain the health of enterprises. Business should pay more attention to the overall quality and ability of internal employees in the management of internal performance, rather than only caring about the size of enterprises. In the internet era, enterprises will gradually incorporate internet technology (IT) into their performance management to help enterprises improve in all aspects.

In today's internet era, enterprises pay more attention to the common development and assessment of employees' personal ability and comprehensive ability. Such assessment system is conducive to enterprises' comprehensive assessment management of employees. At the same time, use the internet to make the employee performance management and appraisal break through the limitation of many factors, such as the examination for the staff in data entry, related statistics, and computation by the computer; at the same time, the end result combined with staff promotion and salary will have effect and will greatly increase the staff's work enthusiasm. The management and application of IT will also reduce the contradictions between internal employees of enterprises, enhance the centripetal force of enterprises, and create a good working atmosphere of enterprises.

In the traditional enterprise management mode, almost all the work flow is completed by manual step by step, which is very unprofitable for the operation of the whole organization of the enterprise. First of all, all-manual management greatly reduces the efficiency of enterprise management, resulting in the waste of enterprise human resources. Moreover, manual management needs a large amount of financial investment, resulting in the rapid rise of enterprise management costs, and, in the process of manual management, due to the quality of personnel and other reasons, management mistakes often appear, bringing unnecessary trouble for the enterprise. As a for-profit organization, enterprises must strictly control the cost rise in the management process. Internet-based enterprise performance management can effectively avoid the disadvantages of traditional management methods and make up for the rise of enterprise costs caused by personnel management, which to a certain extent greatly promotes the efficient operation of enterprise management, increases the benefits of enterprises, and promotes the rapid development of enterprises.

In today's internet era, many enterprises cannot carry out performance management without the introduction and application of various office software, which is necessary equipment for enterprise management [1]. However, in the process of the actual work, there are still many enterprises that maintained a more traditional performance management mode and idea and refused to learn the advanced management experience. Failure to invest in or purchase high-tech products on the market will make it difficult for the company to obtain market information in a timely manner and to judge the situation incorrectly, all of which will lead to problems in the development process of the company [2, 3]. Enterprises begin to use network technology at present, most of the points to performance management, but because the use time is shorter, for the use of related software is still not skilled enough, low efficiency in actual operation does not make enterprise of enterprise management and the internet information match the processing speed. The overall development of the enterprise has a negative effect. Lei Jun, the president of Xiaomi, formulated a strict performance management system for employees in the early stage of the establishment of the company, which increased the pressure of the whole company. After the introduction of internet performance management in the later stage, after a period of running in and out, the company began to enter a stage of rapid development, which laid a foundation for Xiaomi's current status in China [4].

Different enterprises have different applications of the internet, and the actual value of the internet in enterprise performance management is also different. In practical applications, enterprises must attach importance to their own development and timely debug relevant software applications. Instead of applying the indicators of the software directly to their own performance management, enterprises must formulate appropriate indicator systems through research on their own enterprises [5]. In the performance management of Volvo, because of unreasonable performance evaluation indicators, the company top disquiet makes the internal volatility; therefore, the enterprise for the performance management system structure of the building must be on their own actual situation to develop, not because of the blind use of network technology and leading to the interests of the enterprise.

Talent training is the important content of enterprise development. In today's internet age, the development of network technology to the development of various industries article brought convenience, but at the same time, for the application of IT is established on the basis of talent pool, which for some companies still has certain challenges and pressure, it is necessary to pay a high price to introduce high-quality network technical talents. In the development of Alibaba, Jack Ma once hired a very young network technical talent with an annual salary of one million yuan, which shocked the company's senior management. But the fact proved that Jack Ma was right. The network technology giant used his own technology for Alibaba Group (ALG) to block numerous hacker aggressions, to ensure the security of Alibaba company data. But not all enterprises have Alibaba's bold spirit and strength; the use of huge salary space is something many small businesses cannot meet. Therefore, talent barriers are still the main reason for the current internet performance management, and enterprises must find ways to solve them [6–8]. The paper arrangement is as follows: Section 1 presents introduction to the concepts. Section 2 defines the different work of the internet. Different research is used to understand this concept. Section 3 discusses the model introduction. Section 4 updates the different experimental research and analyzes this idea. Section 5 concludes the article.

