### A Study on the Cognitive Factors Influencing the Independent Innovation Capability of Beijing Enterprises

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Abstract. At present, there is still a certain distance between the overall technological innovation capability of Beijing enterprises and the goal of building an innovative country. The concept of human beings is the most important thing that affects innovation activities, and it is the internal driving force of innovation. It manifests as people's attitudes towards innovative activities. Especially the correct understanding of innovation influencing factors by senior management, technology management departments, and other relevant management departments often determines the support for innovation, including resource investment, institutional and incentive mechanism construction, etc. Based on survey data from 532 innovative enterprises in Beijing, this study analyzed the cognitive factors influencing four categories of independent innovation. The research found that the importance of innovation influencing factors in Beijing enterprises is in the order of internal resources, marketization and education, intellectual property protection, policies, and industrial chain. The correct understanding of the factors influencing innovation by senior management and relevant departments often determines the level of support for innovation. Some managers have insufficient understanding of innovation and should consider organizational learning of innovation related knowledge as an important activity for the enterprise, in order to build a favorable management mechanism and platform for supporting technology personnel to achieve innovation.

### **1** Introduction

As a national center for politics, culture, international communication, and technological innovation, Beijing plays an important role in leading and directing the implementation of the innovation driven development strategy and accelerating the construction of an innovative country. Independent innovation is the key to achieving innovation driven, high-end development, and endogenous growth in Beijing.

At present, compared with the goal of building an innovative country, there is still a certain distance and considerable gap in the overall technological innovation capability of Beijing enterprises. For example, in terms of implementing innovation, enterprises have varying degrees of dependence on external technology; In terms of technological level, although there has been a significant improvement in the innovation capability and level of enterprises compared to the past, it cannot be denied that except for a few enterprises that can lead the world, there is still a large gap between the innovation capability of most enterprises and the international firstclass level. The manufacturing and information technology industries are prominent industries for independent innovation of enterprises, but there is still a certain imbalance in various indicators of the development of innovation capabilities of enterprises in Beijing, and it is necessary to identify the shortcomings

and further strengthen them. To gradually narrow the gap and reduce imbalance, more arduous efforts must be made, and the road to innovation for enterprises is long and arduous.

Therefore, although significant achievements have been made in the innovation of science and technology in the capital, it is important to have a clear understanding of the factors influencing the independent innovation capability of enterprises at all levels and relevant departments in Beijing in the context of profound changes. Analyzing the existing problems is crucial for further promoting the innovation driven development strategy.

From the perspective of research on the influencing factors of comprehensive independent innovation capability: Jia N, et al [1] and Genin AL, et al [2] believe that the factors that affect China's independent innovation include potential independent innovation resources, the investment capacity of innovation construction capacity of innovation carriers, and the guarantee ability of innovation environment. Zhu Zhujun, Wang Fang. [3] found that factors such as market segmentation, income inequality, and degree of marketization are important factors affecting the local market effect in independent innovation. Zhang Jiajia. [4] believe that funds are an indispensable investment factor for independent innovation in enterprises. Li Guangyu, Shi Zhanzhong,

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Zhao Zijian [5] studied the impact of R&D investment, market concentration, and other factors on technological innovation in high-tech industries, while Dong Qiuyun [6] explored the internal factors (independent innovation funds, human resource investment, production and manufacturing level, organizational operation mechanism and management system, corporate culture, innovation awareness, etc.) and external factors (policies and regulations, innovation intermediary service system, etc.) that affect independent innovation in Shaanxi hightech enterprises. Liu Siming, Hou Peng, Zhao Yanyun. [7] found that intellectual property legal risks are not conducive to the research and development investment of enterprises. Jiang Hong, Shi Yunming [8] found that the sustained development of independent innovation in Chinese enterprises is hindered by economic factors, knowledge factors, market system mechanisms, social environment, and other factors.

Various internal and external factors have a huge impact on the choice of innovation path and innovation level of enterprises. Independent innovation of enterprises is the result of the comprehensive effects of various internal factors driving, environmental selection, and basic support. And people's understanding of innovation activities, especially the correct understanding of the influencing factors of innovation by senior management, often determines the support for innovation, including resource investment, institutional and incentive mechanism construction. Therefore, it is necessary to study the understanding of the influencing factors of independent innovation capability of enterprises in Beijing.

