Research on Innovation Performance of VR and Tobacco Industrial Cluster Based on Structural Equation Model

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Abstract: As a traditional industry, the tobacco industry is an important part of the national economy and has an important position in meeting social consumption demand and increasing national and local fiscal revenue. And VR industry, as an emerging industrial economy, can effectively empower the development of tobacco industry. To further promote the development of VR and tobacco industry clusters and optimize the industrial structure, this paper constructs a conceptual model of the factors influencing the innovation performance of VR and tobacco industry clusters from a social network perspective based on the triple helix theory. Structural equation method and data of relevant companies of VR and tobacco industry in Nanchang is used to study the influencing factors of their innovation performance, and further examines the influence mechanism of R&D investment, government behavior and cluster atmosphere on innovation performance of these two industrial clusters. The results show that R&D investment, government behavior and cluster atmosphere have positive effects on innovation performance of Nanchang VR and tobacco industry cluster. The conclusions of this paper enrich the influencing factors of cluster innovation performance and expand the scope of innovation performance theory in the context of VR and tobacco industrial cluster.

Key words: VR industrial cluster; innovation performance; triple helix theory; tobacco

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INTRODUCTION

It is pointed out that cultivating several world-class advanced manufacturing clusters plays an essential part in achieving the goal of establishing China's modern economic system and promoting industries to move towards the medium-high end of the global value chain[1]. In 2020, the Torch Center of the Ministry of Science and Technology issued the relevant notice which proposed that in order to further promote the construction of innovative industrial clusters, we should mainly solve major technical problems, enhance the innovation and competitiveness of the industry, promote the establishment and development of regional economic system, establish industrial alliances, and promote cooperative innovation. The innovation of industrial cluster is the result of mutual cooperation and influence among various organizations engaged in knowledge production, dissemination and application. Therefore, innovation performance

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largely depends on how to construct knowledge innovation aggregation among enterprises in industrial cluster to produce more effective output than individual enterprises. In addition, we need to accelerate the development of digital transformation, firmly grasp the development trend of the digital economy, and unified planning and design, comprehensive integration of resources, standardized process control, innovative management mechanisms, to promote the digital transformation of the whole element, business, and scene, to create a new digital economy ecology of the tobacco industry.

In addition, the 19th Party Congress clearly put forward that "innovation is the first driving force leading development and is the strategic support for building a modern economic system". During the "13th Five-Year Plan" period, the tobacco industry has resolutely implemented the decisions and plans of the Party Central Committee and the State Council, promoted the implementation of the innovation-driven development strategy, strengthened the "two-wheel drive" of scientific and technological innovation and institutional innovation, and built an industrial technology system covering agriculture and industry and linking upstream and downstream. At the same time, the State Tobacco Monopoly Administration has set scientific and technological innovation as the goal of new ideas. In the commitment to building a modernized tobacco economic system and promoting the high-quality development of the tobacco industry, the tobacco industry to seize strategic opportunities to continue to build new momentum and new advantages to lead the development. In 2021, the tobacco industry has systematically elaborated on how to achieve the development of the industry. We should always focus on “where to grow tobacco, who to grow tobacco, how to grow tobacco” three major propositions, stabilize core tobacco areas, set scientific and technological innovation as the key to effectively promote its transformation, effectively enhance the endogenous power of production, serve high-quality development and rural revitalization of the overall situation. In addition, we need to accelerate the development of digital transformation, firmly grasp the development trend of the digital economy, unified planning and design, comprehensive integration of resources, standardized process control, innovative management mechanisms, to promote the digital transformation of the whole element, business, and scene, to create a new digital economy ecology of the tobacco industry.

However, the tobacco industry cluster is a resource-based industry cluster in the traditional sense, with low market concentration and less innovation. All along, in the case of huge tobacco revenue, many enterprises rest on their laurels and are unwilling to carry out product reform and innovation, resulting in slow renewal of cigarette products, which makes it difficult to fully meet consumers' consumption and social environment needs and fewer cigarettes are adapted to the current consumer market.[2]In order to improve the development of the tobacco industry cluster system, the tobacco industry must continue to improve industrial support, strengthen its chain, change the production of "all-powerful" for the fine division of labor "professional", the "self-service" for "social network", the manufacturing process "closed" to seek collaborative partners production "open".

Industrial cluster is an organic system of industrial development. Different types of industrial cluster in the global value chain are different in terms of cluster innovation. The innovation of high and new technology enterprise cluster comes from the enhancement of the horizontal connection between its member enterprises and foreign knowledge enterprises, while the innovation of low technology enterprise cluster benefits from the longitudinal connection between its member enterprises and main participants in the overseas value chain.[2]In the new development era, as a high-tech industry, VR industry should promote the development of industrial cluster, which is conducive to leading and stimulating social innovation, and promoting the flow of innovation elements among market subjects. At the same time, the use of VR in the tobacco industry can be very helpful in monitoring youth tobacco product purchases and reducing youth access in retail channels. It also helps to develop a tobacco-specific risk assessment methodology that reflects the regulatory framework of the Tobacco Control Act and the unique characteristics of tobacco products and tobacco use.

