DEVELOPMENT MODEL OF HIGHER EDUCATION CLUSTER IN CHENGDU AND CHONGQING

LIN TANG

A DISSERTATION SUBMITTED IN PARTIAL FULFILLMENT OF
THE REQUIREMENT FOR THE DEGREE OF DOCTOR OF EDUCATION
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Name-Surname	Mr. Lin Tang
Program	Vocational Education
Dissertation Advisor	Assistant Professor Thosporn Sangsawang, Ph.D.
Academic Year	2023

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ABSTRACT

The purposes of this study were to: 1) combine the cluster theory, triple helix model, and regional innovation theory to explain the higher education cluster development model in the Chengdu-Chongqing region, Sichuan province, China and 2) utilize cluster, triple helix, and regional innovation theories to analyze factors impacting Chengdu-Chongqing higher education cluster development, validate survey data, and devise a development model for the region.

This study aimed to explore the factors affecting the development of higher education clusters in the Chengdu-Chongqing region and design a model to improve their effectiveness. The Likert scale was used to collect data, including four first-level dimensions, 14 second-level dimensions, and 39 items. The analysis results from the pre-survey and SPSS software indicated good reliability and validity. Subsequently, 405 valid questionnaires were collected from government officials, university managers, and business leaders in the Chengdu-Chongqing region through an online platform and mailbox. It was analyzed by SmartPLS software, the Cronbach's Alpha and composite reliability of 14 second-level dimensions were all greater than 0.80. The AVE value of variation was more significant than 0.70, and the correlation coefficients between 14 second-level sizes and other measurements were around 0.6. The survey data demonstrated good reliability and discriminant validity. Furthermore, the structural model analysis of collinearity, R^2, and path results of the first and second-level indicators showed no collinearity problems. The influencing factors of government, universities, and enterprises on the effectiveness of the Chengdu-Chongqing higher education cluster were 0.401, 0.411, and 0.142, respectively, indicating a positive influence.

The findings are valuable as they indicate that eight secondary dimensions and 17 items positively impact the effectiveness of the higher education cluster in the Chengdu-Chongqing region. Additionally, a structural model with first and second dimensions has been developed, outlining the government-university-enterprise model of higher education cluster development in Chengdu-Chongqing region, Sichuan province, China.

Keywords: model, higher education, cluster, Chengdu and Chongqing, China

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Lin Tang

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List of Abbreviations

SPSS	Statistical Product and Service Solutions
SmartPLS	Partial Least Squares Structural Equation Modeling
SEM	Structural Equation Modeling
KMO	Kaiser-Meyer-Olkin
AVE	Average Variance Extracted
VIF	Variance Inflation Factor
R^2	Epresents the percentage of variation in the endogenous variable explained by the exogenous variable, with higher
R^2	values indicating a stronger explanatory power.
GUE	Government-University-Enterprise

CHAPTER1
INTRODUCTION

1.1 Background and presentation of the issue

The Chengdu City of Sichuan Province and the Chongqing City of China are located in the western part of China (referred to as the Chengdu-Chongqing region) (Figure 1.1 and Figure 1.2). The two cities are geographically adjacent, with an area of about 200,000 square kilometers, economic solid complementarity, convenient transportation, a population of about 116 million, many universities, and relatively developed science and technology(W. Wu et al., 2023). However, compared with China's Yangtze River Delta region, the Guangdong-Hong Kong-Macao Greater Bay Area, and the world-class Bay Area, economic development is still insufficient, higher education is not yet fully clustered, and there is still much room for higher education to promote economic growth(Y. Zhou, 2023). Chongqing region, the Chinese government has continuously formulated the overall planning of the Chengdu-Chongqing region, such as the Regional Planning of Chengdu- Chongqing Economic Zone, the Development Planning of Chengdu- Chongqing Urban Agglomeration, and the Outline of the Construction Planning of Shuangcheng Economic Circle in Chengdu and Chongqing Region(Jian et al., 2023). From the study of these plans, it can be concluded that (1) the Chengdu-Chongqing region is a new growth pole of China's economic development(Han et al., 2023). At the sixth meeting of the Financial and Economic Committee of the Central Committee of the Communist Party of China, It was stated that to encourage high-level development in China's region, a new center for opening up China's hinterland, particularly for Laos, Vietnam, Thailand, and other Southeast Asian areas, should be built(Han et al., 2023). It is necessary to speed up the construction of the Shuangcheng Economic Circle in the Chengdu-Chongqing region(Hu et al., 2022). Based on objective laws and comparative advantages, we should promote the coordinated development of the Chengdu-Chongqing region, promote the accumulation and flow of human resources, industries, higher education, and other factors in the Chengdu-Chongqing region, and build the Chengdu-Chongqin region into an economic

center, a science and education center, a new inland highland of reform and opening up and a place of residence for high-quality life(Cheshmehzangi & Tang, 2022).

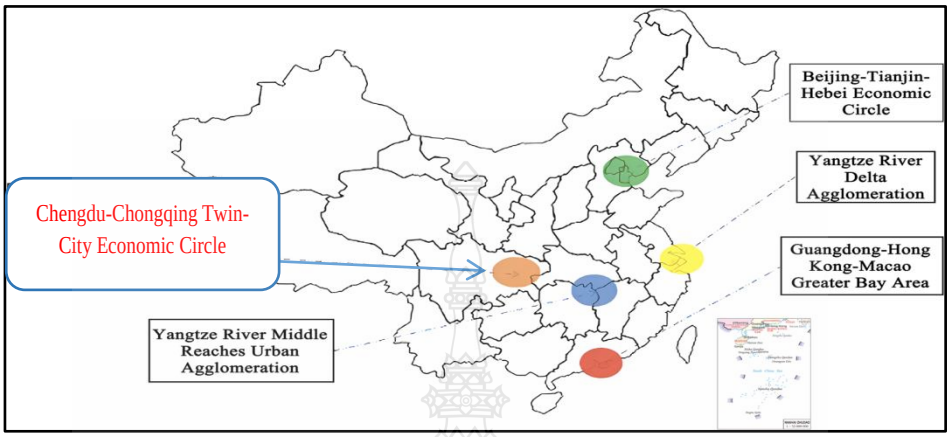

Figure 1.1: Location Map of Chengdu-Chongqing Region, China

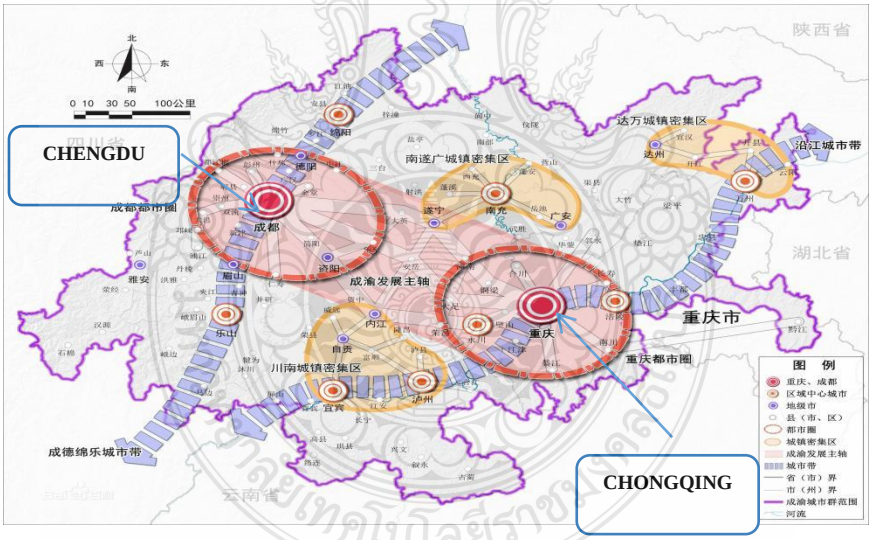

Figure 1.2 Chengdu-Chongqing Area Shuangcheng Economic Circle

(2) High-quality development in the Chengdu-Chongqing region promotes the development of higher education clusters. From the successful experience of the development of the first-class Bay Area in the world, we can find a rule: first-class higher education achieves a first-class Bay Area economy, first-class Bay Area economy feeds back first-class higher education, and the world-class Bay Area is the

gathering center of innovative resources and innovative talents(Guo & Xue, 2023). In the San Francisco Bay Area of the United States, world-renowned research universities such as Stanford University, the University of California, Berkeley, California Institute of Technology, and the University of California, Los Angeles have formed a world-class higher education cluster(Ji & Pan, 2021). Under the background of global changes in the whole world, the pace of globalization, competitive economy, knowledge, technology, and information naturally transform new goals, contents, modes, and education systems(Varghese & Mandal, 2020). Diversifying education services, expanding the integration of education and science, and sustainable regional development with national cluster policies as strategies (Khimmataliev et al., 2022a). Cluster policies in many countries are part of the world used to increase the competitiveness of the national economy, industrial innovation development, production facilities, business entities, and the whole region. Participating in regional higher education institutions of research institutes and leading enterprises conducting cluster business and economic activities in breakthrough areas (Shiposha, 2020).In June 2023, the Ministry of Education of China announced that there are 208 colleges and universities in the Chengdu-Chongqing region (Table 1.1), 21 first-class universities in China, such as Sichuan University, Chongqing University, University of Electronic Science and Technology, Southwest University and Southwest Jiaotong University, which have doctoral training qualifications, and 187 other colleges and universities, of which 12 can train master's degree students. To lay the foundation for higher education clusters in the Chengdu-Chongqing region. Chengdu-Chongqing region has become a significant growth pole of high-quality development in Western China; high positioning brings high investment, whether the government or high-tech enterprises at home and abroad, will flow funds, new technologies, and talents into the Chengdu-Chongqing region, to inject power into the high-quality development of Chengdu- Chongqing region, with more and more high-tech industries and research-intensive enterprises(Wei et al., 2020a). The demand for scientific and technological talents will increase. The San Francisco Bay Area in the United States has an area of 18040 square kilometers, a population of 7.6 million, a scale of 750000 scientific and technological talents, and a

scientific and technological economy accounts for half of the economy of the San Francisco Bay Area.

Table 1.1: Basic Situation of Colleges and Universities in the Chengdu-Chongqing Region

	Public University	**Private University**	**Add up**
Undergraduate	53	27	80
Specialty	71	57	128
First-class universities in China	21	0	21

(3) Higher education cluster promotes the development of the Chengdu-Chongqing region. First-class university clusters and high-tech company clusters in the San Francisco Bay Area gather symbiosis and coordinated development in an excellent interactive mechanism; the outstanding global talents and innovative capital continue to gather, breaking through the barriers from scientific research and innovation to the transformation of achievements to industrial applications, achieving the perfect fit of establishing academic research and political use, in the region(Ba et al., 2022a). The core competitiveness of higher education in the region has also been steadily improved. A large higher education cluster is a culture where the emphasis on innovation and entrepreneurship fosters creativity and risk-taking in a particular region. This environment encourages the formation of start-ups and spin-offs, thereby fostering the development of cutting-edge technologies and stimulating economic growth in the region(Graciano et al., 2022). On the one hand, from the perspective of Chengdu-Chongqing universities themselves, university clusters can activate the educational resources in the region and improve the ability of scientific research and innovation and the quality of personnel training(Wang et al., 2022a). The gathering of colleges and universities based on the geographical spatial relationship is conducive to the sharing of resources, learning, and scientific research among teachers and students of colleges and universities in the cluster, and the integration of higher education resources in the Chengdu-Chongqing region, so that colleges and universities can produce more

significant benefits with limited resources, thus providing high-quality human resources and cutting-edge science and technology for the construction of Chengdu-Chongqing Shuangcheng Economic Circle(Li & Xue, 2022a). On the other hand, from the perspective of cooperation between universities and enterprises, institutions, scientific research institutes, and other institutions in the Chengdu-Chongqing region, the development of the university cluster not only focuses on the development between universities but also pays attention to the linkage development between universities and enterprises, scientific research institutes, communities And so on(Hu et al., 2023). Firstly, the cooperation between universities and enterprises is conducive to eliminating the obstacles of information asymmetry between employers and universities on personnel training, which makes universities and enterprises form a joint force of education and mutual benefit(Hou et al., 2021). Secondly, cooperation between universities, enterprises, and scientific research institutions can promote collaborative innovation, effectively transform the scientific research achievements of universities, make the achievements of universities more beneficial to the public, and make universities more aware of what kind of scientific research is more suitable for society(Cheng et al., 2023). Thirdly, university clusters are the concentrated areas of various educational and scientific research activities and the highly concentrated areas of shopping, cultural entertainment, and services(Tu et al., 2022). Therefore, promoting the development of higher education clusters in the Chengdu-Chongqing region can provide high-quality human resources and cutting-edge science and technology for constructing the Chengdu-Chongqing region and has a driving force for developing the Chengdu and Chongqing region.

(4) The favorable conditions for developing higher education clusters in the Chengdu-Chongqing region. Higher education cluster refers to the concentration of various educational institutions, research centers, and innovation centers in a specific geographical area(Khimmataliev et al., 2022b). In the past two decades, the cluster formation process has been actively underway .In general, according to expert estimates, about 50% of developed economies are currently involved in clustering. In general, according to expert estimates, about 50% of developed economies are currently involved in clustering(Dalevska et al., 2019). This activation of foreign cluster growth

proves its effectiveness. It is the basis for efficient interaction between business units, members, countries, industry associations, and research and education institutions in innovation(Kinash et al., 2019).The geographical proximity and integrated development of the Chengdu-Chongqing region are conducive to breaking the restrictions on exchanges and cooperation between universities in the two regions, promoting the active cooperation of higher education between Chengdu and Chongqing, and promoting the cluster development of higher education in Chengdu-Chongqing region(L. Zhou et al., 2023). The Chinese government and governments at all levels in Chengdu and Chongqing have played an essential role in promoting the development of higher education clusters in Chengdu and Chongqing and implemented a series of preferential policies and funding measures to attract first-class universities and research institutions to settle in the region(Wang et al., 2022b). The convenient transportation and information network in the Chengdu-Chongqing area provide convenience for the exchange and flow of college students, teachers, and researchers and encourage the cooperation of colleges and universities in the Chengdu-Chongqing area. The region has a large population, including many highly educated people, which provides the necessary talent pool for the success of the higher education cluster. Local universities produce graduates yearly, providing a stable of professional and technical personnel and researchers for developing the region's economic and innovative ecosystem. Infrastructure investment is crucial to forming a higher education cluster in the Chengdu-Chongqing region(Feng & Han, 2021). Establishing a modern campus, advanced research facilities, and an incubation center create an excellent learning and research environment. Developing high-speed rail networks, airports, and urban planning has further enhanced the connectivity and accessibility of students, teachers, and industry partners. The region's strong industrial base, including the automotive, electronics, aerospace, and information technology sectors, had fostered close cooperation between academia and industry, which had led to research and development projects, technology transfer, and the commercialization of innovations(O Dwyer et al., 2023a). Industry benefits from cutting-edge research, while academic institutions gain practical insights and opportunities for applied research.

Higher education cluster refers to the phenomenon that interconnected higher education institutions gather and develop in a particular geographical space, characterized by the concentration of universities, research institutions, and related industries in a geographical area to promote collaboration, innovation, and talent development(Brekke, 2021). Researchers, through literature analysis and summary, the current higher education cluster development model, mainly in the New York Bay Area higher education multi-center + core axis cluster model (citation), Tokyo Bay Area higher education single center + peripheral cluster model (citation), Guangdong-Hong Kong Kong-Macao Greater Bay Area Higher Education coastal + inland cluster mode and so on. Chengdu-Chongqing region has development opportunities, preferential policies, and capital. However, it differs from San Francisco Bay Area, New York Bay Area, Tokyo Bay Area, and Guangdong-Hong Kong Kong-Macao Greater Bay Area(Li, 2021). Although the Chengdu-Chongqing higher education cluster has received attention and support, it is necessary to examine its potential development model and evaluate its effectiveness to achieve the expected results. This study aims to provide valuable insights into the development model of higher education clusters in the Chengdu-Chongqing region, assess its impact on regional economic development, innovation, and personnel training, provide information to policymakers, educational institutions, and other stakeholders interested in building and strengthening higher education clusters in similar contexts, and ultimately contribute to the overall regional development and economic growth in Chengdu-Chongqing region.

1.2 Research Significance

Based on the theory of the triple helix model, this study explores the role of government, universities, and enterprises in the development of higher education clusters, shows the effect of higher education clusters, constructs the development model of higher education cluster in Chengdu-Chongqing region, and provides a paradigm for other regions to establish and develop higher education cluster model.

1.3 Purpose of study

1.3.1 Synthesize the cluster theory, triple helix model theory, and regional innovation theory related to the development model of higher education cluster in the Chengdu-Chongqing region.

1.3.2 Using the cluster theory, triple helix model theory, and regional innovation theory to explore the factors affecting the development of the higher education cluster in the Chengdu-Chongqing region and verify the survey data to determine and develop the development model of the higher education cluster in the Chengdu-Chongqing region.

1.4 Research issues and assumptions

1.4.1 Research question: What is a higher education cluster? What are the existing higher education cluster development cases at home and abroad? What is the current situation of higher education in Chengdu and Chongqing? What are the key factors affecting the development of higher education clusters in Chengdu and Chongqing? How can the cluster development model of higher education in the Chengdu-Chongqing region be constructed? How to evaluate the validity of the higher education cluster development model in the Chengdu-Chongqing region?

1.4.2 Research Assumptions: It is assumed that the government, universities, enterprises, and other factors positively influence the development of higher education clusters in the Chengdu-Chongqing region. A perfect higher education cluster will contribute to personnel training, resource sharing, scientific research, and international higher education exchanges in Chengdu and Chongqing. The newly constructed higher education cluster development model in the Chengdu-Chongqing region provides practical cases for higher education clusters in other regions.

1.5 Cnceptual framework

This study analyzes and synthesizes all relevant documents to formulate the policy of higher education clusters in the Chengdu-Chongqing region. The conceptual framework of the higher education cluster development model in the Chengdu-Chongqing region is shown in Figure 1.3

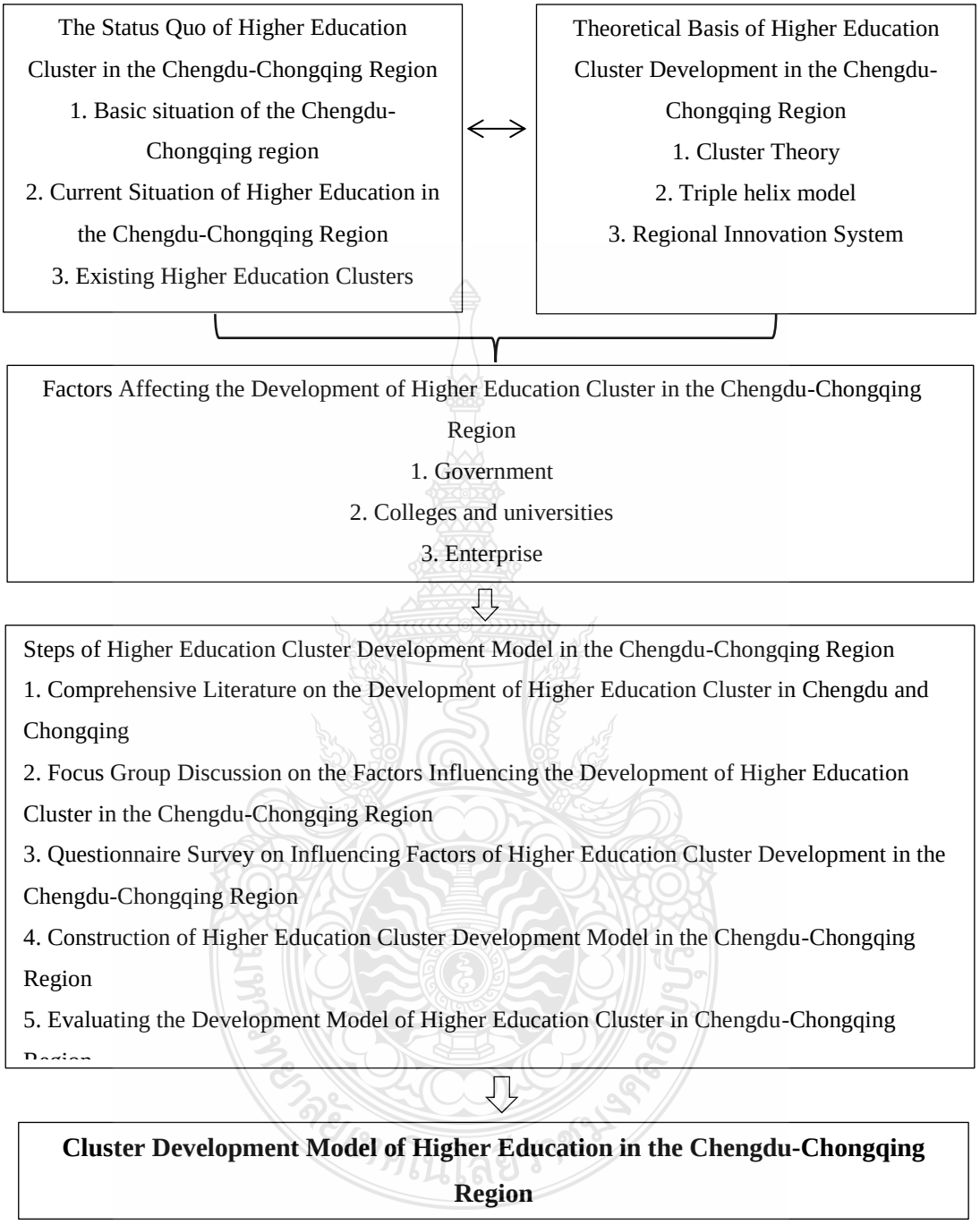

Figure 1.3 Cluster Development Model of Higher Education in the Chengdu-Chongqing Region

1.6 Theoretical perspective

1.6.1 Cluster theory

Cluster theory derives from the work of Michael Porter and emphasizes the benefits of geographic concentration of related industries, institutions, and supporting organizations(Porter, 1998a). Cluster theory provides a valuable theoretical perspective for understanding the development model of higher education clusters in the Chengdu-Chongqing region. The theory focuses on the agglomeration of universities, colleges, research centers, and related institutions in the Chengdu-Chongqing region, and it explores how the proximity of these institutions leads to knowledge spillover, innovation, and enhanced cooperation.

1.6.2 Triple helix model

The triple helix model developed by Etzkowitz and Leydesdorff emphasizes the interconnection and collaboration between academia, industry, and government(Cai & Amaral, 2021). The model provides a theoretical framework for understanding the role of higher education institutions in promoting innovation and economic development. In the context of the Chengdu-Chongqing region, the triple helix model helps analyze the collaboration relationship and knowledge transfer mechanism among universities, industry partners, and government agencies in higher education clusters(Xie et al., 2023a).

1.6.3 Regional innovation system

A regional innovation system focuses on the interactions and relationships among different actors (including universities, research organizations, firms, and government agencies) within a given geographic region(Lew & Park, 2021). The concept of a regional innovation system provides another theoretical perspective for studying the higher education cluster development model in the Chengdu-Chongqing region. In the context of higher education clusters, the regional innovation system perspective emphasizes the importance of building collaborative networks, knowledge flows, and supporting institutions(Hou et al., 2023a). It recognizes that innovation is not limited to a single organization but results from interaction and collaboration within a broader ecosystem. Universities and research institutions within higher education clusters contribute to regional innovation systems by generating new knowledge, providing

research and development infrastructure, and fostering partnerships with industry and government(Vlaisavljevic et al., 2020a). This perspective recognizes the importance of a coordinated and integrated approach to innovation and economic development.

1.7 Defining the Perspective

This study's purpose is to construct the higher education cluster development model in the specific geographical scope of the Chengdu-Chongqing region.

1.7.1 Chengdu-Chongqing Region: refers to an economic and geographical region in China with many famous universities and research institutions(Lu et al., 2022).which determines the development mode and influence of the higher education cluster in the Chengdu-Chongqing Region.

1.7.2 Higher education cluster: It is a platform to promote cooperation and synergy among various stakeholders(Zhuang & Liu, 2022). The higher education cluster in this study refers to the geographical area where higher education institutions, research institutions, and related industries are concentrated in the Chengdu-Chongqing region.

1.7.3 Development model: The development model of the higher education cluster refers to the strategic framework and path of establishing, cultivating, and maintaining the higher education cluster in the Chengdu-Chongqing region, creating a favorable environment, and promoting cooperation and innovation within the higher education cluster(Xie et al., 2023b). The model covers many elements, including policy support, scientific research, personnel training, infrastructure development, collaborative network, knowledge transfer mechanism, and industry participation strategy.

1.7.4 Focus group: a qualitative research method used to gather the insights and opinions of a small group of people on a specific topic or issue(Sim & Waterfield, 2019a). It involves bringing together a selected group of participants with common characteristics or experiences relevant to the focus of the study. The primary purpose of the focus groups was to encourage open and interactive discussions among the

participants, allowing the researchers to explore the participants' attitudes, perceptions, beliefs, and feelings in a more dynamic and context-rich environment.

1.8 Expected benefits

1.8.1 The results of this study can provide a reference for the development of higher education cluster policy in the Chengdu-Chongqing region.

