

## **Analysis on Key Influencing Factors of Industry-Education Integration in Entrepreneurial Universities**

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### **Abstract**

**At present, in order to establish a modern economic system, China needs the integration of science and technology and industry, and the core of the deep integration of science and technology and industry is the need for a number of entrepreneurial universities to promote the integration of industry and education. In order to better draw lessons from the successful experience of foreign integration of industry and education, and promote our universities to carry out deep integration of industry and education towards the construction of modern economic system, we need to identify the key factors in the process of integration of industry and education. Therefore, this paper uses the fuzzy set-DEMATEL method to identify the key factors in the process of integration of industry and education.**

### **Keywords**

**Integration of science and technology and industry, the fuzzy set-DEMATEL method, Entrepreneurial Universities.**

### **1. Introduction**

In recent years, under the guidance of national policies, many universities in China have begun to carry out the practice of integration of industry and education. They generally break the traditional organizational boundaries and cooperate closely with enterprises by means of derivative enterprises, scientific parks and commercialization of technology. However, due to the long-term separation of production, education and research, universities mainly focus on scientific and technological research, and pay little attention to the needs of enterprises, which makes it difficult for universities to seamlessly connect the supply of scientific research technology with the market demand. This situation is obviously not conducive to the integration of industry and education in China's universities.

In fact, there are many examples of integration of industry and education in foreign universities, such as Stanford University, Warwick University in the United Kingdom, Munich University of Technology in Germany, etc. These universities rely on their strong scientific and technological strength and human capital to carry out innovation and entrepreneurship in the market, and constantly obtain economic resources to support their commercial and technological development, gradually forming a unique school-enterprise synergy model. It has made great contributions to the development of local industries, which are also called entrepreneurial universities. Entrepreneurial universities emphasize pragmatism, encourage universities to engage in research and development in the market, tap market demand, coordinate and unify academia and entrepreneurship, while focusing on training innovative and entrepreneurial talents, establishing a good entrepreneurial ecology, giving full play to their economic functions, and effectively promoting the integration of industry and education in universities.

## 2. Literature Review

### 2.1. Research on the Development Motivation of Entrepreneurial Universities

The earliest entrepreneurship universities came into being in Western countries. There are two main reasons for their rise. From the macro level, the rapid development of science and technology has increasingly prominent impact on social economy. As the main body of scientific research and innovation, colleges and universities have become the economic engine concept deeply rooted in the hearts of the people. From the micro perspective, the financial difficulties of higher education, the cultivation of entrepreneurial talents and the demand of Technology and market all have a strong impact on the traditional closed teaching mode of universities, and colleges and universities can not be alone in the "ivory tower".

Gu Yonghong (2014) pointed out that the transformation of knowledge production mode is an important factor to promote the change of university academic organizations. Lu Keke and Gong Fang (2018) pointed out that entrepreneurship university is a new type of university which emerged at the historic moment in the knowledge-based economy society. It conforms to the changes of economic change, regional development and social demand, and also embodies many characteristics of the new mode of knowledge production. Wang Jianhua (2018) pointed out that under the background of innovation-driven development, the university's innovation and entrepreneurship has changed from quantitative change to qualitative change by transforming profound knowledge into application. Liu He and Guo Fengzhi (2018) pointed out that academic capitalization is the internal driving force for the realization of entrepreneurial universities; University Incubator is the external carrier for the growth of entrepreneurial universities; and collaborative innovation is the platform support for the construction of entrepreneurial universities.