# 2 Research Design and Questionnaire Survey

### 2.1. Research Question and Research Design

### 2.1.1, Proposal of research questions

The main research question is as follows: What is the perception of different factors affecting the independent innovation capability of enterprises in Beijing among personnel of different relevant job levels and departments? Is there a significant difference in the perception of factors influencing the independent innovation capability of individuals with different characteristics in enterprises?

### 2.1.2 Research Design

In order to understand the importance evaluation of the factors influencing the independent innovation capability of enterprises by the respondents, the author summarized, organized, and extracted 20 common influencing factors in two categories: internal factors and external factors. The importance evaluation scale of these influencing factors was divided into two categories: internal factors and external factors and external factors. On this basis, this study covered different departments including technology department,

technology management department, other management departments (mainly other management departments that understand the innovation situation of the enterprise), and personnel of different job levels including senior, middle, and staff in the distribution of the survey questionnaire. Firstly, the potential undiscovered structure of these influencing factors was discovered through factor analysis. Based on this, variables were defined, and the scores of the respondents' evaluations of the importance of each influencing factor were analyzed, and their cognitive differences in the various influencing factors of independent innovation of the enterprises listed in the questionnaire were compared. The author proposes the following preliminary research hypotheses:

H1: There are significant differences in the perception of factors affecting the independent innovation ability of employees at different job levels in the enterprise.

H2: There are significant differences in the perception of factors affecting the independent innovation capability of enterprises among personnel from different departments.

According to the factor loadings extracted from exploratory factor analysis, and based on the common characteristics and meanings of the influencing factors with high factor loadings, the author named these four factors as internal resources of enterprises, policies and industrial chains, marketization and education, and intellectual property protection. These four names will be used in subsequent analyses involving structural classification and hypothesis testing.

Based on the results of exploratory factor analysis, the author divides the influencing factors into four categories, namely internal resources of enterprises, policies and industrial chains, marketization and education, and intellectual property protection. Therefore, the preliminary assumptions above can be clearly refined into two series of assumptions as shown in the following figure:

Assumption 1 series:

H11, H12, H13, and H14 represent significant differences in the perception of the impact of internal resources, government and industry chain, marketization and education, and intellectual property protection on the independent innovation capability of enterprises among personnel of different job levels.

Assumption 2 series:

H21, H22, H23, and H24 represent significant differences in the perception of the impact of internal resources, government and industrial chain, marketization and education, and intellectual property protection on the independent innovation capability of enterprises among personnel from different departments.

# 2.1.3 Research hypothesis involves variable organization and variable definition

(1) Assuming the dependent variables of H1 and H2

The dependent variables of H1 and H2 are the importance ratings of the factors influencing the independent innovation capability of the surveyed enterprises. Factor analysis has shown that selecting four factors can explain 64.905% of the total variance. Therefore, assuming that H1 and H2 are both suitable for using the following four dependent variables:

Y1 represents the importance of internal resources in the enterprise, and the data used is titled as "Please evaluate the importance of internal factors that affect your enterprise's independent innovation capability". Y2 represents the importance of the government and industry chain, and the data used is titled "Please evaluate the importance of external factors that affect your company's independent innovation capability".Y3 represents the importance of marketization and education, and the data used is the questionnaire item: "Please evaluate the importance of external factors that affect your company's independent innovation capability." The fourth dependent variable, represented by Y4, is the importance of intellectual property protection. The data used is titled as "Please evaluate the importance of external factors that affect your company's independent innovation capability".

(2) Assuming the independent variables of H1 and H2

The independent variable of H1 is only one, which is the rank of the surveyed personnel. X1 represents the independent variable of H3, and the data used is the questionnaire item "Personnel Rank".

There is only one independent variable for H2, which is the department of the investigated personnel. The independent variable of H4 is represented by X2.

