The Impact Mechanism of Knowledge-Based Organizational Design on Enterprise Innovation Performance: The Mediating Role of Knowledge Reward and Big Data Utilization

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Abstract: This study empirically analyzed the impact mechanism of knowledge-based organizational design on enterprise innovation performance by randomly distributing 176 questionnaires to middle and senior managers in enterprises. The results show that knowledge-based organizational design is a predictor of enterprise innovation performance and can improve it. Knowledge reward and big data utilization play a mediating role in the relationship between knowledge-based organizational design and enterprise innovation performance respectively. Additionally, knowledge-based organizational design can improve enterprise innovation performance through the implementation of knowledge reward and big data utilization.

1. Introduction

In the current global context, technology revolution driven by the Internet has triggered a restructuring of the global research and development process. In the era of "Internet +", organizational structures have become more flexible and flat, and enterprises have more channels for obtaining information. Enterprises need to integrate information and technology deeply, which poses higher requirements and challenges for knowledge management in innovation. Therefore, adhering to a problem-oriented approach, analyzing the problems of enterprise innovation mechanisms in new contexts, and exploring the interactive linkage between big data utilization, organizational design, and knowledge management are of great significance for enterprises to find innovative paths and improve the innovation performance.

Currently, scholars' research on enterprise innovation focuses mainly on enterprise innovation capabilities and organizational strategies. With the deepening of knowledge management in theory and its widespread utilization in practice, issues such as knowledge reward have become new perspectives for studying enterprise innovation. However, there is currently a lack of research on the impact of organizational design and technology optimization from the perspective of knowledge management on enterprise innovation performance, and the interaction mechanism between these factors has not been further clarified. In addition, enterprises are constantly trying to use big data for

scientific decision-making. However, whether the adoption of big data can have a positive effect on enterprise knowledge management and innovation performance remains to be clarified. If the strategic ecological environment in which the enterprise exists is ignored, the enterprise may overlook the core elements that are conducive to competition when making decisions, and may not accurately judge the mechanisms and boundaries of management and action. In summary, this article explores the effective mechanisms for improving enterprise innovation performance in the era of "Internet +" from the perspectives of organizational design or information communication technology usage, and from the perspectives of knowledge reward and big data utilization. The conclusions of this study not only enrich the research results of enterprise innovation theory, but also supplement the relevant theoretical literature on organizational management and knowledge management, revealing the internal mechanism of enterprise innovation performance formation from the perspective of "Internet + knowledge management", which has important theoretical and practical significance.

2. Theoretical Hypotheses

2.1 Knowledge-based Organizational Design and Enterprise Innovation Performance

Organizational systems are an organic integration based on organizational practices and knowledge management. Although both formal and informal institutional environments can affect enterprise innovation performance through business models, the specific path and impact effect are different[1]. The difference in organizational types has an inverted U-shaped relationship with enterprise innovation performance, while the difference in goals has a negative relationship with enterprise innovation performance[2]. Knowledge-based organizational design can also play a role in strategic identification and construction[3]. Strategic flexibility plays a positive moderating role in the impact of knowledge innovation capability on innovation performance. Communication is an important expression of organizational design. Good communication between departments, leaders, and employees helps organizations overcome barriers between departments with knowledge as a carrier. An innovative atmosphere in the enterprise can promote innovation performance[4]. In addition, knowledge-centered organizational design can continuously optimize the current organizational structure or business process. And R&D department constructs the enterprise value chain through formal cross-functional integration, while the M&A department can build the enterprise value chain through informal integration[5]. For the marketing department, formal cross-functional integration has a significant positive impact on innovation performance. The roles of informal and formal organizations play a role in developing the enterprise's crowdsourcing capability through the process of knowledge expression and coding[6]. In summary, we propose the hypothesis that:
H1: Knowledge-based organizational design can improve enterprise innovation performance.

2.2 The Mediating Role of Knowledge Rewards

Organizational design affects the creativity of a company's products, and responsibility decentralization has a positive impact on the creativity of new products[7]. In a "people-oriented" knowledge governance mechanism, when organizations perceive employees' needs and expectations and provide reward for knowledge sharing and creation, they will motivate employees to engage in innovative behavior[8]. Organizational rewards for employees not only include measures such as bonuses and promotions, but also public recognition of employees' knowledge contributions, such as actively sharing knowledge with colleagues, forming new ideas, or sharing new knowledge that has practical utilizations[9]. Knowledge rewards focused on organizational design and governance

perspectives can enhance a company's creativity in new product development, especially when both entrepreneurial orientation and long-term orientation are high-dimensional, the promotion effect of knowledge rewards on new product creativity is most significant[10]. Knowledge rewards have a mediating effect between responsibility decentralization and new product creativity, and also have a promoting effect on cross-departmental coordination[7]. In summary, we propose the hypothesis:

H2: Knowledge rewards play a mediating role between knowledge-based organizational design and enterprise innovation performance.