1.8.2 Through the focus group discussion, this research obtains the factors that affect the higher education cluster in the Chengdu-Chongqing area, investigates the influencing factors, analyzes and verifies the data, and finally determines the factors that constitute the development model of higher education in Chengdu-Chongqing area.

CHAPTER 2
LITERATURE REVIEW

This chapter will further contribute to the research design and present the literature review process to determine and develop the higher education cluster development model in the Chengdu-Chongqing region. This chapter is divided into the following sections:

2.1 Research background

2.2 Focus Group

2.3 Literature Review of Research Relevance

2.4 Conceptual framework of higher education cluster development model

2.5 Evaluation Index of Higher Education Cluster Development Model

2.6 Development Model of Higher Education Cluster in Chengdu And Chongqing

2.1 Research background

2.1.1 Theoretical Perspective of Higher Education Cluster Development Model

This review focuses on three theoretical perspectives: cluster theory, triple helix model, and regional innovation system.

2.1.1.1 Cluster theory: Cluster theory is derived from the work of Michael Porter and emphasizes the benefits of geographical concentration of related industries, institutions, and supporting organizations. In higher education clusters, the theory emphasizes the advantages of placing universities, research institutions, and industry partners near facilitating collaboration, knowledge exchange, and innovation(Boldyreva et al., 2020a). Clusters are geographic concentrations of interconnected companies, specialized suppliers, service providers,firms in related industries, and associated institutions (for example, universities, standards agencies,and trade associations) in particular fields that compete but also cooperate. Critical masses of unusual competitive success in particular business areas, clusters are a striking feature of virtually every national, regional, state, and even metropolitan economy, especially those of more

economically advanced nations(Porter, 1998b).The cluster theory provides a valuable theoretical perspective for understanding the development model of higher education clusters in the Chengdu-Chongqing region(Ding et al., 2023).

According to the cluster theory, the co-location of higher education institutions and related entities creates a suitable environment for knowledge spillover, where individuals and organizations can easily interact and exchange ideas(Zizka et al., 2021). This interaction leads to sharing resources, expertise, and best practices, promotes innovation, and enhances the overall competitiveness of the cluster. Higher education clusters can attract talent, encourage entrepreneurship, and catalyze regional economic development(Parry, 2020).

2.1.1.2 Triple helix mode：The triple helix model, developed by Etzkowitz and Leydesdorff, emphasizes the interconnectedness and collaboration of academia, industry, and government(Carayannis et al., 2022). cooperation between universities and industries is most beneficial to improve regional innovation efficiency, cooperation between universities and governments significantly promotes scale efficiency in the long run, cooperation between industries and governments significantly promotes regional innovation comprehensive efficiency and pure technical efficiency, meanwhile inhibits scale efficiency, coordinated relation among universities, industries, and governments is beneficial to improve regional innovation comprehensive efficiency and scale efficiency. The research results provide useful theoretical support and policy enlightenment for improving regional innovation efficiency(Zhuang et al., 2021).The triple helix model provides a theoretical framework for understanding the role of higher education institutions in promoting innovation and economic development(Gachie, 2020). In the context of the Chengdu-Chongqing region, the triple helix model helps analyze the collaboration relationship and knowledge transfer mechanism among universities, industry partners, and government agencies in higher education clusters(Xie et al., 2023c).

According to the triple helix model, higher education institutions play a vital role in producing and disseminating knowledge. They are critical participants in the innovation process, generating new knowledge through research and education. Through collaboration with industry partners, the University facilitates the transfer of

knowledge and technology to develop innovative products, services, and processes. Government agencies provide the necessary policy support and create an enabling environment for collaboration and innovation(O Dwyer et al., 2023b).

The triple helix model is a concept that describes the interaction and collaboration of academia, industry, and government in promoting innovation and economic development. It emphasizes these three areas' dynamics and knowledge exchange to promote innovation-driven growth(Pan & Guo, 2022).

The triple helix model comprises academia, industry, and government(Yoda & Kuwashima, 2020). Academia refers to universities, research institutes, and other educational institutions involved in research and knowledge creation. Academia is crucial in generating new knowledge through research, experiments, and training skilled professionals. It focuses on theoretical and applied research to advance scientific understanding and develop new technologies. Industry refers to enterprises, companies, and companies involved in commercial activities. Industry uses the knowledge academia generates to create products, services, and technologies(Abbas et al., 2019). Governments consist of public agencies, regulatory bodies, and policymaking entities. It has developed legal frameworks, funding schemes, and policies that affect research and innovation activities. Governments are crucial in providing financial support, infrastructure, and incentives to facilitate cooperation between academia and industry. They aim to facilitate technology transfer, create a favorable business environment and encourage economic growth(Chaves-Avila & Gallego-Bono, 2020).

The triple helix model recognizes that effective collaboration and interaction among the three sectors is critical to a thriving innovation ecosystem. It emphasizes interdependence and mutual benefit in cooperation. In this model, universities and research institutions are intermediaries linking academia, industry, and government to facilitate knowledge exchange, research commercialization, and social impact(Li et al., 2020a).

2.1.1.3 Regional innovation systems : The regional innovation system provides another theoretical perspective for studying the higher education cluster development model in the Chengdu-Chongqing region(Hou et al., 2023b). A regional innovation system focuses on the interactions and relationships among different actors

(including universities, research organizations, firms, and government agencies) within a given geographic region. This perspective recognizes the importance of a coordinated and integrated approach to innovation and economic development(Fernandes et al., 2021a).

In the context of higher education clusters, the regional innovation system perspective emphasizes the importance of building collaborative networks, knowledge flows, and supporting institutions. It recognizes that innovation is not limited to a single organization but is the result of interaction and collaboration within a broader ecosystem(Sadabadi et al., 2022). Universities and research institutions within higher education clusters contribute to regional innovation systems by generating new knowledge, providing research and development infrastructure, and fostering partnerships with industry and government(Vlaisavljevic et al., 2020b).

2.2 Focus Group

2.2.1 Definition of focus groups,

The focus group originates from an approach to group interviewing described by Merton et al. (1956). Since then, it has gained increasing popularity within qualitative research and evaluation(Sim & Waterfield, 2019b).A focus group can be broadly defined as a type of group discussion about a topic under the guidance of a trained group moderator(Halliday et al., 2021) Agar and MacDonald (1995) suggest that a focus group lies somewhere between a meeting (reflecting the fact that it is precisely organized in advance and has a structure) and a conversation (reflecting the fact that the discussion has nonetheless a degree of spontaneity, with individuals picking upon one another's contributions)(Brown, 2022). It is recommended that data collection, and subsequent analysis, should take account of both the dialogue and the interaction that has occurred within the group and seek to capture how meaning is negotiated and co-produced in the group context . Several detailed accounts of focus group methodology are available.

2.2.2 Strengths and weaknesses of focus groups

Advantages of Focus Group	Limitations of focus group
Provides in-depth and qualitative insights.	Small sample sizes may not accurately represent the entire population.
Allowing participants to interact and learn from each other's ideas.	Group dynamics or dominant personalities may influence participants' responses.
To help researchers understand the reasoning behind the participants' views.	The results may be subjective and difficult to generalize.
Ability to observe nonverbal cues and body language.	It may not be appropriate for sensitive or personal topics.
The turnover of collected data is fast compared to other qualitative methods.	Skilled review and analysis are required to ensure reliable results.

Table 2.1 Advantages and Limitations of Focus Group

2.2.3 Use of focus group

The focus group is a qualitative research method utilized across different disciplines to elicit perspectives and viewpoints from a group of individuals concerning a specific subject, product, service, or idea(Barbour & Barbour, 2018). This technique involves assembling a small group of participants (typically 6-10) with shared characteristics or experiences relevant to the research query. During the focus group sessions, a skilled moderator guides the conversation, fostering an environment where participants openly express their thoughts and ideas. In higher education clusters, focus groups offer an effective means to gather invaluable insights and feedback from various stakeholders, including university presidents, government officials, entrepreneurs, and others involved in the cluster's functioning(Heaton et al., 2020).

2.2.3.1 Research Design

In the research design phase, delineate the research question or topic explored through focus groups. Identify the characteristics and experiences that potential participants should possess to provide relevant insights(Knott et al., 2022). Determine the number of focus groups required, considering the diversity of perspectives needed and the expected saturation of information.

2.2.3.2 Participant Recruitment:

Reach out to potential participants who meet the defined criteria using various methods such as invitations, advertisements, or existing networks(K U Hne & Zindel, 2020). Ensure that participants are fully informed about the study's purpose, the voluntary nature of participation, and their right to withdraw at any time.

2.2.3.3 Development of a Structured Facilitator's Guide:

Create a comprehensive facilitator's guide comprising open-ended questions and discussion prompts tailored to guide the focus group discussions(Nobrega et al., 2021). These questions directly relate to the study objectives and encourage participants to share their ideas and experiences candidly.

2.2.3.4 Conducting Focus Group Discussions

Select a convenient time and location for the focus group sessions that accommodate the participants' availability(Adler et al., 2019). The moderator plays a central role, guiding the discussions, fostering active participation, and ensuring all participants have an equal opportunity to express their viewpoints. The moderator actively listens to participants' responses throughout the sessions, using follow-up questions or probing to gain more profound insights.

2.2.3.5 Data Collection

Record the focus group sessions with participants' consent to maintain data accuracy during subsequent analysis(Sim & Waterfield, 2019c). In addition to recordings, moderators or assistants take meticulous notes during the discussions, supplementing the data collected.

2.2.3.6 Data Analysis

Transcribe the audio or video recordings to produce verbatim transcripts of the focus group discussions. Analyze these transcripts to identify recurring themes, patterns, and critical insights from participants' responses(Tuthill et al., 2020). Interpret the findings in the context of the study objectives, considering the interactions among participants.

2.2.3.7 Reporting Findings

Present a comprehensive synthesis report encompassing an overview of the research objectives, the methodology employed, key findings, and illustrative quotes(Garone et al., 2022). Provide a contextually-driven interpretation of the

identified themes and draw connections between the data and the research objectives. Discuss the implications of the findings and offer actionable recommendations based on the valuable insights garnered from the research.

2.3 Literature Review of Research Relevance

2.3.1 University Cluster Research

Taking a panoramic view of the history of world higher education and the economic and social development of various countries in the past hundred years, we can draw an obvious conclusion: the more developed the economy and society are, the more advanced the development of higher education is(Mok & Marginson, 2021). Moreover, a powerful country at the top of the pyramid has a few top universities and a world-class cluster. For example, Ivy League schools in the United States, Russell Group in Britain, TU9 in Germany, and Go8 in Australia.

The concept of strategic alliance first appeared in management sociology, and the organizational field theory put forward by Pierre Bourdieu, an educational sociologist, provides a theoretical basis for it. The essence of university strategic alliance is the dynamic process of evolving the spatial structure of the higher education field(De Wit & Altbach, 2021). Each University has a specific position in the field of higher education(Ali, 2020). Through organized alliance and interaction, sharing resources, Using collective power and team benefits to effect a shift in status and connection in higher education symbiosis and win-win(Sun et al., 2023).

The significance of a university strategic alliance lies in creating a rich and dynamic educational atmosphere through diversified teaching and research teams, realizing complementary resources, and minimizing costs(Ochie et al., 2022).

Due to the development trend of global higher education, first-class universities create opportunities for students to choose independently and study across industries through the alliance mode of complementary advantages and cluster development; Universities also promote exchanges and cooperation in personnel training, scientific research, social services and other aspects of higher education in different countries or regions through resource sharing(Xue & Li, 2022) .

2.3.2 Research on Cooperation between University Cluster and Enterprise

Based on previous studies, this paper examines the source of firm-specific knowledge through geographical richness. The findings suggest a path to knowledge, capacity development, and innovation where people must build partnerships about their responsibilities(Figueiredo et al., 2020) .

The alliance of industry, University, and research is often tense because of different partners. At first, these tensions may not arise immediately, but soon after establishing the alliance, the possibility of tensions increases rapidly. Therefore, early detection of potential tensions is crucial to the success of industry-university-research universities. Through an exploratory study of two international alliances in the energy field, they discussed how these tensions arise and how to resolve them effectively. Depending on the case, they discuss the tensions that can arise at four levels(Stefan et al., 2021) .

In the era of the knowledge economy, we must attach importance to the cooperation between universities, scientific research institutes, and other relevant educational institutions and external institutions such as social enterprises and communities. By sorting out and analyzing the promoting factors and inhibiting factors of the cooperation between external institutions and higher education institutions, effective measures can be determined which is conducive to the development of such cooperation. They consider the contribution of students, scholars, and researchers to the development of knowledge and experience as the most practical aspect of cooperation; Lack of teacher or staff time, shortage of funds, and complex administrative needs are essential factors hindering cooperation (Coman et al., 2020).

2.3.3 Research on University Cluster and Community Cooperation

The research of university alliances is not only limited to cooperation with enterprises but is also devoted to the cooperation between university alliances and society.

In community mental health services, the emphasis on cultural construction is a community-based participatory action research project in Ontario, which is committed to developing, piloting, and evaluating the mental health service model based on the concept of cultural empowerment and university consortia. It plays a vital role in

community mental health services. In order to ensure that the knowledge generated in community college alliance projects is shared and used, research attaches great importance to collaboration and communication with stakeholders(Muenzen et al., 2022).

The role of university and community alliances is extensive and can be relied on to solve many practical problems. In their study, they discussed the establishment of the Lead Coalition, a coalition of college communities to address the lead hazards faced by low-income children in South Bend, Indiana. After summarizing the relevant research, this paper focuses on how each partner in the leading alliance takes this path and identifies three critical factors for the alliance's success (Esmaelnezhad et al., 2023).

2.4 Conceptual framework of higher education cluster development model

University cluster is a phenomenon in that one or several high-level universities as the core, interrelated universities and their related supporting institutions gather in (geographical) space to form a substantive and sustainable competitive advantage(Tijssen et al., 2021). The university cluster combines traditional natural endowment and modern knowledge innovation characteristics(Sedita & Ozeki, 2022).

Collaborative innovation is the foundation of university cluster development; resource sharing is the primary means of university cluster development, and competition and cooperation is the core relationship between cluster universities in the region(Gryshchenko et al., 2021). The above three are the primary connotation and main characteristics of the development of university clusters. The principal value of the development of university clusters is to enhance the competitive advantage of universities in the region; It is conducive to meeting the needs of students for high-quality educational resources and promoting the development of the regional economy(Tang et al., 2022).

The value objectives of regional higher education cooperation and development mainly include innovating cooperation mechanisms and perfecting the higher education system; Exerting synergistic effect and cultivating core competitiveness; Breaking the island effect, and improving the level of running schools(Ba et al., 2022b).

Based on the knowledge management theory, this paper analyzes the influence of the knowledge innovation network on the knowledge growth of the university cluster, establishes the knowledge growth model of the university cluster, and constructs the organic integration mechanism of knowledge resources based on the knowledge innovation network(Zhang & Chen, 2021). Based on stakeholder theory, the external mechanism of the university cluster is analyzed by government and social needs (Liyanage & Netswera, 2021).

The Necessity, Ideas, Principles, and Conditions of Constructing the Sharing Mechanism of Higher Education Resources He believes in constructing regional higher education resources sharing mechanism(Izumi et al., 2021).Policy guarantee, government macro-control, management guarantee, technical guarantee, and micro-operation of universities.

This paper analyzes the experience of campus cooperation in the United States, Japan, and other countries and, based on the cooperation mode and mechanism, puts forward the mode and operation mechanism of campus cooperation in China. It mainly includes a government guidance mechanism, partner selection mechanism, standardized operation, management mechanism, encouraging innovation and development mechanism, venture capital evaluation mechanism, and benefit distribution mechanism(Li et al., 2022) .

Improving the status of higher education in regional economic and social development is inseparable from the regional effects of university clusters. The regional effect of the university cluster is based on the multidimensional effect of human resources and knowledge capital, which points to economic growth and the attitude of serving the people. The most important thing is to achieve regional economic and social development(He et al., 2023).

It is an objective phenomenon that the agglomeration of colleges and universities economically impacts the surrounding areas. The spillover effect of university agglomeration is that some universities gather in some areas to realize the rational allocation and sharing of educational resources(Jiang & Chen, 2023). In the gathering, they unconsciously transfer or disseminate the knowledge and technology of the University through various channels. By absorbing this spillover effect, the surrounding

enterprises can improve their innovation ability and technological level(Qin et al., 2023) .

According to the spatial flow direction of knowledge capital, the aggregation-spillover development mode of the university cluster can be divided into coastal-inland and hinterland-inland development modes; According to the organization form of knowledge capital flow, it can be divided into three modes: learning-learning, production-learning, and production-production. The interactive form of intellectual capital carriers can be divided into talent flow, technology exchange, and patent flow(Yin et al., 2023).

In the article Research on the Development of World-class High-level University Clusters in Dawan District-Taking New York, San Francisco, and Tokyo as Examples(Yingxia et al., 2019). This paper introduces the research fields of university cluster models in three world-class Bay areas, including multi-center + axis, multi-center complementary cluster, and center + border(Wei et al., 2020b) .

According to the development characteristics of Bohai higher education, the multi-agent system of higher education cooperation around Bohai is scientifically determined. From the macro, meso, and micro levels, the operation mechanism of the cooperation subject is constructed, and on this basis, the diversified cooperation mode is constructed(WANG, 2019).

The university cluster is significant in promoting regional economic and social development. The support of human resources or human capital of universities can promote regional economic development. University clusters can strengthen talent gathering. The higher the degree of talent gathering, the faster the knowledge updating and the stronger the academic innovation ability (Mei & Symaco, 2021).

University social service agglomeration refers to universities relying on the advantages of education, teaching, scientific research, and high-quality talents to serve society, promote economic development, meet social needs, and better serve society through running schools. Continuous innovation of cooperative alliances to gain competitive advantage in social services(Yuezhi, 2019).

2.5 Evaluation Index of Higher Education Cluster Development Model

Regarding the relevant research abroad, the research of the university cluster is relatively mature, the research content is practical, and there are many empirical studies. Universities and enterprises in the university cluster have formed a benign interactive relationship, mutual influence, joint innovation, and expected progress(Chen & Li, 2022). In addition, university clusters in countries other than China have many uses. Whether cooperating with enterprises or serving the community, the purpose of the university alliance is to solve the practical problems of the economy, culture, and ecological environment(Allahar & Sookram, 2019). However, due to the differences in political and economic systems and social and cultural backgrounds between China and foreign countries, the research results only partially apply to developing university clusters in China. This requires scholars to dialectically analyze foreign research critically and learn from their experience developing university clusters to explore more suitable for China's university cluster development theory.

As far as the research on the Chengdu-Chongqing region is concerned, the research of Chengdu-Chongqing region mainly focuses on geography and economy, and the main content of the research focuses on the spatial structure and regional economy of Chengdu- Chongqing urban agglomeration(Z. Wang et al., 2023). Chengdu-Chongqing regional development,There are many types of research on the universities in Sichuan and Chongqing, but there are few types of research on higher education in Chengdu and Chongqing(C. Wang et al., 2023). Although there are few direct references, the relevant research in the Chengdu-Chongqing region provides valuable information. First, the study of Chengdu-Chongqing spatial structure and regional economic development provides information for understanding the formation mechanism, development path, and driving force of regional economic development in the Chengdu-Chongqing region(Wu & Zheng et al., 2023a). Secondly, studying higher education in the Sichuan-Chongqing region helps to understand the development level and discipline distribution of higher education in the Sichuan-Chongqing region(Geng & Huang, 2022). It provides essential information for developing the university cluster in the Chengdu-Chongqing economic circle.

Regarding the research on the development of university clusters, although the research on university clusters in China started late, the scope of research is still broad. The research of Chinese scholars on university clusters involves the connotation, essence, and value of university clusters, the mechanism, effect, and mode of university cluster development, and the relationship between university clusters and regional social and economic development(Li & Xue, 2022b). However, the research on university clusters mostly stays at the theoretical level, and the research on the practice design of university clusters is less; Learning from the development experience of foreign university clusters still accounts for a large proportion.

From the perspective of research content, the development of university clusters in China mainly focuses on the theoretical level. This paper analyzes the connotation, essence, effect, and motivation of the development of university clusters in China from the theoretical level by drawing on the experience of foreign university cluster development and analyzing the current situation of the development of university clusters in China(Yang et al., 2021). It puts forward the countermeasures and implementation suggestions for developing university clusters in China. At present, there is almost no practical research on the development of university clusters and research on using university clusters to solve practical social problems, which may be a research paradigm suitable for the development of university clusters in China and may also indicate that the development of University clusters in China is in the initial stage of reference and exploration.

From the perspective of research objects, the development of university clusters in China is mainly concentrated in the eastern developed areas, such as the Bohai Bay, the Yangtze River Delta, the Pearl River Delta, and other developed areas(Liu et al., 2023). Scholars in China tend to explore the development model of university clusters suitable for China's national conditions in these areas. Their research is more valuable and meaningful for the scholars who study the development of foreign university clusters in the Chinese environment. However, there is little research on the development of university clusters in underdeveloped areas such as the central and western regions, which violates the national concept of regional development and makes the regional development differences bigger and bigger, which is not conducive to the development

of university clusters. To solve the contradiction of insufficient regional development imbalance(Kraus et al., 2021).

From the perspective of research orientation, first of all, the research on the development of university clusters in China is still in the stage of university-centered and social enterprises and institutions following the development. The research of Chinese scholars mainly focuses on the development of university clusters with universities as the leader and enterprises driving the surrounding enterprises; Instead of exploring the linkage and cooperation between universities and enterprises(Shijie, 2023). Secondly, the research on developing university clusters in China mainly focuses on the cooperation between universities(Wang & Huang, 2021). However, more research must be done on cooperation between universities, enterprises, and social institutions. Third, the perspective of university cluster development mainly focuses on the economic perspective, that is, the driving role of university cluster development on the regional economy while ignoring the perspective of university cluster Development(Abad-Segura & Gonz A Lez-Zamar, 2021a). The critical role of university cluster development in regional social and cultural services.

2.6. Literature of Higher Education Cluster in Chengdu-Chongqing Region

Uation areas in their respective regions. Such clusters allow for sharing resources, collaborative research opportunities, and healthy competition among institutions. It creates an environment conducive to academic growth and development(H. Wu & S. Lu et al., 2023).

Academic specialization: Each University within a higher education cluster has its area of specialization and expertise(S A Nchez-Barrioluengo et al., 2019). Niversity concentration: Chengdu and Chongqing have established University concentrBy focusing on specific disciplines, universities can build a reputation for excellence and attract students, faculty, and resources in these fields(Xie et al., 2023d). This specialization improves the overall quality of education and research within the cluster.

Research and Innovation: The development model emphasizes the establishment of research and innovation centers within higher education clusters. The centers promote

interdisciplinary collaboration, research funding, and technology transfer. The cluster contributes to regional economic development and technological progress by promoting research excellence and fostering innovation(Derlukiewicz et al., 2020a).

Industry-university collaboration: Encourage close collaboration between universities and industry to bridge the gap between academic knowledge and practical application(Awasthy et al., 2020). Partnerships with local businesses, industry, and government agencies facilitate internships, joint research projects, and knowledge exchange(Lo & Tian, 2020). This collaboration helps align academic programs with industry needs and improves the employability of graduates.

Business Incubation: The development model emphasizes the promotion of entrepreneurship and the establishment of incubation centers in higher education clusters(Vaz et al., 2022). These centers support student entrepreneurship, technology commercialization, and transforming research results into viable enterprises. By fostering an entrepreneurial culture, clusters contribute to economic growth and job creation(Derlukiewicz et al., 2020b).

Internationalization: Chengdu and Chongqing actively promote international cooperation and attract international students and scholars to the higher education cluster(Xie et al., 2023e). This internationalization effort includes establishing exchange programs, joint research projects with overseas institutions, and recruiting international teachers. It enhances the cluster's cultural diversity, global perspectives, and academic cooperation.

Government support: The local government strongly supports the development of higher education clusters. This support includes funding for infrastructure development, research grants, scholarships, and policy incentives to attract and retain high-quality teachers and students. The government's intervention provides a suitable environment for the growth and development of clusters(Brown, 2023).

Regional integration: Chengdu and Chongqing cooperate with surrounding areas and institutions to build a regional higher education network(Hou et al., 2023c). This integration enables resource sharing, joint research projects, and student exchanges. All regions have enhanced their academic capabilities through joint efforts and created synergies for common development.

CHAPTER 3
RESEARCH METHODOLOGY

The purpose of this chapter is as follows: (1) Use a focus group to discuss the development of the higher education cluster in the Chengdu-Chongqing area, summarize the dimensions that affect the development of the higher education cluster in the Chengdu-Chongqing area, and develop the Questionnaire. (2) Adopt the questionnaire investigation method, use SPSS software through the data statistics and analysis, and set up the dimension model of higher education cluster development mode in the Chengdu-Chongqing area. The study used qualitative and quantitative research methods and explained the instruments used for data collection, the data collection procedures, and the statistical methods used for data analysis.