There are still some problems in China's VR industry, such as unbalanced development, lack of core technologies, and limited product application scenarios, which make it urgent to promote the

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innovative development of VR industry clusters.Currently, tobacco industry clusters face problems such as high costs and poor innovation performance. In terms of the relationship between enterprise innovation network and innovation performance, enterprise potential, government behavior orientation and enterprise cooperation driving force all influence the development of innovation network and innovation performance in different degrees and levels.[3] Many scholars have studied government-industry-university collaborative innovation in industrial clusters. Both Zhang[4]and Yuan[5] carried out studies based on the triple helix theory. Zhang[4] argued that industrial cluster is the beginning of innovation activities, the government should provide a supportive policy environment for industrial cluster innovation, universities and research institutes should provide knowledge output, personnel and intellectual support for enterprise cluster innovation. Yuan[5] based on the triple helix theory, constructed the interactive relationship of "universities and research institutes-cluster enterprises-government", in which the three subjects mutually cooperate and jointly promote regional innovation and development.

Through various studies, scholars generally agree that geographic proximity plays a positive role in promoting mutual learning, knowledge dissemination and innovation among enterprises in industrial clusters, and factors including cooperation and sharing among enterprises in clusters, government behavior orientation, and technology R&D play a positive role in promoting innovation performance of industrial clusters. In the existing literature, most researches on industrial clusters pay attention to traditional industries. However, there are few targeted researches on industrial clusters of high-tech industries such as the VR industry. In view of this, based on the triple helix theory, this paper will study the influence mechanism of R&D investment, government behavior and cluster atmosphere on innovation performance of VR and tobacco industrial cluster, and construct structural equation model to carry out empirical test based on the survey data of Nanchang VR and tobacco industry cluster, so as to promote the deep division between enterprises, establish VR industrial clusters, sustain the social network relationship between enterprises, and effectively play the role of industrial clusters on the innovation performance of VRand tobacco industry.

THEORETICAL ANALYSIS AND RESEARCH HYPOTHESIS

Virtual Reality and Tobacco Industrial Cluster

China (Nanchang) virtual reality (VR) industrial cluster has been initially built, with four centers, namely, VR innovation, experience, display, cloud, as well as four platforms, namely, capital, education, standards, trading. In specific, the trading platform has completed a total transaction volume of 130 million yuan, and technological innovation activities have become increasingly frequent.[6]Currently, there are many problems in the construction of Nanchang VR industrial cluster. For example, compared with other VR industrial clusters, it fails to highlight its advantages and cultivate local enterprises with VR related core technologies. In addition, at present, Nanchang VR industrial cluster has not yet built a complete scientific and technological industry chain. However, many key components and technologies of VR products require a complete industrial chain for R&D and production, which also indicates the extremely low innovation performance of the industrial cluster and calls for further measures to improve the innovation performance of the industrial cluster. Therefore, the government-industry-university collaborative relationship should be strengthened. In other words, the government should continue to promote the introduction and encouragement of high-tech core talents and implement preferential policies for the settlement of large high-tech enterprises. Cluster enterprises should also take advantage of the policies and actively upgrade and innovate products and technologies. Professional universities should continue to promote the training of talents with special qualities in VR industry and strengthen exchange and cooperation with cluster enterprises. Based on the triple helix theory, this paper will study and analyze the factors influencing the innovation performance of Nanchang VR industry cluster by establishing a conceptual model, so as to provide some suggestions for improving the innovation capacity of Nanchang VR industry cluster and solving many existing problems.

Analysis of Influencing Factors of Innovation Performance of VR Industry Cluster

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The triple helix theory is a regional government-industry-university innovation economic theory proposed by the famous American economist Henry Etzkowitz in 1990. This innovative theory mainly studies the regional economic cooperative relationship of innovation and collaboration among universities and scientific research institutes, industries, and local governments, which lays more emphasis on the innovation of each subject through effective government-industry-university interaction. The explanation of the theory can be described in the Figure 1 below.

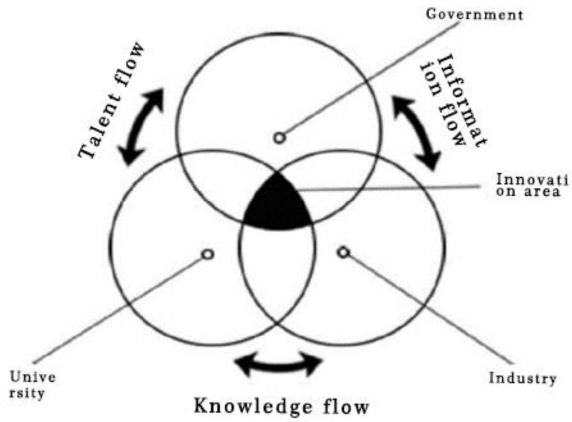

Figure 1 Triple Helix Theory Diagram

Based on this theory, the above triple helix can be summarized into the following three aspects: R&D investment, government behavior and cluster atmosphere, that is, the three influencing factors of innovation performance of VR and tobacco industrial clusters, and a conceptual model is constructed as shown in the Figure 2 below.