# 2.2 Questionnaire survey and sample characteristic analysis

### 2.2.1 Questionnaire survey

The design of the survey questionnaire is divided into two parts: the first part is the basic information of the surveyed personnel and the enterprise, which is used to classify the surveyed personnel and the enterprise they belong to. The second part is about the respondents' understanding of the importance of internal and external influencing factors on independent innovation in enterprises, and the question type is a five level Likert scale question. The author designed the questionnaire as a remote network questionnaire. In recent years, after months of invitation surveys, a total of 756 questionnaires were collected. After excluding incomplete questionnaires, the number of valid questionnaires was 532, with an effective response rate of 70.37%. The final number of valid samples used for data analysis was 532.

### 2.2.2 Sample Characteristics Analysis

The classification of the surveyed personnel is based on two categories. The sample distribution based on department is as follows: 163 respondents are in the technology management department, accounting for 30.6% of the valid questionnaire, 297 respondents are in the technology department, accounting for more than half of the total valid sample size, reaching 55.8%, and 72 respondents are in other management departments, accounting for 13.5% of the valid questionnaire. The sample distribution table based on the respondents' job levels is as follows: 63 respondents (11.8%) hold senior positions, 262 respondents (49.2%) hold middle-level positions, and 207 respondents (38.9%) hold employee positions. Nearly 50% of the respondents are middle-level employees in their respective companies.

### 3. Empirical analysis

# 3.1 Analysis of Questionnaire Reliability and Validity

# 3.1.1 Reliability analysis of questionnaire scale questions

The scale questions are based on the Likert scale. The results showed that the Cronbach's alpha reliability coefficients for the importance scores of internal and external influencing factors of independent innovation capability were both above 0.8, indicating that the scale questions used to understand cognitive attitudes towards various influencing factors have high reliability.

# 3.1.2 Content Validity Analysis of Questionnaire Questions

The author used the correlation analysis tool of SPSS to output the Pearson correlation coefficient and the two tailed significance t-test. The results showed that there was a significant positive correlation (>0.7) between the importance scores of internal influencing factors and the total importance scores of internal influencing factors for various enterprises' independent innovation capabilities, indicating good content validity. There is a significant positive correlation (>0.5) between the importance scores of internal influencing factors and the total importance scores of internal influencing factors for various enterprises' independent innovation capabilities, indicating good content validity.

# 3.2 Descriptive statistical results and hypothesis testing

# 3.2.1 Descriptive statistical results based on exploratory factor classification

The author uses four exploratory factors as the classification basis for the factors affecting the independent innovation capability of enterprises. After categorizing each influencing factor into these four types, the average and standard deviation of the importance scores for these four types of influencing factors are calculated as shown in table 1:

It can be seen that in terms of importance, internal resources of enterprises>marketization and education>intellectual property protection>policies and industrial chains. Among them, the importance of internal resources, marketization and education, and intellectual property protection as factors affecting the Table 1. For them offsetting induced detribution completions independent innovation capability of enterprises is high, significantly higher than the importance of policy and industry chain factors.

 Table 1. Factors affecting independent innovation capability based on exploratory factor classificationImportance level descriptive statistic.

	N	local minimum	maximum value	mean value	standard deviation
Internal resources of the enterprise	532	1.00	5.00	4.0127	.69274
Policies and Industrial Chain	532	1.00	5.00	3.3521	.85729
Marketization and Education	532	1.00	5.00	3.9167	.69581
Intellectual Property Protection	532	1.00	5.00	3.8853	.95866

3.2.2 Testing and Analysis of Hypotheses H1 and H2 Series

The author used syntax in SPSS to run multiple factor analysis of variance. The results of testing hypotheses H11 and H21 are shown in table 2:

(1) Inspection and analysis of H11 and H21

 Table 2. Multi factor ANOVA for Evaluating the Importance of Internal Resources in Enterprises.