3.1 Theoretical Framework

3.2 Sampling Techniques

3.3 Instrumentation

3.4 Data Collection Procedures

3.5 Statistical Analysis

3.1 Theoretical framework

The theoretical framework of this study is based on several key concepts and theories. The first concept is the Chengdu-Chongqing area, which refers to Chengdu City in Sichuan Province and Chongqing City in China (referred to as the Chengdu-Chongqing area)(Pan et al., 2021). Chengdu-Chongqing is the most economically developed area in Western China and one of the critical urban agglomerations in China(He & Hu, 2022). It is similar to the San Francisco Bay Area in the United States, the Tokyo Bay Area in Japan, and the Guangdong-Hong Kong-Macao Greater Bay Area in China. The second concept is the higher education cluster, which refers to several institutions of higher learning in a particular area of accumulation(Mukhamedov et al., 2020). The concepts of higher education cluster and university cluster are often used interchangeably(Hofmeister et al., 2022). Higher education cluster needs to meet the

requirements of both quantity and quality(Niemi & Kousa, 2020). The third concept is the development model, which refers to the development path and mode of a country, region, or organization in political, economic, social, and educational aspects(Abad-Segura & Gonz A Lez-Zamar, 2021b). Countries and areas may choose different development models to promote their development according to their resources, culture, political system, and historical background(Shi et al., 2019).

The theoretical framework of this study mainly involves several vital theories. The first is the cluster theory, which refers to the spatial concentration of higher education institutions, research organizations, and related industries in a specific geographical area(Boldyreva et al., 2020b). It emphasizes the benefits of proximity, knowledge spillovers, and collaboration among cluster participants in driving innovation, productivity, and competitiveness(O Dwyer et al., 2023c). The second one is the Triple Helix Model, a theoretical framework proposed by Etzkowitz and Leydesdorff in 1995 to explain and describe the innovation process and technological development in the modern knowledge economy(Cai & Lattu, 2022). It emphasizes the interaction and collaboration among academia, industry, and government in promoting innovation and economic development encourages technology transfer and cooperation between academia and industry, and at the same time, the support and guidance of government are indispensable(Li et al., 2020b). The third theory is the regional innovation system, which refers to the role of institutions, networks, and resources in promoting innovation and economic growth in a specific geographical area(Fernandes et al., 2021b). It recognizes the importance of interaction and collaboration between different actors, such as universities, research organizations, businesses, and government agencies(Suchek et al., 2021).

Based on these concepts and theories, the theoretical framework of this study proposes that the government, universities, and enterprises positively influence the development of higher education clusters in the Chengdu-Chongqing region.

3.2 Sampling technique

Sampling techniques are methods used in research to select individuals or subsets of items from a larger population, enabling researchers to make inferences about the entire population based on the characteristics of the selected sample(Mweshi & Sakyi, 2020). The study used focus groups, which are qualitative research methods that involve bringing together a small group of participants for a guided discussion on a particular topic to explore the attitudes, beliefs, perceptions, and experiences of the participants about the research topic(L O Hr et al., 2020). This focus group mainly uses purposeful sampling to ensure that focus group members have experience and knowledge related to the research topic and to promote in-depth discussion.

3.2.1 Focus Group Members: Each participant was invited individually because Ludwig (1997:266) felt that the number of participants was not significant who the participants were. Inductive data analysis is used to interpret the collected data(Kyng A S, 2020). Participants were selected using purposive sampling and a maximum variance sampling strategy(Berndt, 2020). Purposive sampling methods enable detailed exploration and understanding of the central theme or problem the researcher wishes to study(Wang et al., 2021). In a purposive sampling strategy, participants are selected because they can purposively inform the significant phenomenon in the study(Staller, 2021). Patton (2002) pointed out that rather than collecting standardized information from a large and statistically significant sample; it is better to collect information together. It is best to focus on a small number of carefully selected participants. According to the needs of this study, the invited focus group members are university presidents, government officials, entrepreneurs, and experts with higher education management qualifications engaged in higher education management or close cooperation with universities; they have an in-depth understanding and research of higher education clusters.

3.2.2 Determination of population: According to Bryman (2012, p. 426), the criterion for sample size is the size required to reach saturation(Hennink & Kaiser, 2022a). Under normal circumstances, focus groups usually comprise 6 to 12 experts(Yulianti & Sulistyawati, 2021) .However, no significant relationship was found between group size and decision efficiency ; it is unlikely that the same group of experts

will produce completely different results from 15 groups of experts. The saturation criteria determined the number of interviewees for this study(Hennink & Kaiser, 2022b). Therefore, nine experts were selected as interviewees for this study, and all participants were invited individually, without knowing each other, to ensure more objective data during the participation process . There are two forms of interviews, focus group meetings and Tencent meetings.

3.3 Instrumentation

3.3.1 Semi-structured interview: A semi-structured interview is a data collection method that asks questions within a predetermined thematic framework(Ruslin et al., 2022). However, questions need to be set in order or phrased. This provides flexibility for interviewees and interviewees and allows the interview guidelines to be modified over time to focus on areas that are particularly important and relevant to the experiences and attitudes of participants suited to the study's objectives(Arthur & Nazroo, 2003) .

3.3.2 Questionnaire survey: A questionnaire survey is a commonly used quantitative research method, through the design of concise questions, to collect many respondents' views, attitudes, behaviors and characteristics, and other information(Chowdhury et al., 2022). After clarifying the purpose of the study, suitable respondents were selected, and data were collected through face-to-face interviews and online surveys. Subsequently, the collected data were input and collated, and the results were interpreted using statistical and analytical methods. Through a questionnaire survey, researchers can objectively understand the opinions and trends of respondents and provide a valuable reference for problem-solving, policy formulation, and market analysis(Mohajan & Others, 2020).

3.3.3 SPSS software: SPSS software is a statistical analysis software mainly used for data processing and statistical analysis in social sciences, market research, and education(Habes et al., 2021). It provides rich statistical methods and charting functions to help users quickly find rules and trends from large amounts of data and draw reliable conclusions. Without programming knowledge, researchers and beginners can easily

use SPSS for high-quality data analysis, supporting scientific research and decision-making(Phakiti, 2023).

3.3.4 SmartPLS Software: SmartPLS is a software tool for Structural Equation Modeling (SEM), used for data analysis and model evaluation in research fields such as social sciences and business management(Sarstedt & Cheah, 2019a). It provides an intuitive and user-friendly graphical user interface, enabling researchers to construct and assess complex structural equation models. SmartPLS estimates model parameters using the Partial Least Squares (PLS) algorithm and provides evaluation metrics, such as path coefficients, factor loadings, and R^2, Q^2.to help researchers interpret the model's explanatory power and predictive accuracy(Shahani & Ahmed, 2022). Due to its simplicity and practicality, SmartPLS has gained widespread adoption in the research community, especially among researchers who are less familiar with statistical analysis and structural equation modeling.

3.4 Data Collection

3.4.1 Literature collection: Through collecting domestic and foreign literature on higher education clusters, the researchers focus on developing higher education clusters in the Chengdu-Chongqing region, an in-depth understanding of its evolution, characteristics, and influencing factors, and comparing them with other regional higher education clusters(Gui, 2022a). This paper discusses the roles of government, universities, and enterprises in developing higher education clusters, reveals their relationship and cooperation, accumulates theoretical knowledge for research, and provides a basis for focus group discussion to determine the theme and open questions. Through literature collection, the researcher made the role of government, universities, and enterprises in developing higher education clusters in the Chengdu-Chongqing region to prepare for the focus group discussion.

3.4.2 Focus Groups

3.4.2.1 The first round: 9 government officials, university administrators, and enterprise leaders are invited to form an expert group to conduct semi-structured interviews through video conference, with the researcher as the host. Experts are guided

to brainstorm the influencing factors and effects of developing higher education clusters in the Chengdu-Chongqing region, focusing on the role of government, universities, and enterprises in developing higher education clusters in the Chengdu-Chongqing region. Researchers gradually drill down into questions and ask for details to ensure comprehensive data is available. Still, experts can play freely in the discussion process and provide more comprehensive and in-depth insights. Questionnaire 1 (see Appendix A) was formed by carefully recording and sorting out the contents of the first round of interviews and was sent to nine experts for evaluation.

3.4.2.2 The second round: The experts review the overall structure and question sets, clarity and accuracy, sequence and logic of Questionnaire 1, and the researcher sorts out and summarizes the experts' replies according to the similarities or differences. Similarities mean that most of the nine experts agree, most disagreement is discarded, the second Questionnaire (see Appendix B) is formed, and nine more experts are sent to evaluate.

3.4.2.3 The third round: After the return of Questionnaire 2, identify, classify and summarize the results of expert discussion, find out the similarities and differences, merge the same items, and discard the majority of objections from Questionnaire 3 (see Appendix C), and send it to 9 experts for evaluation again.

3.4.3 Questionnaire:

After the third Questionnaire was collected, the researchers synthesized the expert opinions, which were relatively consistent except for modifying individual sentences. Using the Likert Scale, the researchers developed a questionnaire (see Appendix D) and planned to conduct research through online survey platforms, e-mail, social media, or website links. Questionnaires were distributed to university administrators, government officials, and business leaders in the Chengdu-Chongqing region, and their support and participation were sincerely requested to recover the survey data on time.

3.5 Statistical Analysis

SPSS software and SmartPLS software were used for statistical analysis. SPSS (Statistical Package for the Social Sciences) is the earliest statistical analysis software in the world, and it is also the most widely used statistical analysis software(Rahman & Muktadir, 2021). It uses exploratory analysis, partial correlation, analysis of variance, nonparametric test, multiple regression, logistic regression, and other statistical analysis methods to explore the relationship between variables and provide support and interpretation of research questions(Humble, 2020). These analysis methods will provide a credible scientific basis for deriving research results and data interpretation. This study uses SPSS software to analyze the reliability of the survey results. It carries out exploratory factor analysis and confirmatory factor analysis to ensure the reliability and rationality of the survey results(Lorenzo-Seva, 2022).SmartPLS is a statistical analysis software tool for structural equation modeling (SEM)(Sarstedt & Cheah, 2019b). which can analyze the relationship between variables in complex models, verify the significance of assumptions, evaluate the fitness of models, and interpret the results of studies, providing a scientific basis for statistical analysis.

CHAPTER 4
RESULTS

Through four rounds of focus group discussion and questionnaire survey, this chapter comprehensively and deeply discusses the key factors affecting the development of higher education clusters in the Chengdu-Chongqing region. As a qualitative research method, a focus group encourages participants to freely express their views and experiences and provides rich qualitative data for research questions. Subsequently, a questionnaire survey was conducted to collect many participants' opinions, further enriching the study's data sources. The questionnaire data are quantified through the reliability analysis, exploratory factor analysis, and confirmatory factor analysis of SPSS software, and the internal mode and relationship of the development of the higher education cluster in the Chengdu-Chongqing region are revealed. The comprehensive research method of this chapter ensures the scientific credibility of the research results. It contributes substantially to the decision-making and related research on developing higher education clusters in the Chengdu-Chongqing region.

4.1 Demographic data

4.2 Results and Analysis

4.3 summary

4.1 Demographic data

4.1.1 Focus Group

The first round: brainstorming: nine government officials, university administrators, and business leaders were invited to form a focus group, and semi-structured interviews were conducted through video conferencing, with the researcher as the host. Focusing on the discussion of the influencing factors and effects of the development of higher education cluster in the Chengdu-Chongqing region, this paper mainly discusses the role of government, universities, and enterprises in the development of higher education cluster in the Chengdu-Chongqing area and puts forward some reasons. After careful summary, the researcher refines six first-level

indicators and 14 second-level indicators of the government's influencing factors on the development of higher education clusters in the Chengdu-Chongqing region, and five first-level indicators and 16 second-level indicators of the university's influencing factors on the development of higher education clusters in Chengdu-Chongqing region. There are three first-level indicators and seven second-level indicators for the influencing factors of enterprises on the development of the higher education cluster in the Chengdu-Chongqing region, and four first-level indicators and 16 second-level indicators for the effect of the higher education cluster in Chengdu-Chongqing region, which are sorted out to form questionnaire 1 (see Appendix a) and sent to experts for comments.

The second round: expert opinion review: Experts reviewed the overall structure and question sets, refinement and accuracy, sequence and logic of Questionnaire 1, and the researcher sorted out and summarized the expert replies according to similarities or differences, which meant that most of the nine experts agreed, while differences intended the opposite. For example, the international cooperation and exchange policy in the government's influencing factors overlaps with the international cooperation and exchange in universities, and it is suggested to merge and retain it in the university factors. The supervision and evaluation measures in the government factors have little correlation with the higher education cluster, so it is suggested to abandon it; University factors in the local economic development and social responsibility and personnel training to merge; Merging scientific research cooperation and production, teaching and research in enterprise factors; It is suggested that the indicators of personnel training, resource sharing, and international exchange and collaboration should be integrated. At the same time, the researchers also streamlined the relevant statements. Finally, they retained four first-level indicators and ten second-level indicators of government influencing factors, four first-level indicators and 12 second-level indicators of university influencing factors, and two first-level indicators and five second-level indices of enterprise influencing factors. The effect of the higher education cluster in the Chengdu-Chongqing region has four first-level indicators and 12 second-level indicators, forming the second questionnaire (see Appendix B).

Round 3: Reassessment: After the return of questionnaire 2, the results of the expert discussion are comprehensively studied, identification, classification, and induction are carried out, similarities and differences are found, relevant expressions are simplified, and questionnaire 3 (see Appendix C) is formed, and nine experts are sent again for evaluation.

4.1.2 Questionnaire Survey

After Questionnaire 3 was recovered, except for the revision of individual sentences, expert opinions were more consistent; using the Likert scale, the researcher made a questionnaire (see Appendix D). The survey was conducted through online survey platforms, e-mail, social media, or website links, and questionnaires were distributed to university administrators, government officials, and business leaders in the Chengdu-Chongqing region. Advanced pre-survey, through the Analysis of the credibility and effectiveness of pre-survey data, get better results, and then conduct formal research.

4.2 Research and Statistical Analysis Results

The focus group results synthesize qualitative research on higher education clusters in the Chengdu-Chongqing region, which includes nine experts with profound relevance, authority, and representative opinions. To make the study more extensive and figurative, the researchers adopted the questionnaire survey method to solicit more opinions. The results were analyzed and verified by SPSS software to ensure the accuracy and credibility of the study.

4.2.1 Questionnaire Design

The choice of measurement questionnaire is an essential issue in studying organizational behavior. The quality of questionnaire selection has a significant impact on the reliability of the results of the study. This questionnaire is divided into three parts. The first part is the basic information of individuals, including gender, age, education, identity, and working life; The second part, according to the 4.1 focus group, obtains the Chengdu-Chongqing area higher education cluster development of the influence factor

(independent variable), includes the government factor, the university factor, the enterprise factor, as well as their concrete choice, altogether 27 items. The third part is the evaluation criteria (dependent variable) of the development of the Chengdu-Chongqing higher education cluster, including personnel training, resource sharing, scientific research, international exchanges, and their specific options, a total of 12 items. The survey was designed as a Likert five-level scale (see Appendix D). The second part divided the agreement degree into very agree, relatively agree, neutral, somewhat disagree, and significantly different. In the third part, the indicators were divided into important, significant, general, not necessary, and unimportant, and the corresponding scores were 5, 4, 3, 2, and 1. The researchers set substitute symbols for each index item to meet the needs of later research data analysis and construction of the first and second-level index model maps (see Appendix E).

4.2.2 Pre-investigation

Firstly, this study conducts a pre-investigation on university managers, business leaders in the related education industry, and government officials in charge of education involved in studying the development of higher education clusters in Chengdu and Chongqing.Through the spss23.0 software on the pre-survey data for each dimension and the overall reliability coefficient of the report, followed by exploratory factor analysis of the pre-survey data, rotating the composition matrix in line with the expected division of the questionnaire dimensions.

4.2.2.1 Sample Population

A total of 80 valid questionnaires were collected in this pre-survey, and now the sample population is reported as follows:

Table 4.1 Sample Population Data of Pre-survey

Items	Options	Frequency	Percent
Gender	Male	48	60.0
	Female	32	40.0
Age	Under 30years	18	22.5
	30-45years	26	32.5

	45-60years	36	45.0
Education background	High school/technical secondary school and below	21	26.3
	Undergraduate and specialty	27	33.8
	Graduate student	32	40.0
Identity	Government official	23	28.7
	University administrator	43	53.8
	Principal of the enterprise	14	17.5
Working Life	Under 5years	14	17.5
	5-10 years	18	22.5
	10-15years	20	25.0
	15 years or more	28	35.0

From Table 4.1, we can see that in the sample population of the pre-survey, 60% are male, 45% are mainly aged 45-60, 32.5% are 30-45, and 22.5% are under 30. Academic qualifications are especially postgraduate qualifications, accounting for 40%, followed by undergraduate qualifications, accounting for 33.8%, and finally, high school/secondary school qualifications and below, accounting for 26.3%.Among the identities, university administrators accounted for 53.8%, followed by government officials, accounting for 28.7%, and finally, business leaders, accounting for 17.5%.In the working life, more than 15 years accounted for 35%, followed by 10-15 years, accounting for 25%, 5-10 years, accounting for 22.5%, and finally, less than five years, accounting for 17.5%.

4.2.2.2 Reliability analysis

With the help of spss23.0 software, the reliability of the questionnaire data is tested. When the Clonbach coefficient is more than 0.7, the reliability of the questionnaire data is in the normal range. When the Clonbach coefficient is in the field of 0.8-0.9, it can be considered that the questionnaire has excellent reliability.

Table 4.2 Reliability Analysis of Questionnaire

variable	Cronbach's Alpha	Number of terms	Total Cronbaha's Alpha
Policy Support	0.897	3	
Infrastructure Support	0.792	2	
Financial Support	0.882	3	
Scientific Research Project Support	0.888	2	
Interdisciplinary Research Program	0.905	5	
Joint Training of Talents	0.892	3	
Science Outreach Program	0.910	2	
International Exchange and Cooperation	0.847	2	
Industry university research cooperation	0.844	3	
Co-construction between school and enterprise	0.848	2	0.947
The Effect of Talents Cultivation in the Development of Higher Education Cluster	0.895	3	
The Effect of Resource Sharing in Higher Education Cluster Development	0.877	3	
Scientific Research Achievements of Higher Education Cluster Development	0.919	4	
International Exchange Effect of Higher Education Cluster Development	0.872	2	

As can be seen from Table 4.2, Policy Support、Infrastructure Support、Financial Support、Scientific Research Project Support、Interdisciplinary Research Program、Joint Training of Talents、Science Outreach Program、International Exchange and Cooperation、Industry university research cooperation、Co-constraction between school and enterprise、The reliability coefficients of talent cultivation, resource sharing, scientific research and international communication of higher education cluster development are 0.897, 0.792, 0.882, 0.888, 0.905, 0.892, 0.910,

0.847, respectively. .844、0.848、0.895、0.877、0.919、0.872.The reliability coefficient of the questionnaire is 0. 947. In summary, the reliability coefficient of the pre-survey data is greater than 0. 7. It can be considered that the data has good reliability and is suitable for further Analysis.

4.2.2.3 Exploratory Factor Analysis

When testing the validity, the KMO value should be observed first. When the KMO value is more significant than 0.5 and the significance is less than 0.05, factor analysis can further test the data validity. The details are as follows:

Table 4.3 Questionnaire KMO Value Table

KMO	Approx. Chi-Square	df	Sig.
0.722	2820.435	741	0.000

It can be seen from Table 4.3 that the KMO value of this group of data is 0.722 > 0.5, and the significance is 0.000 < 0.005, which is suitable for factor analysis. This article first chooses the exploratory factor analysis; after the Spss23.0 software computation, the precipitation is the total variance explanation table, the rotation ingredient matrix table, concrete is as follows:

Table 4.4 Exploratory Factor Analysis of Questionnaire

Component	Initial Eigenvalues			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	13.730	35.205	35.205	4.015	10.294	10.294
2	3.014	7.729	42.935	3.371	8.643	18.937
3	2.580	6.615	49.549	2.724	6.984	25.921
4	2.190	5.616	55.166	2.693	6.905	32.826
5	2.122	5.440	60.606	2.670	6.846	39.673
6	1.648	4.227	64.832	2.581	6.618	46.290
7	1.618	4.149	68.981	2.522	6.467	52.757
8	1.537	3.941	72.921	2.513	6.444	59.201
9	1.232	3.160	76.081	1.989	5.101	64.302
10	1.223	3.135	79.216	1.989	5.100	69.402
11	1.125	2.883	82.100	1.958	5.020	74.422
12	.889	2.278	84.378	1.898	4.865	79.288

13	.752	1.928	86.306	1.844	4.729	84.017
14	.655	1.680	87.986	1.548	3.969	87.986
15	.550	1.410	89.396			
16	.441	1.130	90.526			
17	.432	1.108	91.634			
18	.364	.933	92.567			
19	.330	.846	93.414			
20	.303	.777	94.191			
21	.266	.682	94.872			
22	.240	.616	95.488			
23	.216	.555	96.043			
24	.198	.507	96.551			
25	.187	.479	97.030			
26	.172	.441	97.471			
27	.157	.403	97.874			
28	.127	.325	98.199			
29	.115	.294	98.494			
30	.099	.254	98.748			
31	.094	.240	98.988			
32	.085	.219	99.207			
33	.066	.169	99.376			
34	.061	.157	99.532			
35	.054	.137	99.670			
36	.047	.121	99.791			
37	.038	.097	99.888			
38	.027	.068	99.957			
39	.017	.043	100.000			

It can be seen from Table 4.4 that the percentage of the sum of squares of the first-factor rotation load in the total variance explanation table is 10.294% < 40%, indicating that there is no standard severe method deviation problem in this group of data; Secondly, the cumulative variance explanation rate of the 12th factor in the table after rotation was 87.986% > 60%, which indicated that the 14 factors could effectively represent 87.986% of the information content of the questionnaire. The factor loading coefficients in the rotated principal component matrix table are then observed as follows:

Table 4.5 Questionnaire Factor Load Coefficient Table

	Component													
	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Policy support1					.880									
Policy support2					.832									
Policy support3					.738									
Infrastructure support1													.827	
Infrastructure support2													.815	
Financial support1				.881										
Financial support2				.748										
Financial support3				.682										
Research project support1														.750
Research project support2														.677
Interdisciplinary research program1	.869													
Interdisciplinary research program2	.725													
Interdisciplinary research program3	.780													
Interdisciplinary research program4	.774													
Interdisciplinary research program5	.756													
Joint training of talents1						.888								
Joint training of talents2						.657								
Joint training of talents3						.775								
Science extension programme1									.888					
Science extension programme2									.815					
International school exchange and cooperation1												.819		
International school exchange and cooperation2												.863		
Industry university research cooperation1							.862							
Industry university research cooperation2							.728							
Industry university research cooperation3							.772							
School enterprise co construction1											.859			
School enterprise co construction2											.765			
Effect of personnel training1								.827						
Effect of personnel training2								.724						
Effect of personnel training3								.728						

Effectiveness of resource sharing1		.897		
Effectiveness of resource sharing2		.757		
Effectiveness of resource sharing3		.797		
Scientific research effectiveness1	.938			
Scientific research effectiveness2	.867			
Scientific research effectiveness3	.687			
Scientific research effectiveness4	.716			
Effectiveness of international exchange1				.868
Effectiveness of international exchange2				.827

From Table 4.5, it can be seen that the first factor is the three items of the Interdisciplinary research program, and the load value is between 0.725 and 0.869; The second factor is the four items of scientific research effectiveness, and the load value is between 0.716 and 0.938;The third factor is the three items of point of resource sharing, and the load value is between 0.757 and 0.897; The fourth factor is the three items of Financialsupport, and the load value is between 0.682 and 0.881;The fifth factor is the three items of Policy support, with load values ranging from 0.738 to 0.880; The sixth factor is the three items of Joint training of talents, with load values ranging from 0.657 to 0.888; The seventh factor is the three items of Industry university research cooperation, and the load value is between 0.728 and 0.862;The eighth factor is the three items of practical personnel training, and the load value is between 0.724 and 0.827; The ninth factor is two items of Science Extension Programme, and the load values are 0.815 and 0.888 respectively; The tenth factor is the two items of adequate difference national exchange, and the load values are 0.827 and 0.868 respectively;The eleventh factor is two items of school enterprise eco construction, and the load values are 0.765 and 0.859 respectively; The 12th factor is the two items of International school exchange and cooperation, and the load values are 0.819 and 0.863 respectively; The 13th factor is two items of infrastructure support, the load values are 0.827 and

0.815 respectively;The 14th factor is the two items of research project support, and the load values are 0.677 and 0.750 respectively. To sum up, the above load does not appear that the same item belongs to two factors or has two or more different dimensions under the same factor, which meets the expected division of 14 sizes. This data group has good construct validity and is suitable for further Analysis.

