Analysis of Conflicts in Talent Resource Allocation within the Education-Industry Integration of Independent Colleges

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Abstract: *This paper examines resource allocation conflicts in independent colleges' integration of production and education, using the conflict analysis graph model (GMCR) to propose solutions. It constructs a four-helix model involving government, industry associations, enterprises, and colleges, analyzing strategic choices and preferences. Using AHP and expert scoring, it evaluates decision weights and finds equilibrium solutions. The study reveals multiple solutions in GMR and SMR, but only one in Nash and SEQ, where all parties actively participate in the integration of industry and education, forming a conducive environment and supporting talent training systems. The paper innovates by applying GMCR to resource conflicts but acknowledges limitations due to reliance on theory and expert scores rather than operational data. Future research should explore model application in real-world scenarios.*

Keywords: Integration of industry and education, Talent training, Resource allocation, Conflict analysis, Talent cultivation.

1. Introduction

The global 'new industrial revolution' has ushered in a transformative era characterized by rapid technological advancements, digitalization, and intellectualization [1]. In response to these changes, China has strategically transitioned from a 'catch-up strategy' to an 'innovation-driven development strategy' [2]. This shift underscores China's commitment to fostering a knowledge-based economy and enhancing its global competitiveness. Central to this strategy is the cultivation of top-notch innovative talents, who are essential for driving technological breakthroughs and economic growth [3]. In this evolving landscape, the concept of 'integration of industry and education' has emerged as a critical pathway for higher education institutions to align their curricula and training programs with the needs of the industry. This integration aims to bridge the gap between academic knowledge and practical skills, ensuring that graduates are well-prepared to meet the demands of the modern workforce [4].

As a significant component of China's higher education system, independent colleges play a pivotal role in this endeavor. Their exploration and implementation of industry-education integration and school-enterprise cooperation are vital for enhancing the quality of applied talent training [5]. Independent colleges, with their unique positioning as institutions that combine the strengths of both public and private education, are well-suited to pioneer innovative approaches to industry-education integration. These institutions often have greater flexibility in curriculum design and resource allocation, allowing them to adapt more swiftly to the dynamic needs of the industry. By fostering close collaboration with enterprises, industry associations, and government bodies, independent colleges can create a more seamless and effective ecosystem for talent development. However, despite the potential benefits, the integration of industry and education faces numerous challenges and dilemmas. One of the primary issues is the misalignment between the supply and demand of talent resources. Government, industry associations, enterprises, and universities each have distinct objectives and priorities, leading to conflicts in resource allocation and cooperation. For instance, universities may focus on academic rigor and theoretical knowledge, while enterprises prioritize practical skills and immediate applicability. This divergence can result in a mismatch between the skills graduates acquire and the competencies required by the industry. Another significant challenge is the lack of a unified framework or standard for industry-education integration [6]. Without clear guidelines and incentives, stakeholders may struggle to align their efforts effectively.

Additionally, the varying levels of commitment and resources among different parties can further complicate the process. For example, some enterprises may be reluctant to invest in long-term partnerships with educational institutions, fearing a lack of return on investment. Similarly, universities may face constraints in terms of funding and infrastructure, limiting their ability to fully engage in industry-education integration. Moreover, the integration of industry and education requires a cultural shift within both academia and industry. Traditional educational models often emphasize theoretical learning and academic achievement, while the modern workforce demands a more holistic approach that includes practical experience, problem-solving skills, and adaptability. Encouraging this shift requires not only changes in curriculum and pedagogy but also a rethinking of the roles and responsibilities of all stakeholders involved. To address these challenges, a multi-faceted approach is necessary. Independent colleges, as key players in the higher education system, have a unique opportunity to lead the way in this transformation [7]. By addressing the challenges and dilemmas in resource allocation and cooperation, and by fostering a culture of collaboration

and innovation, these institutions can play a pivotal role in cultivating the high-quality skilled talents needed to drive China's economic and technological advancement in the new industrial revolution.

