An Empirical Study on the Factors Influencing the Growth of High-tech Enterprise Clusters Based on SPSS

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Abstract— On the basis of studying the growth environment of high-tech enterprise clusters, this paper establishes a system of influencing factors from macro, meso and micro levels. Taking Jinan high-tech enterprise cluster as an example, a questionnaire was designed to collect data, and SPSS factor analysis and single factor analysis of variance were used to statistically process the collected survey data. Finally, seven major factors affecting the growth of high-tech enterprise clusters and the extent of their impact were analyzed.

Keywords-high-tech enterprises; cluster growth; influence factor; SPSS

1 INTRODUCTION

At present, the research on high-tech enterprise clusters at home and abroad mainly focuses on discussing the advantages of clusters, analyzing the causes of clusters and public policy issues in industrial clusters. There is no systematic and specialized research on the influencing factors and mechanism of high-tech enterprise cluster growth. This paper fills the research gap from both theoretical and empirical perspectives. This paper theoretically analyzes the environmental factors that affect the growth of high-tech enterprise clusters, and takes Jinan high-tech enterprise clusters as an example, using SPSS software to empirically study the factors and their impact on the growth of high-tech enterprise clusters.

2 ENVIRONMENT FOR THE CLUSTER GROWTH OF HIGH TECH ENTERPRISES

J. A. Robelandt (1998) divided the analysis level of clusters into three levels: macro (country), meso (industry) and micro (enterprise) [1]. Based on the theoretical analysis of high-tech enterprises' growth factors, this paper analyzes the influencing factors of high-tech enterprises' cluster growth from three levels: macro, meso and micro environment.

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2.1 Macro Environment for the Cluster Growth of High-tech Enterprises

Technical resources. High-tech enterprises are based on high-tech products and high-tech. a high-tech and its products have a short life cycle. rich high-tech resources are of great significance for the development of high-tech enterprises.

Economic development. Economic development has overall influence. Its level determines the average income level and affects the consumption level and consumption structure. The higher the wage level of people in the region, the higher the consumption level, and the stronger the consumption ability of high-tech products with higher added value, which will promote the development of high-tech industries.

Government action. The government is a factor with a special identity, and its influence on the cluster growth of high-tech enterprises is mainly to encourage, support, guide, standardize and serve enterprises by formulating policies and regulations, so that high-tech enterprises can grow and develop in a loose environment.

Society and culture. The biggest difference between high-tech enterprises and traditional enterprises is that they are based on knowledge and technological innovation. Facts have proved that the final realization of a series of technological innovation links, such as the creation, dissemination and application of knowledge, is not only the logical evolution of technology itself, but also depends on the institutional arrangement and cultural and other environmental factors of innovation.

2.2 Medium Environment for the Cluster Growth of High-tech Enterprises

Social service system refers to the software and hardware support system that can promote the rapid growth of high-tech enterprises and improve the quality and efficiency of enterprises. Clustering of high-tech enterprises is more likely to be restricted by the supply of factors and bear the risks of market, technology and other aspects.

The industrial environment is the first growth environment for enterprises. From the development of China's high-tech industry, we can see the role of industrial environment in the development of enterprises. In order to promote the development of high-tech industries, macro policy environment optimization and industrial policy adjustment have played a very important role [2].

The degree of association between the cluster and the outside world. The correlation with the market outside the cluster determines the size of the cluster scale effect. If a cluster's products can become a part of the domestic industrial chain, its market can be fully developed; Similarly, if a cluster's products can be integrated into the global value chain, its products can go abroad, create a good reputation, and improve the competitiveness and attractiveness of the cluster.

Cluster attraction. It is reflected in two aspects: 1. Talent attraction. Whether a cluster can successfully attract talents is the basic element of its development. When a cluster can provide greater development space, it will inevitably attract more foreign talents to join in; 2. Enterprise attraction. When a cluster can attract all kinds of specialized enterprises to join, its competitiveness will be greatly improved. Because all kinds of enterprises gather here, they can obtain economies of scale and reduce production costs. The cluster effect will be more obvious and the influence will continue to expand.

2.3 Micro Environment for the Cluster Growth of High-tech Enterprises

Corporate strategy. The management of high-tech enterprises is more challenging than that of any traditional enterprise. Therefore, more strategic guidance is needed. If the strategic positioning is ambiguous, the sustainable growth of enterprises will be seriously hampered and their competitiveness will be weakened.