4.2.3 Formal Research

4.2.3.1 Sample Population

Statistical information on the sample population of 405 valid questionnaires returned by the formal survey is now reported as follows:

Table 4.6 Data of Sample Population Participated in Formal Survey

Items	Options	Frequency	Percent
Gender	Male	244	60.2%
	Female	161	39.8%
Age	Under 30years	97	24.0%
	30-45years	127	31.4%
	45-60years	181	44.7%
Education background	High school/technical secondary school and below	95	23.5%
	Undergraduate and specialty	142	35.1%
	Graduate student	168	41.5%
Identity	Government official	131	32.3%
	University administrator	185	45.7%
	Principal of the enterprise	89	22.0%
Working Life	Under 5years	48	11.9%
	5-10 years	57	14.1%
	10-15years	134	33.1%
	15 years or more	166	41.0%

Based on Table 4.6, it can be observed that in the sample population, males account for 60.2%, while females account for 39.8%. The age distribution is mainly concentrated in the 45-60 age group, representing 44.7% of the sample, followed by the 30-45 age group, comprising 31.4%, and lastly, individuals below 30 years old, making

up 24%. Regarding educational background, most of the sample population holds postgraduate degrees, representing 41.5%, undergraduate degrees at 35.1%, and finally, individuals with a high school diploma or below, accounting for 23.5%. As for occupational roles, the sample population primarily comprises university administrators, making up 45.7%; government officials at 32.2%; and business executives at 22%. Concerning work experience, the majority of the sample population has over 15 years of experience, comprising 41%, followed by 10-15 years of experience at 33.1%, and subsequently, 5-10 years at 14.4%, with individuals having less than five years of experience representing 11.9%.

4.2.3.2 Reliability and Convergence Validity Analysis

Next, the reliability and convergent validity of the formal survey were reported. When Cronbach's Alpha is less than 0.3, it indicates that the data are in an unreliable assessment range. If it falls between 0.3 and 0.4, the questionnaire data are in a marginally reliable range. The value between 0.4 and 0.5 indicates that the data are in a moderately reliable assessment range. A range of 0.5 to 0.7 is considered reliable (the most common field). If it falls between 0.7 and 0.9, it is highly reliable (the second most common range). When Cronbach's Alpha is more significant than 0.9, the questionnaire data are highly reliable. Composite Reliability (CR) combines all the measurement variables' reliabilities, which can measure the consistency of construct indicators. A CR value higher than 0.7 indicates a high level of internal consistency for latent variables in this study. Average Variance Extracted (AVE) represents the percentage of Variance in the observed variables that the latent variable can explain. For this study, an AVE value greater than 0.5 indicates good convergent validity of the research data, as follows:

Table 4.7 Reliability and Convergence Validity of Formal Survey Data

	Cronbach Alpha	Composite reliability	AVE
Industry university research cooperation	0.89	0.899	0.819
International Exchange and Cooperation	0.839	0.84	0.861
Infrastructure Support	0.854	0.855	0.873
The effect of international exchange and cooperation in the development of higher education clusters	0.86	0.861	0.878
Effect of scientific research on cluster development of higher education	0.911	0.912	0.789
The effect of talent training on the development of higher education clusters	0.869	0.875	0.791
Resource sharing effect of higher education cluster development	0.874	0.88	0.798
Interdisciplinary Research Program	0.93	0.931	0.781
Scientific Research Project Support	0.864	0.907	0.878
Joint Training of Talents	0.902	0.905	0.836
Science Outreach Program	0.881	0.931	0.892
Co-construction between school and enterprise	0.836	0.851	0.858
Policy Support	0.893	0.895	0.824
Financial Support	0.878	0.881	0.804

Based on Table 4.7, the reliability coefficients for the constructs "Industry university research cooperation," "International Exchange and Cooperation," "Infrastructure Support," "The effect of international exchange and cooperation in the development of higher education clusters," "Effect of scientific research on cluster development of higher education," "The effect of Scientific Research on Cluster Higher Education," "Resource sharing effect of higher education cluster development," "Interdisciplinary Research Program," "Scientific Research Project Support," "Joint Training of Talents," "Science Outreach Program," "Co-construction between school and enterprise," "Policy Support," and "Financial Support" are 0.89, 0.839, 0.854, 0.86,

0.911, 0.869, 0.874, 0.93, 0.864, 0.902, 0.881, 0.836, and 0.893, respectively, all of which exceed 0.8.

The Composite Reliability (CR) values for the constructs are 0.899, 0.84, 0.855, 0.861, 0.912, 0.875, 0.88, 0.931, 0.907, 0.905, 0.931, 0.851, 0.895, and 0.881, respectively, all of which surpass the industry standard of 0.7.

Furthermore, the Average Variance Extracted (AVE) values for the constructs are 0.819, 0.861, 0.873, 0.878, 0.789, 0.791, 0.798, 0.781, 0.878, 0.836, 0.892, 0.858, 0.824, and 0.804, respectively, all of which exceed the required industry standard of 0.5.

Based on the above findings, the data collected in this research demonstrate high reliability and good model convergent validity.

4.2.3.3 Discriminant validity

Now, we will report the discriminant validity of the formal survey data. Discriminant validity testing ensures that each measurement variable belongs only to its respective latent construct and does not overlap with other constructs. The commonly used methods for discriminant validity testing are cross-loadings and the Fornell-Larcker criterion, as follows:

1) Cross-load capacity Cross-loadings

Cross-loadings: Cross-loadings examine how much each measurement variable primarily loads on its intended construct and not on other constructs. A measurement variable should have a higher loading on its corresponding construct to demonstrate discriminant validity than on different constructs.

Table 4.8 Discriminatory Validity of Formal Survey Data

	component													
	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Industry university research cooperation1	0.914													
Industry university research cooperation2	0.902													
Industry university research cooperation3	0.900													
International Exchange and Cooperation1		0.925												
International Exchange and Cooperation2		0.931												
Infrastructure Support1			0.935											
Infrastructure Support2			0.933											
Cluster higher education international exchange and cooperation1				0.935										
Cluster higher education international exchange and cooperation2				0.939										
Scientific Research on Cluster Higher Education1					0.928									
Scientific Research on Cluster Higher Education2					0.894									
Scientific					0.868									

Research on Cluster Higher Education3 Scientific	0.862				
Research on Cluster Higher Education4 Scientific		0.921			
Research on Cluster Higher Education1 Scientific		0.869			
Research on Cluster Higher Education2 Scientific		0.878			
Research on Cluster Higher Education3 Cluster High Education Resource Sharing1			0.915		
Cluster High Education Resource Sharing2			0.883		
Cluster High Education Resource Sharing3			0.882		
Interdisciplinary Research Program1				0.923	
Interdisciplinary Research Program2				0.884	
Interdisciplinary Research Program3				0.875	
Interdisciplinary Research Program4				0.851	
Interdisciplinary Research Program5				0.884	

Scientific Research Project Support1	0.920				
Scientific Research Project Support2	0.954				
Joint Training of Talents1		0.932			
Joint Training of Talents2		0.911			
Joint Training of Talents3		0.899			
Science Outreach Program1			0.929		
Science Outreach Program2			0.96		
Co-construction between school and enterprise1				0.914	
Co-construction between the school and enterprise2				0.938	
Policy Support1					0.93
Policy Support2					0.894
Policy Support3					0.898
Financial Support1					0.912
Financial Support2					0.885
Financial Support3					0.892

Table 4.8 shows that the first factor, "Industry university research cooperation," consists of 3 items with loading factor values of 0.914, 0.902, and 0.9, respectively. The

second factor, "International Exchange and Cooperation," comprises two things with loading factor values of 0.925 and 0.931. The third factor, "Infrastructure Support," includes two items with loading values of 0.935 and 0.933. The fourth factor, "Cluster higher education international exchange and cooperation," consists of 2 items with loading values of 0.935 and 0.939. The fifth factor, "Scientific Research on Cluster Higher Education," comprises four items with loading values of 0.928, 0.894, 0.866, and 0.862. The sixth factor, "Scientific Research on Cluster Higher Education," consists of 3 items with loading values of 0.921, 0.869, and 0.878. The seventh factor, "Cluster High Education Resource Sharing," includes three items with loading values of 0.915, 0.883, and 0.882. The eighth factor, "Interdisciplinary Research Program," consists of 5 items with loading values of 0.923, 0.884, 0.875, 0.851, and 0.884. The ninth factor, "Scientific Research Project Support," comprises two things with loading values of 0.92 and 0.954. The tenth factor, "Joint Training of Talents," includes three items with loading values of 0.932, 0.911, and 0.899. The eleventh factor, "Science Outreach Program," consists of 2 items with loading values of 0.929 and 0.96. The twelfth factor, "Co-construction between school and enterprise," includes loading values of 0.914 and 0.938. The thirteenth factor, "Policy Support," consists of 3 items with loading values of 0.93, 0.894, and 0.898. The fourteenth factor, "Financial Support," includes three items with loading values of 0.912, 0.885, and 0.892.

All the above loading values indicate that no item belongs to more than one factor or that no element contains two or more dimensions. This confirms the expected division of the 14 dimensions. These results demonstrate that the data in this study possess good structural validity, making them suitable for further Analysis.

2）Fornell-Larcker Criterion

Fornell-Larcker Criterion: The Fornell-Larcker criterion assesses the discriminant validity by comparing the square root of the AVE of each construct with the correlation coefficients between constructs. For discriminant validity to be established, the square root of the AVE of each construct should be greater than its correlations with other constructs.

Table 4.9 Fornell-Larcker Criterion Analysis

	1	2	3	4	5	6	7	8	9	10	11	12	13	14
1Industry university research cooperation	**0.905**													
2International Exchange and Cooperation	0.387	**0.928**												
3Infrastructure Support	0.453	0.549	**0.934**											
4Cluster higher education international exchange and cooperation	0.526	0.563	0.490	**0.937**										
5Scientific Research on Cluster Higher Education	0.491	0.564	0.672	0.429	**0.888**									
6Scientific Research on Cluster Higher Education	0.325	0.513	0.515	0.513	0.311	**0.889**								
7Cluster High Education Resource Sharing	0.441	0.451	0.450	0.409	0.438	0.436	**0.893**							
8Interdisciplinary Research Program	0.456	0.575	0.588	0.592	0.499	0.614	0.522	**0.884**						
9Scientific Research Project Support	0.433	0.442	0.402	0.400	0.412	0.325	0.395	0.452	**0.937**					
10Joint Training of Talents	0.422	0.463	0.440	0.480	0.417	0.562	0.565	0.508	0.429	**0.914**				
11Science Outreach Program	0.413	0.408	0.436	0.402	0.418	0.290	0.297	0.485	0.357	0.303	**0.944**			
12Co-construction between school and enterprise	0.495	0.434	0.409	0.619	0.381	0.552	0.419	0.509	0.328	0.466	0.392	**0.926**		
13Policy Support	0.525	0.435	0.474	0.508	0.409	0.402	0.611	0.460	0.420	0.533	0.396	0.514	**0.908**	
14Financial Support	0.484	0.589	0.477	0.637	0.532	0.537	0.448	0.594	0.387	0.450	0.446	0.578	0.477	**0.897**

Note: The data of the diagonal line is the square root of the AVE value of the surface, and the data of the off-diagonal line is the correlation coefficient between the surface and other surfaces

Based on Table 4.9, it can be observed that the correlation coefficients between "Industry university research cooperation" and other dimensions range from 0.325 to 0.526, while the square root of AVE for "Industry university research cooperation" is 0.905, which is greater than 0.526. Similarly, "International Exchange and Cooperation" exhibits correlation coefficients ranging from 0.408 to 0.589 with other dimensions, and

its AVE square root is 0.928, more significant than 0.589. For "Infrastructure Support," the correlation coefficients with different sizes range from 0.402 to 0.672, while its AVE square root is 0.934, more significant than 0.672. The factor "Cluster higher education international exchange and cooperation" demonstrates correlation coefficients from 0.4 to 0.637 with other dimensions, and its AVE square root is 0.937, more significant than 0.637. Likewise, "Scientific Research on Cluster Higher Education" exhibits correlation coefficients ranging from 0.311 to 0.532 with other dimensions, and its AVE square root is 0.888, more significant than 0.532. The factor "Scientific Research on Cluster Higher Education" demonstrates correlation coefficients from 0.290 to 0.562 with other dimensions, and its AVE square root is 0.889, more significant than 0.562. For "Cluster High Education Resource Sharing," the correlation coefficients with different sizes range from 0.297 to 0.611, while its AVE square root is 0.893, more significant than 0.611. Similarly, the "Interdisciplinary Research Program" exhibits correlation coefficients ranging from 0.452 to 0.594 with other dimensions, and its AVE square root is 0.884, more significant than 0.594.

The correlation coefficients between "Scientific Research Project Support" and other dimensions range from 0.328 to 0.429, while its AVE square root is 0.937, more significant than 0.429. "Joint Training of Talents" demonstrates correlation coefficients from 0.303 to 0.533 with other dimensions, and its AVE square root is 0.914, more significant than 0.533. For the "Science Outreach Program," the correlation coefficients with different sizes range from 0.392 to 0.446, while its AVE square root is 0.944, more significant than 0.446.

The factor "Co-construction between school and enterprise" exhibits correlation coefficients of 0.514 and 0.578 with other dimensions, and its AVE square root is 0.926, more significant than 0.578. "Policy Support" shows a correlation coefficient of 0.477 with the "Financial Support" dimension, while its AVE square root is 0.908, more significant than 0.477. The AVE square root for "Financial Support" is 0.897.

In conclusion, all 14 dimensions in this model have correlation coefficients around 0.6 with other dimensions, and the AVE square root values for each size are more significant than their respective correlation coefficients with different dimensions.

Therefore, this model exhibits good discriminant validity, making it suitable for further Analysis.

4.2.3.4 Structural Model Analysis of Level I Indicator

1) Collinearity analysis of primary index

The Variance Inflation Factor (VIF) can be used to detect the issue of multicollinearity among the indicators within a construct. When the number of hands with VIF values greater than 10 is significant, multicollinearity has become a severe threat to the stability of parameter estimates. Specifically, high VIF values suggest that some indicators within the construct are highly correlated, which may lead to inflated standard errors and unstable parameter estimates in regression models. Multicollinearity can make it challenging to identify the individual effects of each indicator on the construct, as their products become difficult to distinguish due to the high correlation among them. Therefore, researchers need to address multicollinearity issues to ensure the reliability and accuracy of their parameter estimates in statistical analyses.

Table 4.10 Collinearity Analysis of First-order Indicators

	Higher education cluster development results
Enterprise factor	1.875
Government factor	2.857
University factor	2.475

Based on Table 4.10, it can be observed that the Variance Inflation Factor (VIF) values for the first-order indicators, namely "Enterprise Factors," "Government Factors," and "University Factors" in the development effectiveness of the Chengdu-Chongqing higher education cluster, are 1.875, 2.857, and 2.475, respectively. All these VIF values are less than 5, indicating that the research model at the first-order indicator level does not exhibit severe multicollinearity issues. This suggests that the data in the model are suitable for further Analysis, and the first-order indicators, representing "Enterprise Factors," "Government Factors," and "University Factors," do not have highly correlated relationships that could threaten the stability of parameter estimates.

2) Level 1 indicator R^2 analysis

Table 4.11 First-order Indicators R^2 Analysis

	Adjust R^2	Explanatory power
Higher education cluster development results	0.744	强

Based on Table 4.11, it can be observed that the adjusted R^2 value for the dependent variable "Higher education cluster development results" is 0.744. This indicates that the independent variables "Enterprise factor," "Government factor," and "University factor" collectively explain approximately 74.4% of the Variance in the dependent variable. The high adjusted R^2 value signifies a robust explanatory power of the independent variables in predicting the variation in the "Higher education cluster development results." It suggests that these three factors significantly influence higher education cluster development outcomes. Overall, the model demonstrates a high explanatory capability in explaining the dependent variable, making it a robust representation for further Analysis and interpretation.

3) Level 1 Indicator Path Result

Table 4.12 Level 1 Indicator Path Result Analysis Table

	Original Sample	Sample Mean	Standard deviation	T statistic	P value
Enterprise factor -> Higher education cluster development results	0.142	0.142	0.038	3.745	0.000
Government factor -> Higher education cluster development results	0.401	0.401	0.044	9.133	0.000
University factor -> Higher education cluster development results	0.411	0.411	0.038	10.882	0.000

Based on Table 4.12, it is evident that the path from "Enterprise factor" to "Higher education cluster development results" in the Chengdu-Chongqing region is statistically significant, with a path coefficient of 0.142, which is greater than 0. This positive coefficient signifies a positive influence, and a p-value of less than 0.001 indicates its significance.

Similarly, the path from the "Government factor" to the development effectiveness of the higher education cluster in the Chengdu-Chongqing region is statistically

significant, with a path coefficient of 0.401, greater than 0. A p-value of less than 0.001 confirms the significance of this positive influence.

Furthermore, the path from the "University factor" to the development effectiveness of the higher education cluster in the Chengdu-Chongqing region is also statistically significant, with a path coefficient of 0.411. A p-value of less than 0.001 supports this significant positive influence.

In summary, the findings demonstrate that the "Enterprise factor," "Government factor," and "University factor" have statistically significant positive effects on the development effectiveness of the higher education cluster in the Chengdu-Chongqing region. These results provide evidence of the impact and importance of these factors in contributing to the outcomes of higher education cluster development.

4.2.3.5 Structural model analysis of secondary indicator

1) Collinearity analysis of secondary index

Table 4.13 Collinearity Analysis of Secondary Indicator

	Cluster higher education international exchange and cooperation	Scientific Research on Cluster Higher Education	Scientific Research on Cluster Higher Education	Cluster High Education Resource Sharing
Industry university research cooperation	1.575	1.575	1.575	1.575
International Exchange and Cooperation	1.652	1.652	1.652	1.652
Infrastructure Support	1.611	1.611	1.611	1.611
Interdisciplinary Research Program	1.984	1.984	1.984	1.984
Scientific Research Project Support	1.407	1.407	1.407	1.407
Joint Training of Talents	1.574	1.574	1.574	1.574
Science Outreach Program	1.406	1.406	1.406	1.406
Co-construction between school and enterprise	1.596	1.596	1.596	1.596
Policy Support	1.666	1.666	1.666	1.666
Financial Support	1.817	1.817	1.817	1.817

Based on Table 4.13, it can be observed that the Variance Inflation Factor (VIF) values for the independent variables "Industry university research cooperation" are all 1.575 < 5 for the four dependent variables. Similarly, for the independent variable "International Exchange and Cooperation," the VIF values are all 1.652 < 5 for the four dependent variables. The independent variable "Infrastructure Support" exhibits VIF values of 1.611 < 5 for the four dependent variables. The VIF values for the independent variable "Interdisciplinary Research Program" are all 1.984 < 5 for the four dependent variables. For the independent variable "Scientific Research Project Support," the VIF values are all 1.407 < 5 for the four dependent variables. The independent variable, "Joint Training of Talents," demonstrates VIF values of 1.574 < 5 for the four dependent variables. The VIF values for the independent variable "Science Outreach Program" are 1.406 < 5 for the four dependent variables. The independent variable, "Co-construction between school and enterprise," exhibits VIF values of 1.596 < 5 for the four dependent variables. The VIF values for the independent variable "Policy Support" are all 1.666 < 5 for the four dependent variables. Lastly, the independent variable "Financial Support" demonstrates VIF values of 1.817 < 5 for the four dependent variables.

Based on the Analysis, it can be concluded that the Variance Inflation Factor (VIF) values for the model's path are all less than 5, indicating that multicollinearity is not severe among the independent variables. Therefore, the data in this study do not exhibit a severe multicollinearity problem, making it suitable for further Analysis.

2) Analysis of secondary indicator R ²

Table 4.14 Secondary Indicator R ² Analysis Table

	Adjust R^2	Explanatory power
Cluster higher education international exchange and cooperation	0.463	中等
Scientific Research on Cluster Higher Education	0.458	中等
Scientific Research on Cluster Higher Education	0.443	中等
Cluster High Education Resource Sharing	0.409	中等

Based on Table 4.14, it can be observed that the R^2 value for the dependent variable "The effect of international exchange and cooperation in the development of higher education clusters" is 0.467. The indicates that the independent variables

"Industry university research cooperation, International Exchange and Cooperation, Infrastructure Support, Interdisciplinary Research Program, Scientific Research Project Support, Joint Training of Talents, Science Outreach Program, Co-construction between school and enterprise, Policy Support, Financial Support" collectively explain approximately 46.3% of the Variance in the dependent variable "The effect of international exchange and cooperation in the development of higher education clusters."

Similarly, for the dependent variable "Effect of scientific research on cluster development of higher education," the R^2 value is 0.458. The indicates that the independent variables "Industry university research cooperation, International Exchange and Cooperation, Infrastructure Support, Interdisciplinary Research Program, Scientific Research Project Support, Joint Training of Talents, Science Outreach Program, Co-construction between school and enterprise, Policy Support, Financial Support" collectively explain approximately 45.8% of the Variance in the dependent variable "Effect of scientific research on cluster development of higher education."

For the dependent variable "Scientific Research on Cluster Higher Education Effect," the R^2 value is 0.443, indicating that the independent variables "Industry university research cooperation, International Exchange and Cooperation, Infrastructure Support, Interdisciplinary Research Program, Scientific Research Project Support, Joint Training of Talents, Science Outreach Program, Co-construction between school and enterprise, Policy Support, Financial Support" collectively explain approximately 44.3% of the Variance in the dependent variable "Scientific Research on Cluster Higher Education Effect."

Finally, for the dependent variable "Resource sharing effect of higher education cluster development," the R^2 value is 0.409, indicating that the independent variables "Industry university research cooperation, International Exchange and Cooperation, Infrastructure Support, Interdisciplinary Research Program, Scientific Research Project Support, Joint Training of Talents, Science Outreach Program, Co-construction between school and enterprise, Policy Support, Financial Support" collectively explain approximately 40.9% of the Variance in the dependent variable "Resource sharing effect of higher education cluster development."

Overall, the R^2 values for all four dependent variables in this study are more significant than 0.4, indicating that the explanatory power of the independent variables on the dependent variables is at a moderate level.

3) Path Result

Table 4.15 Secondary Indicator Path Result Analysis Table

	Original Sample	Sample Mean	Standard deviation	T statistic	P value
Industry university research cooperation -> Cluster higher education international exchange and cooperation	0.118	0.119	0.052	2.282	0.023
Industry university research cooperation -> Scientific Research on Cluster Higher Education	0.146	0.147	0.049	2.995	0.003
Industry university research cooperation -> Scientific Research on Cluster Higher Education	-0.073	-0.073	0.047	1.553	0.121
Industry-University research cooperation -> Cluster High Education Resource Sharing	0.064	0.062	0.054	1.18	0.238
International Exchange and Cooperation -> Cluster higher education international exchange and cooperation	0.126	0.127	0.056	2.244	0.025
International Exchange and Cooperation -> Scientific Research on Cluster Higher Education	0.161	0.162	0.05	3.204	0.001
International Exchange and Cooperation -> Scientific Research on Cluster Higher Education	0.088	0.089	0.054	1.637	0.102
International Exchange and Cooperation -> Cluster High Education Resource Sharing	0.056	0.055	0.056	1.001	0.317
Infrastructure Support -> Cluster higher education international exchange and cooperation	0.036	0.034	0.049	0.74	0.459
Infrastructure Support -> Scientific Research on Cluster Higher Education	0.356	0.356	0.045	7.91	0.000
Infrastructure Support -> Scientific Research on Cluster Higher Education	0.139	0.139	0.055	2.553	0.011
Infrastructure Support -> Cluster High Education Resource Sharing	0.045	0.046	0.052	0.87	0.384
Interdisciplinary Research Program -> Cluster higher education international exchange and cooperation	0.147	0.147	0.062	2.377	0.017
Interdisciplinary Research Program -> Scientific Research on Cluster Higher Education	0.002	0.001	0.056	0.04	0.968
Interdisciplinary Research Program -> Scientific Research on Cluster Higher Education	0.26	0.259	0.053	4.932	0.000
Interdisciplinary Research Program -> Cluster High Education Resource Sharing	0.167	0.168	0.06	2.789	0.005
Scientific Research Project Support -> Cluster higher education international exchange and cooperation	0.015	0.017	0.047	0.323	0.746
Scientific Research Project Support -> Scientific Research on Cluster Higher Education	0.061	0.061	0.046	1.326	0.185
Scientific Research Project Support -> Scientific Research on Cluster	-0.03	-0.03	0.05	0.595	0.552

Higher Education					
Scientific Research Project Support -> Cluster High Education Resource Sharing	0.03	0.03	0.048	0.624	0.533
Joint Training of Talents -> Cluster higher education international exchange and cooperation	0.05	0.05	0.049	1.029	0.304
Joint Training of Talents -> Scientific Research on Cluster Higher Education	0.046	0.045	0.053	0.867	0.386
Joint Training of Talents -> Scientific Research on Cluster Higher Education	0.235	0.234	0.046	5.082	0.000
Joint Training of Talents -> Cluster High Education Resource Sharing	0.212	0.213	0.052	4.069	0.000
Science Outreach Program -> Cluster higher education international exchange and cooperation	-0.001	-0.002	0.05	0.023	0.982
Science Outreach Program -> Scientific Research on Cluster Higher Education	0.058	0.06	0.045	1.297	0.195
Science Outreach Program -> Scientific Research on Cluster Higher Education	-0.07	-0.072	0.045	1.555	0.120
Science Outreach Program -> Cluster High Education Resource Sharing	-0.046	-0.048	0.047	0.978	0.328
Co-construction between school and enterprise -> Cluster higher education international exchange and cooperation	0.2	0.199	0.052	3.821	0.000
Co-construction between school and enterprise -> Scientific Research on Cluster Higher Education	-0.026	-0.026	0.046	0.565	0.572
Co-construction between school and enterprise -> Scientific Research on Cluster Higher Education	0.188	0.189	0.053	3.509	0.000
Co-construction between school and enterprise -> Cluster High Education Resource Sharing	-0.007	-0.007	0.05	0.143	0.886
Policy Support -> Cluster higher education international exchange and cooperation	0.065	0.065	0.055	1.182	0.237
Policy Support -> Scientific Research on Cluster Higher Education	-0.023	-0.024	0.054	0.431	0.667
Policy Support -> Scientific Research on Cluster Higher Education	-0.017	-0.017	0.049	0.356	0.722
Policy Support -> Cluster High Education Resource Sharing	0.298	0.3	0.05	5.979	0.000
Financial Support -> Cluster higher education international exchange and cooperation	0.194	0.193	0.06	3.239	0.001
Financial Support -> Scientific Research on Cluster Higher Education	0.146	0.145	0.053	2.77	0.006
Financial Support -> Scientific Research on Cluster Higher Education	0.122	0.124	0.053	2.309	0.021
Financial Support -> Cluster High Education Resource Sharing	0.032	0.031	0.057	0.562	0.574

From the table, the following path results are significant among the many path results:

①The path from "Infrastructure Support" in the "Government factor" to the scientific research effectiveness in developing higher education clusters in the Chengdu-Chongqing region is statistically significant, with a path coefficient of 0.356, greater than 0. This positive coefficient indicates a positive influence and a p-value of less than 0.001 supports its significance.