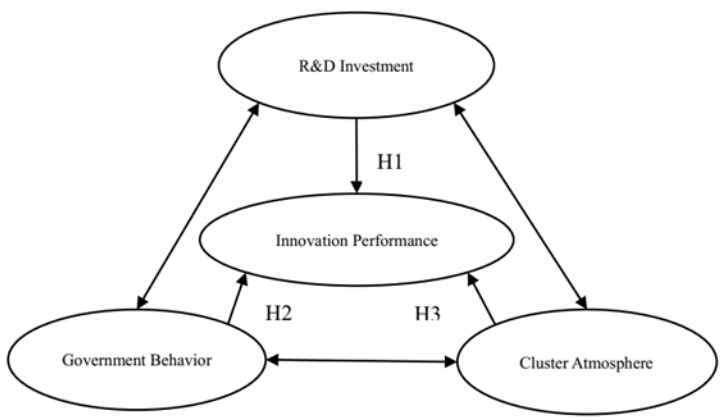

Figure 2 Conceptual Model of Influencing Factors of Innovation Performance of Nanchang VR Industrial Cluster

Research Hypothesis

According to the logical relationship among factors influencing the innovation performance of Nanchang VR and tobacco industrial cluster, this paper proposes three hypotheses based on the VR and tobacco industry cluster conceptual model constructed above.

From the perspective of the relationship between enterprises and research organizations, Hu et al.[7]pointed out that universities and research institutions are the core elements of the network innovation mode of cluster enterprises. Graf et al.[8]took four regions in East Germany as examples and pointed out that universities and research institutions play an important role in regional innovation network. Enterprises with strong innovation intention and large innovation investment have better performance in terms of business performance and profitability through their own R&D or cooperation with universities and R&D centers, which can promote the development

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of innovation performance of industrial clusters. R&D investment of enterprises includes the proportion of capital investment of R&D activities, the proportion of R&D personnel, the frequency of cooperation between enterprises and universities or research institutes, etc. Generally speaking, the more an enterprise invests in R&D activities, the more it can improve its independent innovation ability, produce higher innovation performance and higher added value of products. The number of patents owned by an enterprise is also an intangible asset. In addition, the close cooperation between enterprises and universities or research institutes is conducive to the introduction of core professionals and the cultivation of their own technical teams.

H1: R&D investment factors have a positive correlation with innovation performance of industrial clusters.

The Technological Innovation Research Center of Tsinghua University takes government policy, social culture and facilities as the factors that affect enterprise innovation performance. From the perspective of the interaction between enterprises and governments, Liu et al.[9]proposed that the government provides a supportive environment for cluster enterprise innovation through policy formulation and infrastructure construction. Bai et al.[3] pointed out that government behaviors have a strong guiding and promoting effect, which not only include government policy behavior, but also include planning behavior and investment behavior, greatly influencing the development direction and scale expansion of the industry. Government behaviors mainly include government tax incentives, talent introduction policies and investment in infrastructure construction. Government, as the "visible hand", can effectively regulate the market economy, make up for the limitations of market adjustment in terms of the mastery of the overall economy and market information. In order to promote the development of VR industry cluster, governments conduct tax credit on enterprise related operation behaviors, implement investment support policies, promote the introduction of talents from other domestic areas and even other countries, develop talent retention mechanism, coordinate specific departments to build VR infrastructure, which plays a crucial role.

H2: Government behavior factors have a positive correlation with innovation performance of industrial clusters.

Some scholars further proposed that there is a positive correlation between cluster atmosphere and cluster innovation performance. Tomplinson[10]found that the close relationship between SMEs and suppliers can promote innovation. Krause[11]concluded from the perspective of enterprise cooperation that there is a positive correlation between the cooperative relationship between enterprises in clusters and innovation performance of industrial clusters. Yeniyurtet al.[12]believe that innovation performance is influenced by trust, cooperation and innovation attitude and behavior of enterprises. Dooley et al.[13] believe that geographic proximity plays an important role in promoting the dissemination of all kinds of knowledge and information of cluster enterprises. Since knowledge is an important basic resource for innovation of cluster enterprises, it can be concluded that geographic proximity can promote cooperation and innovation development. The positive behavior of enterprises in the cluster improves the innovation performance of enterprises, and the improvement of enterprise innovation performance promotes the own behavior of cluster enterprises.[3]The cluster atmosphere includes the richness of the sources and channels of enterprise operating funds, the frequency of collective sales among enterprises, the degree of information sharing and communication between enterprises, and the frequency of cooperation between enterprises and local upstream and downstream manufacturers. To a certain extent, the higher frequency of collective procurement and collective sales among industrial cluster enterprises is conducive to reducing procurement and sales costs, learning from each other by taking advantage of location, making progress together and constantly improving independent innovation ability.

H3: Cluster atmosphere factors have a positive correlation with innovation performance of industrial clusters.

DATA SOURCE AND VARIABLE SELECTION

Data Sources

In this paper, the database is established by the effective questionnaires collected in the questionnaire survey. The recipients of the questionnaire survey mainly include employees or

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managers in the VR enterprises in Nanchang, engaging in different departments including production, sales, R&D, etc. A total of 321 questionnaires was recovered after the elimination of invalid questionnaires.

Variable Selection

In order to make the selected indicators more scientific and representative, based on the comprehensive consideration, R&D investment, government behavior and cluster atmosphere are included in independent variables. As shown in Table 1, the following indicators are selected to reflect the innovation performance of VR industrial clusters and its influencing factors.