2. Literature Review

2.1 Conflict Analysis Theories

Since Pawlak proposed a new approach to conflict analysis based on rough set theory, conflict analysis theory has been the subject of extensive research in recent years, aiming to understand and manage various types of conflicts [8]. Scholars have explored the complexity and diversity of conflict from a number of perspectives. Phillios and Greene explores the issue of Western bias in conflict studies by analyzing the history of international conflict and the history of domestic conflict [9]. Pryanikova explores the theory and practice of conflictology through literature spanning the period from 2002 to 2022, covering a wide range of aspects of conflict psychology, social conflict theory, and the role of gender and individual behavioral differences in conflict [10]. Hock, on the other hand, explores the theory and practice of conflict management, covering a number of research areas, including the relationship between Jungian personality dimensions and conflict-handling behaviors, and organizational conflict management theory. Conflict analysis also has applications in education [11]. Wirandana & Khoirunurrofik used nine years of data from 34 provinces in Indonesia to analyze the impact of government finance on education, arguing that varying levels of government support can cause inequality in education and lead to conflicts over educational resources [12]. After analyzing data from 32 education systems, Glassow et.al concluded that teachers with economic disparities have an impact on student achievement and that educational resources should be allocated accordingly to prevent conflict [13].

2.2 The Application of Analytic Hierarchy Process in Conflict Analysis

The Analytic Hierarchy Process (AHP), as a multi-criteria decision-making analysis tool, decomposes complex problems into a hierarchical structure, helping decision-makers systematically evaluate and compare the pros and cons of different options [14]. In recent years, its application in conflict analysis has received widespread attention. The AHP has significant advantages in conflict analysis because it can quantify and compare various aspects of conflicts, thus providing conflict managers with a clearer decision-making path [15]. For example, Guiora et.al proposed a conflict resolution method based on AHP, aiming to resolve conflicts through recourse strategies [16]. This method emphasizes the importance of balancing different opinions in group decision-making. In addition, the research by Chaube et.al pointed out that although AHP has broad application prospects in conflict analysis, there are certain inconsistency problems [15]. To reduce this inconsistency, they proposed a variety of extended methods, further improving AHP by integrating multiple computational strategies. These improved methods not only enhance the reliability of AHP in conflict analysis but also strengthen its effectiveness in practical applications. In terms of specific applications, Catapani summarized provided a practical framework for determining which level, proposed by Madden, a conflict should be classified into. This framework focuses on five key analysis areas, including the perception of the accused species, previous attempts to solve the problem, doubts about the situation itself, the degree of willingness to find solutions, and the views of others seeking solutions [17], [18], [19]. The application of this framework helps conflict managers design more effective intervention measures, thereby reducing conflicts. The application of the Analytic Hierarchy Process in conflict analysis demonstrates its potential and advantages in solving complex conflict problems. Through continuous improvement and expansion, AHP is expected to provide more scientific and efficient decision-making support for conflict managers in the future.

2.3 The Resource Conflict Faced by the Integration of Production and Education in Independent Colleges

In independent colleges, the conflict of resource allocation between talent training and industry-education integration is a complex and multi-faceted problem. In recent years, with the increasing demand for high-quality talent in society, independent colleges are facing many challenges and opportunities in the talent training mode. One of the main problems faced by independent colleges in the process of talent training is the limited resources [20]. Due to the lack of funds and human resources, many independent colleges find it difficult to provide teaching equipment and faculty comparable to traditional research universities. In addition, the synergy between disciplines in independent colleges is weak, and the difficulty of students' employment is also a common problem. The existence of these problems makes independent colleges have to make choices under limited resource conditions when training talents, which leads to a conflict of resource allocation. Independent colleges need to balance the relationship between education and industrial demand in the process of integration of industry and education [21]. The research shows that through effective school-enterprise cooperation, the teaching effect can be improved [22]. However, how to establish an effective school-enterprise cooperation mechanism in independent colleges is still an urgent problem to be solved [23]. Some studies suggest that these problems can be better solved by strengthening cooperation with enterprises and government support [24]. In addition, independent colleges also need to pay attention to the construction of teachers in the process of talent training [25], the stability of the teaching staff directly affects the quality of teaching. Therefore, independent colleges need to attract and retain excellent teachers through a variety of measures to improve the quality of teaching and students' learning experience. In terms of the innovation of talent training mode, independent colleges are also constantly exploring new methods. For example, some independent colleges improve students' professional ability and ability to solve complex problems by means of classified training, strengthening teacher construction, and establishing practice platform [26], these measures will help students find the ideal job in the fierce market competition, and realize the seamless connection between professional ability and job demand. In the process of talent training, independent colleges also need to pay attention to the individualized development of students. The research shows that through diversified training modes