### 2.2. Research on the Development Model of Entrepreneurial Universities

In the study of Entrepreneurial University model, Liu Ye and Feng Guojie (2016) pointed out that the formation of entrepreneurial university is due to the game between tradition and reality. The personality expression of entrepreneurial university model is based on the self-selection of the unique higher education model. The formation of Entrepreneurial University ecology depends on the pattern matching and co-evolution. He Yu-bing and Ding Jiamin (2015) borrowed the idea of ecosystem and put forward the basic framework of building an entrepreneurship education ecosystem (EEE) in entrepreneurial universities. Liu Run and Wang Jiaonan (2017) attach great importance to promoting cooperation with local governments, building a complete knowledge-based industrial ecological chain of "creative chain-technology chain-industry chain-market chain", and building a new model of "government-university-industry" to promote regional innovative industrial clusters. Chen Xialing (2015) there are five main modes in the construction of entrepreneurship universities in China: service social development mode, academic entrepreneurship mode, professional entrepreneurship mode, entrepreneurship education mode and enterprise management mode. Fu Bajun (2018) pointed out the reasonable factors in the research of the classification system of entrepreneurial universities. He divided entrepreneurial universities into two categories: teaching service and academic application, each of which is divided into profit-making and public welfare.

## 3. Research Method

### 3.1. DEMATEL

DEMATEL is a method by which scholars use graph theory and matrix tools to judge the strength of factors and evaluate their strength. Moreover, this method can effectively analyze the degree of interaction among many factors in complex systems, and determine the primary

and secondary relationship between factors according to the direct influence matrix. The specific steps are as follows:

Firstly, determine the influencing factors in the system and mark them; secondly, organize a group of experts to analyze the influencing relationship among the factors, and use the scoring rules of no = 0, weak = 1, medium = 2, strong = 3 to score the degree of influence among the factors in the system, and generate the initial N-order matrix  $A = \{a_{ij}\}_{n \times n}$ , Among them, the factors given by experts are scored for the degree of influence of the factors.

Through the formula  $B = \frac{A}{\max \sum_{j=1}^n a_{ij}}$ , the direct influence matrix A is transformed into standard influence matrix B.

Formula:  $M = B(I - B)^{-1}$ , Standard influence matrix B is transformed into comprehensive influence matrix M, where I is the unit matrix.

The sum of each row and each element of matrix M is calculated to show the influence degree and the influence degree of each element.

$$M_l = (M_l(1), M_l(2), M_l(3), \dots, M_l(n))^T$$

$$M_r = (M_r(1), M_r(2), M_r(3), \dots, M_r(n))$$

The centrality and causality of each factor were calculated.

$$M_i = M_l(i) + M_r(i)$$

$$R_i = M_l(i) - M_r(i)$$

The factor centrality is that it indicates the position of the factor in the evaluation index system and the size of its role; the factor causality is that if the factor causality is more than 0, it means that the factor has a great influence on other factors, which is called cause factor; if the factor causality is less than 0, it means that the factor has little influence on other factors, which is called result factor.

### 3.2. Fuzzy Set Theory

Fuzzy theory is a method used to deal with expert's subjective judgment. Different experts make corresponding judgments based on their previous experience and knowledge. Their subjective will is strong, and their language is often ambiguous. Therefore, it is necessary to translate the language description of each expert into fuzzy values so as to obtain more objective judgments. In this paper, Chi-Jen Lin and Wei-wen Wu (2008) fuzzy numbers are transformed into exact numerical values to quantify the subjective judgments of expert groups.

The specific steps are as follows:

Standardization of triangular fuzzy numbers. According to formula1, formula2 and formula3, the subjective differences among experts are reduced.

$$\mu l_{ij}^k = \frac{l_{ij}^k - L}{\Delta} \quad (1)$$

$$\mu m_{ij}^k = \frac{m_{ij}^k - L}{\Delta} \quad (2)$$

$$\mu r_{ij}^k = \frac{r_{ij}^k - L}{\Delta} \quad (3)$$

$$L = \min l_{ij}^k, \quad R = \max r_{ij}^k, \quad \Delta = R - L, \quad 1 \leq k \leq n.$$

Calculate left and right standard values

$$\mu l s_{ij}^k = \frac{\mu m_{ij}^k}{1 + \mu m_{ij}^k - \mu l_{ij}^k} \quad (4)$$

$$\mu r s_{ij}^k = \frac{\mu r_{ij}^k}{1 + \mu r_{ij}^k - \mu m_{ij}^k} \quad (5)$$