Table 1
Main Variables

		Sign	Observation Variable
Independent variables	**R&D investment**	**C1**	The proportion of capital investment of R&D activities in the enterprise
		C2	The number of R&D personnel in the enterprise
		C3	The frequency of cooperation between enterprises and universities or research institutes
	Government behavior	**C4**	The sources and channels of enterprise operating funds
		C5	The investment in infrastructure construction
		C6	The supporting cooperating programs of the government
	Cluster atmosphere	**C7**	The degree of information communication between cluster enterprises
		C8	The degree of collective sales engaged by cluster enterprises
		C9	The frequency of secondment of assets or personnel between cluster enterprises
Dependent variables	**Innovation performance**	**D1**	The proportion of income from new technology and products to sales
		D2	Whether new technology and products serve as major source of growth
		D3	Patents owned by the enterprise

Reliability and Validity Analysis

Reliability refers to the consistency and stability of the survey results obtained by using the same method for the same survey object in the questionnaire process. The most commonly used reliability coefficient is the Cronbach α reliability coefficient. Generally speaking, if Cronbach α reliability coefficient is higher than 0.6, it is indicated that the data has good reliability. If it is lower than 0.5, the data is not suitable for further analysis.

Reliability analysis

In this paper, Cronbach's α value was calculated to evaluate the reliability of the questionnaire item corresponding to each variable. The test results of SPSS.24 are shown in the Table 2.

Table 2
Reliability Analysis Results

Variable	Number of items	Cronbach α coefficient
R&D investment	3	.949
Government behavior	3	.878
Cluster atmosphere	3	.959

As can be seen from the above table, the Cronbach's α values of this questionnaire are all above 0.8, indicating that each variable has good reliability and suitable for further research.

Validity analysis

Validity analysis is to test the validity of questionnaires to determine whether the designed items are reasonable and can effectively reflect the research objectives. Correlation matrix, KMO test and Bartlett sphericity test were applied for validity test in this paper, and the specific results in the Table 3 are as follows.

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Table 3
Correlation Matrix

Correlation Matrix													
		C1	**C2**	**C3**	**C4**	**C5**	**C6**	**C7**	**C8**	**C9**	**D1**	**D2**	**D3**
Correlation	**C1**		.93	.84	.87	.84	.60	.82	.81	.71	.93	.87	.89
	C2	.93		.82	.88	.87	.59	.85	.85	.74	.96	.91	.92
	C3	.84	.82		.89	.86	.63	.87	.88	.78	.84	.82	.87
	C4	.87	.88	.89		.92	.65	.89	.88	.79	.88	.87	.91
	C5	.84	.87	.86	.92		.61	.89	.89	.80	.89	.87	.91
	C6	.60	.59	.63	.65	.61		.61	.59	.56	.59	.56	.60
	C7	.82	.85	.87	.89	.89	.61		.94	.86	.87	.85	.88
	C8	.81	.85	.88	.88	.89	.59	.94		.86	.85	.84	.87
	C9	.71	.74	.78	.79	.80	.56	.86	.86		.75	.76	.78
	D1	.93	.96	.84	.88	.89	.59	.87	.85	.75		.91	.93
	D2	.87	.91	.82	.87	.87	.56	.85	.84	.76	.91		.92
	D3	.89	.92	.87	.91	.91	.60	.88	.87	.78	.93	.92	
Significance (One-tailed)	**C1**		.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
	C2	.00		.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
	C3	.00	.00		.00	.00	.00	.00	.00	.00	.00	.00	.00
	C4	.00	.00	.00		.00	.00	.00	.00	.00	.00	.00	.00
	C5	.00	.00	.00	.00		.00	.00	.00	.00	.00	.00	.00
	C6	.00	.00	.00	.00	.00		.00	.00	.00	.00	.00	.00
	C7	.00	.00	.00	.00	.00	.00		.00	.00	.00	.00	.00
	C8	.00	.00	.00	.00	.00	.00	.00		.00	.00	.00	.00
	C9	.00	.00	.00	.00	.00	.00	.00	.00		.00	.00	.00
	D1	.00	.00	.00	.00	.00	.00	.00	.00	.00		.00	.00
	D2	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00		.00
	D3	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	

The upper half part of the above table shows correlation. Correlation coefficients between data mostly range from 0.7 to 0.8, all above 0.5, and all variables are correlated. The lower half part shows significance (one-tailed). From the above matrix, it can be concluded that variables are significantly correlated with each other, which has passed the test.

Table 4
KMO and Bartlett Sphericity Test of R&D Investment

KMO and Bartlett sphericity test		
KMO measure of sampling adequacy		.744
	Approximate chi-square	1018.697
Bartlett sphericity test	Degree of freedom	3
	Significance	.000

KMO test is used to test the correlation between variables. The test value obtained is between 0 and 1, and the closer the value is to 1, the stronger the correlation between variables is. When the KMO test value is below 0.5, factor analysis is not suitable. At the same time, Bartlett test value should

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be less than 0.05.

As can be seen from the test results in Table 4, KMO value is 0.744, greater than 0.7, indicating good data effect. Bartlett sphericity test value is 0.00, indicating a strong correlation between the observed variables.

Table 5
KMO and Bartlett Sphericity Test of Government Behavior

KMO and Bartlett sphericity test		
KMO measure of sampling adequacy		.659
	Approximate chi-square	779.134
Bartlett sphericity test	Degree of freedom	3
	Significance	.000

According to the test results in Table 5, the KMO value is 0.659, indicating that the correlation between variables is acceptable. Bartlett sphericity test value is 0.00, indicating a strong correlation between the observed variables.

Table 6
KMO and Bartlett Sphericity Test of Cluster Atmosphere

KMO and Bartlett sphericity test		
KMO measure of sampling adequacy		.753
	Approximate chi-square	1154.644
Bartlett sphericity test	Degree of freedom	3
	Significance	.000

As can be seen from the test results in Table 6, KMO value is 0.753, indicating strong correlation between variables. Bartlett sphericity test value is 0.00, indicating a strong correlation between the observed variables.