and flexible teaching management mechanisms, students' comprehensive quality and innovation ability can be effectively improved [27]. Therefore, independent colleges need to pay attention to the individual needs of students in the process of talent training and provide more choices and development opportunities. Zhuang &Shi have cataloged existing research on educational cooperation between the integrated industrial and higher education sectors, filling the gaps in industry-education integration with respect to education [28].

The conflict of talent training resource allocation in independent colleges under the background of integration of industry and education is a complex problem, which needs to be considered and solved from many aspects. By strengthening the cooperation between schools and enterprises, optimizing the teaching staff, innovating the training mode of talents, and paying attention to the individualized development of students, we can effectively alleviate the conflict of resource allocation and improve the quality of personnel training in independent colleges. Future research can further explore the specific practice and experience of independent colleges in different regions and industry backgrounds, and provide more reference for the talent training of independent colleges.

2.4 Research Question

Based on the above considerations, this paper examines the following questions:

1) What are the decision-making preferences of the government, industry associations, enterprises, and independent colleges in the resource allocation of talent cultivation for industry-education integration?

2) What strategies will the government, industry associations, enterprises, and independent colleges adopt to make all parties more satisfied?

3. Method

3.1 Conflict Analysis Graph Model Theory

The graph model theory of conflict analysis (GMCR) is a decision analysis method for formal analysis of conflict behavior based on classical game theory and partial game theory [29]. Conflict analysis is mainly composed of three elements: the decision makers involved in the conflict, the strategies that each decision maker may adopt, and their preference information. Among them, the decision maker (DM) is at least two or more individuals or groups that can make independent decisions. In a conflict system with clear consent, there are clear and independent interest demands; the possible strategies, that is, the strategy options, are the behavior options that describe the decision-makers to take or give up in the conflict, forming a strategy set; preference is the strategy ranking of decision makers according to their own interest demands and expected goals. The conflict analysis graph model is represented by $V = \{N, S, P, G\}$, where N ($N \geq 2$) denotes a finite non-empty set containing all decision makers; s denotes a non-empty set of all feasible states ; p denotes the preference information of decision makers; g

represents the state transition diagram of the decision maker, and the specific process is shown in Figure 2. Conflict analysis graph model theory (GMCR) is a decision analysis method for formal analysis of conflict behavior. Its main analysis elements include decision-makers involved in conflict, possible strategies, and preference information of each participant [29].