Calculating total standardized values

$$\mu_{ij}^k = \frac{\mu l s_{ij}^k (1 - \mu l s_{ij}^k) + (\mu r s_{ij}^k)^2}{1 - \mu l s_{ij}^k + \mu r s_{ij}^k} \quad (6)$$

Get the impact values  $A_i$  given  $A_j$  by the  $k$ th expert

$$w_{ij}^k = L + \mu_{ij}^k \Delta \quad (7)$$

Find the average value among experts, that is, as the overall evaluation result of the final expert group.

$$w_{ij} = \frac{1}{n} \sum_{k=1}^{k=n} w_{ij}^k$$

#### 4. Fuzzy Set-DEMATEL Analysis

Through the analysis of word frequency of case universities, this paper summarizes the practical experience of Huawei University in the process of entrepreneurship transformation. In order to make the practical experience of Huawei University more applicable to China's national conditions, this paper relies on expert group scoring, and uses the method of fuzzy set-DEMATEL to identify the key influencing factors of Huawei University in the process of integration of production and teaching. In order to ensure the scientific of research and the impartiality of expert scoring, this paper invites experts of industry, University and research, entrepreneurship University and enterprise basic research, a group of experts composed of 10 experts to score the influencing factors. This study designed questionnaires based on linguistic variables used by expert groups such as Wang and chen. The questionnaire adopts the Likert 5 scale (with great influence, great influence, small influence, little influence and no influence), and evaluates the interrelationship among 10 influencing factors, totaling 100 interrelationship

influence sets. Each expert is asked to make a free judgment on the influence degree of each influencing factor according to the linguistic variables, and then get the different experts' opinions on each influencing factor. Data on the extent of impact.

In order to avoid the influence of subjective differences among experts, the scores given by experts are fuzzified according to the method of fuzzy sets in Chapter 3, and the direct influence matrix of factors affecting the integration of industry and education in entrepreneurial universities is calculated. The results are as follows:

**Table 1.** The direct impact matrix o

Factor	F1	F2	F3	F4	F5	F6	F7	F8	F9	F10
F1	0.000	0.227	0.500	0.194	0.304	0.582	0.500	0.582	0.231	0.463
F2	0.694	0.000	0.773	0.694	0.654	0.654	0.740	0.694	0.359	0.384
F3	0.806	0.267	0.000	0.267	0.658	0.839	0.839	0.839	0.654	0.773
F4	0.385	0.182	0.839	0.000	0.730	0.773	0.806	0.773	0.335	0.500
F5	0.658	0.378	0.806	0.658	0.000	0.806	0.773	0.806	0.500	0.740
F6	0.304	0.161	0.463	0.161	0.384	0.000	0.500	0.773	0.409	0.161
F7	0.335	0.267	0.463	0.773	0.654	0.654	0.000	0.773	0.546	0.267
F8	0.384	0.582	0.582	0.425	0.765	0.773	0.267	0.000	0.839	0.773
F9	0.425	0.161	0.359	0.694	0.582	0.546	0.280	0.582	0.000	0.839
F10	0.194	0.194	0.546	0.658	0.694	0.654	0.227	0.740	0.773	0.000

According to DEMATEL method, it is transformed into a comprehensive impact matrix.