			Layered Approach						
			Sum of		mean		significanc		
			squares	df	square	F	e		
	Main	(Combined)	15.221	4	3.805	8.697	.000		
	effect	Your department is	8.240	2	4.120	9.417	.000		
Internal		Your position is	6.981	2	3.490	7.977	.000		
Internal resources	2-way interactio	2-way Your department is * interactio Your position is		4	2.693	6.155	.000		
enterprise	n								
enterprise		model	25.992	8	3.249	7.426	.000		
		residual	228.829	523	.438				
	amount to		254.821	531	.480				
a. The interr	al resources	s of the enterprise are pro	vided by your	departmen	t, and your po	sition is			

It can be seen that there are significant differences in the perception of the impact of "internal resources" on the independent innovation capability of enterprises among personnel from different departments (significance value=0.000) and different job levels (significance value=0.000). Therefore, assuming that both H11 and H21 are supported. In addition, there is a significant interaction effect between departments and positions (significance value=0.000).

Next, we will further analyze the specific situation of the differences, mainly by examining the multi classification analysis table output based on the running syntax, as shown in table 3. Due to the significant interaction effect between departments and positions, the analysis here mainly examines the adjusted mean results, which are calculated after controlling for the influence of another independent variable.

From the adjusted mean in the table above, it can be seen that other management departments relatively do not attach importance to the impact of "internal resources" on the independent innovation capability of the enterprise, while senior management relatively attaches more importance to the impact of "internal resources" on the independent innovation capability of the enterprise.

**Table 3.** Multi classification analysis table for evaluating the importance of internal resources in enterprises.

				Predicted mean		deviation	
		N	unadjusted	Factor adjustmen t value	unadjusted	Factor adjustmen t value	
Internal	Your depart ment is	Technology Management Department	163	4.0874	4.0531	.07474	.04042
resourc		technical department	297	4.0471	4.0714	.03445	.05875
es of the		Other management departments	72	3.7014	3.6788	31130	33385
enterpri	Your	high-rise	63	4.3016	4.3340	.28890	.32134
se	positio	middle-level	262	3.9680	3.9666	04465	04609
	n is	staff	207	3.9813	3.9732	03141	03947
a. The in	ternal reso	ources of the enterprise ar	e provide	d by your de	partment, and	d your position	on is

#### (2) Inspection and analysis of H12 and H22

The author used syntax in SPSS to run multiple factor analysis of variance. The results of testing hypotheses H12 and H22 are shown in table 4:

Table 4. Multivariate ANOVA of Policy and Industry Chain Importance Evaluation.

			Layered Approach					
			Sum of	1			significanc	
			squares	df	mean square	F	e	
	Main effect	(Combined)	27.399	4	6.850	10.323	.000	
				1				
D.1.1.		Your department is	5.399	2	2.700	4.068	.018	
Policies		Your position is	22.000	2	11.000	16.577	.000	
Industri	2-way Your department is *		15 810 4	3 0 5 3 5 0	5.056	6 000		
al Chain	interaction	Your position is	15.010		5.955	5.950	.000	
al Cham		model	43.209	8	5.401	8.140	.000	
		residual	347.047	523	.664			
		amount to	390.256	531	.735			
a. Policy and industrial chain by your department, your position is								
-								

It can be seen that there are significant differences in the perception of the impact of "policies and industrial chains" on the independent innovation capability of enterprises among personnel from different departments (significance value=0.018) and different job levels (significance value=0.000). Therefore, assuming that both H32 and H42 are supported. In addition, there is a significant interaction effect between departments and positions (significance value=0.000). Next, further analyze the specific situation of the differences, as shown in table 5.

From the adjusted mean in the table above, it can be seen that other management departments are relatively less concerned about the impact of "policies and industry chains" on the independent innovation capability of enterprises, and senior management is relatively less concerned about the impact of "policies and industry chains" on the independent innovation capability of enterprises.

			=		
Table 5. Multiple	Classification Anal	lysis of Policy	and Industry	Chain Im	portance Evaluation.