3.2 The Conflict Model and Analysis of Talent Training Resources in the Integration of Industry and Education

3.2.1 Conflict Background Analysis

With reference to the triple helix organizational structure [30], this paper expands the interest decision-making subject of the integration of industry and education into a four-helix organizational structure, namely, government, enterprises, industry associations, and universities. The government provides policy and financial support or constraints for industry associations, enterprises, and universities, and supervises the decision-making subjects such as industry associations, enterprises and universities. Other decision-making subjects feedback the operation to the government, which is conducive to the government's timely optimization of relevant policies. Under the guidance of the government, the industry association carries out daily professional science popularization, organizes professional-related events, enhances the popularity of the school's integration of production and education, students ' theoretical and practical application ability, and expands the industry resources of enterprises; under the supervision of the government, enterprises put forward the demand for talents, integrate into the design of the integration of production and education in colleges and universities, obtain human resources, participate in the relevant activities of industry associations, and obtain supply chain resources; colleges and universities carry out the integration of industry and education and curriculum design, meet the talent needs of enterprises, and participate in professional competitions organized by industry associations. The relationship between the decision-making subjects is shown in Figure 1.
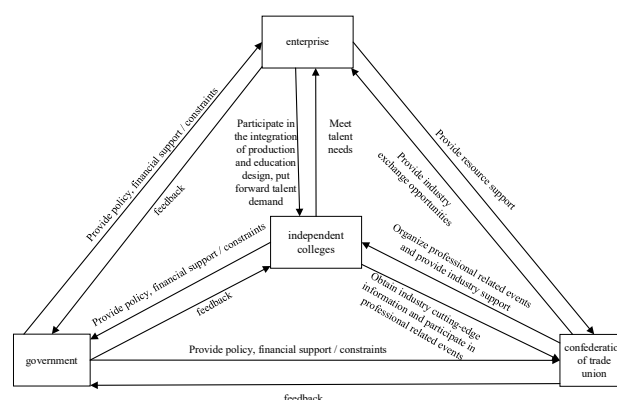
Figure 1: The relationship between the decision-making subjects of industry-education integration

3.2.2 Definition of decision makers and strategy analysis

This paper takes the government (DM1), industry association (DM2), enterprise (DM3), and independent colleges (DM4) as the core subjects of the conflict of resource allocation of talent cultivation in the integration of industry and education, that is,

the government (DM1), industry association (DM2), enterprise (DM3) and independent colleges (DM4) as the decision-makers. DM1-DM4 constitute a set N, and the strategy choices that each decision-maker can choose are as shown in Table 1:

Table 1: DM1-DM4 strategy set

Decision makers	Description	Strategy
DM1	Subjects enacting relevant policies	a. Promulgate inclusive support policies, provide financial subsidies, etc., to fully support the development of industry-education integration b. Support key institutions and majors, and promote the integration of industry and education.
DM2	The bridge and link between government and enterprise	c. Only complete the daily science d. Actively hold professional-related events, hold industry exchange meetings, convey industry frontier information, and promote the integration of industry and education.
DM3	Talent demand side	e. Actively invest in funds, provide experts and other resources, and deeply participate in the integration of industry and education. f. Passive participation in the integration of industry and education
DM4	Talent supply side	g. Actively embrace changes, fully participate in the integration of production and education, and enrich the professional and curriculum settings. h. Promoting the integration of industry and education in key majors i. Prudent participation

3.3 Analytical Hierarchy Process

The analytic hierarchy process is used to construct the hierarchical structure model of decision-making indicators [31], [32], and the experts are scored. The evaluation basis is shown in Table 2.

Table 2: Statty nine-level scaling method and its meaning

Scale	Implication
1	Equally important
3	The former is a little more important than the latter
5	The former is more important than the latter
7	The former is much more important than the latter
9	The former is extremely more important than the latter
2,4,6,8	The intermediate value of the above judgment
reciprocal	The latter corresponding to the above judgment value is more important than the former.

4. Result

4.1 Feasible State

Theoretically, there are $2^9 = 512$ states in the conflict model, but in reality, each decision-maker can only choose one of the strategies according to the implementation of the integration of production and education. Therefore, after eliminating the impossible state, only 24 feasible states are left, as shown in Table 3. Among them, 'Y' indicates that the decision-maker adopts the strategy, and 'N' indicates that the decision-maker does not adopt the strategy.