Competitive environment. It is also important for the cluster to have a good competition and cooperation environment. Fierce competition can promote continuous innovation of enterprises. Especially when a powerful new competitor appears, the imitation effect will make the innovative ideas pass forward, backward and horizontally. A good cooperation atmosphere can also promote informal exchanges, mutual cooperation and common development between high-tech enterprises, thus reducing transaction costs. The competitiveness of clusters also comes from conscious joint action.

The enterprise's technological innovation capability. The ability of technological innovation is fundamental to the survival of high-tech enterprises. If an enterprise is only satisfied with the current technical level and does not want to make progress, it will soon be eliminated by fierce competition. Due to the great competitive pressure among enterprises in the cluster, continuous innovation is the only way for enterprises to survive [3].

Through the analysis of the macro, meso and micro environmental factors of the cluster growth of high-tech enterprises, it can be seen that whether the cluster can grow rapidly is closely related to whether its environment can provide diversified services. Combined with the environmental factors of high-tech enterprises' own growth and clustered growth, this paper summarizes the specific factors that affect high-tech enterprises' clustered growth as follows [4].

Table 1 The influencing factors system of high-tech enterprise cluster growth

Influence Factors	Index
Micro Factors	Enterprise plan, business model, enterprise management ability, enterprise management concept, enterprise innovation ability
	Cooperative marketing, cooperative production, technical mutual assistance, information sharing and cooperative training among enterprises
	The degree of difficulty for new enterprises to seize the market, the embeddedness of local enterprises, and tax treatment
Meso Factors	Various agencies, enterprise consulting services, talent service agencies, news media and other intermediary service agencies
	Transportation, post and telecommunications, information network, logistics channels
	Retail, catering, environmental sanitation, medical, cultural and sports, tourism, housekeeping services and other living service institutions
	Banks, insurance enterprises, leasing enterprises, securities enterprises, property rights trading institutions and other financial service departments

	Clustering of related industries, proximity to markets, local culture, industrial parks, and specialized markets
	Knowledge dissemination, innovation network, and connection with university scientific research institutions
Macro Factors	Social security system, government administrative efficiency, government service awareness, local brand publicity
	Industrial layout guidance, national investment in industrial research and development, and industrial development support

3 AN EMPIRICAL ANALYSIS OF THE FACTORS AFFECTING THE CLUSTER GROWTH OF HIGH TECH ENTERPRISES

This paper takes Jinan high-tech enterprise cluster as an example, and on the basis of the above research, designs the questionnaire "Factors influencing the growth of high-tech enterprise cluster in Jinan" to empirically study the factors influencing the growth of high-tech enterprise cluster and their importance. The survey contents mainly include: basic information of enterprises, business operation, cooperation degree of enterprises in the cluster, government functions, policy advantages, etc. The questionnaire requires respondents to make a 5-level judgment according to the actual situation of the enterprise and the conformity of various possible influencing factors. For example, 1 represents that the factor is extremely inconsistent, and 5 represents that it is very consistent. SPSS factor analysis and single factor analysis of variance are used to statistically process the collected survey data to determine the main factors affecting the growth of high-tech enterprise clusters, and analyze the different degrees of influence of each factor.

3.1 Survey and Sample

In October 2021, 40 questionnaires were distributed in Jinan High tech Zone, and 36 questionnaires were collected for preliminary statistical processing. The questionnaire design was revised and improved. At the beginning of November 2021, a large-scale questionnaire survey was conducted in Lixia District, High tech Zone and Licheng District of Jinan City, where more than 100 high-tech enterprises and their auxiliary enterprises were investigated, including Shandong Hongda Technology Group Co., Ltd., Jinan Zhuoxin Intelligent Technology Co., Ltd., Jinan Funonda Water Technology Development Co., Ltd. and Jinan Xintian Technology Co., Ltd.

A total of 200 questionnaires were distributed, 156 were recovered, and 128 were valid. The recovery rate and effective rate were 78.0% and 82.1%, respectively, which met the requirements of the technical method of social questionnaire. The basic information of the sample is shown in Table 2.

