A Study to Identify Factors of Relational Risk in the Industry-University Research Innovation Alliance based on Improved DEMATEL

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***Abstract* — As a new alliance model, the industry-university research alliances have some characteristics such as complicated and nonlinear relationships because there are many parties in this alliance. And there are very complicated risk problems, especially for relational risk problems. How to identify the factors of the relational risk in the industry-university research alliances effectively and use these outcomes to do risk management are very significant for the relational risk management in these alliances. In this paper we use interval numbers to describe the level of effect among the factors of the relationship in these alliances because it is hard to describe the level of effects only using the concrete numbers where experts know the benefits and pitfalls according to their experience and practices. So we can use interval number Decision Making Trial and Evaluation Laboratory (DeMaTEL) to identify the important influential factors of the relational risk in these alliances. Also identify the reason influential factors and the result influential ones. The conclusions should benefit risk management studies in the future.**

Keywords - relational risk; industry-university research alliance; interval number; decision making trial and evaluation laboratory (DEMATEL)

I. INTRODUCTION

When we research the factors of innovation risk, we must identify the key factors according to the logic of risk management. At present, there are some methods used to identify risk factors, such as Experts Investigation, Factors Analysis, Structure Equation Model (SEM), Gray-correlation Analysis, Decision making trial and evaluation laboratory (DEMATEL). Experts Investigation was used to identify risk factors of enterprise dynamics alliances [1]; Experts Investigation together with Factors Analyses was used to identify the key factors in enterprise cooperation innovation [2].As a kind of qualitative analysis method, Experts Investigation can be used to preliminarily identify risks. But we need more scientific methods to identify factors of risks based on quantitative analysis methods. Other experts used Factor Analysis and found out the six key knowledge transfer risks factors among supply chain members [3]. Gray Systems Theory also was used to identify enterprise merge risk factors[4].When we use Factor Analysis and Gray Correlation Analysis, we need concrete numbers to describe the relationships in complicated systems beforehand. So Factor Analysis and Gray Correlation Analysis usually are limited when analyzing those complicated systems. Some experts applied the rough set theory to identify the risk factors in enterprise synergy knowledge innovation, and eliminated redundant risk factors, then attained the core factors. But he couldn't rank the core risk factors further [5]. Other experts applied SEM to identify the key risk factors in enterprise organization innovation [6]. In SEM, the hypothesis model and the actual data must be accordant, if not, researchers can't make conclusions; Combine the traditional DEMATEL and 2-tuple linguistic as a new try, the proposed approach is to integrate the linguistic assessment information about the association between risk factors given by experts, and further rank and classify the collaborative relational risk factors[7]. But the influence between each other in complicated systems usually is fuzzy， language information cannot be expressed properly, so experts extend DEMATEL on fuzzy triangular numbers, use it as a try to identify risks [8]. Although using fuzzy numbers to evaluate comparatively scientific, but the threshold of fuzzy numbers is very hard to figure out, and it is also hard to operate fuzzy numbers. So some experts choose interval numbers in DEMATEL to identify influential factors of risks. We can't use concrete numbers to describe complicated relationships among complicated systems, but we can give the up level and the down level and transfer into interval numbers to handle. Some experts used interval extended DEMATEL to identify IT outsourcing influential factors during knowledge transfer [9].

The Industry-University-Research Alliance, as a new alliance model, has many diversity members and connected with many facets, the relationship among members is very complicated and nonlinear. During the cooperation process, the risk problem is outstanding, especially for relational risk. Relational risks are effected by many factors and overlap each other. It is very hard to use a concrete number to describe the relationships among those factors. Meanwhile, we need deeply explore the relationship among factors of relational risk in order to research on Industry-University-Research Alliance's risk management systematically, only do some preliminary identifications or find out the core factors is not enough for the future research. So we use interval numbers to improve DEMATEL as so to identify the key factors, the reason influential factors and result influential factors.

II. CONSTRUCTION OF THE INTERVAL DEMATEL MODEL

A possibility degree formula was presented for the comparison between two interval numbers and ranking interval numbers[10].Then an extend DEMATEL method was put forward based on interval numbers.[9] On these above research, here we try to identify risk factors in the industry-university-research innovation alliance.

Step1: Construct the interval-number direct influential matrix of risk factors between each other in Industry-University-Research innovation Alliance, where the relationship among influential factors is interval numbers. The interval direct influential matrix is noted A, A is：

$$A=\begin{pmatrix} [0,0] & [a_{12}^-, a_{12}^+] & \cdots & [a_{1n}^-, a_{1n}^+] \\ [a_{21}^-, a_{21}^+] & [0.0] & \vdots & [a_{2n}^-, a_{2n}^+] \\ \vdots & \cdots & [0,0] & \vdots \\ [a_{n1}^-, a_{n1}^+] & [a_{n2}^-, a_{n2}^+] & \cdots & [0,0] \end{pmatrix}$$

Step2: Calculate synthetic direct influential matrix according to the above interval-number direct influential matrix. The synthetic direct influential matrix is noted T, By the following formulas [9],we can get T.

$$X=\lambda A \tag{1}$$

$$\lambda=1/\max_{1\le i\le n}(\sum_{j=1}^{n} a_{ij}^+) \tag{2}$$

$$T=\left(X^-(I-X^-)^{-1}, X^+(I-X^+)^{-1}\right) \tag{3}$$

where $X^- = \left(x_{ij}^-\right)_{n\times n}$ $X^+ = \left(x_{ij}^+\right)_{n\times n}$.