Table 3: The feasible state of each decision maker

DM	DM1		DM2		DM3		DM4		
Strategy / Feasible state	a	b	c	d	e	f	g	h	i
S_1	Y	N	Y	N	Y	N	Y	N	N
S_2	N	Y	Y	N	Y	N	Y	N	N
S_3	Y	N	N	Y	Y	N	Y	N	N
S_4	N	Y	N	Y	Y	N	Y	N	N
S_5	Y	N	Y	N	N	Y	Y	N	N
S_6	N	Y	Y	N	N	Y	Y	N	N
S_7	Y	N	N	Y	N	Y	Y	N	N
S_8	N	Y	N	Y	N	Y	Y	N	N
S_9	Y	N	Y	N	Y	N	N	Y	N
S_{10}	N	Y	Y	N	Y	N	N	Y	N
S_{11}	Y	N	N	Y	Y	N	N	Y	N
S_{12}	N	Y	N	Y	Y	N	N	Y	N
S_{13}	Y	N	Y	N	N	Y	N	Y	N
S_{14}	N	Y	Y	N	N	Y	N	Y	N
S_{15}	Y	N	N	Y	N	Y	N	Y	N
S_{16}	N	Y	N	Y	N	Y	N	Y	N
S_{17}	Y	N	Y	N	Y	N	N	N	Y
S_{18}	N	Y	Y	N	Y	N	N	N	Y
S_{19}	Y	N	N	Y	Y	N	N	N	Y
S_{20}	N	Y	N	Y	Y	N	N	N	Y
S_{21}	Y	N	Y	N	N	Y	N	N	Y
S_{22}	N	Y	Y	N	N	Y	N	N	Y
S_{23}	Y	N	N	Y	N	Y	N	N	Y
S_{24}	N	Y	N	Y	N	Y	N	N	Y

4.2 State Transition Diagram

With the help of the conflict analysis decision support system, the state transition between DM1 and DM4 can be obtained. Based on this, the strategy state transition diagram of each decision maker is drawn in Figure 2(a)-Figure 2(d). The arrow direction indicates that the initial state is transferred to the reachable state, and the double arrow indicates that the state is reversible.
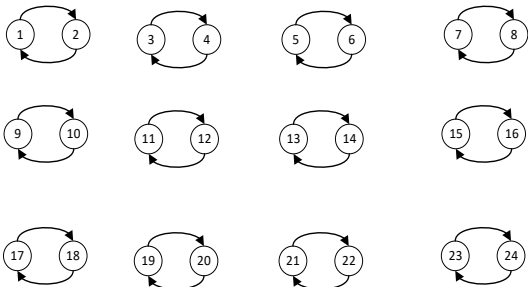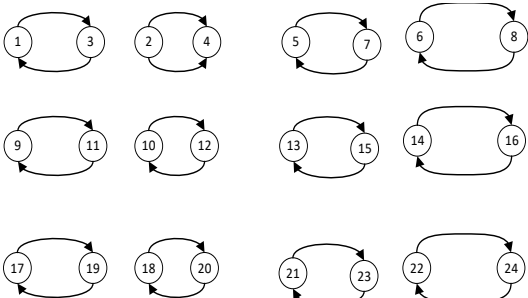

Figure 2(a): Government state transition diagram

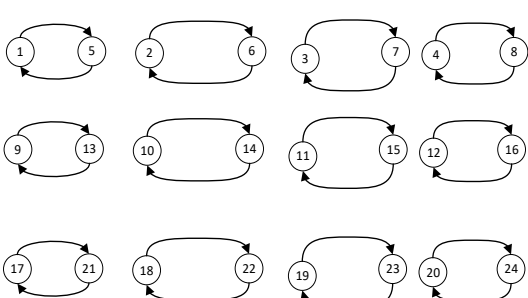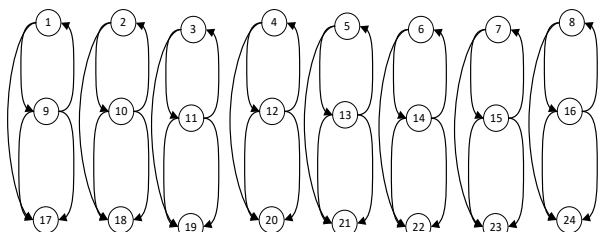**Figure 2(b):** State transition diagram of industry association

Figure 2(c): Enterprise state transition diagram

Figure 2(d): State transition diagram of independent colleges
Figure 2: State transition diagram of each decision-maker

4.3 Preference Information of Decision-makers

The geometric average method is used to score the experts [30], [31], and the final score is obtained. The YAAHP software is used to obtain the strategy weight ranking of each decision-maker, as shown in Table 4, and the preferences of decision-makers are shown in Table 5.