Table 2 Basic Information of Samples

Enterprise Establishment Time (%)			Number of Employees at the Time of Establishment (%)			Number of Employees at the end of 2020 (%)		
2000-2010	2011-2015	2015-2020	＜20	20-50	＞50	＜200	200-500	＞500
11.8	40.6	47.6	23.4	45.3	31.3	31.2	58.6	10.2

3.2 SPSS Data Analysis

This paper uses the factor analysis method in SPSS11.5 system software to analyze the influencing factors of high-tech enterprise cluster growth. Factor analysis is to find a few common factors controlling all variables by studying the internal dependency of the correlation matrix of multiple indicators, and express each indicator variable as a linear combination of common factors to reproduce the correlation between the original variables and factors. The purpose of factor analysis is to find the basic structure of variables, simplify the observation system, reduce the dimension of variables, explain the whole problem with a few variables.

$$X = (X_1, X_2, \ldots X_n)^T$$

They are observable random vectors. The common factor to be found is $F = (F_1, F_2, \ldots F_n)^T$. The model is

$$X_1 = a_{11}F_1 + a_{12}F_2 + \ldots + a_{1n}F_n + \xi_1$$

$$X_2 = a_{21}F_1 + a_{22}F_2 + \ldots + a_{2n}F_n + \xi_2$$

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$$X_P = a_{P1}F_1 + a_{P2}F_2 + \ldots + a_{Pn}F_n + \xi_P \quad (1)$$

SPSS11.5 system software is used as the analysis tool × The result of KMO test on 128 sample data is 0.801, which indicates that this sample is suitable for factor analysis. Then the principal component analysis method is used to conduct factor analysis on the sample data, and the total variance explained (Table 3) is obtained. Seven new factors are extracted according to the principle that the cumulative contribution rate reaches 80%. The cumulative contribution rate of these seven factors has reached 80.598%, and the characteristic values are greater than 1. The rotated component matrix (a) and the component score coefficient matrix are obtained by rotating the load matrix using the maximum variance method [5].

Table 3 Total Variance Explained

Component	Initial Characteristic Value			Factor Disjunction Result after Rotation		
	Characteristic value	Contribution rate%	Cumulative contribution rate%	Characteristic value	Contribution rate%	Cumulative contribution rate%

1	10.515	35.048	35.048	4.200	14.000	14.000
2	2.609	8.697	43.746	4.175	13.918	27.918
3	2.025	6.751	50.497	3.907	13.025	40.943
4	1.831	6.102	56.599	3.285	10.950	51.893
5	1.717	5.724	62.323	2.144	7.146	59.038
6	1.399	4.663	76.986	1.852	6.174	65.213
7	1.084	3.612	80.598	1.616	5.386	80.598

According to the load size on different indicators, the seven new factors are named respectively (Table 4).

Table 4 Factors Affecting the Cluster Growth of High tech Enterprises

Principal Factor	**Index**	**Load**
Enterprise Operation	Enterprises pay attention to staff skills and quality	0.784
	Team cooperation level of enterprise managers	0.866
	Ideas and methods of middle and senior managers	0.780
	Enterprise's ability to expand product sales channels	0.694
	Enterprises' adaptability to changes in market situation	0.648
Innovation System	Enterprise innovation input	0.747
	Degree of connection between enterprises, universities and scientific research structures	0.836
	Government investment in enterprise R&D	0.535
Industrial Threshold	Stable number of enterprises	0.664
	Tax treatment	0.883
	It is difficult for foreign enterprises to enter	0.830
	It is difficult for new enterprises to seize the market of this industry	0.684

Enterprise Collaboration	The enterprise is familiar with the operation trend of local peers	0.510
	Enterprises and partner enterprises cooperate to open up the market	0.677
	Enterprise agglomeration level	0.595
	Easy communication and learning between enterprises	0.727
	Share orders with partners	0.767
Government Services	Government administrative efficiency	0.576
	The government actively prepares to build industrial parks	0.487
	The government organizes local product fairs	0.779
	The government cultivates famous brands in the industry	0.818
	The government guides the construction of specialized markets	0.874
	Government talent policy	0.7360
Industrial Policy	Industrial layout	0.436
	Industry long-term planning	0.549
	Industrial development support	0.486
Social Service System	Transportation, logistics and communication facilities	0.580
	Better living conditions	0.686
	Enterprise financing conditions	0.834
	Intermediary services	0.720

4 CONCLUSIONS

On the basis of theoretical analysis, this paper establishes the influencing factors system of high-tech enterprise cluster growth from three aspects: macro, meso and micro. According to this system, a questionnaire is designed to collect data, and SPSS factor analysis and one-way ANOVA are used to statistically process the collected survey data. Finally, seven main factors affecting high-tech enterprise cluster growth and their impact degrees are obtained. The research conclusion has theoretical guiding significance and practical application value for the research of cluster growth formed by the interaction of high-tech enterprises in China.

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