2.3 The Mediating Role of Big Data Utilization

In a dynamic competitive environment, companies need to constantly adjust their organizational structure and processes by integrating professional knowledge, business knowledge, and practical experience to adapt to external environmental changes. From the perspective of the integration of information technology and business departments, big data utilization help business-related departments understand each other's missions, goals, and plans, reduce cognitive barriers caused by organizational structure, avoid the big data productivity paradox caused by organizational adaptability and flexibility, and promote innovation efficiency by using big data utilization as a technical means[11]. From the perspective of enterprise process integration, the integration of business processes and information technology processes can enable companies to efficiently use big data to mine market and customer potential needs, thereby better developing products and services[11]. In addition, work and task characteristics, organizational environment, and individual characteristics all have an impact on the deep-level use of enterprise information technology and information systems, and the use of big data is precisely the functional embodiment of enterprise information technology and information systems[12]. With the support of big data technology, companies have more comprehensive information and advanced information processing technologies, which help them have higher decision-making rationality and efficiency[13]. In summary, we propose the hypothesis:

H3: Big data utilization plays a mediating role between knowledge-based organizational design and enterprise innovation performance.

2.4 The Chain Mediating Role of Big Data Utilization and Knowledge Rewards

Good organizational communication and the fit between big data systems and enterprise strategies, all affect the scientific decision-making of enterprise investments. The use of knowledge rewards focused on organizational design can enhance a company's creativity in new product development[10]. Chierici et al. (2019) found that big data knowledge management plays a mediating role between social media knowledge acquisition and innovation capability[14]. By using big data analysis and mining, companies can extract valuable knowledge or information, efficiently help companies integrate resources, and enhance innovation performance. In the era of big data, companies can not only achieve data empowerment through the three processes of data combination, data bundling with enterprise resources, and data utilization and value creation but also use different forms of data empowerment at different stages of business development to realize the value of digitalization[15]. In summary, we propose the hypothesis:

H4: Big data utilization and knowledge rewards play a chain mediating role between knowledge-based organizational design and enterprise innovation performance.

Based on the exploration of the relationships between the above-mentioned variables, this paper proposes the following conceptual model, see Figure 1.
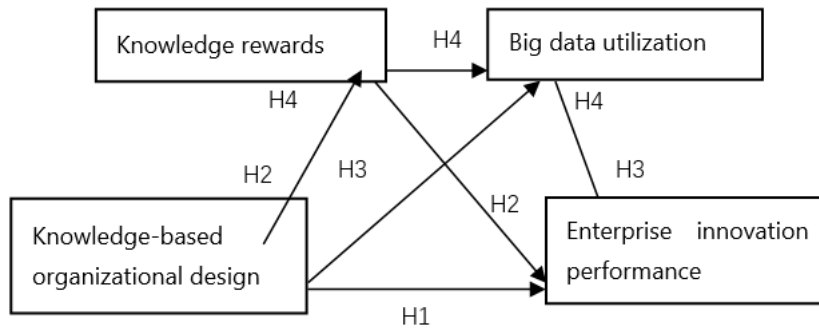
Figure 1: Concept Model

3. Research Subjects and Methods

3.1 Sample and Data Collection

This study measured the constructs of knowledge-based organizational design, knowledge rewards, big data utilization, and innovation performance using a Likert five-point scale (1 indicating complete agreement and 5 indicating complete disagreement). The study focused on innovation performance in companies and surveyed middle and senior managers in various industries such as healthcare and finance in mainland China. From September 2021 to April 2022, an online questionnaire was distributed to managers in cities such as Shanghai, Tianjin, Jiangsu, and Zhengzhou. After removing invalid questionnaires, a total of 176 valid questionnaires were obtained. Based on the nature of the enterprise, state-owned enterprises accounted for 21.02%, collectively-owned enterprises for 2.27%, joint ventures for 6.82%, foreign-funded enterprises for 6.82%, private enterprises for 51.14%, and other enterprises for 11.93%. In terms of the size of the enterprise, those with 10-49 employees accounted for 17.05%, 50-99 employees accounted for 17.61%, 100-149 employees accounted for 16.48%, 150-199 employees accounted for 6.25%, 200-499 employees accounted for 13.07%, and those with over 500 employees accounted for 29.55%. In terms of the age of the enterprise, those that were 0-1 year old accounted for 10.23%, 2-5 years old accounted for 18.18%, 6-10 years old accounted for 19.89%, 11-20 years old accounted for 28.98%, and those over 20 years old accounted for 22.73%.