Table 4: Strategy weight ranking of each decision maker

strategy / Decision Maker		DM1	DM2	DM3	DM4
a	weight	0.2325	0.0761	0.0209	0.0983
	sort	2	4	8	3
b	weight	0.0258	0.4568	0.1046	0.4914
	sort	7	1	4	1
c	weight	0.0106	0.0133	0.0428	0.0131
	sort	9	8	7	8
d	weight	0.0424	0.0533	0.1713	0.0522
	sort	6	5	2	5
e	weight	0.4433	0.2388	0.0826	0.1987
	sort	1	2	5	2
f	weight	0.0887	0.0341	0.0165	0.0397
	sort	4	6	9	6
g	weight	0.0458	0.0257	0.3476	0.0098
	sort	5	7	1	9
h	weight	0.0982	0.0902	0.1595	0.0215
	sort	3	3	3	7
i	weight	0.0126	0.0117	0.0541	0.0754
	sort	8	9	6	4

Table 5: Decision preference ranking of each decision maker

Decision maker	Preference ranking
DM1	$S_{11} \succ S_9 \succ S_3 \succ S_1 \succ S_{19} \succ S_{17} \succ S_{12} \succ S_{10} \succ S_4 \succ S_2 \succ S_{20} \succ S_{18} \succ S_{15} \succ S_{13} \succ S_7 \succ S_5 \succ S_{23} \succ S_{21} \succ S_{16} \succ S_{14} \succ S_8 \succ S_6 \succ S_{24} \succ S_{22}$
DM2	$S_{12} \succ S_{10} \succ S_4 \succ S_{20} \succ S_2 \succ S_{18} \succ S_{16} \succ S_{14} \succ S_8 \succ S_{24} \succ S_6 \succ S_{22} \succ S_{11} \succ S_9 \succ S_3 \succ S_{19} \succ S_1 \succ S_{17} \succ S_{15} \succ S_{13} \succ S_7 \succ S_{23} \succ S_5 \succ S_{21}$
DM3	$S_4 \succ S_8 \succ S_3 \succ S_7 \succ S_2 \succ S_6 \succ S_1 \succ S_5 \succ S_{12} \succ S_{16} \succ S_{11} \succ S_{15} \succ S_{20} \succ S_{24} \succ S_{19} \succ S_{23} \succ S_{10} \succ S_{14} \succ S_9 \succ S_{13} \succ S_{18} \succ S_{22} \succ S_{17} \succ S_{21}$
DM4	$S_{20} \succ S_{18} \succ S_{12} \succ S_4 \succ S_{10} \succ S_2 \succ S_{24} \succ S_{22} \succ S_{16} \succ S_8 \succ S_{14} \succ S_6 \succ S_{19} \succ S_{17} \succ S_{11} \succ S_3 \succ S_9 \succ S_1 \succ S_{23} \succ S_{21} \succ S_{15} \succ S_7 \succ S_{13} \succ S_5$

5. Discussion

GMCR has four basic stability [29]: NASH Nash stability, GMR general hyperrational stability, SMR symmetric hyperrational stability, and SEQ sequence stability. Under the stability of NASH, each decision-maker does not consider the counterattack situation of the opponent, and once the decision is made, it is the final state; under the stability of GMR, the decision of each decision-maker will cause the counterattack of other decision-makers, and all opponents are irrational in counterattack; the stability of the SMR is similar to that of the GMR, but it has an additional process for the decision maker to respond to the counterattack of the opponent than the GMR. Under the stability of SEQ, all opponents are rational in

counterattacking, and they will consider their own interests when counterattacking other decision-makers. The relationship diagram of the four stable states is shown in Figure 3.
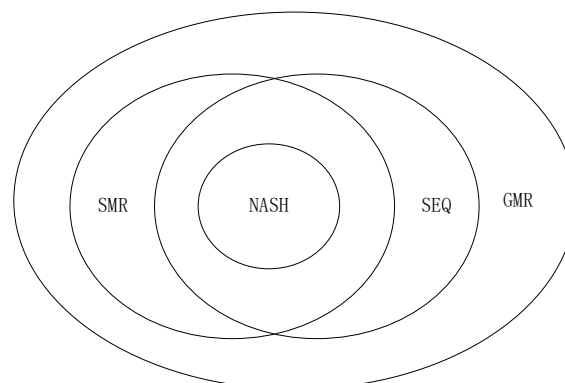
Figure 3: Relationship diagram of four stable states

In this paper, through the conflict analysis decision support system, the equilibrium solution of the resource allocation conflict of the main body of the integration of production and education personnel training is obtained, as shown in Table 6.