② The path from "Infrastructure Support" in the "Government factor" to the effectiveness of "Joint Training of Talents" in the development of higher education clusters in the Chengdu-Chongqing region is statistically significant, with a path coefficient of 0.139, which is greater than 0. This positive coefficient suggests a positive influence, and its significance is indicated by a p-value of 0.011, which is less than 0.05.

③The path from "Policy Support" in the "Government factor" to the effectiveness of resource sharing in developing higher education clusters in the Chengdu-Chongqing region is statistically significant, with a path coefficient of 0.298, greater than 0. This positive coefficient indicates a positive influence and a p-value of less than 0.001 supports its significance.

④ The path from "Financial Support" in the "Government factor" to the effectiveness of "International Exchange and Cooperation" in the development of higher education clusters in the Chengdu-Chongqing region is statistically significant, with a path coefficient of 0.194, which is greater than 0. This positive coefficient suggests a positive influence, and its significance is indicated by a p-value of 0.001, which is less than 0.05.

⑤The path from "Financial Support" in the "Government factor" to the scientific research effectiveness in the development of higher education clusters in the Chengdu-Chongqing region is statistically significant, with a path coefficient of 0.146, which is greater than 0. This positive coefficient indicates a positive influence, and its significance is supported by a p-value of 0.006, which is less than 0.05.

⑥ The path from "Financial Support" in the "Government factor" to the effectiveness of "Joint Training of Talents" in the development of higher education clusters in the Chengdu-Chongqing region is statistically significant, with a path coefficient of 0.122, which is greater than 0. This positive coefficient suggests a positive influence, and its significance is indicated by a p-value of 0.021, which is less than 0.05.

These results provide evidence of the significant positive influences of specific factors within the "Government factor" on various aspects of developing higher education clusters in the Chengdu-Chongqing region. The statistically considerable paths demonstrate the critical role played by these factors in contributing to the effectiveness and success of higher education cluster development in the area.

⑦The path from "International Exchange and Cooperation" in the "University factor" to the effectiveness of "International Exchange and Cooperation" in the development of higher education clusters in the Chengdu-Chongqing region is statistically significant, with a path coefficient of 0.126, which is greater than 0. This positive coefficient indicates a positive influence, and its significance is supported by a p-value of 0.025, which is less than 0.05.

⑧The path from "International Exchange and Cooperation" in the "University factor" to the scientific research effectiveness in the development of higher education clusters in the Chengdu-Chongqing region is statistically significant, with a path coefficient of 0.161, which is greater than 0. This positive coefficient suggests a positive influence, and its significance is indicated by a p-value of 0.001, which is less than 0.05.

⑨The path from "Interdisciplinary Research Program" in the "University factor" to the effectiveness of "International Exchange and Cooperation" in the development of higher education clusters in the Chengdu-Chongqing region is statistically significant, with a path coefficient of 0.147, which is greater than 0. This positive coefficient indicates a positive influence, and its significance is supported by a p-value of 0.017, which is less than 0.05.

⑩The path from "Interdisciplinary Research Program" in the "University factor" to the effectiveness of "Joint Training of Talents" in the development of higher education clusters in the Chengdu-Chongqing region is statistically significant, with a path coefficient of 0.26, which is greater than 0. This positive coefficient suggests a positive influence and a p-value of less than 0.001 indicates its significance.

⑪The path from the "Interdisciplinary Research Program" in the "University factor" to the effectiveness of resource sharing in the development of higher education clusters in the Chengdu-Chongqing region is statistically significant, with a path coefficient of 0.167, which is greater than 0. This positive coefficient indicates a positive influence, and its significance is supported by a p-value of 0.005, which is less than 0.05.

⑫The path from "Joint Training of Talents" in the "University factor" to the effectiveness of "Joint Training of Talents" in the development of higher education clusters in the Chengdu-Chongqing region is statistically significant, with a path coefficient of 0.235, which is greater than 0. This positive coefficient suggests a positive influence and a p-value of less than 0.001 indicates its significance.

⑬The path from "Joint Training of Talents" in the "University factor" to the effectiveness of resource sharing in the development of higher education clusters in the Chengdu-Chongqing region is statistically significant, with a path coefficient of 0.212, which is greater than 0. This positive coefficient indicates a positive influence and a p-value of less than 0.001 supports its significance.

These results demonstrate the significant positive effects of specific factors within the "University factor" on developing higher education clusters in the Chengdu-Chongqing region. The statistically considerable paths provide evidence of the critical role played by these factors in contributing to the effectiveness and success of higher education cluster development in the region.

⑭The path from "Industry university research cooperation" in the "Enterprise factor" to the effectiveness of "International Exchange and Cooperation" in the development of higher education clusters in the Chengdu-Chongqing region is statistically significant, with a path coefficient of 0.118, which is greater than 0. This positive coefficient indicates a positive influence, and its significance is supported by a p-value of 0.023, which is less than 0.05.

⑮The path from "Industry university research cooperation" in the "Enterprise factor" to the scientific research effectiveness in the development of higher education clusters in the Chengdu-Chongqing region is statistically significant, with a path coefficient of 0.146, which is greater than 0. This positive coefficient suggests a positive influence, and its significance is indicated by a p-value of 0.003, which is less than 0.05.

⑯The path from "Co-construction between school and enterprise" in the "Enterprise factor" to the effectiveness of "International Exchange and Cooperation" in the development of higher education clusters in the Chengdu-Chongqing region is statistically significant, with a path coefficient of 0.2, which is greater than 0. This positive coefficient indicates a positive influence and a p-value of less than 0.001 supports its significance.

⑰The path from "Co-construction between school and enterprise" in the "Enterprise factor" to the effectiveness of "Joint Training of Talents" in the development of higher education clusters in the Chengdu-Chongqing region is statistically significant, with a path coefficient of 0.188, which is greater than 0. This positive coefficient suggests a positive influence and a p-value of less than 0.001 indicates its significance.

These results demonstrate the significant positive effects of specific factors within the "Enterprise factor" on developing higher education clusters in the Chengdu-Chongqing region. The statistically considerable paths provide evidence of the critical role played by these factors in contributing to the effectiveness and success of higher education cluster development in the region.

4.3 Summary

4.3.1 Results of focus group studies

Using focus groups, the researchers analyzed the influencing factors of higher education cluster development in the Chengdu-Chongqing region. Initially, the theme "Influencing Factors and Effectiveness of Higher Education Cluster Development in the

Chengdu-Chongqing Region" was used to collect expert opinions through brainstorming. The researchers categorized these opinions into three groups: government factors, university factors, and enterprise factors, with a total of four aspects of effectiveness. Through three rounds of soliciting ideas from the focus groups, consensus was reached among the experts regarding the influencing factors of higher education cluster development in the Chengdu-Chongqing region. Among them were ten government factors, 12 university factors, and five enterprise factors. The effectiveness of developing the higher education cluster included talent cultivation, resource sharing, scientific research, international exchange, and cooperation, with 12 aspects.

4.3.2 Analysis of investigation result

To ensure the scientific validity and rationality of the research results, the researchers converted the findings from the focus groups into a questionnaire (Appendix D). The questionnaire was administered to investigate university administrators, relevant education industry executives, and government officials in charge of education, all involved in researching the higher education cluster development model in the Chengdu-Chongqing region. A preliminary survey was conducted, and 80 valid responses were collected. The collected data from the initial study were then subjected to reliability analysis and exploratory factor analysis using SPSS 23.0 software. The rotated component matrix from the exploratory factor analysis aligned with the expected divisions of the questionnaire dimensions.

After conducting the preliminary and refining of the questionnaire, the formal survey was administered to a large sample of government officials, university administrators, and enterprise leaders in the Chengdu-Chongqing region. The data collected from the traditional study were subjected to credibility analysis, convergent validity analysis, and discriminant validity analysis using Smartpls 4.0 software. Additionally, the structural model was further analyzed, and results were obtained for the first-level and second-level indicators, including collinearity analysis, R-squared Analysis, and path analysis.

CHAPTER 5
DISCUSSION AND RECOMMENDATION

This chapter elucidates the development model of the higher education cluster in the Chengdu-Chongqing region and explores its underlying mechanisms. The research findings reveal the identification of factors and their effects that influence the development of the higher education cluster in the Chengdu-Chongqing region. However, it is essential to acknowledge that the study's sample size is limited, and the data sources have certain restrictions, necessitating further expansion of the scope and in-depth exploration of specific stage strategies. Future research could concentrate on different development stages to explore alternative higher education cluster models in the Chengdu-Chongqing region, thereby enhancing the depth and breadth of the investigation.

5.1 Discussion and Summary

5.2 Contribution of the Study

5.3 Limitations of the Study

5.4 Prospects for Future Research

5.1 Discussion and Summary

In the fourth chapter, the researchers used focus groups to discuss the influencing factors and results of developing higher education clusters in Chengdu and the Chongqing region. They used the questionnaire survey method to conduct a pre-survey and formal survey on the results of the focus groups. The survey results' reliability and validity were analyzed using SPSS23.0 and Smartpls4.0 software. From a series of analysis results, the reliability and validity of the survey data are very high, and Smartpls4.0 software presents the first and second-level index model operation results.

5.1.1 Analysis of influencing factors of the independent variable on the dependent variable

The path coefficients can provide insights into the strength and direction of the causal relationship between independent and dependent variables. A path coefficient greater than 0 indicates a positive influence; when it is less than 0, it signifies a negative impact. The statistical results were input into Smartpls4.0, and the corresponding outcomes are presented in Table 5.1, Figure 5.1, Table 5.2, and Figure 5.2.

Table 5.1 Level 1 Indicator Path Result Analysis

Table 5.1 shows that the path from Enterprise factor to Higher education cluster development results in the Chengdu-Chongqing region is significant, with a path coefficient of 0.142, indicating a positive influence and a highly significant p-value of less than 0.001. Additionally, the path from the Government factor to the effectiveness of the development of the higher education cluster in the Chengdu-Chongqing region is also significant, with a path coefficient of 0.401, indicating a positive influence and a highly significant p-value of less than 0.001. Moreover, the path from the University factor to the effectiveness of the development of the higher education cluster in the Chengdu-Chongqing region is significant, with a path coefficient of 0.411, indicating a positive influence and a highly significant p-value of less than 0.001. Subsequently, the results of the first-level indicator model calculations are reported as follows:

	Original Sample	Sample Mean	Standard deviation	T statistic	P value
Enterprise factor -> Higher education cluster development results	0.142	0.142	0.038	3.745	0.000
Government factor -> Higher education cluster development results	0.401	0.401	0.044	9.133	0.000
University factor -> Higher education cluster development results	0.411	0.411	0.038	10.882	0.000

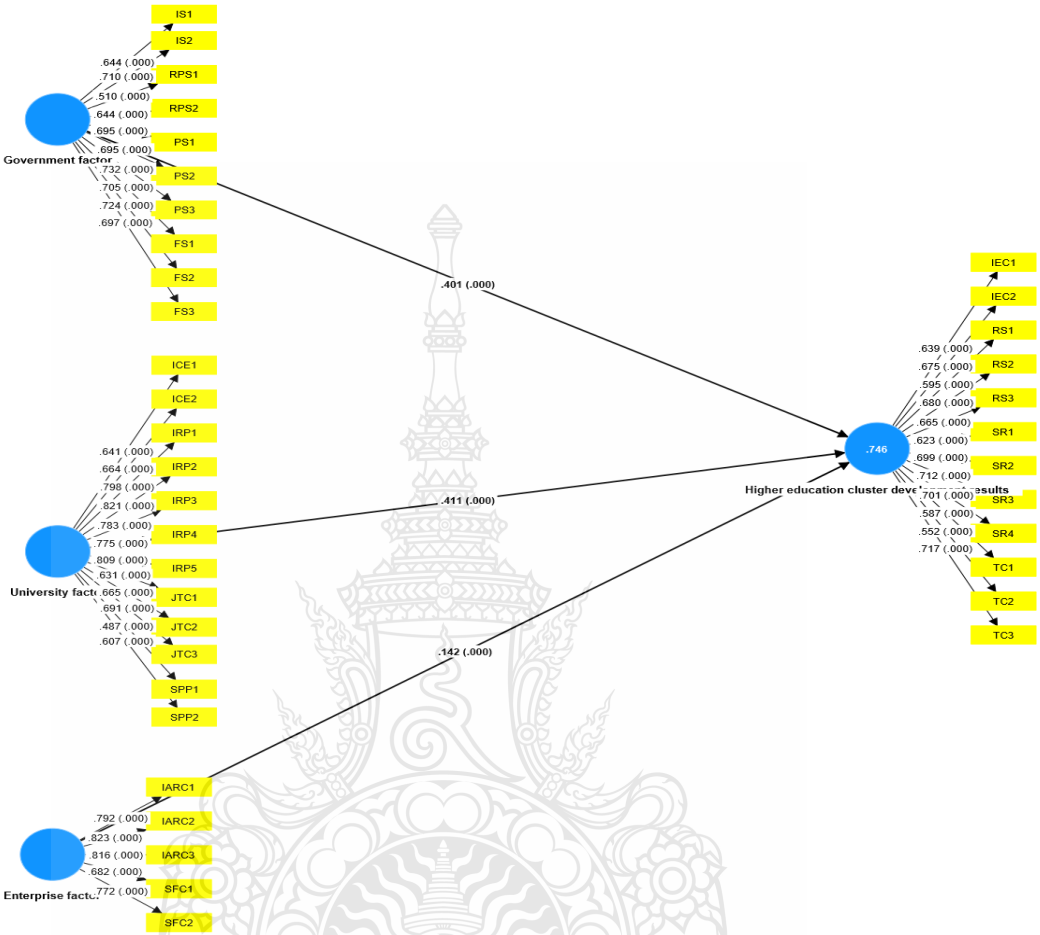

Figure 5.1 Calculation results of the first level index model

Table 5.2 Secondary Indicator Path Result Analysis

	Original Sample	Sample Mean	Standard deviation	T statistic	P value
Industry university research cooperation -> Cluster higher education international exchange and cooperation	0.118	0.119	0.052	2.282	0.023
Industry university research cooperation -> Scientific	0.146	0.147	0.049	2.995	0.00

Research on Cluster Higher Education					3
Industry university research cooperation -> Scientific	-0.073	-0.073	0.047	1.553	0.12
Research on Cluster Higher Education					1
Industry-University research cooperation -> Cluster High	0.064	0.062	0.054	1.18	0.23
Education Resource Sharing					8
International Exchange and Cooperation -> Cluster higher	0.126	0.127	0.056	2.244	0.02
education international exchange and cooperation					5
International Exchange and Cooperation -> Scientific	0.161	0.162	0.05	3.204	0.00
Research on Cluster Higher Education					1
International Exchange and Cooperation -> Scientific	0.088	0.089	0.054	1.637	0.10
Research on Cluster Higher Education					2
International Exchange and Cooperation -> Cluster High	0.056	0.055	0.056	1.001	0.31
Education Resource Sharing					7
Infrastructure Support -> Cluster higher education	0.036	0.034	0.049	0.74	0.45
international exchange and cooperation					9
Infrastructure Support -> Scientific Research on Cluster	0.356	0.356	0.045	7.91	0.00
Higher Education					0
Infrastructure Support -> Scientific Research on Cluster	0.139	0.139	0.055	2.553	0.01
Higher Education					1
Infrastructure Support -> Cluster High Education Resource	0.045	0.046	0.052	0.87	0.38
Sharing					4
Interdisciplinary Research Program -> Cluster higher	0.147	0.147	0.062	2.377	0.01
education international exchange and cooperation					7
Interdisciplinary Research Program -> Scientific Research on	0.002	0.001	0.056	0.04	0.96
Cluster Higher Education					8
Interdisciplinary Research Program -> Scientific Research on	0.26	0.259	0.053	4.932	0.00
Cluster Higher Education					0
Interdisciplinary Research Program -> Cluster High Education	0.167	0.168	0.06	2.789	0.00
Resource Sharing					5
Scientific Research Project Support -> Cluster higher	0.015	0.017	0.047	0.323	0.74
education international exchange and cooperation					6
Scientific Research Project Support -> Scientific Research	0.061	0.061	0.046	1.326	0.18
on Cluster Higher Education					5
Scientific Research Project Support -> Scientific Research	-0.03	-0.03	0.05	0.595	0.55
on Cluster Higher Education					2
Scientific Research Project Support -> Cluster High	0.03	0.03	0.048	0.624	0.53
Education Resource Sharing					3
Joint Training of Talents -> Cluster higher education	0.05	0.05	0.049	1.029	0.30
international exchange and cooperation					4
Joint Training of Talents -> Scientific Research on Cluster	0.046	0.045	0.053	0.867	0.38
Higher Education					6

Joint Training of Talents -> Scientific Research on Cluster Higher Education	0.235	0.234	0.046	5.082	0.000
Joint Training of Talents -> Cluster High Education Resource Sharing	0.212	0.213	0.052	4.069	0.000
Science Outreach Program -> Cluster higher education international exchange and cooperation	-0.001	-0.002	0.05	0.023	0.982
Science Outreach Program -> Scientific Research on Cluster Higher Education	0.058	0.06	0.045	1.297	0.195
Science Outreach Program -> Scientific Research on Cluster Higher Education	-0.07	-0.072	0.045	1.555	0.120
Science Outreach Program -> Cluster High Education Resource Sharing	-0.046	-0.048	0.047	0.978	0.328
Co-construction between school and enterprise -> Cluster higher education international exchange and cooperation	0.2	0.199	0.052	3.821	0.000
Co-construction between school and enterprise -> Scientific Research on Cluster Higher Education	-0.026	-0.026	0.046	0.565	0.572
Co-construction between school and enterprise -> Scientific Research on Cluster Higher Education	0.188	0.189	0.053	3.509	0.000
Co-construction between school and enterprise -> Cluster High Education Resource Sharing	-0.007	-0.007	0.05	0.143	0.886
Policy Support -> Cluster higher education international exchange and cooperation	0.065	0.065	0.055	1.182	0.237
Policy Support -> Scientific Research on Cluster Higher Education	-0.023	-0.024	0.054	0.431	0.667
Policy Support -> Scientific Research on Cluster Higher Education	-0.017	-0.017	0.049	0.356	0.722
Policy Support -> Cluster High Education Resource Sharing	0.298	0.3	0.05	5.979	0.000
Financial Support -> Cluster higher education international exchange and cooperation	0.194	0.193	0.06	3.239	0.001
Financial Support -> Scientific Research on Cluster Higher Education	0.146	0.145	0.053	2.77	0.006
Financial Support -> Scientific Research on Cluster Higher Education	0.122	0.124	0.053	2.309	0.021
Financial Support -> Cluster High Education Resource Sharing	0.032	0.031	0.057	0.562	0.574

From the table, the following path results are significant among the many path results:

①The path from "Infrastructure Support" in the "Government factor" to the scientific research effectiveness in developing higher education clusters in the Chengdu-Chongqing region is statistically significant, with a path coefficient of 0.356, greater than 0. This positive coefficient indicates a positive influence and a p-value of less than 0.001 supports its significance.

②The path from "Infrastructure Support" in the "Government factor" to the effectiveness of "Joint Training of Talents" in the development of higher education clusters in the Chengdu-Chongqing region is statistically significant, with a path coefficient of 0.139, which is greater than 0. This positive coefficient suggests a positive influence, and its significance is indicated by a p-value of 0.011, which is less than 0.05.

③The path from "Policy Support" in the "Government factor" to the effectiveness of resource sharing in developing higher education clusters in the Chengdu-Chongqing region is statistically significant, with a path coefficient of 0.298, greater than 0. This positive coefficient indicates a positive influence and a p-value of less than 0.001 supports its significance.

④The path from "Financial Support" in the "Government factor" to the effectiveness of "International Exchange and Cooperation" in the development of higher education clusters in the Chengdu-Chongqing region is statistically significant, with a path coefficient of 0.194, which is greater than 0. This positive coefficient suggests a positive influence, and its significance is indicated by a p-value of 0.001, which is less than 0.05.

⑤The path from "Financial Support" in the "Government factor" to the scientific research effectiveness in the development of higher education clusters in the Chengdu-Chongqing region is statistically significant, with a path coefficient of 0.146, which is greater than 0. This positive coefficient indicates a positive influence, and its significance is supported by a p-value of 0.006, which is less than 0.05.

⑥The path from "Financial Support" in the "Government factor" to the effectiveness of "Joint Training of Talents" in the development of higher education clusters in the Chengdu-Chongqing region is statistically significant, with a path coefficient of 0.122, which is greater than 0. This positive coefficient suggests a

positive influence, and its significance is indicated by a p-value of 0.021, which is less than 0.05.

These results provide evidence of the significant positive influences of specific factors within the "Government factor" on various aspects of developing higher education clusters in the Chengdu-Chongqing region. The statistically considerable paths demonstrate the critical role played by these factors in contributing to the effectiveness and success of higher education cluster development in the area.

⑦The path from "International Exchange and Cooperation" in the "University factor" to the effectiveness of "International Exchange and Cooperation" in the development of higher education clusters in the Chengdu-Chongqing region is statistically significant, with a path coefficient of 0.126, which is greater than 0. This positive coefficient indicates a positive influence, and its significance is supported by a p-value of 0.025, which is less than 0.05.

⑧The path from "International Exchange and Cooperation" in the "University factor" to the scientific research effectiveness in the development of higher education clusters in the Chengdu-Chongqing region is statistically significant, with a path coefficient of 0.161, which is greater than 0. This positive coefficient suggests a positive influence, and its significance is indicated by a p-value of 0.001, which is less than 0.05.

⑨The path from "Interdisciplinary Research Program" in the "University factor" to the effectiveness of "International Exchange and Cooperation" in the development of higher education clusters in the Chengdu-Chongqing region is statistically significant, with a path coefficient of 0.147, which is greater than 0. This positive coefficient indicates a positive influence, and its significance is supported by a p-value of 0.017, which is less than 0.05.

⑩The path from "Interdisciplinary Research Program" in the "University factor" to the effectiveness of "Joint Training of Talents" in the development of higher education clusters in the Chengdu-Chongqing region is statistically significant, with a path coefficient of 0.26, which is greater than 0. This positive coefficient suggests a positive influence and a p-value of less than 0.001 indicates its significance.

⑪The path from the "Interdisciplinary Research Program" in the "University factor" to the effectiveness of resource sharing in the development of higher education clusters in the Chengdu-Chongqing region is statistically significant, with a path coefficient of 0.167, which is greater than 0. This positive coefficient indicates a positive influence, and its significance is supported by a p-value of 0.005, which is less than 0.05.

⑫The path from "Joint Training of Talents" in the "University factor" to the effectiveness of "Joint Training of Talents" in the development of higher education clusters in the Chengdu-Chongqing region is statistically significant, with a path coefficient of 0.235, which is greater than 0. This positive coefficient suggests a positive influence and a p-value of less than 0.001 indicates its significance.

⑬The path from "Joint Training of Talents" in the "University factor" to the effectiveness of resource sharing in the development of higher education clusters in the Chengdu-Chongqing region is statistically significant, with a path coefficient of 0.212, which is greater than 0. This positive coefficient indicates a positive influence and a p-value of less than 0.001 supports its significance.

These results demonstrate the significant positive effects of specific factors within the "University factor" on developing higher education clusters in the Chengdu-Chongqing region. The statistically considerable paths provide evidence of the critical role played by these factors in contributing to the effectiveness and success of higher education cluster development in the region.

⑭The path from "Industry university research cooperation" in the "Enterprise factor" to the effectiveness of "International Exchange and Cooperation" in the development of higher education clusters in the Chengdu-Chongqing region is statistically significant, with a path coefficient of 0.118, which is greater than 0. This positive coefficient indicates a positive influence, and its significance is supported by a p-value of 0.023, which is less than 0.05.