EMPIRICAL ANALYSIS

Model Construction

Structural equation usually consists of three matrix equations:

$$\eta = \beta\eta + \Gamma\xi + \zeta (1)$$
$$Y = \Lambda y\eta + \varepsilon \ (2)$$
$$X = \Lambda x\xi + \sigma (3)$$

Equation (1) is the structural equation, where η is the endogenous latent variable, ξ is the exogenous latent variable, β represents the coefficient matrix of the interaction between the endogenous latent variable η, γ represents the influence of the exogenous latent variable ξ on the endogenous latent variable η, and ζ is the error vector. Equation (2), (3) are the measurement equations. X is the measurement equation of exogenous latent variables, where Λx refers to the correlation coefficient matrix between the exogenous latent variables and the measurable variables, while Y is the measurement equation of endogenous latent variables, where Λy refers to the correlation coefficient matrix between the endogenous latent variables and the measurable variables. Latent variables can be reflected by measurable variables through the measurement equations.[14]

In reference to the studies of Guo[15] and Luo[16], the former constructs structural equation model to empirically study new energy industrial clusters, while the latter conducts empirical research on the factors influencing innovation performance of industrial clusters. The preliminary model constructed is shown in Figure 3 below.

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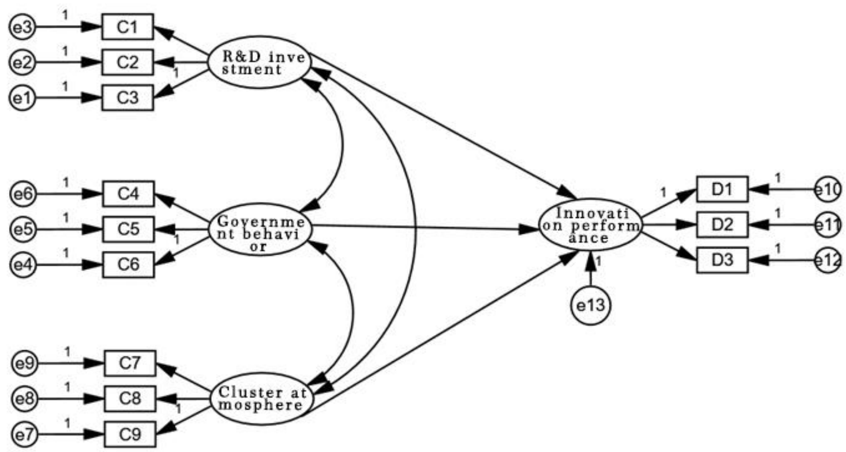

Figure 3 The Preliminary Model Structure

There are 3 exogenous latent variables in this model, namely, R&D investment, government behavior and cluster atmosphere, corresponding to 9 exogenous observed variables: The proportion of capital investment of R&D activities in the enterprise, the number of R&D personnel in the enterprise, the frequency of cooperation between enterprises and universities or research institutes; The sources and channels of enterprise operating funds, the investment in infrastructure construction, the supporting cooperating programs of the government; The degree of information communication between cluster enterprises, the degree of collective sales engaged by cluster enterprises, the frequency of secondment of assets or personnel between cluster enterprises. The residuals corresponding to the observation variables are E1-E9. There is one endogenous latent variable, innovation performance of VR industrial cluster, corresponding to three endogenous observation variables:The proportion of income from new technology and products to sales, whether new technology and products serve as major source of growth,patents owned by the enterprise.

Model Identification

Model identification is required after the initial structural equation model is established. According to the relationship between the number of model data points and the number of parameters, model identification can be divided into three types: exact identification, over identification and low identification. Only when the model is exactly identified and over identified can the subsequent fitting be carried out. t rule is commonly used to judge whether the model can be identified. Assuming that the model has m exogenous observation variables and n endogenous observation variables, the number of formed data points of the model is $\frac{1}{2} * (m+n) * (m+n+1)$. Let the number of free parameters to be estimated is t, then the degree of freedom of the final structural equation model can be expressed as $d_f = \frac{1}{2(m+n)(m+n+1)} - t$. When $d_f \geq 0$, that is, exact identification and over identification, the model can be identified.

In the structural equation model of VR and tobacco industrial cluster in this paper, there are 9 exogenous observation variables and 3 endogenous observation variables, that is, m=9 and n=3. Through a series of calculations, t value is 30, that is, there are 30 free parameters to be estimated. Hence, d_f =78-30=48>0, which belongs to over identification according to the model recognition standard, so subsequent fitting can be carried out.

Model Estimation

After confirming that the model can be recognized, the sample data for model estimation is generally required to be large enough. Bentler and Chousuggested that the sample number should be no less than 100, and preferably more than 200.[17]In terms of estimation method selection, the estimation method in this paper is Maximum Likelihood (ML) estimation.

After establishing the structural equation model

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of VR industrial cluster, the variance and covariance of observed variables in the model were estimated. The results of AMOS.24 of are as shown in Figure 4.