3.2 Variable Measurement

(1) Knowledge-Based Organizational Design: This scale comprises 5 items that measure knowledge-based organizational design with regard to cross-departmental member collaboration, communication between leaders and employees, team composition, cross-departmental project implementation, and functional and responsibility settings [9]. The Cronbach's α value for this questionnaire was 0.888.

(2) Knowledge Rewards: This scale consists of 4 items that measure knowledge rewards [9]. The Cronbach's α value for this questionnaire was 0.788.

(3) Big Data Utilization: This questionnaire comprises 5 items that measure big data utilization[16]. The Cronbach's α value for this questionnaire was 0.916.

(4) Innovation Performance: This questionnaire consists of 8 items that measure innovation performance in companies[17]. The Cronbach's α value for this questionnaire was 0.950.

4. Research Results and Analysis

4.1 Validity Test

Table 1: The Analysis of Convergence Validity and Discriminant Validity.

	Std.Loading	CR	AVE	Organizational Design	Knowledge rewards	Big Data Utilization	Innovation Performance
Knowledge-Based Organizational Design	0.735-0.850	0.8883	0.6145	(0.784)			
Knowledge Rewards	0.664-0.767	0.7863	0.4801	0.724**	(0.693)		
Big Data Utilization	0.726-0.881	0.9182	0.6927	0.740**	0.681**	(0.832)	
Innovation Performance	0.781-0.908	0.9502	0.7052	0.742**	0.694**	0.822**	(0.840)

Note: 1) ** $p < 0.01$. 2) The square root of AVE is shown in parentheses on the diagonal.

This study used Amos21.0 software to test the model fit. A four-factor model was constructed based on the research content and compared with two competing models with three factors and two factors. The results indicated that the four-factor model demonstrated good structural validity of the scale, with a good fit ($\chi2/df=2.542$, CFI=0.905, TLI=0.891, RMR=0.059, NFI=0.853, IFI=0.905), outperforming the other two competing models. The combination reliability (C.R.) values of the four dimensions of knowledge-based organizational design, knowledge rewards, big data utilization, and innovation performance were 0.8883, 0.7863, 0.9182, and 0.9502, respectively, all of which were greater than 0.6, indicating good convergent validity of the scale. The AVE values of the four factors, except for knowledge rewards which was slightly below 0.5, were all above 0.5, indicating good convergent validity of the scale (see Table 1). The correlation coefficients between the four factors ranged from 0.681 to 0.822, which was below the critical value of 0.85, indicating good discriminant validity of the scale. Furthermore, knowledge-based organizational design and innovation performance were significantly correlated, indicating good criterion-related validity of the questionnaire, which can be further explored in relation to innovation performance in companies.

4.2 Common Method Bias Test

The data of this study were obtained from self-reported measures, which may lead to common method bias. In order to reduce common method bias, various methods were used during the survey. In addition, the "Control for Unmeasured Single-Method Factor" method was used to test for common method bias. By comparing the main fit indices of the confirmatory factor analysis model and the model containing the method factor, it was found that the $\Delta\chi2/df=0.104$, ΔCFI=0.016, ΔTLI=0.008, ΔRMR=0.006, ΔRMSEA=0.003, ΔNFI=0.021, and ΔIFI=0.017. The changes in each fit index were less than 0.03, indicating that the model with the method factor did not significantly improve, and there was no serious common method bias problem.

4.3 Descriptive Statistical Results

The Cronbach's α values of the four constructs ranged from 0.788 to 0.950, indicating good internal consistency of the sample data. Knowledge-based organizational design was positively correlated with knowledge rewards (r=0.724, $p<0.01$), big data utilization (r=0.740, $p<0.01$), and innovation performance (r=0.742, $p<0.01$); knowledge rewards were positively correlated with big data utilization (r=0.681, $p<0.01$) and innovation performance (r=0.694, $p<0.01$); big data utilization was positively correlated with innovation performance (r=0.822, $p<0.01$). These results

indicate the possibility of further exploring the relationships between these constructs.