⑮The path from "Industry university research cooperation" in the "Enterprise factor" to the scientific research effectiveness in the development of higher education clusters in the Chengdu-Chongqing region is statistically significant, with a path coefficient of 0.146, which is greater than 0. This positive coefficient suggests a

positive influence, and its significance is indicated by a p-value of 0.003, which is less than 0.05.

⑯The path from "Co-construction between school and enterprise" in the "Enterprise factor" to the effectiveness of "International Exchange and Cooperation" in the development of higher education clusters in the Chengdu-Chongqing region is statistically significant, with a path coefficient of 0.2, which is greater than 0. This positive coefficient indicates a positive influence and a p-value of less than 0.001 supports its significance.

⑰The path from "Co-construction between school and enterprise" in the "Enterprise factor" to the effectiveness of "Joint Training of Talents" in the development of higher education clusters in the Chengdu-Chongqing region is statistically significant, with a path coefficient of 0.188, which is greater than 0. This positive coefficient suggests a positive influence and a p-value of less than 0.001 indicates its significance.

These results demonstrate the significant positive effects of specific factors within the "Enterprise factor" on developing higher education clusters in the Chengdu-Chongqing region. The statistically considerable paths provide evidence of the critical role played by these factors in contributing to the effectiveness and success of higher education cluster development in the region.

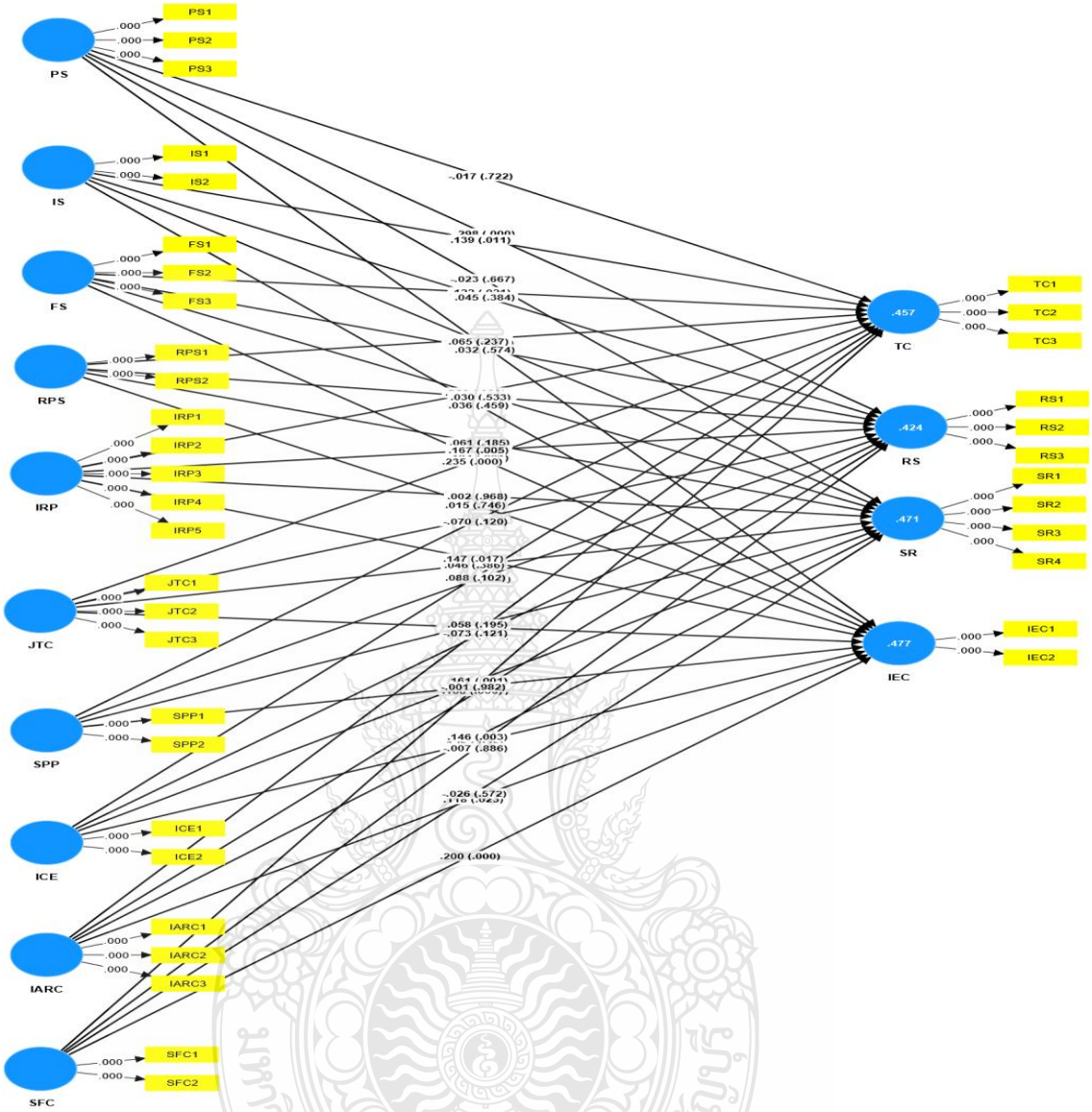

Figure 5.2 Calculation results of the secondary index model

5.1.2 Model of Higher Education Cluster Development in Chengdu-Chongqing Region

Based on the research findings, it is evident that within the government factors, "Policy support," "Infrastructure support," and "Financial support" exert a strong influence on the development effectiveness of the higher education cluster in the Chengdu-Chongqing region. Among the university factors, "Interdisciplinary Research

Program," "Joint Talent Training," and "International Cooperation and Exchange" show a strong influence on the development effectiveness of the higher education cluster. Similarly, within the enterprise factors, "Industry-Academia Research Collaboration" and "School-Enterprise Collaboration" substantially impact the development effectiveness of the higher education cluster.

On the other hand, the government factor "Scientific Research Project Support" and the university factor "Science Outreach Program" have a weaker influence on the development effectiveness of the higher education cluster in the Chengdu-Chongqing region.

Based on the analysis results, the researchers integrated the three-helix model. They established a comprehensive model to analyze the factors influencing the development of the higher education cluster in the Chengdu-Chongqing region, as depicted in Figure 5.3.

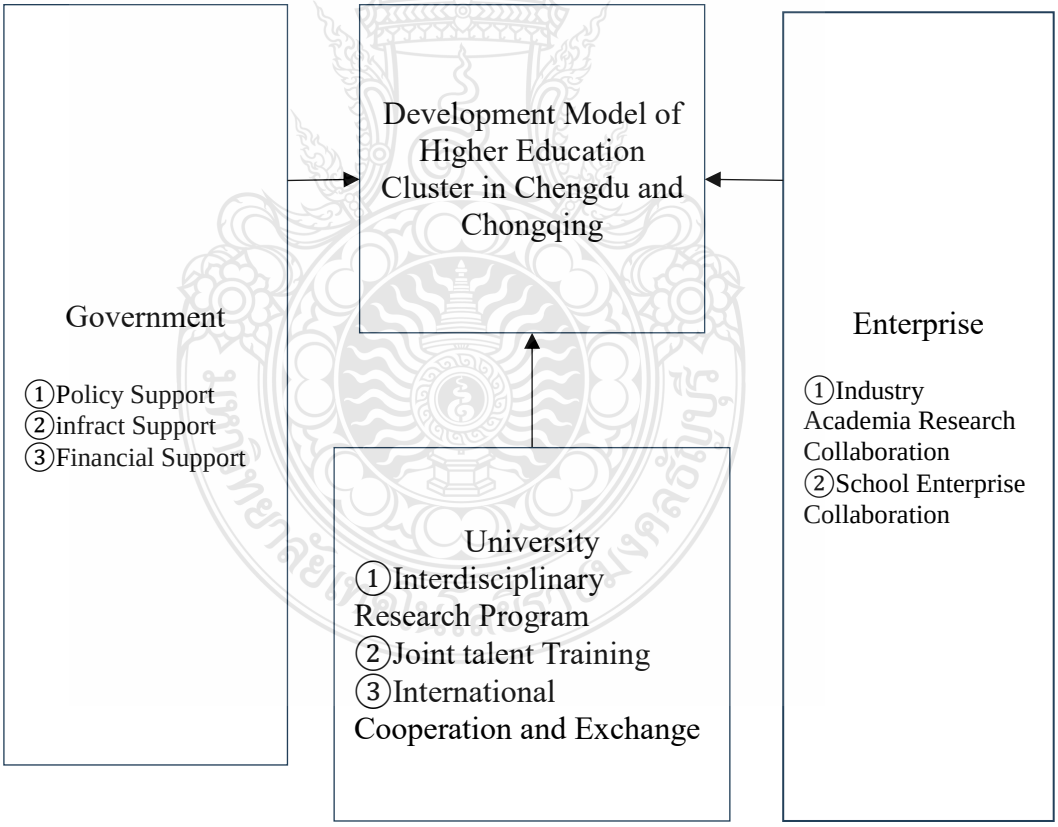

Figure 5.3 GUE Model of Higher Education Cluster Development in Chengdu and Chongqing

5.1.3 Mechanism of Influencing Factors on the Development of Higher Education Cluster in the Chengdu-Chongqing Region

5.1.3.1 The more significant the intensity of government infrastructure support, the better the development effectiveness of the higher education cluster in the Chengdu-Chongqing region.

Government infrastructure support is a crucial driving force for developing the higher education cluster in the Chengdu-Chongqing region(D. Wu et al., 2023b). The government's provision of advanced laboratories, research equipment, and libraries to universities establishes a solid foundation for scientific research and academic exchange in higher education. These state-of-the-art facilities attract outstanding domestic and international teachers and researchers to join the universities, thereby forming high-level academic teams and research centers and enhancing the academic reputation and competitiveness of the universities.

Moreover, government infrastructure support strengthens the industry-academia-research cooperation between universities and enterprises. Collaborating with enterprises on scientific and technological research projects allows universities to be more responsive to market demands, promote the transformation and application of technical achievements, and drive technological innovation and industrial upgrading(Caingcoy, 2023). The increasing government infrastructure support contributes to constructing an innovative ecosystem conducive to developing the higher education cluster. It fosters interdisciplinary collaboration among universities, creating a collaborative innovation atmosphere and promoting the enhancement of regional innovation capacity and sustainable economic and social development(Kumar et al., 2022).

Therefore, the magnitude of government infrastructure support is closely related to the development effectiveness of the higher education cluster in the Chengdu-Chongqing region, injecting a powerful impetus into the progress and development of the Chengdu-Chongqing region.

5.1.3.2 The more significant the intensity of government policy support, the better the development effectiveness of the higher education cluster in the Chengdu-Chongqing region.

The greater the intensity of government policy support, the more positive impact it has on the development effectiveness of the higher education cluster in the Chengdu-Chongqing region(Sun et al., 2022a). Government policies may encompass financial investment, tax incentives, land policies, and university construction planning. These policy supports can promote the development of universities, attract outstanding teachers and research talents, and enhance universities' teaching and research capabilities. Additionally, government policy support facilitates collaboration between universities and enterprises, promoting the transformation of scientific and technological achievements and industrial upgrading. The proactive SupportSupport of government policies provides a solid foundation for the overall development of the higher education cluster in the Chengdu-Chongqing region, positively influencing the region's economic and social innovative capabilities and driving the sustained prosperity of the cluster's universities.

5.1.3.3 The more significant the government's financial SupportSupport, the better the development effect of the higher education cluster in the Chengdu-Chongqing region

The greater the intensity of government financial support, the more significant the positive impact it has on the development of the higher education cluster in the Chengdu-Chongqing region(Sun et al., 2022b). Sufficient financial investment provides necessary funding support for higher education institutions, facilitating the construction of advanced teaching and research facilities, recruiting excellent teachers and research talents, and promoting the development of disciplines and scientific research. Government funding fosters resource sharing and collaboration among universities, leading to disciplinary cross-fertilization and complementary strengths.

Furthermore, government financial support encourages collaboration between universities and enterprises, promoting the transformation of scientific and technological achievements and industrial upgrading. This financial SupportSupport provides a solid foundation for developing the higher education cluster in the Chengdu-

Chongqing region, driving the sustained growth and enhancement of innovative capabilities within the group.

5.1.3.4 The deeper the international exchange and cooperation of universities, the better the development of higher education clusters in the Chengdu-Chongqing region.

The deeper the engagement of universities in international exchange and cooperation, the more positive and profound impact it has on the development of the higher education cluster in the Chengdu-Chongqing region(Gui, 2022b). International trade and cooperation may encompass academic exchanges with overseas universities, faculty and student visits, joint research projects, and other forms of collaboration. Firstly, international businesses and associations enrich the universities' educational resources and talent pool. Collaborating in academic exchanges with top international universities attracts outstanding foreign teachers and researchers to lecture and conduct research in the Chengdu-Chongqing region while also providing local faculty and students with a broader academic perspective and an international learning environment.

Secondly, collaborative research projects with international partners contribute to improving universities' research capabilities. Engaging in joint research projects with high-level research institutions abroad brings together complementary resources, facilitating innovative scientific and technological achievements and fostering breakthroughs in cutting-edge fields.

Moreover, international exchange and cooperation foster interdisciplinary collaboration. Collaborative cross-disciplinary research with universities from different countries promotes the integration of disciplines, leading to more comprehensive and innovative research outcomes. Importantly, international exchange and cooperation bring international development opportunities to the higher education cluster. Through close collaboration with foreign universities, the reputation and visibility of the Chengdu-Chongqing higher education cluster will be enhanced internationally, attracting more international students and scholars to study and conduct research in the region and further promoting the cluster's development.

Therefore, the depth of universities' engagement in international exchange and cooperation directly relates to the global influence and international competitiveness of

the higher education cluster in the Chengdu-Chongqing region. Actively advancing international trade and cooperation will provide strong SupportSupport for the sustained development and enhancement of the cluster's innovative capabilities.

5.1.3.5 The deeper the universities carry out the interdisciplinary research plan, the better the development effect of the higher education cluster in the Chengdu-Chongqing region

The deeper the engagement of universities in interdisciplinary research programs, the more positive impact it has on the development of the higher education cluster in the Chengdu-Chongqing region(Gui, 2022c). Interdisciplinary research refers to the integration and intersection of different disciplinary fields to address complex problems and challenges by combining knowledge and methods from multiple disciplines.

Firstly, interdisciplinary research promotes innovation and knowledge exchange. By initiating multidisciplinary research projects, universities bring together experts and researchers from diverse disciplinary fields, forming interdisciplinary teams. This collaboration facilitates knowledge exchange and academic cooperation, stimulates innovative thinking, and generates new research perspectives and outcomes.

Secondly, interdisciplinary research expands the research areas and development directions of universities. Universities can venture into a broader range of research fields through multidisciplinary collaboration, diversify their research directions, and enhance their overall research capabilities.

Moreover, interdisciplinary research contributes to addressing complex real-world problems. Many practical issues involve multiple disciplinary domains, and Analysis limited to a single discipline may not effectively tackle these intricate problems. However, interdisciplinary research can integrate the strengths of different fields to provide more comprehensive and in-depth solutions.

Most importantly, interdisciplinary research is crucial for cultivating versatile talents. A multidisciplinary research environment nurtures students with a broader knowledge background and comprehensive abilities, enabling them to engage in cross-disciplinary exchanges and collaborations and enhancing their employability and competitiveness.

Therefore, the depth of universities' engagement in interdisciplinary research programs is of significant importance for developing the higher education cluster in the Chengdu-Chongqing region. Interdisciplinary research provides strong SupportSupport for the cluster's innovative capabilities and competitiveness, elevating its domestic and international influence.

5.1.3.6 The deeper colleges and universities carry out the joint training of talents, the better the development effect of higher education clusters in the Chengdu-Chongqing region is.

The deeper the collaboration between universities and enterprises in joint talent training, the more positive impact it has on the development of the higher education cluster in the Chengdu-Chongqing region(Ying et al., 2023). Joint talent training refers to the cooperative efforts between universities, enterprises, and research institutions to jointly cultivate high-level talents with interdisciplinary and practical capabilities.

Firstly, joint talent training promotes production, learning, research, and application integration. Through standard training programs with enterprises and research institutions, students engage in practical learning experiences and directly encounter industry demands and challenges. This approach fosters the development of highly qualified talents better suited to meet real-world needs.

Secondly, joint talent training enhances students' employability. Students gain richer practical experience and skills training through joint training, making them more competitive in the job market and increasing their chances of employment.

Moreover, joint talent training facilitates cooperation and exchange between universities and the industrial sector. By participating in common training programs, universities gain insight into the demands and trends of the industry, enabling them to better serve industrial development, promote the transformation of scientific and technological achievements, and facilitate industrial upgrading.

Most importantly, joint talent training brings about innovative mechanisms for industrial talent cultivation within the higher education cluster. The collaboration between universities and enterprises in building internships and training bases provides

students with more practical opportunities, nurturing advanced talents with innovative spirit and functional abilities.

Therefore, the depth of universities' engagement in joint talent training is essential for developing the higher education cluster in the Chengdu-Chongqing region. Joint talent training provides strong SupportSupport for the cluster's innovative capabilities and competitiveness, driving the higher education cluster to achieve greater industry integration and innovation success.

5.1.3.7 The closer the school-enterprise cooperation, the better the development effect of the higher education cluster in the Chengdu-Chongqing region

The closer the collaboration between enterprises and universities in school-enterprise cooperation, the more positive impact it has on developing, the higher education cluster in the Chengdu-Chongqing region(Zhou et al., 2022). School-enterprise collaboration refers to the strategic partnership between universities and enterprises, which can take various forms, including joint research projects, talent development programs, and technology transfer.

Firstly, school-enterprise cooperation can enhance the teaching and research capabilities of universities. As a vital component of real-world society, enterprises provide universities with direct practical environments and demand information. Through collaborative education and research projects with enterprises, universities can better address suitable needs, improve the practicality of teaching content, and enhance the applicability of research outcomes.

Secondly, school-enterprise cooperation contributes to the cultivation of versatile talents. The involvement of enterprises provides students with internship opportunities and work experience, helping them understand the actual work environment and enhancing their practical abilities and professional qualities, making them more adaptable to the job market.

Moreover, school-enterprise cooperation promotes the transformation and application of scientific and technological achievements. Enterprises can apply the research outcomes of universities to actual production, driving the commercialization of scientific and technical achievements and industrial upgrading.

Most importantly, school-enterprise cooperation creates development opportunities for industrial integration within the higher education cluster. Through collaboration with enterprises, universities can better understand the needs and trends of industrial development, providing intellectual SupportSupport and technological innovation for industrial advancement.

Therefore, the degree of closeness in school-enterprise cooperation by enterprises is crucial for developing the higher education cluster in the Chengdu-Chongqing region. Close school-enterprise cooperation will Support the cluster's innovative capabilities and competitiveness, driving the higher education cluster to achieve greater industry integration and innovation success.

5.1.3.8 The closer the cooperation of enterprises, universities, and research institutes, the better the development effect of the higher education cluster in the Chengdu-Chongqing region.

The closer the collaboration between enterprises, academia, and research institutions in industry-university-research cooperation, the more positive impact it has on developing the higher education cluster in the Chengdu-Chongqing region(Hou et al., 2023d). Industry-university-research cooperation is a collaborative model between universities, enterprises, and research institutions aimed at jointly conducting research projects, technology transfer, and talent development to promote industrial development and technological innovation.

Firstly, industry-university-research cooperation facilitates innovation and upgrading of industrial technology. By collaborating with universities and research institutions, enterprises can leverage their research capabilities and innovative thinking to develop new technologies and products, enhancing their market competitiveness.

Secondly, industry-university-research cooperation helps to drive the transformation and application of research outcomes. Research achievements from universities and research institutions can be quickly transformed into practical products and services through collaboration with enterprises, thus achieving the commercialization of scientific and technological achievements.

Moreover, industry-university-research cooperation allows universities to integrate closely with the industry. Through collaboration with enterprises, universities

can gain insights into the development needs and trends of the industry, enabling them to adjust their teaching and research directions and enhance the practicality and adaptability of talent development.

Industry-university-research cooperation creates industrial integration and innovation opportunities within the higher education cluster. By collaborating with enterprises, universities can better integrate into industrial development, promote the deep integration of industry, academia, and research, and enhance the cluster's innovative capabilities and competitiveness.

Therefore, the degree of closeness in industry-university-research cooperation by enterprises is of utmost importance for developing the higher education cluster in the Chengdu-Chongqing region. Close industry-university-research cooperation will Support the cluster's innovative capabilities and industrial development, driving the higher education cluster to achieve greater industry integration and innovation success.

5.2 Contribution of the Study

The results of this study mainly have the following four contributions:

5.2.1 Theoretical Contribution: The study of the development model of the higher education cluster in the Chengdu-Chongqing region provides new perspectives and insights for the theoretical research on higher education clusters. Through in-depth research on the formation, development, and operational mechanisms of the higher education cluster in the Chengdu-Chongqing region, a series of theoretical frameworks and models for cluster development can be established, offering valuable references and insights for research on higher education clusters in the other areas.

5.2.2 Practical Contribution: The study of the development model of the higher education cluster in the Chengdu-Chongqing region provides guidance and recommendations for the practical operation of the higher education cluster in the area. By conducting in-depth research on the cluster development model, the strengths and characteristics of the group in the region can be identified, providing a scientific basis for planning, construction, and management of the cluster, thereby facilitating the healthy development of the higher education cluster.

5.2.3 Policy Contribution: The study of the development model of the higher education cluster in the Chengdu-Chongqing region provides a reference basis for relevant government departments to formulate policies. Through in-depth research on the cluster's development model and mechanisms, targeted supportive policies can be acquired by the government, including funding provisions, tax incentives, land, and other favorable policies, thereby promoting the sustainable development of the higher education cluster.

5.2.4 Social Contribution: The study of the development model of the higher education cluster in the Chengdu-Chongqing region contributes to the economic and social development of the area. The story of the higher education cluster promotes the gathering and mobility of talents, enhances the region's innovative capabilities and competitiveness, drives the upgrading and development of industries, and actively contributes to the prosperity of the regional economy and society.

5.3 Limitations of the Study

Although the research on the development model of the higher education cluster in the Chengdu-Chongqing region has made significant contributions, there are also some limitations:

5.3.1 Regional Specificity: The study of the development model of the higher education cluster in the Chengdu-Chongqing region is targeted at a specific geographical area, and the applicability and generalizability of its results and conclusions to other parts may be limited. Variations in economic, cultural, and social environments among different regions can influence the applicability and effectiveness of the cluster development model.

5.3.2 Data Limitations: The study of the development model of the higher education cluster in the Chengdu-Chongqing region may be constrained by data limitations. Obtaining a large amount of accurate data may present particular challenges, affecting the credibility and reliability of the research findings.

5.3.3 Temporal Constraints: The study's time frame may be limited and may not cover the entire trajectory of cluster development. Higher education clusters are

characterized by long-term development processes, and a relatively short study period may only partially capture the characteristics and trends of cluster development.

5.3.4 Research Methods: The selection and use of research methods may influence the research outcomes. Improper or limited application of research methods may lead to biased or inaccurate research conclusions.

Overall, although studying the development model of the higher education cluster in the Chengdu-Chongqing region has certain limitations, they still need to diminish its importance and value. Building on the research outcomes, further exploration and resolution of these limitations will provide more comprehensive and accurate guidance for developing higher education clusters.

5.4 Prospects for Future Research

According to some limitations of this study, in future research, more in-depth Analysis should be carried out in the following aspects:

5.4.1 In-depth Multi-perspective Research: Future research can delve into the development model of higher education clusters from multiple perspectives, including the role and impact of government support policies, industry-academia-research cooperation, and international exchange and cooperation. Moreover, the focus can be placed on the collaborative development among different academic disciplines and the relationship between higher education clusters and regional economic and social development.

5.4.2 Cross-regional Comparative Research: Through cross-regional comparative research, a comparative analysis of the higher education clusters in the Chengdu-Chongqing region with those in the other areas can be conducted to analyze the characteristics, strengths, weaknesses, similarities, and differences of different groups, seeking valuable insights for cluster development models in various regions.

5.4.3 Effectiveness Evaluation and Optimization: Future research can strengthen the evaluation and optimization of the effectiveness of developing higher education clusters in the Chengdu-Chongqing region. Through quantitative indicators and qualitative Analysis, the effects and impacts of cluster development can be assessed, identifying existing issues and bottlenecks and proposing corresponding optimization

measures and policy recommendations to enhance the sustainability and excellence of cluster development.

5.4.4 Innovative Model Research: Research can focus on innovative models and successful experiences in developing higher education clusters, exploring the deep integration of emerging industries and higher education and best practices in collaboration between universities and enterprises. By studying innovative models, valuable references and insights can be provided for developing higher education clusters in other regions.

5.4.5 Talent Cultivation and Industry Demand Alignment: Future research can pay more attention to the close alignment between talent cultivation within higher education clusters and industry demand. Research can explore how to cultivate versatile talents that meet industrial development needs, promoting the organic connection between higher education and the industrial market, thus providing more robust Support Support for regional economic and social development.

In conclusion, future research on the development model of higher education clusters in the Chengdu-Chongqing region can be multidimensional and innovative, contributing significantly to the sustainable development of higher education clusters and the prosperity of regional economic and social development.