2. Related Work

Tsai and Ghoshal (1995) studied the relationship between the relationship strength of various departments within an enterprise and innovation and pointed out that network relationship strength is conducive to promoting resource exchange and integration between different departments or teams within the enterprise [2]. Therefore, the impact of network relationship strength is different. Among them, strong relationship is more conducive to the development of applied research and development, while weak relationship is more conducive to the success of basic research and development. Powell (1986) conducted an investigation and study on the pharmaceutical industry and found that the stronger the relationship was between employees in an enterprise, the more conducive it was to promoting the enterprise's product innovation [9]. Zheng Meiqun and CAI Li et al. (2005) establish that a strong relationship is more conducive to the development and strong intrateam relations have a high level of trust and cooperation, which is directly conducive to the shaping of the innovation atmosphere within the team and ultimately can promote the innovation performance of the team [10]. Wang Ping (2011) studied enterprises in Zhongkai High-Tech Industrial Development Zone, Huizhou City, Guangzhou Province, and found that relationship strength can promote the improvement of enterprise performance. Compared with weak relationship, strong network relationship is more conducive to promoting the financial performance of high-tech enterprises. Compared with strong relationship, weak relationship is more conducive to the improvement of high-tech enterprises' innovation performance. In addition, it is found that strong relationship network can positively moderate the promoting effect of entrepreneurial orientation on high-tech firms' financial performance.

Some other scholars have studied the strength of network relationship from other aspects. Zhao Di [11] used the actual research data for quantitative analysis and found that network relationship can reduce the degree of information asymmetry and have a positive impact on the acquisition of external funds such as bank financing, finance lease, trade credit, equity financing, and government funds for new enterprises. Yan Ying [12] conducted an empirical study on the relationship between the strength of network relationship and the competitive advantage of industrial clusters by taking nearly 200 textile enterprises in the textile industrial cluster of Yuci District, Jinzhong City, Shanxi Province, as the research object. The research results show that network relationship strength has a significant positive impact on the competitive advantage of industrial clusters and is the most important factor among the four factors that affect the competitive advantage of industrial clusters (namely, network relationship strength, technological innovation, organizational learning, and social capital) [13].

The concept of value network was first proposed by Adrian Slywotzky (1998), and value network is defined as a new business model. The change of competitive environment requires enterprises to study the decomposition and reconstruction of value chain with network thinking (Berger, 1999). Sriniras [14] believes that value network is a network of value flow and topological space formed by value chain enterprises according to common rules. Bovet Martha (2000) believes that value network is an ecosystem composed of customers, other enterprises, partners, and suppliers in order to quickly respond to customer needs and realize low-cost and efficient manufacturing. Achrol Kotler [15] believes that value network is a special network organization. The operation of this network organization is separated from the hierarchical structure and is a consortium formed by some economic organizations specialized in tasks or skills embedded in a shared value system through multilateral connections and interdependence. The roles and responsibilities of network members are determined by the value system. Gulati [16] points out that more and more enterprises and their stakeholders are in the value network, including their partners, suppliers, customers, and competitors. These different types of participants establish interest communities, and the network relationship transcends industrial boundaries or even national boundaries. Value network is also known as value creation ecology and value ecosystem (Ou Xiaohua, 2015). Cheng Liru and Zhou Xuan (2011) point out that value network is a network system of multiple economic relations between enterprises and their stakeholders: value creation network with customers as the core, cooperative relationship network with production enterprises as the core, and competitive relationship network with relations between network subjects as the core.

Wu Haiping and Xuan Guoliang (2002) made a systematic and comprehensive elaboration of the concept of value network. They believed that value network is a structure of value creation, transfer, distribution, and utilization. Its essence is that enterprises in different links of the value chain and their related stakeholders cooperate to create value for customers. The ecological characteristics of interaction, evolution, expansion, and environmental dependence are formed, independent of market and bureaucratic governance structure. Zhou Xuan (2005) believes that value network is a value creation and value management system built with customer value as the core, and its structure mainly includes two types, namely, controlling equity network and noncontrolling contract network. Lu Taihong et al. (2012) analyzed the research origin of value network from the perspectives of sociology, economics, management, and other disciplines. Although scholars have explained the definition of value network from different theoretical perspectives, they all emphasize its characteristics of customer-centered, resource-sharing, dynamic, cocreating value, and shifting from zero-sum game to win-win cooperation. It is a "customer-centric dynamic network in which companies collaborate to increase value and quickly meet customer needs."