5. Hypothesis testing

5.1 Direct Effects

This study used the SPSS Process developed by Hayes to test the mediating effects. Controlling for the industry, nature, size, and age of the enterprise, the mediating effects of knowledge rewards and big data utilization between knowledge-based organizational design and innovation performance were analyzed. The regression analysis results showed that knowledge-based organizational design had a positive predictive effect on knowledge rewards (β=0.727, p<0.001). Knowledge-based organizational design and knowledge rewards had a positive predictive effect on big data utilization (β=0.512, p<0.001; β=0.310, p<0.001). When knowledge-based organizational design, knowledge rewards, and big data utilization were used simultaneously to predict innovation performance, each of these factors had a significant positive effect on innovation performance(β=0.208, p<0.01; β=0.169, p<0.01; β=0.547, p<0.001), supporting hypothesis H1 (see Table 2).

Table 2: Analysis of Direct Effects Results

Predictor	Knowledge Reward		Big Data Utilization		Enterprise Innovation Performance	
	Regression Coefficient Significance					
	β	t	β	t	β	t
Industry	0.039	0.666	-0.128	-2.354*	-0.001	-0.015
Enterprise Nature	0.137	2.272*	-0.069	-1.205	-0.036	-0.749
Enterprise Size	-0.120	-1.971	-0.044	-0.768	0.045	0.941
Enterprise Age	0.066	1.267	0.064	1.304	0.034	0.821
Knowledge-Based Organizational Design	0.727	13.964***	0.512	7.18***	0.208	3.071**
Knowledge Rewards			0.310	4.336***	0.169	2.684**
Big Data Utilization					0.547	8.539***
R	0.74		0.78		0.854	
R2	0.548		0.608		0.730	
F	41.212		43.730		64.815	

Note：**p<0.01，***p<0.001

5.2 Mediation Effect Test

As shown in Table 3, the bias-corrected percentile bootstrap test was used with 5,000 repetitions to further test the mediation effect between knowledge rewards and big data utilization in knowledge-based organizational design and enterprise innovation performance. The results indicated a significant overall mediation effect value of 0.518. The overall mediation effect was specifically generated by three mediation chains: the first path was the indirect effect 1 composed of knowledge-based organizational design → knowledge rewards → enterprise innovation performance, with an indirect effect value of 0.121 and a 95% confidence interval of [0.377, 0.674] that did not include 0, indicating a significant mediation effect of knowledge rewards in the relationship between knowledge-based organizational design and enterprise innovation performance, supporting hypothesis H2. The second path was the indirect effect 2 composed of knowledge-based organizational design → big data utilization → enterprise innovation performance, with an indirect effect value of 0.276 and a 95% confidence interval of [0.155, 0.424] that did not include 0, indicating a significant mediation effect of big data utilization in the relationship between

knowledge-based organizational design and enterprise innovation performance, supporting hypothesis H3. The third path was the indirect effect 3 composed of knowledge-based organizational design → knowledge rewards → big data utilization → enterprise innovation performance, with an indirect effect value of 0.122 and a 95% confidence interval of [0.062, 0.186] that did not include 0, indicating a significant mediation effect of knowledge rewards and big data utilization in the relationship between knowledge-based organizational design and enterprise innovation performance, supporting hypothesis H4. The specific paths are shown in Figure 2.

Table 3: Mediation Effects of Knowledge Rewards and Big Data Utilization in Knowledge-based Organizational Design and Enterprise Innovation Performance.

	Effect Value	Boot SE	Boot CI Lower	Boot CI Upper	Relative Mediation Effect
Total Mediation Effect	0.518	0.075	0.377	0.674	71.65%
Indirect Effect 1	0.121	0.050	0.027	0.224	16.71%
Indirect Effect 2	0.276	0.069	0.155	0.424	38.12%
Indirect Effect 3	0.122	0.032	0.062	0.186	16.82%

Note:

Indirect Effect 1: Knowledge-based organizational design → Knowledge rewards → Enterprise innovation performance.

Indirect Effect 2: Knowledge-based organizational design → Big data utilization → Enterprise innovation performance.