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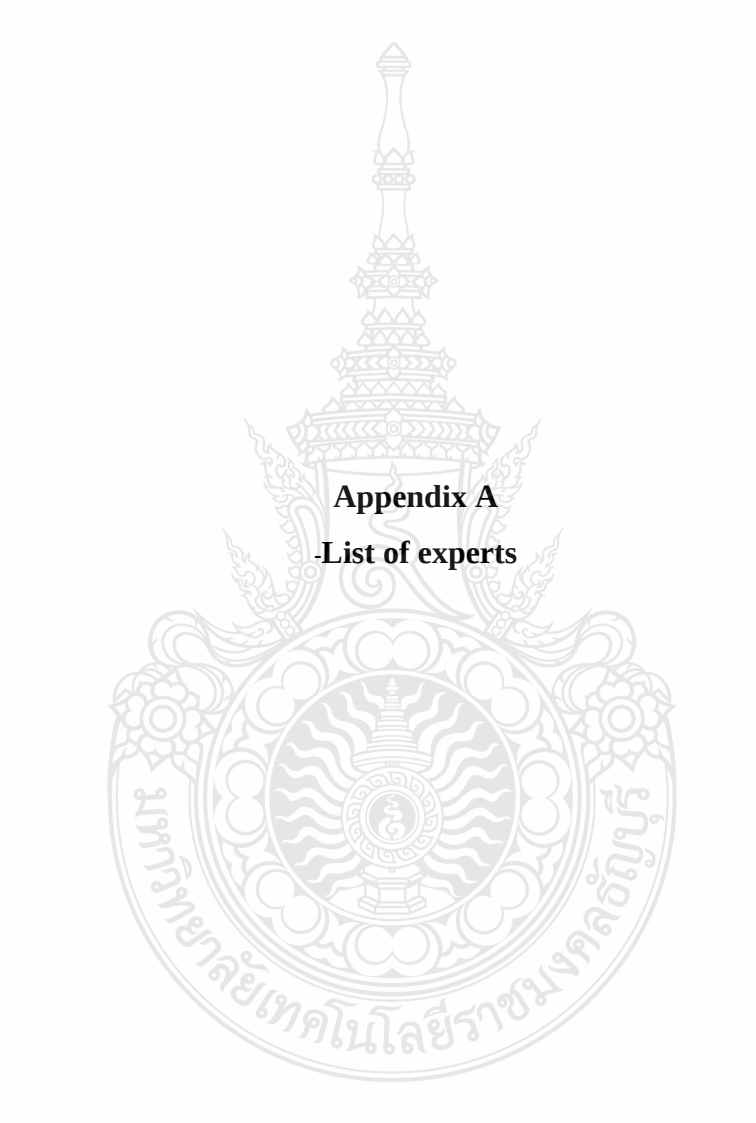

Appendix A

-List of experts

The experts were:

1.Professor.Dr.Xianguo Tuo. President of Sichuan University of Science &Engineering, China.

2.Associate Professor Dr.Wenbin Zhou. Director of General Office of Chongqing Municipal People's Government, China.

3.Professor.Dr.Sifan Yang. Dean of the School of Educational Sciences, Chongqing Normal University,China.

4.Professor.Dr.Guohong Du, HR, Chengdu University of Information TechnologyAssociate Professor Mr.Qingsong He. Chairman of Chengdu Shangdian Education Technology Co Ltd, China.

5.Professor.Dr.Mingyi Wang. President of Sichuan Normal University,China.

6.Associate Professor Mr.Minglang Tao. Chairman of Chengdu Golden Cicada Technology Co Ltd, China.

7.Associate Professor Dr.Lei Tang. Director of the Education Department of Sichuan Province, China.

8.Associate Professor Dr.Jian Luo. Director of General Office of Sichuan Provincial People's Government, China.

9.Associate Professor Mr.Dongsheng Cheng. Dean of Mingde Academy in Chongqing, China.

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15 July, 2023

Dear Associate Professor Mr.Dongsheng Cheng. Dean of Mingde Academy in Chongqing, China.

Subject: Respectfully requesting a letter of invitation of experts for Ph.D. Dissertation

I am writing to request your assistance as an honorary external research reviewer in evaluating the research instruments of Mr. Lin Tang, Doctor of Science Program in Technical Education (Vocational Education) Rajamangala University of Technology Thanyaburi, who has been working on the dissertation titled "Development Model of Higher Education Cluster in Chengdu and Chongqing". under the supervision of Assistant Professor Dr. Thosporn Sangsawang. In this regard, I would like to request your valuable time to evaluate the research instruments as I strongly believe that your expertise will be of great value in improving the research instruments.

If you have any questions or need further information, please feel free to contact Mr. Lin Tang on the e-mail:lin_t@mail.rmutt.ac.th

Yours sincerely,

(Assistant Professor Arnon Niyomphol)
Dean of Faculty of Technical Education

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15 July, 2023

Dear Associate Professor Dr.Jian Luo. Director of General Office of Sichuan Provincial People's Government, China.
Subject: Respectfully requesting a letter of invitation of experts for Ph.D. Dissertation

I am writing to request your assistance as an honorary external research reviewer in evaluating the research instruments of Mr. Lin Tang, Doctor of Science Program in Technical Education (Vocational Education) Rajamangala University of Technology Thanyaburi, who has been working on the dissertation titled "Development Model of Higher Education Cluster in Chengdu and Chongqing". under the supervision of Assistant Professor Dr. Thosporn Sangsawang. In this regard, I would like to request your valuable time to evaluate the research instruments as I strongly believe that your expertise will be of great value in improving the research instruments.

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Yours sincerely,

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15 July, 2023

Dear Associate Professor Dr.Lei Tang. Director of the Education Department of Sichuan Province, China.

Subject: Respectfully requesting a letter of invitation of experts for Ph.D. Dissertation

I am writing to request your assistance as an honorary external research reviewer in evaluating the research instruments of Mr.Lin Tang, Doctor of Science Program in Technical Education (Vocational Education) Rajamangala University of Technology Thanyaburi, who has been working on the dissertation titled "Development Model of Higher Education Cluster in Chengdu and Chongqing". under the supervision of Assistant Professor Dr. Thosporn Sangsawang. In this regard, I would like to request your valuable time to evaluate the research instruments as I strongly believe that your expertise will be of great value in improving the research instruments.

If you have any questions or need further information, please feel free to contact Mr.Lin Tang on the e-mail:lin_t@mail.rmutt.ac.th

Yours sincerely,

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Dean of Faculty of Technical Education

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15 July, 2023

Dear Associate Professor Mr.Minglang Tao. Chairman of Chengdu Golden Cicada Technology Co Ltd, China.

Subject: Respectfully requesting a letter of invitation of experts for Ph.D. Dissertation

I am writing to request your assistance as an honorary external research reviewer in evaluating the research instruments of Mr. Lin Tang, Doctor of Science Program in Technical Education (Vocational Education) Rajamangala University of Technology Thanyaburi, who has been working on the dissertation titled "Development Model of Higher Education Cluster in Chengdu and Chongqing". under the supervision of Assistant Professor Dr. Thosporn Sangsawang. In this regard, I would like to request your valuable time to evaluate the research instruments as I strongly believe that your expertise will be of great value in improving the research instruments.

If you have any questions or need further information, please feel free to contact Mr. Lin Tang on the e-mail:lin_t@mail.rmutt.ac.th

Yours sincerely,

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15 July, 2023

Dear Prof. Dr.Mingyi Wang. President of Sichuan Normal University,China.
Subject: Respectfully requesting a letter of invitation of experts for Ph.D. Dissertation

I am writing to request your assistance as an honorary external research reviewer in evaluating the research instruments of Mr. Lin Tang, Doctor of Science Program in Technical Education (Vocational Education) Rajamangala University of Technology Thanyaburi, who has been working on the dissertation titled "Development Model of Higher Education Cluster in Chengdu and Chongqing". under the supervision of Assistant Professor Dr. Thosporn Sangsawang. In this regard, I would like to request your valuable time to evaluate the research instruments as I strongly believe that your expertise will be of great value in improving the research instruments.

If you have any questions or need further information, please feel free to contact Mr. Lin Tang on the e-mail:lin_t@mail.rmutt.ac.th

Yours sincerely,

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15 July, 2023

Dear Associate Professor Mr.Qingsong He. Chairman of Chengdu Shangdian Education Technology Co Ltd, China.

Subject: Respectfully requesting a letter of invitation of experts for Ph.D. Dissertation

I am writing to request your assistance as an honorary external research reviewer in evaluating the research instruments of Mr. Lin Tang, Doctor of Science Program in Technical Education (Vocational Education) Rajamangala University of Technology Thanyaburi, who has been working on the dissertation titled "Development Model of Higher Education Cluster in Chengdu and Chongqing", under the supervision of Assistant Professor Dr. Thosporn Sangsawang. In this regard, I would like to request your valuable time to evaluate the research instruments as I strongly believe that your expertise will be of great value in improving the research instruments.

If you have any questions or need further information, please feel free to contact Mr. Lin Tang on the e-mail:lin_t@mail.rmutt.ac.th

Yours sincerely,

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15 July, 2023

Dear Prof. Dr.Sifan Yang. Dean of the School of Educational Sciences, Chongqing Normal University,China.

Subject: Respectfully requesting a letter of invitation of experts for Ph.D. Dissertation

I am writing to request your assistance as an honorary external research reviewer in evaluating the research instruments of Mr. Lin Tang, Doctor of Science Program in Technical Education (Vocational Education) Rajamangala University of Technology Thanyaburi, who has been working on the dissertation titled "Development Model of Higher Education Cluster in Chengdu and Chongqing". under the supervision of Assistant Professor Dr. Thosporn Sangsawang. In this regard, I would like to request your valuable time to evaluate the research instruments as I strongly believe that your expertise will be of great value in improving the research instruments.

If you have any questions or need further information, please feel free to contact Mr. Lin Tang on the e-mail:lin_t@mail.rmutt.ac.th

Yours sincerely,

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15 July, 2023

Dear Associate Professor Dr.Wenbin Zhou. Director of General Office of Chongqing Municipal People's Government, China.
Subject: Respectfully requesting a letter of invitation of experts for Ph.D. Dissertation

I am writing to request your assistance as an honorary external research reviewer in evaluating the research instruments of Mr. Lin Tang, Doctor of Science Program in Technical Education (Vocational Education) Rajamangala University of Technology Thanyaburi, who has been working on the dissertation titled "Development Model of Higher Education Cluster in Chengdu and Chongqing". under the supervision of Assistant Professor Dr. Thosporn Sangsawang. In this regard, I would like to request your valuable time to evaluate the research instruments as I strongly believe that your expertise will be of great value in improving the research instruments.

If you have any questions or need further information, please feel free to contact Mr. Lin Tang on the e-mail:lin_t@mail.rmutt.ac.th

Yours sincerely,

(Assistant Professor Arnon Niyomphol)
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15 July, 2023

Dear Prof. Dr.Xianguo Tuo. President of Sichuan University of Science & Engineering, China.

Subject: Respectfully requesting a letter of invitation of experts for Ph.D. Dissertation

I am writing to request your assistance as an honorary external research reviewer in evaluating the research instruments of Mr. Lin Tang, Doctor of Science Program in Technical Education (Vocational Education) Rajamangala University of Technology Thanyaburi, who has been working on the dissertation titled "Development Model of Higher Education Cluster in Chengdu and Chongqing", under the supervision of Assistant Professor Dr. Thosporn Sangsawang. In this regard, I would like to request your valuable time to evaluate the research instruments as I strongly believe that your expertise will be of great value in improving the research instruments.

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Yours sincerely,

(Assistant Professor Arnon Niyomphol)
Dean of Faculty of Technical Education

Appendix A

Influencing Factors and Effects of Higher Education Cluster Development in the Chengdu-Chongqing Region

Influencing Factors and Effects of Higher Education Cluster Development in the Chengdu-Chongqing Region

Influencing factors

1. The Role of Government in the Development of Higher Education Cluster in the Chengdu-Chongqing Region

1.1 Policy Support and Planning

1.1.1 Government's Role in Cluster Development: The Government actively plans and provides strategic guidance and policy support for the Chengdu-Chongqing higher education cluster to determine its development direction, goals, and critical areas.

1.1.2 Talent Recruitment and Research Project Support: Targeted policies are introduced by the Government to attract both domestic and international talents to the cluster. Additionally, support is provided for research projects, fostering collaboration between higher education institutions and enterprises in scientific and technological research and development.

1.1.3 Support for Student Employment and Entrepreneurship: The Government implements policies to support university students' employment and entrepreneurship, offering training, entrepreneurship loans, and incubators to enhance their employability and entrepreneurial abilities, contributing to regional economic development and talent cultivation.

1.2 Infrastructure Support

1.2.1 Government Allocation of Land and Urban Transportation Infrastructure: In support of developing the Chengdu-Chongqing higher education cluster, the Government actively allocates land and constructs urban transportation infrastructure. This provides the group with suitable land resources and an efficient urban transportation network, facilitating its expansion and development.

1.2.2 Construction of New University Campuses, University Cities, and University Science Parks: Focusing on developing the Chengdu-Chongqing higher education cluster, the Government builds new university campuses, university cities,

and university science parks. By establishing these infrastructures, the Government aims to create a high-quality education, research, and innovation environment for the cluster, attracting more outstanding students and research talents to study and work here. This, in turn, promotes technological innovation and industrial transformation within the higher education cluster.

1.3 Funding and Financial Support

1.3.1 Government establishes dedicated financial allocations for the Chengdu-Chongqing higher education cluster, providing specific financial support to promote development in education, research, and talent cultivation. This enhances the overall strength of the higher education cluster.

1.3.2 Government increases funding for research projects in the Chengdu-Chongqing higher education cluster. By investing more in research projects, the Government encourages universities to engage in more scientific and technological research activities, strengthen research outcomes' transformation, and promote collaboration between academia, industry, and research institutions. This fosters technological innovation and regional industrial upgrading.

1.3.3 Government provides scholarships and financial aid to students in the Chengdu-Chongqing higher education cluster. Encouraging academic excellence and active participation in social activities, the Government also offers financial support to help more students access quality education, alleviate their financial burden, and promote the accessibility and development of higher education.

1.4 Research Project Support

1.4.1 Government will issue research projects specifically for the higher education cluster in the Chengdu-Chongqing region. This initiative aims to encourage the cluster's universities to engage in scientific and technological research activities, enhance research capabilities, and promote technological innovation and regional industrial development.

1.4.2 Government will entrust major projects to the universities within the Chengdu-Chongqing higher education cluster. By assigning significant tasks to

universities, the Government can leverage their research advantages and innovation capabilities, facilitate deep cooperation between universities, Government, and enterprises, promote the transformation and application of scientific achievements, and inject new impetus into local economic development.

1.5 International Cooperation and Exchange Policy

1.5.1 Promoting International Collaboration Projects in Higher Education: The Government should strengthen cooperation with foreign higher education institutions, promote international collaboration projects among universities, and facilitate educational exchanges and academic cooperation.

1.5.2 Enhancing International Academic Exchange and Collaboration: The Government should provide financial support and policy guarantees, encouraging higher education institutions to participate in international academic conferences and collaborative projects and strengthening exchanges and cooperation with the international academic community.

1.6 Oversight and Evaluation Measures

1.6.1 Supervision and Evaluation of the Higher Education Cluster: The Government should establish a comprehensive oversight and evaluation system for the higher education cluster, enhancing regulatory measures for teaching and academic activities within the group.

1.6.2 Policy Support for Advancement of the Higher Education Cluster: The Government should provide policy support to the higher education cluster, encouraging continuous improvement in management practices within higher education institutions.

2. The Role of Colleges and Universities in the Development of Higher Education Cluster in Chengdu and Chongqing

2.1 Interdisciplinary Research Programs

2.1.1 The cluster universities in the Chengdu-Chongqing region actively collaborate among academic departments and research institutions. Close cooperation

between universities enables knowledge and resource sharing, fostering cross-disciplinary integration and innovative development in various fields.

2.1.2 Cooperative Research Projects among Cluster Universities: Universities within the Chengdu-Chongqing region collaborate on diverse research projects, enhancing exchanges and cooperation and promoting the sharing and applying of research outcomes.

2.1.3 Academic Alliances and Mutual Recognition of Courses and Degrees: Cluster universities in the Chengdu-Chongqing region frequently form academic alliances, mutually recognizing courses and degrees. By establishing credit transfer mechanisms, universities offer students access to a broader range of educational resources and degree recognition.

2.1.4 Active Sharing of Research Facilities and Resources: Cluster universities in the Chengdu-Chongqing region proactively share research facilities and resources. Through mutual assistance and complementation, they enhance research efficiency and capabilities.

2.1.5 Collaborative Publication of Academic Journals: Cluster universities in the Chengdu-Chongqing region collaborate on publishing academic journals, facilitating the exchange and dissemination of academic achievements, and enhancing the reputation and influence of the cluster universities in the academic community.

2.2 Joint Talent Cultivation

2.2.1 Cluster universities in the Chengdu-Chongqing region frequently collaborate on faculty training. Strengthening cooperation between universities, they jointly cultivate the teaching staff, promoting the improvement of teaching standards and the enhancement of education quality.

2.2.2 Cluster universities in the Chengdu-Chongqing region often engage in joint student cultivation. Implementing standard training programs, they offer students opportunities for cross-institutional training and learning, cultivating outstanding talents with interdisciplinary knowledge and comprehensive capabilities.

2.2.3 Mechanisms to Facilitate Inter-Institutional Learning and Foster Diverse Academic Environment: Cluster universities in the Chengdu-Chongqing region

establish mechanisms to promote interdisciplinary learning and create a diverse academic atmosphere. Encouraging cross-disciplinary and educational exchanges, they break down disciplinary barriers, foster an open and diverse academic atmosphere, and inspire students' innovative thinking and intellectual exploration.

2.3 Science Promotion Plan

2.3.1 Establishing an Ecosystem for Innovation and Entrepreneurship: Cluster universities will create a collaborative network for innovation, providing comprehensive support to entrepreneurs, including guidance from mentors and assistance from entrepreneurship incubators. This will cultivate a conducive atmosphere for innovation and entrepreneurship, inspiring vitality.

2.3.2 Fair Sharing of Intellectual Property: Encouraging equitable sharing of benefits among collaborating institutions, cluster universities will establish a robust intellectual property management mechanism. This will clarify intellectual property ownership and how benefits are shared among collaborating institutions, ensuring a fair and reasonable distribution of benefits. This approach will incentivize partners to actively participate in scientific research cooperation and innovation projects.

2.4 International Cooperation and Exchange

2.4.1 Conducting International Academic Exchanges: International academic exchanges foster collaboration among scholars, knowledge dissemination, and disciplinary development, contributing to global social progress.

2.4.2 Attracting International Outstanding Students and Scholars: Attracting international outstanding students and scholars by providing a high-quality academic environment and scholarship policies, promoting academic cooperation and cultural exchange between countries.

2.4.3 Promoting International Collaboration Projects: Promoting international collaboration projects to facilitate multinational exchanges and cooperation in academic, research, cultural, and other fields, advancing global development and progress.

2.5 Local Economic Development and Social Responsibility

2.5.1 Supporting Local Economic Development: Universities actively support local economic development by promoting technological innovation, industry-academia collaboration, talent cultivation, entrepreneurship support, and social services. These efforts contribute to the innovative upgrading and sustainable development of the local economy.

2.5.2 Undertaking Social Responsibility and Serving Local Communities: Universities take on social responsibility and actively serve local communities by participating in charitable activities, providing professional consulting services, and implementing community service projects. Through these initiatives, they give back to society and contribute to the development and improvement of local communities.

2.5.3 Providing Intellectual Support and Talent Cultivation for Local Development: Universities offer intellectual support and talent cultivation for local development. Through technological innovation, industry-academia collaboration, and nurturing outstanding talents, they provide academic backing for the innovative upgrading of the local economy. Moreover, they train professionals in line with local demands, promoting regional development and progress.

3. The Role of Enterprises in the Development of Higher Education Cluster in the Chengdu-Chongqing Region

3.1 Industry-University-Research Collaboration

3.1.1 Enterprises provide convenient support for transforming advanced technological achievements in Chengdu-Chongqing universities. They actively participate in transforming and applying scientific research outcomes, offering financial, technical, and market support, thereby facilitating the commercialization and industrialization of university research achievements.

3.1.2 Enterprises, research institutes, and cluster universities in the Chengdu-Chongqing region jointly establish high-level collaborative innovation platforms. The three parties collaborate to build innovation research platforms, sharing resources and

conducting joint research to promote the deep integration of industry, academia, and research, enhancing innovation capabilities and technological proficiency.

3.1.3 Enterprises, research institutes, and cluster universities in the Chengdu-Chongqing region will establish the Chengdu-Chongqing Industry-University-Research Innovation Alliance. Close cooperation among the industry, academia, and research sectors is achieved through this alliance, facilitating the integration and optimization of innovative resources and providing robust support for regional industrial development and technological innovation.

3.2 University-Enterprise Co-construction

3.2.1 Joint Establishment of National-Level Science and Technology Achievement Incubation Base: In the Chengdu-Chongqing region, universities and enterprises collaborate to establish a national-level science and technology achievement incubation base. This base will provide comprehensive support in incubation, acceleration, and investment, facilitating the transformation of excellent scientific achievements and the pregnancy and development of innovative entrepreneurial projects.

3.2.2 Joint Establishment of Chengdu-Chongqing Youth Entrepreneurship and Employment Fund: Universities and enterprises collaborate to establish the Chengdu-Chongqing Youth Entrepreneurship and Employment Fund. This fund will provide financial support and entrepreneurship training for young people with entrepreneurial intentions and potential, encouraging youth innovation and entrepreneurship, increasing entrepreneurial and employment opportunities, and retaining outstanding talents in the region.

3.3 Research Collaboration

3.3.1 Number of Cross-Institutional Research Collaboration Projects: Evaluating the quantity of research collaboration projects between enterprises and multiple universities or research institutions, reflecting the breadth of research collaboration and the collaboration network.

3.3.2 Number of Jointly Applied Research Projects: Measuring the number of research projects jointly applied for by enterprises and universities, reflecting the level of project collaboration in research cooperation.

Evaluation Criteria of Higher Education Cluster Development in the Chengdu-Chongqing Region

1. Talent Cultivation

1.1 Implementation of Student Cross-Institutional Exchange and Cultivation: Cluster universities will establish a student exchange mechanism, allowing students to study and be cultivated in different universities. This will broaden students' academic perspectives and knowledge, promoting the comprehensive development of outstanding talents.

1.2 Establishment of an Online Course-Sharing Platform: Cluster universities will jointly build an online course resource platform, sharing high-quality teaching resources to provide students with a broader range of learning options and academic support, enhancing teaching quality and effectiveness.

1.3 Pilot Reforms in Basic Discipline Enrollment: Cluster universities will collaborate on pilot reforms in primary discipline enrollment, exploring new enrollment models and selection criteria to provide more equitable and flexible admission opportunities for outstanding students, attracting more exceptional talents to join the higher education cluster.

1.4 Number of Cross-Institutional Innovation and Entrepreneurship Education Cooperative Projects: Evaluating the quantity of innovation and entrepreneurship education cooperative projects conducted between cluster universities to cultivate innovation and entrepreneurship talents.

2. Resource Sharing

2.1 Teacher Co-Citation and Shared Appointments among Cluster Universities: Cluster universities will establish a mechanism for teacher co-citation and shared appointments, allowing teachers to cite each other's work and be appointed across institutions, providing students with a broader range of academic guidance and resource support, thereby enhancing teaching quality and research outcomes.

2.2 Shared Building of Library Resources, Experimental Equipment, and Information Materials among Cluster Universities: Universities will collaborate to build library resources, share research experimental equipment, and utilize information databases jointly. This will provide faculty and students with comprehensive learning and research conditions, enhancing research efficiency and teaching quality.

2.3 Shared Sports and Medical Resources, Campus Accessibility among Cluster Universities: Cluster universities will share sports facilities, medical resources, and open campuses. This will enrich students' campus life and provide comprehensive student services and support.

2.4 Complementary Curriculum Resources and Cross-Institutional Elective Courses: Assessing the complementary nature of curriculum resources and the availability of cross-institutional elective courses among cluster universities, enriching students' learning choices.

3. Scientific Research

3.1 Integration of Science and Technology Resources and Establishment of Joint Laboratories among Cluster Universities: Cluster universities collaboratively integrate science and technology research resources, establish joint laboratories to promote research cooperation and technological innovation, and strengthen the transformation and application of scientific and technical achievements.

3.2 Mutual Opening of National Key Laboratories and Provincial-Ministerial Key Laboratories among Cluster Universities: Universities establish a sharing mechanism, mutually opening key laboratories, providing research facilities and resource support, and promoting academic exchanges and research collaboration.

3.3 Joint Application and Undertaking of National Major Research Projects or International Scientific and Technological Cooperation Projects among Cluster Universities: Universities jointly apply for significant research projects and undertake national and international cooperation projects to enhance research collaboration and technological innovation capabilities.

3.4 Establishment of Cooperative Mechanisms for Technology Transfer among Cluster Universities: Universities jointly establish technology transfer platforms to

promote the transformation and commercialization of scientific and technological achievements and facilitate technology exchanges and industry-academia-research cooperation.