Innovation performance is an index to measure the innovation results of enterprises, which reflects the economic benefits gained from innovation activities. The academic circle has not reached a consensus on the definition of innovation performance. Hagedoorn Cloodt (2003) made a systematic description of enterprise innovation performance. They divided innovation performance into two aspects: broad and narrow. In the narrow sense, innovation performance only refers to the results obtained in the process of putting inventions and innovations into the market. Innovation performance is reflected in the output of innovation activities and their impact on enterprises (Chen Jin and Chen Yufen, 2006). Gao Jian et al. (2004) defined innovation performance as the efficiency of innovation process, the outcome of output and its contribution to business success, including output performance and process performance. Li Shouwei and Zhu Yao (2016) believe that enterprise innovation performance refers to the innovation results brought to enterprises after a series of innovation activities conducted by enterprises and other organizations interact, connect, and cooperate with each other. Wang Yifeng and Wang Xiaomeng (2016) emphasize that innovation performance is the result of innovation activities and the embodiment of enterprise value. Integrating the scholar's point of view, this study thinks that enterprise innovation performance is brought about by the results of innovation, including innovation construct put forward to the final new product or service into the market; all the scores in the whole process include both the innovation result performance and process performance, which emphasizes innovation efficiency and focuses on efficiency. Figure 1 depicts the communication framework for the different communication layers of the internet of things (IOT).

Internet is the best source to get information on various topics to improve knowledge. The internet has changed our daily life, including the way we see the world and the way we communicate. At present, there are rich and colorful IOT devices connected to the internet. Although the internet was born between 2008 and 2009, the number of devices connected to the internet will be about 50 billion by 2020, according to IBsG estimates.

3. Model Introduction

The effect of weather on plant water requirements will be given by the formula ET0 for crop evaporation, which can be defined as the rate of evaporation from ground 8 to 15 cm high, assuming that the ground has the same height, well-grown plants and is completely sheltered from water shortage. Evaporation is expressed in millimeters (mm) per day. Then, ETO is calculated from (1) by considering climatic parameters (P) such as temperature (T), solar radiation, wind speed, and humidity. But formula ET0 will be further determined by the Penman–Monteith equation as shown in (2):

$$\mathrm{ETO} = \frac{0.408\Delta(R-G) + \gamma(900/(T+273))u(e_s - e_a)}{\Delta + \gamma(1+0.34u)}, \quad (1)$$

$$\lambda\mathrm{ET} = \frac{\Delta(R-G) + \rho_a c_p (e_s - e_a)/r_a}{\Delta + \gamma(1 + r_s/r_a)}. \quad (2)$$

Different crop types, different growing stages, and different growing environments have different farmland coefficients.

$$\mathrm{ET}_c = k_c \times \mathrm{ETO}. \quad (3)$$

In terms of fertilization, this research uses the formula established by American soil scientist Stanford for estimating the amount of fertilization, which is currently the most important approach for determining the amount of fertilization. The core is to fertilize according to the target yield of crops. The estimation formula of fertilizer application amount is as follows:

$$L = \frac{(a-b)}{r}. \quad (4)$$

The model is a regression structure and must meet the conditions n. The NARX formula of this nonlinear autoregressive model is (5), where F represents the nonlinear function of the neural network: the multilayer perceptron used has three layers.