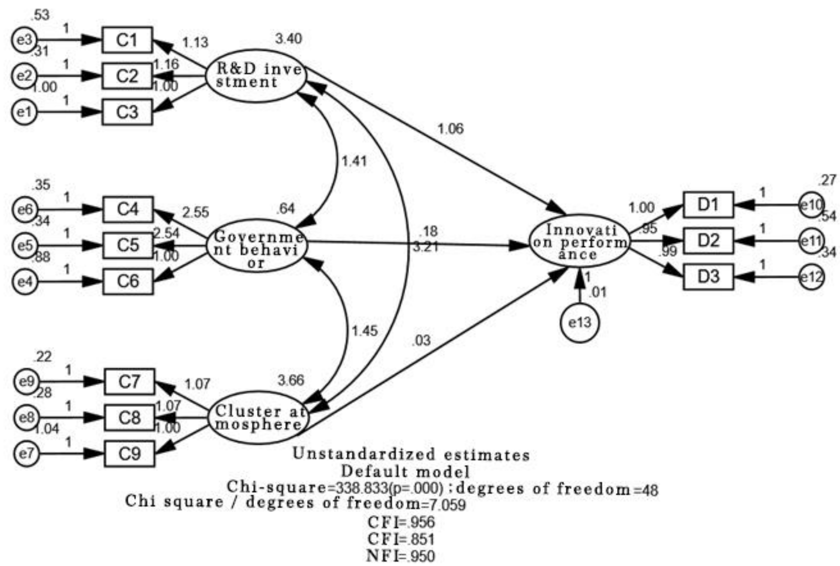

Figure 4 Basic Results of Structural Equation Model

Table 7
Results of Coefficient Estimation

			Estimate	S.E.	C.R.	P
Innovation performance	<---	R&D investment	1.061	.088	2.064	***
Innovation performance	<---	Government behavior	.176	.247	.711	.477
Innovation performance	<---	Cluster atmosphere	.033	.061	.538	.591
C3	<---	R&D investment	1.000			
C2	<---	R&D investment	1.158	.039	29.435	***
C1	<---	R&D investment	1.127	.041	27.474	***
C6	<---	Government behavior	1.000			
C5	<---	Government behavior	2.543	.174	14.628	***
C4	<---	Government behavior	2.554	.175	14.628	***
C9	<---	Cluster atmosphere	1.000			
C8	<---	Cluster atmosphere	1.071	.036	29.729	***
C7	<---	Cluster atmosphere	1.074	.036	30.247	***
D1	<---	Innovation performance	1.000			
D2	<---	Innovation performance	.955	.023	41.131	***
D3	<---	Innovation performance	.985	.020	48.397	***

*Note: *** indicates significance in the level of 0.001*

It can be seen from Table 7, R&D investment, government behavior and cluster atmosphere all have a positive effect on the innovation performance of VR and tobacco industrial clusters, among which R&D investment has a significant relationship with the innovation performance of VR industrial clusters. Therefore, hypothesis H1, H2 and H3 are verified.

Model Fitting

Table 8
Evaluation Index of Model Fitting

Index		Criterion
Absolute fit index	*CMIN*	The small the better, < 300
	GFI	> 0.9
	RMR	< 0.05 excellent, < 0.08 good
	RMSEA	< 0.05 excellent, < 0.08 good
Relative fit index	*NFI*	> 0.9,the closer to 1, the better
	TLI	> 0.9,the closer to 1, the better
	CFI	> 0.9,the closer to 1, the better

Table 9
Model Fit Index Test

Fit Index	CMIN	CMIN/DF	GFI	RMR	RMSEA	NFI	TLI	CFI	IFI
	338.8	7.059	0.858	0.115	0.134	0.950	0.941	0.957	0.957

According to the test result of fit index in Table 9, based on the fitting criterion in Table 8 we can conclude that except CMIN (Chi- square value), GFI, RMR and RMSEA, all indexes have reached acceptable model fitting criterion. Based on the M.I. (Modification Indices) estimated by the model, we can carry out further model modification for the relevant variables.

Model Modification

Table 10
Modification Index Table

			M.I.	Par Change
e11	<-->	e12	13.050	.099
e9	<-->	e10	7.054	.054
e8	<-->	e13	4.558	-.038
e8	<-->	e10	5.433	-.049
e6	<-->	e13	8.657	-.056
e6	<-->	e10	17.196	-.095
e5	<-->	e13	13.105	.069
e5	<-->	e12	9.453	.077
e5	<-->	e8	4.458	.053
e4	<-->	e13	5.604	-.062
e4	<-->	e6	4.582	.079
e3	<-->	e12	13.106	-.100
e3	<-->	e11	8.112	-.095
e3	<-->	e10	10.644	.082
e3	<-->	e6	13.910	.114
e3	<-->	e5	13.636	-.112
e2	<-->	e13	5.904	.038
e2	<-->	e12	9.366	-.068
e2	<-->	e10	30.419	.111
e2	<-->	e3	9.299	.083
e1	<-->	e13	5.914	-.067
e1	<-->	e12	5.509	.086
e1	<-->	e10	19.077	-.147
e1	<-->	e8	13.496	.136
e1	<-->	e6	17.628	.169
e1	<-->	e4	6.924	.143

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e1	<-->	e2	32.231	-.205

It can be seen from Table 10 model correction index table that the modification index (MI) between *e1* and *e2* is the maximum, which is 32.231. Therefore, we modify the model by establishing the relationship between *e1* and *e2*. Based on the modification index, four times of modification between *e1* and *e2*, *e2* and *e10*, *e3* and *e10*, *e1* and *e8*, the relatively ideal parameter fitting degree is achieved for the model data. The correction results are shown in Table 11.