			N	Predicte	ed mean	deviation	
			Ν		Factor		Factor
				unadjusted	adjustment	unadjusted	adjustment
				5	value	5	value
Polic ies and Indu	Your departm ent is	Technology Management Department	163	3.4581	3.5366	.10595	.18443
Chai		technical department	297	3.3479	3.2950	00421	05709
n		Other management departments	72	3.1296	3.1701	22250	18203
	Your	high-rise	63	2.8624	2.8111	48970	54100
	position	middle-level	262	3.3639	3.3533	.01174	.00115
	is	staff	207	3.4863	3.5153	.13418	.16319
a. Poli	cy and indu	ustrial chain by your depa	rtment, you	r position is			

(3) Inspection and analysis of H13 and H23

The author used syntax in SPSS to run multiple factor analysis of variance. The results of testing hypotheses H13 and H23 are shown in table 6:

Table 6. Multi factor ANOVA of Marketization and Education Importance Evaluation Table.

				Laye	ered Approacl	h				
			Sum of				significan			
			squares	df	mean square	F	ce			
	Main	(Combined)	8.963	4	2.241	4.870	.001			
	effect									
Maulaatin		Your department is	7.700	2	3.850	8.368	.000			
Marketiz		Your position is	1.263	2	.631	1.372	.254			
and	2-way	Your department is								
Educatio	interactio	* Your position is	7.506	4	1.877	4.079	.003			
n	n	•								
11		model	16.469	8	2.059	4.475	.000			
		residual	240.615	523	.460					
	amount to		257.083	531	.484					
a. Marketi	a. Marketization and Education by your department, your position is									

It can be seen that there are significant differences in the perception of the impact of "marketization and education" on the independent innovation capability of enterprises among personnel in different departments (significance value=0.000). Therefore, assuming H43 is supported. However, there is no significant difference in the perception of the impact of "marketization and education" on the independent innovation capability of enterprises among personnel of different job levels (significance probability=0.254). Therefore, hypothesis H33 is not supported. In addition, there is a significant interaction effect between departments and positions (significance probability=0.003). Next, further analyze the specific situation of the differences, as shown in table 7.

From the adjusted mean in the table above, it can be seen that other management departments relatively do not attach importance to the impact of "marketization and education" on the independent innovation capability of enterprises. The senior, middle, and staff all agree that the impact of "marketization and education" on the independent innovation capability of enterprises is very important.

	-	
Table 7. Multiple Classification	Analysis of Marketization and Education	Importance Evaluation.

				Predicted mean		deviation	
			Ν	unadjusted	Factor adjustment value	unadjusted	Factor adjustment value
Mark etizat ion and	Your departm ent is	Technology Management Department	163	3.9387	3.9535	.02198	.03685
Educ		technical department	297	3.9776	3.9687	.06089	.05201
ation		Other management departments	72	3.6157	3.6187	30093	29797
	Your	high-rise	63	3.8677	3.8964	04894	02031
	position	middle-level	262	3.8740	3.8727	04262	04395
	is	staff	207	3.9855	3.9785	.06884	.06181
a. Mai	ketization	and Education by your de	partment, y	our position is			

(4) Inspection and analysis of H14 and H24

The author used syntax in SPSS to run multiple factor analysis of variance. The results of testing hypotheses H14 and H24 are shown in table 8:

Table 8. Multivariate ANOVA of the Importance Evaluation of Intellectual Property Protection

				La	ayered Approa	ch	
			Sum of				significanc
			squares	df	mean square	F	e
	Main effect	(Combined)	26.394	4	6.598	7.700	.000
T ( 11 )							
Intellect		Your department is	16.078	2	8.039	9.381	.000
ual Duomont		Your position is	10.316	2	5.158	6.019	.003
Propert y Protocti	2-way interaction	Your department is * Your position is	13.424	4	3.356	3.916	.004
Protecti		model	39.818	8	4.977	5.808	.000
OII		residual	448.188	523	.857		
	amount to		488.006	531	.919		
a. Intelled	ctual property	protection by your departs	ment, your posi	ition is			

It can be seen that there are significant differences in the perception of the impact of "intellectual property protection" on the independent innovation capability of enterprises among personnel from different departments (significance value=0.000) and different job levels (significance value=0.003). Therefore, assuming that both H34 and H44 are supported. In addition, there is a significant interaction effect between departments and positions (significance probability=0.004). Next, further analyze the specific situation of the differences, as shown in table 9.