Table 6: Equilibrium solution

Stable States	NASH	GMR	SMR	SEQ
S_1		√	√	
S_2		√	√	
S_3		√	√	
S_4		√	√	
S_9		√	√	
S_{10}		√	√	
S_{11}		√	√	
S_{12}		√	√	
S_{17}		√	√	
S_{18}		√	√	
S_{19}	√	√	√	√
S_{20}		√	√	
S_{23}		√	√	

Under the 13 equilibrium states, enterprises generally tend to actively participate in the integration of production and education. When the government begins to generally promote the integration of industry and education, due to limited resources, industry associations can choose to not only carry out daily science popularization but also actively promote it. At this time, most enterprises will actively respond to the government's call to promote the integration of industry and education, and independent colleges will also actively respond. However, some independent colleges have limited resources and can only choose to focus on promotion. Some independent colleges may choose to participate cautiously for special reasons. When the government chooses to focus on promoting the integration of industry and education, the policy resources obtained by the association are less than the resources generally promoted by the government. Therefore, it only chooses to carry out daily science popularization. The relevant industries that the government focuses on promoting will respond positively. Enterprises will actively invest according to their own needs to obtain more matching talents. Independent colleges will respond to the call of the government to focus on promoting and choose to promote all in the case of spare capacity. However, taking into account special factors such as relocation, transfer, and other circumstances, they will choose to promote cautiously.

6. Conclusion and Limitations

1) In a complex integrated system, the final decision of each decision-maker is the process of interactive game decisions of all stakeholders. Based on the theory of conflict analysis graph model, this paper constructs a four-level decision-making game model for the government, industry associations, enterprises, and universities participating in the talent training system of industry-education integration. The model pays as much attention as possible to the decision-making stakeholders of the operation of the talent training system of the integration of production and education in independent colleges and truly reflects the decision-making status of each decision-making subject.

2) With the help of conflict analysis decision support system, it is found that $S_1, S_2, S_3, , S_4, S_9, S_{10}, S_{11}, S_{12}, S_{17}, S_{18}, S_{19}, S_{20}, S_{23}$ are equilibrium solutions under GMR and SMR stability, but there is only one equilibrium solution under Nash and SEQ stability. Through analysis, it is found that it has the advantages of other equilibrium solutions and can make up for the shortcomings of other equilibrium solutions. It is the most satisfactory solution in the operation conflict of the talent training system of industry-education integration in independent colleges.

3) The state shows that in the current active market economy, promoting the integration of industry and education is the only way for social development. As the most important subject in the operation of the talent training system, colleges and universities hold a cautious attitude in the promotion of the integration of industry and education due to the characteristics that their curriculum and training programs cannot be easily changed. The government, associations, and enterprises all let go and actively participate in it. At this time, the whole society forms an atmosphere of integration of industry and education. Industry associations can obtain relatively average resources, carry out professional work, and continuously expand the development of industry associations. Enterprises release a positive signal of employment demand, put the employment demand ahead, form in-depth cooperation when colleges and universities carry out the integration of industry and education, and stabilize the supply of talent. In order to promote the healthy operation of the independent college talent training system.

4) As a complex social system, the allocation of resources for the integration of industry and education involves all aspects. It cannot work well by relying on the efforts of one party alone. As a government, it gives space for the free development of society. As an industry association, it actively plays the professionalism of the association. Enterprises follow their own laws of economic development. Independent colleges should consider the only way for their own development while complying with social development, so as to improve the allocation of resources for the integration of industry and education, give full play to the role of personnel training, and realize the development of social modernization.

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