Table 11
The Ultimate Model Fitted Value

Fit Index	CMIN	CMIN/DF	GFI	RMR	RMSEA	NFI	TLI	CFI	IFI
	168.991	3.841	0.919	0.080	0.094	0.975	0.972	0.981	0.981

The modified RMSEA value of the model is 0.094, which is higher than the standard of 0.08, but between 0.08 and 0.10. According to the conclusion of Wu Minglong in *Structural Equation Models: Operation and Application of AMOS*, this model belongs to the general adaptation model, which means it can be accepted.

The final model output is shown in Figure 5:

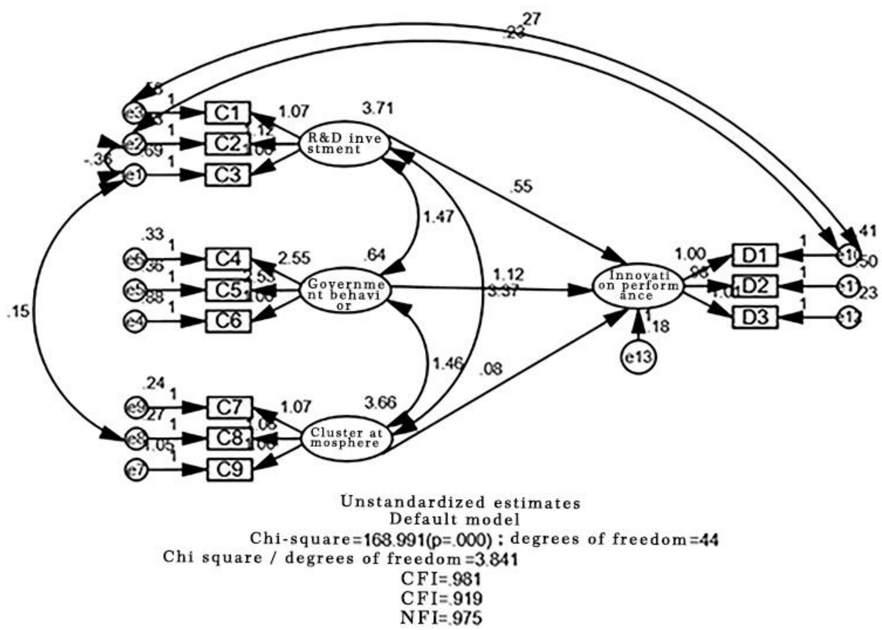

Figure 5 The Output of Modified Model

Table 12
Results of Coefficient Estimation

			Estimate	S.E.	C.R.	P
Innovation performance	<---	R&D investment	.548	.076	7.226	***
Innovation performance	<---	Government behavior	1.120	.254	4.404	***
Innovation performance	<---	Cluster atmosphere	.078	.062	1.244	.214
C3	<---	R&D investment	1.000			
C2	<---	R&D investment	1.117	.041	27.269	***
C1	<---	R&D investment	1.074	.035	30.543	***
C6	<---	Government behavior	1.000			
C5	<---	Government behavior	2.534	.173	14.658	***

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C4	<---	Government behavior	2.555	.174	14.700	***
C9	<---	Cluster atmosphere	1.000			
C8	<---	Cluster atmosphere	1.063	.036	29.589	***
C7	<---	Cluster atmosphere	1.073	.036	29.910	***
D1	<---	Innovation performance	1.000			
D2	<---	Innovation performance	.975	.025	38.511	***
D3	<---	Innovation performance	1.014	.022	46.570	***

Note: *** indicates significance in the level of 0.001

Simultaneous output path coefficient and significance test Table 12.

Through the above modification, we can carry out the hypothesis testing analysis. In the construction of the conceptual model of Nanchang VR and tobacco industrial cluster, this paper proposed three hypotheses referring to Porter's "Diamond model". Through the fitting and modification of questionnaire survey results and structural equation model, the following conclusions can be drawn.

Hypothesis H1: R&D investment factors have a positive relationship with innovation performance of industrial clusters. According to the path coefficients in SEM, the path coefficient R&D investment on VR industrial cluster innovation performance is 0.54, which indicates the positive significant correlation. Therefore, enterprise R&D investment, including the proportion of capital investment of R&D activities in the enterprise, the number of R&D personnel in the enterprise, the frequency of cooperation between enterprises and universities or research institutes, etc., can be beneficial to enhance its independent innovation ability and improve the innovation performance of industrial clusters. At the same time, we should take "industry-university-research" activities as a platform, expand cooperation between the tobacco industry and social research institutions through cooperation between enterprises and research institutions and colleges, shorten the technology development and application cycle, form an enterprise-centered technology innovation system, and strengthen the close links between raw materials, processes, sales and research and development. This is conducive to the improvement of upstream and downstream industry chain innovation, promoting the transformation and upgrading of the overall tobacco industry cluster, and forming a technical support to promote the rapid development of tobacco.[19]

Hypothesis H2: Government behavior factors have a positive relationship with innovation performance of industrial clusters. According to the path coefficients in SEM, the path coefficient of government behavior on the innovation performance of VR and tobacco industrial cluster is 1.22, which is a positive correlation, indicating that the tax credit, investment assistance policies, infrastructure construction, introduction of talents provided by the government have a positive promoting effect on the innovation performance of Nanchang VR industry cluster. In addition, through government support for the construction of a number of tobacco agricultural industry clusters in major tobacco-producing counties that meet the goals of modernization, it can effectively gather and rationally allocate production factors such as land, capital, science and technology, and talents to demonstrate and drive the modernization of tobacco production methods.[20]

Hypothesis H3: Cluster atmosphere factors have a positive relationship with innovation performance of industrial clusters. According to the path coefficients in SEM, the path coefficient of cluster environment on the innovation performance of VR industrial cluster is 0.42, indicating that enterprise information sharing and communication can enhance the mutual communication and learning of VR and tobacco cluster enterprise personnel, which is conducive to optimize the use of resources, reduce relevant costs, make full use of geographical advantages to learn from each other, make progress together, and continue to improve independent innovation capacity.