$$y(k+1) = Fy(k), \ldots, y(k-n+1), u(k), \ldots, u(k-m+1). \quad (5)$$

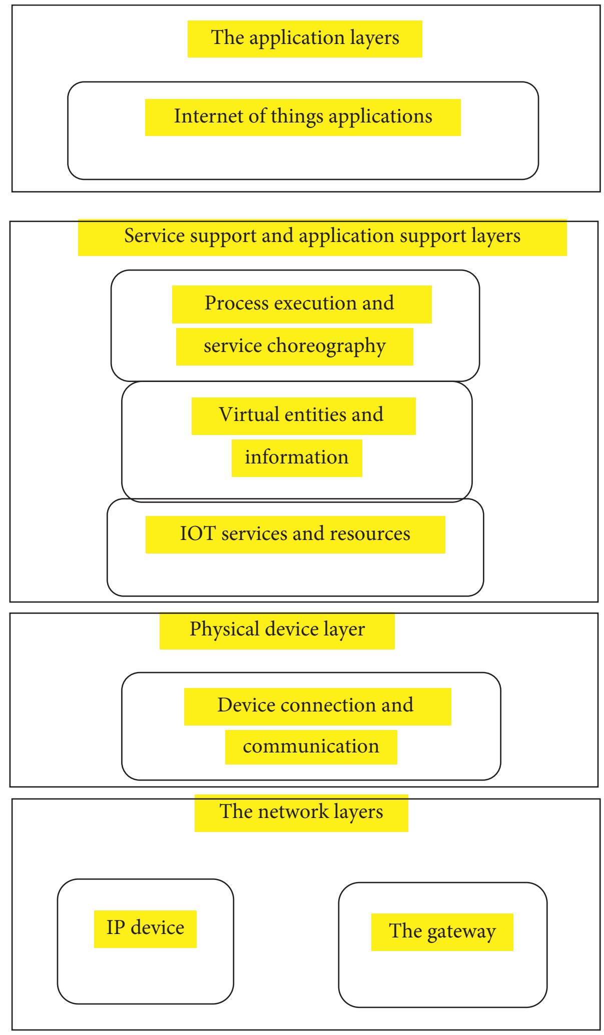

Figure 1: IOT reference architecture and functional components.

At the same time, it is known that the model is a serial parallel model. The output of the identification model is determined by

$$\hat{y}(k+1) = \varphi y(k), \ldots, y(k-n+1), u(k), \ldots, u(k-m+1). \quad (6)$$

At some point $t = k+1$, all the historical values of input and output can be entered into the neural network pairs. The output of the model plant $(k+1)$ y represents an estimate of the current output $\hat{y}(k+1)$ of the plant. The errors of the two signals are used to adjust the parameters of the neural network, as shown below:

$$e(k+1) = y(k+1) - \hat{y}(k+1). \quad (7)$$

Once the training is complete, the next step is to validate the model using the second set of data collected during the experiment. Evaluation of the model involves observing the evolution of the output to a known input mode at each sampling time (Ts = 15 min). The output of the network is its weight function:

$$\widehat{y}(k+1) = W_2 \tan h(W_1\overline{u}), \tag{8}$$

where $\widehat{y}(k+1)$ is the output of the network, $\overline{u}$ is the input mode, W_1 is the weight matrix of the hidden layer, W_2 is the weight matrix of the output layer, and tanh is the activation function of the hidden layer.

4. Experimental Analysis

Taking the Internet of Things enterprises in Jiangsu Province as the research sample, the sample range is selected from southern Jiangsu Province, the central and northern parts of the Internet of Things, as well as Beijing, Suzhou, Xuzhou, etc. Research enterprise questionnaire respondents mainly are the company's executives and enterprise technology innovation, market development, product development, human resources, strategic planning, and other areas of the business and the department responsible for the people, how they for enterprise development, especially with external organizations to carry out innovation activities through collaborative innovation and other forms have more understanding, guarantee letter validity of the questionnaire sample had a higher.

4.1. Correlation Analysis. Before regression analysis of data, correlation analysis can preliminarily test whether there is mutual influence between variables. SPSS22.0 software was used to conduct Pearson correlation analysis on all variables in the model (Table 1).

From the results of correlation analysis, the degree of openness, closeness, and stability of collaborative innovation network is significantly correlated with the three measurement dimensions of resource integration, and the enterprise innovation performance ($P < 0.01$), h1.H2H3, H4, H5, and H6 are preliminarily supported and suitable for further research.