From the adjusted mean in the table above, it can be seen that the technology management department places relatively more emphasis on the impact of "intellectual property protection" on the independent innovation capability of enterprises, while senior management places relatively more emphasis on the impact of "intellectual property protection" on the independent innovation capability of enterprises.

 Table 9. Multiple Classification Analysis Table of Importance Evaluation of Intellectual Property Protection.

	Predicte	ed mean	devi	iation
N	unadjusted	Factor adjustment value	unadjusted	Factor adjustment value

Intellectu al Property Protectio n	Your departm ent is	Technology Management Department	163	4.1411	4.1085	.25577	.22312		
		technical department	297	3.7508	3.7749	13450	11040		
		Other management departments	72	3.8611	3.8356	02423	04974		
	Your	high-rise	63	4.3492	4.2618	.46387	.37646		
	position	middle-level	262	3.8168	3.8035	06854	08186		
	is	staff	207	3.8309	3.8744	05442	01096		
a. Intellect	a. Intellectual property protection by your department, your position is								

### 4. Conclusion and Suggestions

# 4.1 Importance and Implications of Influencing Factors

The order of importance of influencing factors is internal resources of the enterprise>marketization and education>intellectual property protection>policies and industrial chain, and the importance of the first three types of influencing factors is significantly higher than that of the fourth type. The key to the success of the independent innovation strategy lies in establishing a technology innovation system that is centered around enterprises and combines industry, academia, and research.

Firstly, under the conditions of a market economy, it should be emphasized that enterprises are the main body of innovation. Only by adhering to this principle, grasping the market demand orientation, and making enterprises the main body of technological innovation, can our innovation have sustainability and development potential. Promoting independent innovation with enterprises as the main body can make technological development targeted, reduce research waste, and achieve twice the result with half the effort.

Secondly, independent innovation of enterprises cannot be separated from a fair competition market environment, where the market is the dominant force that "forces" and motivates enterprise innovation. Generally speaking, the external factors for independent innovation of enterprises mainly come from market competition pressure and certain incentives, which will urge enterprises to break away from low-cost competition and achieve a higher level of technological and capability innovation. To promote independent innovation of enterprises, it is necessary to strengthen the construction of a market-oriented environment.

Thirdly, protecting intellectual property rights is of great significance for promoting independent innovation of enterprises. It is necessary to further improve the national intellectual property system, create a legal environment that respects and protects intellectual property rights, optimize the special review mechanism for intellectual property rights, and avoid the loss of independent intellectual property rights.

# 4.2 Cognitive differences and inspirations on influencing factors

From the comparison of different departments, the technology management department relatively attaches more importance to the impact of "intellectual property protection" on the independent innovation capability of enterprises. Other relevant management departments relatively do not attach importance to the impact of "internal resources of enterprises", "policies and industrial chains", and "marketization and education" on the independent innovation capability of enterprises.

From the comparison of different job levels, senior, middle, and staff unanimously believe that the impact of "marketization and education" on the independent innovation capability of enterprises is very important. Senior management places greater emphasis on the impact of "internal resources" and "intellectual property protection" on the independent innovation capability of enterprises.

The concept of human beings is the most important thing that affects innovation activities. It is the internal driving force of innovation, which can arouse people's enthusiasm, initiative, and enthusiasm for innovation and help enterprises achieve a very high innovation goal. It manifests as people's attitudes towards innovative activities. Especially the correct understanding of innovation influencing factors by senior management, technology management departments, and other relevant management departments often determines the support including for innovation, resource investment, institutional and incentive mechanism construction, etc.

Innovation involves various aspects such as enterprise management mechanisms, and innovation requires people to design and operate, so the key is still the innovation of people's concepts. Therefore, in the construction of corporate culture and training and education work, only by continuously improving the innovative consciousness and cognition of cadres and employees can enterprises maintain their youthful vitality and constantly develop and move forward in the fierce market competition.

Chinese enterprises generally have weak innovation awareness, and many managers lack sufficient understanding of the factors influencing innovation. Therefore, organizational learning of innovation related knowledge should be regarded as an important activity for enterprises, in order to build favorable conditions, management mechanisms, and platforms to support scientific and technological personnel in achieving innovation.

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