**Table 2.** Comprehensive Influencing Matrix

Factor	F1	F2	F3	F4	F5	F6	F7	F8	F9	F10
F1	0.090	0.092	0.173	0.123	0.155	0.199	0.157	0.207	0.135	0.159
F2	0.225	0.109	0.281	0.243	0.271	0.296	0.252	0.313	0.218	0.223
F3	0.231	0.136	0.190	0.196	0.266	0.309	0.253	0.323	0.248	0.261
F4	0.173	0.115	0.261	0.147	0.254	0.281	0.236	0.293	0.195	0.214
F5	0.217	0.146	0.277	0.235	0.194	0.306	0.250	0.319	0.230	0.256
F6	0.121	0.082	0.163	0.116	0.158	0.129	0.152	0.220	0.150	0.125
F7	0.152	0.113	0.202	0.213	0.225	0.245	0.131	0.267	0.197	0.170
F8	0.185	0.166	0.251	0.210	0.273	0.297	0.191	0.227	0.261	0.258
F9	0.158	0.099	0.189	0.203	0.215	0.230	0.159	0.243	0.136	0.228
F10	0.145	0.111	0.222	0.212	0.241	0.257	0.166	0.277	0.233	0.152

According to the comprehensive influence matrix of the factors influencing the integration of industry and education in entrepreneurial universities, the degree of influence and the degree of influence among the factors are calculated, and then the degree of centrality D (the sum of the degree of influence and the degree of influence) and the degree of causality R (the difference

between the degree of influence and the degree of influence) among the 10 factors are calculated and ranked. The results are as follows:

**Table 3.** Index and ranking of influencing factors

Factor	Influence degree	Affected degree	Centrality	Cause degree
F1	1.802	2.500	4.302	-0.6979
F2	2.982	1.878	4.860	1.1045
F3	2.938	3.292	6.230	-0.3548
F4	2.612	2.796	5.408	-0.1834
F5	2.920	3.291	6.212	-0.3708
F6	1.714	3.688	5.403	-1.9738
F7	2.297	2.820	5.117	-0.5221
F8	2.849	3.930	6.779	-1.0805
F9	2.259	2.918	5.177	-0.6593
F10	2.464	2.968	5.432	-0.5038

## 5. Conclusion

(1) Centrality analysis. Centrality indicates the position of this factor in the system and the size of its role. The greater the centrality, the greater the role of this factor in the influencing factor system of the integration of industry and education in entrepreneurial universities. According to the data of Table3, the centrality of entrepreneurship implementation (F8), top-level entrepreneurship attitude (F3), entrepreneurship income expectation (F5) and business value demonstration (F10) is higher. Among them, entrepreneurship operation is the most centralized, which is the key factor. High-level entrepreneurship attitude, expectation of entrepreneurship income and business value are the most important factors in the integration of industry and education in entrepreneurial universities. The core of the integration of industry and education in entrepreneurial universities is to promote universities to step out of the "ivory tower" to meet the market demand and give full play to the economic value of universities. Therefore, the implementation of entrepreneurship operation can greatly drive universities to carry out entrepreneurship practice, so it can have a great impact on the integration of industry and education in entrepreneurial universities. High-level entrepreneurship attitudes and earnings expectations can affect the university's awareness of entrepreneurship, and drive entrepreneurship universities to integrate production and teaching. Business value highlights the value of creating market economy, greatly improving the reputation, scientific research strength and economic strength of universities, and enhancing the integration ability of production and teaching. Therefore, in the integration of industry and education in entrepreneurial universities, we need to carry out business operation, break the barriers between universities and the market, and find market demand, so as to achieve the integration of industry and education.

(2) Identification of key influencing factors. From the data of Table3, we can see that entrepreneurship operation implementation (F8) is the most centralized of all factors, and is vulnerable to other factors. It is closely related to other factors and plays a vital role in the success of the integration of industry and education in entrepreneurial universities. High-level entrepreneurship attitude (F3) is the most active factor in cultivating the willingness to integrate industry and education, which has an indelible impact on the integration of industry

and education in entrepreneurial universities. Technological market demand (F1) is the most important factor among all factors. It is also the most active factor in the construction of Industry-Education integration environment. It supports the realization of Industry-Education integration in entrepreneurial universities. Therefore, entrepreneurship operation practice (F8), high-level entrepreneurship attitude (F3) and technological market demand (F1) can be regarded as the key factors in the integration of industry and education in entrepreneurial universities, which is also the aspect that needs to be strengthened in the construction of integration of industry and education in entrepreneurial universities in China.

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