Indirect Effect 3: Knowledge-based organizational design → Knowledge rewards → Big data utilization → Enterprise innovation performance.
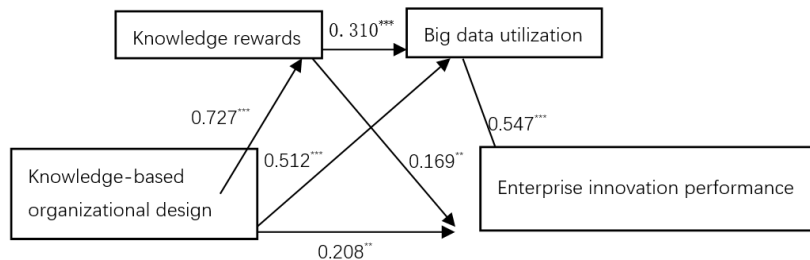
Note: **p<0.01, ***p<0.001.

Figure 2: Path coefficient diagram.

6. Conclusions and Discussions

6.1 Conclusions

This study explores the mechanism of the impact of knowledge rewards and big data utilization as intermediary variables on enterprise innovation performance based on knowledge management and organizational management, with knowledge-based organizational design as the motivation. The research conclusions are as follows: (1) knowledge-based organizational design is a precursor variable of enterprise innovation performance, which can improve enterprise innovation performance. (2) Knowledge rewards play a mediating role in the relationship between knowledge-based organizational design and enterprise innovation performance. (3) Big data utilization plays a mediating role in the relationship between knowledge-based organizational design and enterprise innovation performance. (4) Knowledge-based organizational design can improve enterprise innovation performance through knowledge rewards and big data utilization in sequence.

6.2 Theoretical Contributions and Managerial Implications

The theoretical contributions of this study are: (1) This study confirms that knowledge-based organizational design can improve enterprise innovation performance from the perspective of the integration of knowledge management and organizational management, enriching the precursor variables of enterprise innovation performance research. (2) This study analyzes the mechanism of the impact of knowledge rewards and big data utilization on enterprise innovation performance as intermediary variables, based on knowledge-based organizational design. By analyzing the impact mechanism of knowledge-based organizational design, big data utilization, and knowledge rewards on enterprise innovation performance, this study provides a theoretical basis for improving enterprise innovation performance.

The managerial implications of this study are: (1) Enterprises need to construct a professional team according to the changes of management situation to achieve the work goals. In the era of rapid market demand iteration, the rapid restructuring of teams based on projects or tasks is an important way to achieve innovative results. Enterprises can purposefully overlap the functions or responsibilities of some teams to increase the fit between team members and reduce communication costs. Formal or informal communication between team members and superiors can reduce resistance in innovation activities, improve communication quality and work efficiency, and thus improve enterprise innovation performance. (2) Organizations need to attach importance to the role of knowledge rewards in improving enterprise performance. On the one hand, enterprises can focus on sharing existing knowledge and use material or spiritual rewards to motivate employees, making employees feel needed, respected, and recognized, and thus stimulating their internal innovative motivation. On the other hand, enterprises also need to pay attention to the knowledge creation or innovation of employees. Therefore, enterprises should use material or spiritual rewards appropriately to promote the integration of employees' personal innovative behavior and enterprise development, thus promoting the improvement of enterprise innovation performance. (3) Enterprises need to design organizational structures or management forms conducive to big data utilization. The use of communication technology allows enterprise operation and management data to be easily fed back to management personnel's communication devices. By using scientific statistical methods to diagnose big data collected from multiple channels, enterprises' managers and relevant business department personnel can respond more quickly and accurately to changes in market environment or demand. (4) Enterprises need to coordinate organizational management, knowledge management, and innovation performance. In the context of the overlap of the Internet economy and the knowledge economy, enterprise organizational design needs to be more functional and flat, and functionalization needs to be based on product and market specialization. In addition, objects, content, or results related to knowledge rewards can further spread within the enterprise through big data technology, thus positively promoting enterprise innovation performance.

6.3 Research Limitations and Future Prospects

There are limitations in this study. First, the research conclusions are generated based on cross-sectional data empirical testing and cannot dynamically reflect the change mechanism between variables from the dimension of time. In future research, experimental methods or case studies can be considered to explore the longitudinal change mechanism of research objects. Second, this study focuses on analyzing effective strategies to promote entrepreneurship and innovation performance from the perspective of the integration of knowledge management and organizational management. Therefore, in future research, more multidimensional or diversified influencing factors can be included to analyze enterprise innovation behavior from a more comprehensive perspective and improve enterprise innovation performance.

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Data sharing agreement

The datasets used and/or analyzed during the current study are available from the corresponding author on reasonable request.

Declaration of Conflicting Interests

The author(s) declared no potential conflicts of interest with respect to the research, author-ship, and/or publication of this article.

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