4.2. Regression Analysis of Collaborative Innovation Network and Resource Integration. In the conceptual model set in this paper, the influencing factors of resource integration are collaborative innovation network, including the degree of openness, tightness, and stability of collaborative innovation network. Four models are estimated. Model 1 only contains control variables, and model 2, model 3, and model 4 gradually include the openness, tightness, and stability of collaborative innovation network, respectively, to verify the hypothesis of the impact of collaborative innovation network factors on resource integration, as shown in Table 2.

As can be seen from Table 3, with the addition of new variables, model R2 values are significantly improved. Among the structural factors of collaborative innovation network, the openness, closeness, and stability of collaborative innovation network can explain 55.5% of the total variance of resource integration construction, and the regression coefficients of all three are positive and significant. 0.001 indicates that the structural factors of collaborative innovation network have a significant positive impact on the construction of resource integration, and the openness degree, tightness degree, and stability degree of collaborative innovation network are conducive to the enterprise's resource integration. The theoretical hypotheses H1, H2, and H3 proposed in this paper have been verified.

In the hypothetical model of this paper, resource integration has a certain impact on enterprise innovation performance. Resource integration includes three dimensions: resource identification and acquisition, resource internalization and integration, and resource allocation and utilization. So, four models are estimated based on assumptions. Model 1 only contains control variables, and models 2, 3, and 4 gradually include resource identification and acquisition, resource internalization and integration, and resource allocation and utilization of resource integration, respectively, to verify the impact of resource integration on enterprise innovation performance, as shown in Table 3.

As can be seen from Table 4, with the addition of new variables, model R2 values are significantly improved. Among the structural factors of resource integration, resource identification and acquisition, resource internalization and integration, and resource allocation and utilization can explain 42.8% of the total variance of innovation performance construction, and the regression coefficients of the three are positive and the significance level is P&lt. 0.01, indicating that the structural factors of resource integration have a significant positive impact on the construction of innovation performance, resource identification and acquisition, resource internalization and integration, and resource allocation and utilization and have a significant positive impact on enterprise innovation performance. The theoretical hypotheses H4, H5, and H6 proposed in this paper have been verified.

The mediation is called complete mediation. If a mediation variable only explains part of the relationship between independent variables and dependent variables, and a small part of the independent variable's influence on the dependent variable does not need to go through the mediation variable, we call this mediation variable partial mediation. According to the theoretical model, three models are estimated. Model 2 adds independent variables into collaborative innovation network, and Model 3 adds resource integration. The specific results are shown as follows.

It is verified again that collaborative innovation network has a significant positive impact on innovation performance, but after adding resource integration variable into the regression model, the regression coefficient and significance level of collaborative innovation network on innovation performance decline. Therefore, resource integration plays a partial intermediary role between collaborative innovation networks. Collaborative innovation network indirectly affects innovation performance through resource integration, and hypothesis H7 is verified.

AMOS output of the model showed that the CMIN/DF value of the model was 0.834 (critical value less than 2). The parameter estimation (maximum 0.88, minimum 0.72) of the four measurement indexes of technological innovation

Table 1: Correlation analysis results of main research variables.

Variable	1	2	3	4	5	6	7
Openness	1						
How closely	0.666**	1					
Degree of stability	0.677**	0.611**	1				
Resource identification and acquisition	0.464**	0.614**	0.417**	1			
Resource internalization and fusion	0.616**	0.624**	0.661**	0.603**	1		
Resource allocation and utilization	0.612**	0.634**	0.616**	0.663**	0.714**	1	
Innovation performance	0.670**	0.627**	0.636**	0.417**	0.676**	0.601**	1

Table 2: Regression results of influencing factors of resource integration.

	Model 1	Model 2	Model 3	Model 4
Constant term	0.107	0.133	0.138	0.148
Control variables				
Number of employees	0.08	−0.034	−0.071	−0.117
Enterprise age	0.114	−0.048	−0.048	0.017
Annual sales	0.07	0.037	0.04	0.043
Collaborative innovation network				
Openness		0.744**	0.347**	0.334**
How closely			0.470**	0.334**
Degree of stability				0.308***
Model statistics				
R2	0.043	0.388	0.407	0.444
Dw	0.818	1.113	1.303	1.373

Table 3: Regression results of resource integration and innovation performance.