CONCLUSIONS AND SUGGESTIONS

Conclusions

Based on the VR industry cluster in Nanchang, this paper analyzes and discusses the relationship between cluster atmosphere, government behavior and R&D investment on innovation performance of industrial cluster. The results show that R&D investment can significantly improve the innovation performance of industrial clusters; Government behavior can significantly improve the innovation performance of industrial clusters; the

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relationship between cluster climate and industrial cluster innovation performance is also positive. Therefore, the increase of R&D investment, implementation of government policies, cooperation and sharing among clusters, personnel and knowledge flow all have positive effects on the improvement of innovation performance of VR and tobacco industrial clusters to varying degrees.

Suggestions

Analysis of positive factors

Nanchang VR and tobacco Industrial Base is based on the strong support of the national and Jiangxi provincial policies, and the policy dividend is a favorable external condition for the smooth development of Nanchang VR and tobacco industrial cluster. The verification of hypothesis H2 above also proves that government behavior can play a positive role in promoting the innovation performance of Nanchang VR industrial cluster. In addition, industrial cluster has its own huge advantages. The first advantage is the external economic benefits. The aggregation of enterprises in the cluster can produce synergistic effects, and the in-depth division and cooperation can increase the benefits of products in the cluster and improve product value. Secondly, all kinds of costs can be saved. Geographical proximity provides great convenience to enterprises, including reducing costs of transportation, storage and negotiation between enterprises, as well as the transaction cost of cluster enterprises and financial institutions. Industrial clusters strengthen the network relationship between cluster enterprises and improve the efficiency of financing, establishing not only the relationship of mutual learning and cooperation among cluster enterprises, but also the competing relationship. Industry clusters can trigger benign competition between enterprises, cultivating learning ability and innovation R&D ability. Furthermore, Nanchang VR and tobacco industrial cluster will form a brand effect to some extent in the future, and products with strong brand influence can attract more consumers. Similarly, industrial clusters with strong regional influence will also attract more investors, customers, suppliers and scientific research talents, which can not only promote the development and prosperity of upstream and downstream industries to a certain extent, but also promote the development of the whole region.

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Suggestions

Based on the perspective of "government-industry-university", this paper puts forward the following development suggestions.

For knowledge-end universities (or research institutes), Jiangxi Province is facing great pressure and challenges due to its underdeveloped economy. In order to perfect the VR and tobacco industry chain, policy support for the VR and tobacco industry of the whole province should be strengthened, financial support for the purchase of relevant professional equipment should be provided, and the quality of the research environment should be improved. R&D innovation teams in VR industry that make contributions to the development of the industry should be provided with project funding and individual incentive system, and in some universities in Nanchang with proper conditions, VR industry major can be set up to cultivate professional talents. University-industry cooperation pattern can be established to combine theoretical learning in universities and practice in enterprises and train professional skilled talents[18]. Support and attention should be given to provincial and national projects of virtual technology research in universities to train young backbone.

In terms of promoting the development of VR enterprises, it is necessary to strengthen the leadership and demonstration role of leading enterprises. The technological innovation of leading enterprises affects the innovation performance of the whole industrial cluster through knowledge spillover, which means that leading enterprises as the center, drive the development of the whole industrial cluster. The improvement of innovation ability of leading enterprises can solve the current shortcomings of VR industry cluster in Nanchang. In terms of promoting the development of the tobacco industry, through tobacco industry clusters, efficient market-oriented operations should be formed, tobacco brands with local characteristics should be developed, the establishment of core enterprises should be accelerated, and leading and market-oriented enterprises should be constructed.

In terms of government policies, the VR industry can closely follow the construction of the Belt and Road and introduce advanced technologies and talents by taking advantage of the technological, human and financial resources of the Belt and Road countries to meet the demand for VR research talents. Enterprises can compare different suppliers to find the most cost-effective way, that is, buy all kinds of raw materials, including raw materials, spare parts, machinery and equipment, etc., at a lower cost and higher technical level. Through the exchange of information with countries along the Belt and Road, on the one hand, the demand of the domestic users can be grasped; on the other hand, the foreign market change can be understood, which can provide advantages for products to introduce the world in the future.

In addition, the future development of Nanchang VR industrial cluster should highlight the characteristics of Jiangxi Province and Nanchang city, which can be a huge advantage. For Nanchang city, it can actively combine VR and red tourism resources, make use of unique advantages of Jiangxi Province in red resources, vigorously promote the application of VR in red tourist attractions and other red resources, and use intelligent means to improve the service experience of tourists and meet their individual needs. For example, VR glasses and other technologies can be used to enable tourists to reconnect with history in immersive experience, create cultural highlights, and strengthen interaction with tourists.

Author Declaration

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