4. International Exchange and Collaboration

4.1 Regular Organization of High-level Science and Technology Forums among Cluster Universities: Cluster universities regularly organize international high-level science and technology forums, attracting outstanding scholars and experts from domestic and global communities, promoting cutting-edge scientific and technological exchanges and cooperation, and driving academic innovation and technological development.

4.2 Collaboration in Education with Internationally Renowned Universities among Cluster Universities: Universities actively establish cooperative relationships with internationally renowned universities to conduct joint education programs, academic exchanges, and collaborative research, sharing high-quality educational resources and cultivating talents with a global perspective and international competitiveness.

4.3 Attracting International Outstanding Students and Scholars across Universities: Assessing the efforts of cluster universities in attracting international outstanding students and scholars, promoting talent exchange.

4.4 Coverage of Cross-Institutional International Academic Exchange Activities: Evaluating the coverage of international academic exchange activities conducted by cluster universities, enhancing the breadth of intellectual exchange.

Appendix B

Influencing Factors and Effects of Higher Education Cluster Development in the Chengdu-Chongqing Region

Influencing Factors and Effects of Higher Education Cluster Development in the Chengdu-Chongqing Region

Influencing factors

1. Government's Role in the Development of the Chengdu-Chongqing Higher Education Cluster:

1.1 Policy Support

1.1.1 The government formulates development plans for the higher education cluster, guiding and promoting its overall growth, optimizing resource allocation, and enhancing competitiveness and influence.

1.1.2 The government implements talent attraction and research project policies to attract outstanding talents and foster research innovation. Talent attraction policies include incentives and programs, while research project policies provide funding and support, thereby driving the development and innovation capacity of the higher education cluster.

1.1.3 The government formulates policies to support employment and entrepreneurship among university students.

1.2 Infrastructure Support

1.2.1 The government allocates land and invests funds to develop modern urban transportation facilities tailored to the development of the higher education cluster in the Chengdu-Chongqing region, providing an excellent campus environment and convenient transportation conditions, thus promoting the healthy growth and optimized learning and research environment of the cluster.

1.2.2 The government constructs new university campuses, university towns, and university science parks in response to developing the higher education cluster in the Chengdu-Chongqing region.

1.3 Financial Investment and Fiscal Support

1.3.1 The government establishes special fiscal appropriations for the cluster universities in the Chengdu-Chongqing region to provide them with financial support and development guarantees.

1.3.2 The government invests research project funds in the cluster universities in the Chengdu-Chongqing region to drive scientific research and innovation development.

1.3.3 The government provides scholarships and financial aid to students in the cluster universities in the Chengdu-Chongqing region.

1.4 Support for Research Projects

1.4.1 The government releases research projects for the cluster universities in the Chengdu-Chongqing region.

1.4.2 The government commissions significant projects to the cluster universities in the Chengdu-Chongqing region.

2. Role of Universities in the Development of the Chengdu-Chongqing Higher Education Cluster:

2.1 Interdisciplinary Research Initiatives

2.1.1 Cluster universities in the Chengdu-Chongqing region collaborate on research projects across different disciplines and research institutions to foster interdisciplinary integration and sharing of research outcomes.

2.1.2 Cluster universities in the Chengdu-Chongqing region frequently engage in collaborative research projects.

2.1.3 Cluster universities in the Chengdu-Chongqing region often participate in academic alliances and recognize each other's courses and degrees.

2.1.4 Cluster universities in the Chengdu-Chongqing region frequently share research facilities and resources.

2.1.5 Cluster universities in the Chengdu-Chongqing region frequently collaborate on publishing academic journals.

2.2 Joint Talent Cultivation

2.2.1 Cluster universities in the Chengdu-Chongqing region frequently collaborate on faculty training and development.

2.2.2 Cluster universities in the Chengdu-Chongqing region often join student training programs.

2.2.3 Cluster universities in the Chengdu-Chongqing region establish mechanisms to promote cross-institutional learning and create diverse academic environments.

2.3 Science Promotion Initiatives

2.3.1 Cluster universities establish an ecosystem for innovation and entrepreneurship, providing mentors, resources, and platforms to facilitate the transformation of scientific achievements and industrial development.

2.3.2 Intellectual property management encourages fair sharing of benefits between collaborating institutions, promoting the sharing and cooperation of research outcomes and fostering positive development of innovation collaboration.

2.4 International Cooperation and Exchange

2.4.1 Cluster universities in the Chengdu-Chongqing region strengthen international collaborations to enhance higher education's global influence and reputation, fostering international recognition of higher education in Chengdu-Chongqing.

2.4.2 Cluster universities in the Chengdu-Chongqing region actively attract international talents and send graduate students to renowned universities abroad.

3. Role of Enterprises in the Development of the Chengdu-Chongqing Higher Education Cluster:

3.1 Industry-University-Research Collaboration:

3.1.1 Enterprises facilitate the transformation of advanced technological achievements from Chengdu-Chongqing universities, offering conveniences such as technology transfer and collaborative investments, promoting the commercialization

and industrialization of research outcomes, and fostering collaborations between universities and industries in technological innovation.

3.1.2 Chengdu-Chongqing enterprises, research institutes, and cluster universities jointly establish high-level collaborative innovation platforms.

3.1.3 Enterprises, research institutes, and Chengdu-Chongqing cluster universities collaborate to form the Chengdu-Chongqing Industry-University-Research Innovation Alliance.

3.2 University-Enterprise Joint Initiatives:

3.2.1 Chengdu-Chongqing universities and enterprises co-build national-level technology achievement incubation bases, providing excellent incubation environments and support for transforming research outcomes and fostering innovative entrepreneurship, thus facilitating technological achievements' rapid dissemination and industrial development.

3.2.2 Chengdu-Chongqing universities and enterprises jointly establish the Chengdu-Chongqing Youth Entrepreneurship and Employment Fund.

Evaluation Criteria of Higher Education Cluster Development in the Chengdu-Chongqing Region

1. Talent Cultivation:

1.1 Cluster universities can implement student exchange and training programs across campuses, allowing students to study and be trained in different universities. This fosters a comprehensive development of talented individuals and promotes academic exchange and collaboration among institutions.

1.2 Cluster universities establish online course-sharing platforms, enabling the mutual sharing and openness of teaching resources. This provides students with a broader range of subject choices and learning opportunities, leading to the optimization of educational resources and the improvement of teaching quality.

1.3 Cluster universities conduct pilot projects for essential discipline enrollment reforms, exploring new admission models and selection criteria to offer fairer and more flexible admission opportunities for outstanding students, attracting more talents to the higher education cluster.

2. Resource Sharing:

2.1 Cluster universities implement policies that facilitate teacher collaboration, citation sharing, and mutual appointment, promoting cooperation and exchange among educators. It enables cross-campus student guidance, strengthens academic partnerships, and enhances teaching and research capabilities.

2.2 Cluster universities share and jointly build resources such as books, literature, experimental equipment, and information materials, optimizing students' and faculty's learning and research conditions.

2.3 Cluster universities share sports and medical resources, allowing mutual access to campus facilities, enriching students' campus life, and providing comprehensive student services and support.

3. Scientific Research:

3.1 Cluster universities integrate scientific and technological resources, establishing joint laboratories to promote research collaboration and drive innovation and development in scientific research.

3.2 Cluster universities open national and provincial key laboratories to each other, creating opportunities for academic exchange and research collaboration.

3.3 Cluster universities jointly apply for and undertake national major research projects or international scientific and technological cooperation projects, fostering research collaboration and enhancing scientific innovation.

3.4 Cluster universities establish a mechanism for technology transfer and collaborative synergy, facilitating the transformation and application of research outcomes and promoting the industrialization and commercialization of innovative achievements.

4. International Exchange and Cooperation:

4.1 Cluster universities regularly organize high-end scientific and technological forums, attracting outstanding scholars and experts from both domestic and international spheres. It fosters academic exchange and cooperation, driving scientific research and innovation.

4.2 Cluster universities collaborate with renowned international institutions for joint educational programs, academic exchange, and cooperative research, providing access to high-quality educational resources and cultivating talents with a global perspective and international competitiveness.

Appendix C

Influencing Factors and Effects of Higher Education Cluster Development in the Chengdu-Chongqing Region

Influencing Factors and Effects of Higher Education Cluster Development in the Chengdu-Chongqing Region

Influencing factors

1. The Role of Government in the Development of Higher Education Cluster in the Chengdu-Chongqing Region

1.1 Policy Support

1.1.1 The government formulates development plans for the higher education cluster.

1.1.2 The government establishes policies for talent recruitment and research projects.

1.1.3 The government formulates policies to support employment and entrepreneurship among university students.

1.2 Infrastructure Support

1.2.1 The government allocates land and invests in urban transportation infrastructure to support the development of the higher education cluster in the Chengdu-Chongqing region.

1.2.2 The government constructs new university campuses, university towns, and university science and technology parks to cater to the growth of the higher education cluster in the region.

1.3 Financial Support

1.3.1 The government sets up dedicated financial appropriations for the cluster universities in the Chengdu-Chongqing region.

1.3.2 The government allocates research project funding to support scientific research initiatives at the cluster universities.

1.3.3 The government provides scholarships and financial aid to students attending cluster universities in the Chengdu-Chongqing region.

1.4 Research Project Support

1.4.1 The government releases research projects targeting the cluster universities in the Chengdu-Chongqing region.

1.4.2 The government commissions significant projects to the cluster universities in the Chengdu-Chongqing region.

2. The Role of Colleges and Universities in the Development of Higher Education Cluster in Chengdu and Chongqing

2.1 Interdisciplinary Research Program

2.1.1 Different academic departments and research institutions among the cluster universities in the Chengdu-Chongqing region will collaborate in research.

2.1.2 The cluster universities in the Chengdu-Chongqing region frequently initiate joint research projects.

2.1.3 The cluster universities in the Chengdu-Chongqing region often form academic alliances and mutually recognize courses and degrees.

2.1.4 The cluster universities in the Chengdu-Chongqing region frequently share research facilities and resources.

2.1.5 The cluster universities in the Chengdu-Chongqing region frequently collaborate in publishing academic journals.

2.2 Joint Talent Cultivation

2.2.1 The cluster universities in the Chengdu-Chongqing region often collaborate in cultivating faculty resources.

2.2.2 The cluster universities in the Chengdu-Chongqing region frequently engage in joint student cultivation programs.

2.2.3 The cluster universities in the Chengdu-Chongqing region create mechanisms to promote cross-institutional learning and foster a diverse academic environment.

2.3 Science Promotion Programs

2.3.1 The cluster universities in the Chengdu-Chongqing region will establish an ecosystem to promote innovation and entrepreneurship.

2.3.2 Intellectual property management encourages fair sharing of benefits among collaborating institutions.

2.4 International Cooperation and Exchange

2.4.1 The cluster universities in the Chengdu-Chongqing region will strengthen international cooperation, collectively enhancing the global reputation of higher education.

2.4.2 The cluster universities in the Chengdu-Chongqing region will attract international talents and mutually exchange graduate students with renowned universities abroad.

3. The Role of Enterprises in the Development of Higher Education Cluster in the Chengdu-Chongqing Region

3.1 Industry-Academia-Research Collaboration:

3.1.1 Enterprises will facilitate the commercialization of advanced technological achievements from universities in the Chengdu-Chongqing region.

3.1.2 Chengdu-Chongqing enterprises, research institutions, and cluster universities will establish high-level collaborative innovation platforms jointly.

3.1.3 Enterprises, research institutions, and cluster universities in the Chengdu-Chongqing region will jointly build the Chengdu-Chongqing Industry-Academia-Research Innovation Alliance.

3.2 School-Enterprise Collaboration:

3.2.1 Chengdu-Chongqing universities and enterprises will establish a national technology achievement incubation base jointly.

3.2.2 Chengdu-Chongqing universities and enterprises will jointly establish the Chengdu-Chongqing Youth Entrepreneurship and Employment Fund.

Evaluation Criteria of Higher Education Cluster Development in Chengdu Aad Chongqing

1. Talent Cultivation:

1.1 Inter-cluster universities can implement student cross-campus exchange and training.

1.2 Inter-cluster universities have established an online course-sharing platform.

1.3 Inter-cluster universities have initiated pilot projects to reform undergraduate enrollment in basic disciplines.

2. Resource Sharing:

2.1 Teachers from inter-cluster universities can share and mutually appoint, and they can guide students across different campuses.

2.2 Inter-cluster universities have achieved shared construction of resources such as books, literature, experimental equipment, and information materials.

2.3 Inter-cluster universities have achieved shared access to sports and medical resources and have opened their campuses to each other.

3. Scientific Research:

3.1 Inter-cluster universities integrate scientific and technological resources and have established joint laboratories.

3.2 Inter-cluster universities mutually open access to national vital and provincial key laboratories.

3.3 Inter-cluster universities jointly apply for and undertake major national research projects or international scientific and technological cooperation projects.

3.4 Inter-cluster universities have established a collaborative mechanism for the technology transfer of achievements.

4. International Exchange and Cooperation:

4.1 Inter-cluster universities regularly organize high-end science and technology forums.

4.2 Inter-cluster universities collaborate with internationally renowned universities in joint education programs.

Appendix D

Questionnaire on Influencing Factors of Higher Education Cluster Development in Chengdu And Chongqing

Questionnaire on Influencing Factors of Higher Education Cluster Development in Chengdu And Chongqing

Dear Sir/Madam

We are studying the factors that affect the development of higher education clusters in Chengdu and Chongqing. Thank you very much for taking the time to fill in the questionnaire.

This study preliminarily constructs the factors affecting the development of higher education clusters in the Chengdu-Chongqing region, including government, university, and enterprise factors. Mainly from the personnel training, resource sharing, scientific research, international exchanges, and cooperation to evaluate the effectiveness of the higher education cluster development model in the Chengdu-Chongqing region. Please rate this metric based on your understanding and experience, where five is strongly agreed (or very important), four is somewhat decided (or rather important), three is neutral (or average), two slightly disagree (or not necessary), and one is strongly disagree (or very not important). The consultation results only apply to this academic research, and we will keep the information and evaluation results of the questionnaire strictly confidential.

1. Personal Basic Information

(1) Your gender: Male ☐ Female ☐

(2) Your age is: Under 30 ☐ 30-45 ☐ 45-60 ☐

(3) Education background： High school/technical secondary school and below ☐
Undergraduate and specialty ☐ Graduate student ☐

(4)Identity: Government official ☐ University administrator ☐
Principal of the enterprise ☐

(5)Working Life: Under 5 ☐ 5-10 ☐ 10-15 ☐ 15 years or more ☐

2. Influencing Factors of Higher Education Cluster Development in Chengdu And Chongqing

(1)Government factors						
Influencing factors		View				
		5	4	3	2	1
Policy Support	1) The government formulates development plans for the higher education cluster.					
	2) The government establishes policies for talent recruitment and research projects.					
	3) The government formulates policies to support employment and entrepreneurship among university students.					
Infrastructure Support	4) The government allocates land and invests in urban transportation infrastructure to support the development of the higher education cluster in the Chengdu-Chongqing region.					
	5) The government constructs new university campuses, university towns, and university science and technology parks to cater to the growth of the higher education cluster in the region.					
Financial Support	6)The government sets up dedicated financial appropriations for the cluster universities in the Chengdu-Chongqing region.					
	7) The government allocates research project funding to support scientific research initiatives at the cluster universities.					
	8) The government provides scholarships and financial aid to students attending cluster universities in the Chengdu-Chongqing region.					
Research Project Support	9) The government releases research projects targeting cluster universities in the Chengdu-Chongqing region.					
	10) The government commissions significant projects to the cluster universities in the Chengdu-Chongqing region.					
(2)University factors						
Influencing factors		View				
		5	4	3	2	1

Interdisciplinary Research Program	1) Different academic departments and research institutions among the cluster universities in the Chengdu-Chongqing region will collaborate in research.					
	2) The cluster universities in the Chengdu-Chongqing region frequently initiate joint research projects.					
	3) The cluster universities in the Chengdu-Chongqing region often form academic alliances and mutually recognize courses and degrees.					
	4) The cluster universities in the Chengdu-Chongqing region frequently share research facilities and resources.					
	5) The cluster universities in the Chengdu-Chongqing region frequently collaborate in publishing academic journals.					
Joint Talent Cultivation	6) The cluster universities in the Chengdu-Chongqing region often collaborate in cultivating faculty resources.					
	7) The cluster universities in the Chengdu-Chongqing region frequently engage in joint student cultivation programs.					
	8) The cluster universities in the Chengdu-Chongqing region create mechanisms to promote cross-institutional learning and foster a diverse academic environment.					
Science Promotion Programs	9) The cluster universities in the Chengdu-Chongqing region will establish an ecosystem to promote innovation and entrepreneurship.					

	10) Intellectual property management encourages fair sharing of benefits among collaborating institutions.					
International Cooperation and Exchange	11) The cluster universities in the Chengdu-Chongqing region will strengthen international cooperation, collectively enhancing the region's global reputation of higher education.					
	12) The cluster universities in the Chengdu-Chongqing region will attract international talents and mutually exchange graduate students with renowned universities abroad.					
(3) Enterprise factors						
Influencing factors		View				
		5	4	3	2	1
Industry-Academia-Research Collaboration	1) Enterprises will facilitate the commercialization of advanced technological achievements from universities in the Chengdu-Chongqing region.					
	2) Chengdu-Chongqing enterprises, research institutions, and cluster universities will establish high-level collaborative innovation platforms jointly.					
	3) Enterprises, research institutions, and cluster universities in the Chengdu-Chongqing region will jointly build the Chengdu-Chongqing Industry-Academia-Research Innovation Alliance.					
School-Enterprise Collaboration	4) Chengdu-Chongqing universities and enterprises will establish a national technology achievement incubation base					

	jointly.					
	5) Chengdu-Chongqing universities and enterprises will jointly establish the Chengdu-Chongqing Youth Entrepreneurship and Employment Fund.					

3. Evaluation Criteria of Higher Education Cluster Development in Chengdu And Chongqing

Talent Cultivation	1) Inter-cluster universities can implement student cross-campus exchange and training.					
	2) Inter-cluster universities have established an online course-sharing platform.					
	3) Inter-cluster universities have initiated pilot projects to reform undergraduate enrollment in basic disciplines.					
Resource Sharing	1) Teachers from inter-cluster universities can share and mutually appoint, and they can guide students across different campuses.					
	2) Inter-cluster universities have achieved shared construction of resources such as books, literature, experimental equipment, and information materials.					
	3) Inter-cluster universities have achieved shared access to sports and medical resources and have opened their campuses to each other.					
Scientific Research	1) Inter-cluster universities integrate scientific and technological resources and have established joint laboratories.					

	2) Inter-cluster universities mutually open access to national vital laboratories and provincial key laboratories.					
	3) Inter-cluster universities jointly apply for and undertake major national research projects or international scientific and technological cooperation projects.					
	4) Inter-cluster universities have established a collaborative mechanism for the technology transfer of achievements.					
International Exchange and Cooperation	1) Inter-cluster universities regularly organize high-end science and technology forums.					
	2) Inter-cluster universities collaborate with internationally renowned universities in joint education programs.					

Appendix E

Questionnaire on Influencing Factors of Higher Education Cluster Development in Chengdu And Chongqing

Questionnaire on Influencing Factors of Higher Education Cluster Development in Chengdu And Chongqing

Replacement symbol of each index item

(1)Government factors		
Influencing factors		Substitute Symbol
Policy Support（PS）	1) The government formulates development plans for the higher education cluster.	PS1
	2) The government establishes policies for talent recruitment and research projects.	PS2
	3) The government formulates policies to support employment and entrepreneurship among university students.	PS3
Infrastructure Support（IS）	4) The government allocates land and invests in urban transportation infrastructure to support the development of the higher education cluster in the Chengdu-Chongqing region.	IS1
	5) The government constructs new university campuses, university towns, and university science and technology parks to cater to the growth of the higher education cluster in the region.	IS2
Financial Support（FS）	6)The government sets up dedicated financial appropriations for the cluster universities in the Chengdu-Chongqing region.	FS1
	7) The government allocates research project funding to support scientific research initiatives at the cluster universities.	FS2
	8) The government provides scholarships and financial aid to students attending cluster universities in the Chengdu-	FS3

	Chongqing region.	
Research Project Support（RPS）	9) The government releases research projects targeting cluster universities in the Chengdu-Chongqing region.	RPS1
	10) The government commissions significant projects to the cluster universities in the Chengdu-Chongqing region.	RPS2
(2)University factors		
Influencing factors		Substitute Symbol
Interdisciplinary Research Program（IRP）	1) Different academic departments and research institutions among the cluster universities in the Chengdu-Chongqing region will collaborate in research.	IRP1
	2) The cluster universities in the Chengdu-Chongqing region frequently initiate joint research projects.	IRP2
	3) The cluster universities in the Chengdu-Chongqing region often form academic alliances and mutually recognize courses and degrees.	IRP3
	4) The cluster universities in the Chengdu-Chongqing region frequently share research facilities and resources.	IRP4
	5) The cluster universities in the Chengdu-Chongqing region frequently collaborate in publishing	IRP5

	academic journals.	
Joint Talent Cultivation（JTC）	6) The cluster universities in the Chengdu-Chongqing region often collaborate in cultivating faculty resources.	JTC1
	7) The cluster universities in the Chengdu-Chongqing region frequently engage in joint student cultivation programs.	JTC2
	8) The cluster universities in the Chengdu-Chongqing region create mechanisms to promote cross-institutional learning and foster a diverse academic environment.	JTC3
Science Promotion Programs（SPP）	9) The cluster universities in the Chengdu-Chongqing region will establish an ecosystem to promote innovation and entrepreneurship.	SPP1
	10) Intellectual property management encourages fair sharing of benefits among collaborating institutions.	SPP2
International Cooperation and Exchange（ICE）	11) The cluster universities in the Chengdu-Chongqing region will strengthen international cooperation, collectively enhancing the global reputation of higher education.	ICE1
	12) The cluster universities in the Chengdu-Chongqing region will	ICE2

	attract international talents and mutually exchange graduate students with renowned universities abroad.	
(3) Enterprise factors		
Influencing factors		Substitute Symbol
Industry-Academia-Research Collaboration（IARC）	1) Enterprises will facilitate the commercialization of advanced technological achievements from universities in the Chengdu-Chongqing region.	IARC1
	2) Chengdu-Chongqing enterprises, research institutions, and cluster universities will establish high-level collaborative innovation platforms jointly.	IARC2
	3) Enterprises, research institutions, and cluster universities in the Chengdu-Chongqing region will jointly build the Chengdu-Chongqing Industry-Academia-Research Innovation Alliance.	IARC3
School-Enterprise Collaboration（SFC）	4) Chengdu-Chongqing universities and enterprises will establish a national technology achievement incubation base jointly.	SFC1
	5) Chengdu-Chongqing universities and enterprises will jointly establish the Chengdu-Chongqing Youth Entrepreneurship and Employment	SFC2

	Fund.	

Evaluation Criteria of Higher Education Cluster Development in Chengdu And Chongqing

Influencing factors		Substitute Symbol
Talent Cultivation（TC）	1)Inter-cluster universities can implement student cross-campus exchange and training.	TC1
	2)Inter-cluster universities have established an online course-sharing platform.	TC2
	3)Inter-cluster universities have initiated pilot projects to reform undergraduate enrollment in basic disciplines.	TC3
Resource Sharing（RS）	1) Teachers from inter-cluster universities can share and mutually appoint, and they can guide students across different campuses.	RS1
	2) Inter-cluster universities have achieved shared construction of resources such as books, literature, experimental equipment, and information materials.	RS2
	3) Inter-cluster universities have achieved shared access to sports and medical resources and have opened their campuses to each other.	RS3
Scientific Research（SR）	1) Inter-cluster universities integrate scientific and technological resources and	SR1

	have established joint laboratories.	
	2) Inter-cluster universities mutually open access to national vital laboratories and provincial key laboratories.	SR2
	3) Inter-cluster universities jointly apply for and undertake major national research projects or international scientific and technological cooperation projects.	SR3
	4) Inter-cluster universities have established a collaborative mechanism for the technology transfer of achievements.	SR4
International Exchange and Cooperation（IEC）	1) Inter-cluster universities regularly organize high-end science and technology forums.	IEC1
	2) Inter-cluster universities collaborate with internationally renowned universities in joint education programs.	IEC2

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วิทยานิพนธ์ฉบับนี้เป็นงานวิจัยที่เกิดจากการค้นคว้าและวิจัย ขณะที่ข้าพเจ้าศึกษาอยู่ในคณะครุศาสตร์อุตสาหกรรม มหาวิทยาลัยเทคโนโลยีราชมงคลธัญบุรี ดังนั้น งานวิจัยในวิทยานิพนธ์ฉบับนี้ถือเป็นลิขสิทธิ์ของมหาวิทยาลัยเทคโนโลยีราชมงคลธัญบุรี และข้อความต่าง ๆ ในวิทยานิพนธ์ฉบับนี้ ข้าพเจ้าขอรับรองว่าไม่มีการคัดลอกหรือนำงานวิจัยของผู้อื่นมานำเสนอในชื่อของข้าพเจ้า

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(Mr.Lin Tang)