	Model 1	Model 2	Model 3	Model 4
Constant term	0.308	0.333	0.346	0.363
Control variables				
Number of employees	0.078	0.079	−0.039	−0.036
Enterprise age	0.337	0.068	0.067	0.068
Annual sales	0.087	0.063	0.33	0.309
Resource integration				
Resource identification and acquisition		0.469**	0.907***	0.907***
Resource internalization and fusion			0.496***	0.4933**
Resource allocation and utilization				0.394**
Model statistics				
R2	0.074	0.976	0.388	0.498
Dw	0.966	3.376	3.994	3.367

performance reached the significance level of 0.01, indicating that the hypothesis model and sample data can be adapted. In terms of overall fitting effect, RMSEA of the model is 0.004, smaller than 0.5. The values of AGFI and GFI were 0.996 and 0.997, both greater than the reference value of 0.9. RMR value is $0.02 < 0.05$ reference value. The above statistical fitting indicators show that the fitting effect is good, which verifies the validity of the technology innovation performance measurement scale in this paper.

Figure 2 shows construction reliability analysis of technological innovation performance based on the above analysis, and the following conclusions can be drawn: the factor structure of the three measurement scales of network relationship strength is reasonable, which can be further analyzed.

Figure 3 shows the moderating effect of network potential on the relationship between value network symbiosis and independent innovation. According to the simple slope analysis results, the slopes of regression lines of independent innovation and value network symbiosis are all positive, indicating that value network symbiosis has a positive effect on independent innovation, which is consistent with the research hypothesis H5 in this paper. Furthermore, the slope of the regression line corresponding to the low network potential is small, while the slope of the regression line corresponding to the high network potential is large, indicating that, with the increase of the network potential, the positive effect of value network symbiosis on independent innovation is enhanced. In other words, network potential has a positive moderating effect on the relationship between value network symbiosis and independent innovation, which is consistent with hypothesis H9. Bootstrap test results of the mediating effect of collaborative innovation and independent innovation are shown in Figure 4.

Table 4: Analysis results of mediating effect of resource integration.

	Model 1	Model 2	Model 3
Constant term	0.208	0.246	0.244
Control variables			
Number of employees	0.078	−0.202	−0.088
Enterprise age	0.227	0.078	0.048
Annual sales	0.087	0.072	0.047
The independent variables			
Collaborative innovation network		0.720***	0.400**
Intervening variable			
Resource integration			0.244**
R2	0.074	0.404	0.424
Dw	0.064	2.272	2.224

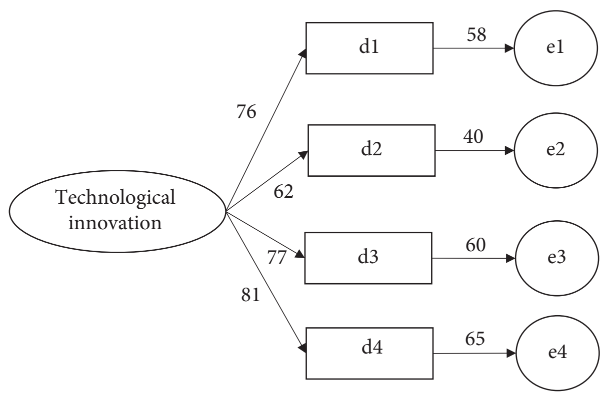

Figure 2: The revised measurement model of technological innovation performance.

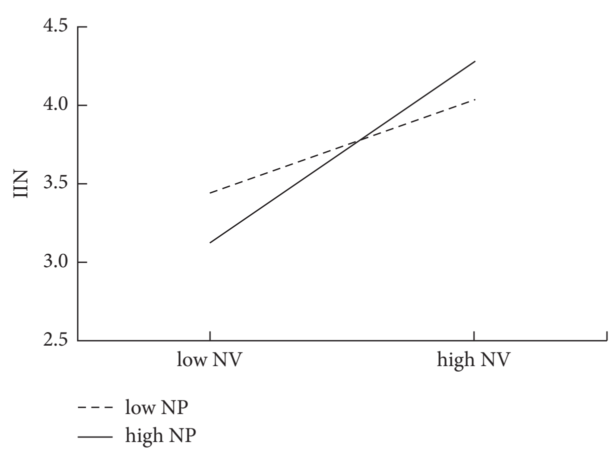

Figure 3: Moderating effect of network potential.

Bootstrap test was performed on the whole for the dual mediation model in this study, and the analysis results are shown in Figure 4. The total indirect effect of coinnovation and independent innovation in the dual intermediary path between value network symbiosis and enterprise innovation performance (0.200) does not contain zero value between the upper and lower limit of 95% confidence interval (Boot LLCI = 0.127, Boot ULCI = 0.281) and accounted for 40.323% of the total effect (TE) of value network symbiosis on enterprise innovation performance (TE = 0.496). This indicates that the dual mediating role of collaborative innovation and independent innovation between value network symbiosis and firm innovation performance is a partial mediating role.

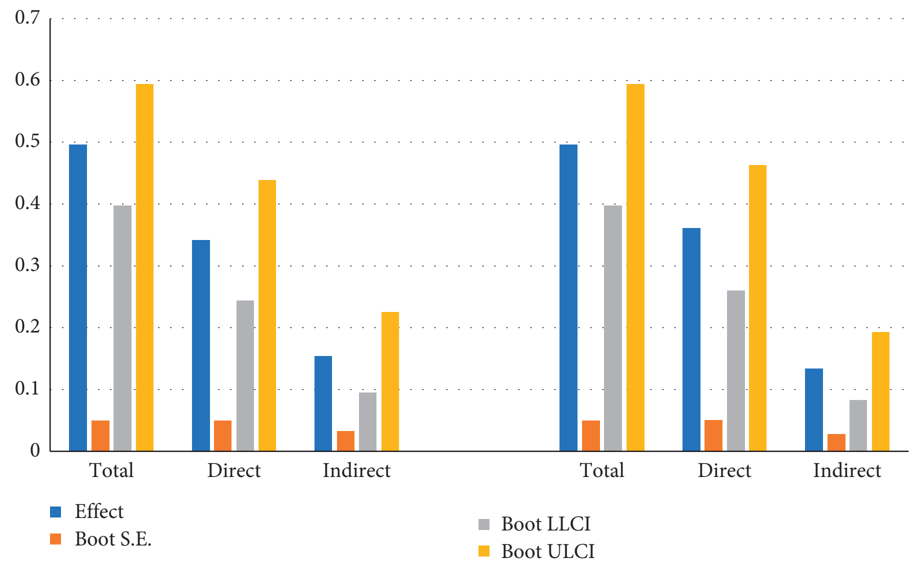

FIGURE 4: Bootstrap test results of the mediating effect of collaborative innovation and independent innovation.

5. Conclusion

This paper measures the network potential of enterprises from three aspects: network location centrality, network relationship closeness, and network resource richness. In the value network system, enterprises with higher network potential usually occupy key nodes or even core nodes of the network, are easier to establish strong connections with more network members, and have richer resource endowment and stronger ability to control, acquire, and utilize heterogeneous resources in the network. These advantages in network structure, network relationships and resource capacity have fully stimulated the vitality of self-innovation of enterprises; in addition, enterprises and other network members are promoted to form closely collaborative independent innovation consortia, thus forming a strong collaborative innovation potential of the network system. Therefore, the level of network potential plays an important role in regulating the collaborative innovation among members and the independent innovation of individuals in the value network symbiosis system. Furthermore, empirical analysis is made on the moderating effect of network potential at different levels. The lower-level network potential has no significant moderating effect. Enterprises with low network potential are usually marginalized in the value network, difficult to establish higher quality network connections, and can only obtain local network resources, so it is difficult to have an effective positive impact on enterprise innovation activities. Therefore, improving network potential is an important task for network enterprises to carry out innovation activities and follow innovation performance.

Data Availability

The data used to support the findings of this study are available from the corresponding author upon request.

Conflicts of Interest

The author declares that he has no conflicts of interest.

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