Step3: Calculate the central degree and the reason degree

The sum of every row in the interval-number synthetic direct influential matrix T is

$$R_j = \sum_{i=1}^{n} t_{ij} = \sum_{i=1}^{n} [t_{ij}^-, t_{ij}^+] = [\sum_{i=1}^{n} t_{ij}^-, \sum_{i=1}^{n} t_{ij}^+] (j = 1,2,\cdots,n)$$

The sum of every rank in the interval-number synthetic direct influential matrix T is

$$D_i = \sum_{j=1}^{n} t_{ij} = \sum_{j=1}^{n} [t_{ij}^-, t_{ij}^+] = [\sum_{j=1}^{n} t_{ij}^-, t_{ij}^+] (i = 1,2,\cdots,n)$$

The central degree

$$G_i = R_i + D_i = [R_i^- + D_i^+, R_i^- + D_i^+] \tag{4}$$

The reason degree

$$H_i = R_i - D_i = [R_i^- - D_i^+, R_i^- - D_i^+] \tag{5}$$

Step4：compare and rank the central degree and the reason degree

Using the following a possibility degree formula to compare, we can get the important degree in the complicated system.

$$P(a \ge b) = \frac{\min\{L(a)+L(b), \max(a^+ - b^-, 0)\}}{L(a)+L(b)} \tag{6}$$

where $a = [a^-, a^+], b = [b^-, b^+]$ are interval numbers，

$L(a) = a^+ - a^-, L(b) = b^+ - b^-$ ； $p(a \ge b)$ is a possibility degree of a≥b.

$$\omega_i = \frac{\sum_{j=1}^{n} p_{ij} + \frac{n}{2} - 1}{n(n-1)}, i = 1,2,\cdots n \tag{7}$$

$\omega = (\omega_1, \omega_2, \cdots \omega_n)$ is a ranking vector of the possibility degree matrix $P = (p_{ij})_{n\times n}$,we can rank the interval number according to the ranking vector's partial ones. Then we can rank the factors of relational risk in Industry-University-Research innovation Alliance.

III. IDENTIFYING THE FACTORS OF RELATIONAL RISK

A. Choose the Factors of Relational Risk in Industry-University-Research Innovation Alliance

Williamson (1975) considered that relational risk came from potential speculating actions among members, they used devious means to attain great benefits, and opportunism actions are the main reason for relational risk[11]. Parkhe (1993) pointed out relational risks usually came from concealing information painstakingly or distorting information, side-step the responsibility or not to undertake as they promised, occupying other members' core technology and main personnel[12]. Delerue (2004) thought that relational risk came from eight faces: the flexibility of perception, right, dependence on each other, the probable cheating among alliances, conflicts with each other, non-learning, loss of core ability and encroaching others[13].Both Das[14] and Williamson [11]thought configuring stock right in alliances, putting into proprietary resource, the level of

fairness and common benefits are the key factors which effect the risk of alliances. Ring and Van de Ven (1992) pointed out that members in strategy alliances probably depended on fairness more than efficiency when evaluating the relationships [15].Relational risk in alliances mainly came from three points: potential opportunism actions, differences of targets and conflicts on benefits among alliances, proprietary of assets[16].Based on the research of Das and Teng, Helenedelerue (2004) put forward that members could target relational risk because of non-symmetry [17] .

Relational risk came from alliances, usually it was arisen by potential opportunism actions and unreasonable benefits allocation among members in alliances[18].The collaboration risk among supply chain enterprises came from: trust among members, opportunism actions and asymmetrical information among members[4].In shared distribution alliances the collaboration risk came from opportunism actions, different targets and conflicts on benefit among members, sharing knowledge and losing it[19].In international alliances, differential culture among members also is a kind of opportunism actions. And potential opportunism actions are the key factor which will arise relational risk in strategy alliances[18].According to the research on 205 enterprise alliances , it is found that there is not the interval-u shaped relationship between environmental uncertainty and relational risk; and a positive effect between cultural distance and relational risk and there is a negative relationship between shared vision and relational risk[20].Relational risk in cooperation R&D came from two faces: lose risk and invest risk[21-22].Because of the heterogeneity of resources and the differential functions in differential alliances, The more the differences of proprietary resources among members, the more cooperation is than competition does, and the level of relational risk is low[23]. During R&D, if the member has a stronger taking-in ability, it has great probability to attain more potential knowledge and technology. As a result, the other members have great being invaded risk. Meanwhile, if the member has a stronger taking-in ability, it has great ability to protect its own heterogeneous resources in order to avoid being stealing away[24].

We can comprehend the sources of relational risk from two fields: the transaction cost theory and the resource reliance theory[25].In the transaction cost theory, members evaluate their transaction cost and own benefits from alliances, if the benefits from alliances are smaller than the transaction cost, betrayed actions will be targeted and relational risks arise in alliances[26].In the resource reliance theory, the special reliance among members is depended on the characteristics of resources which gives members a kind of unfairness. If one member attains what he want, he will not make effort as before, even separate himself from the alliance, that will target relational risk[27].One alliance is constructed based on reliance with each other and complement of resources. If the balance is destroyed, there will be asymmetrical power and arise relational risk [28].

Combing those above literature，the factors that effect innovation relational risk in alliances are asymmetrical power or asymmetrical scale, configuring stock right, investing proprietary assets, the level of fairness in alliances, invading others' resources, shared benefits, differential culture among members, shared knowledge and losing, asymmetrical information, conflicting of target among members, the ability of absorbing and learning, opportunism actions, the contract risks, the quality of relationship, the ways of control, the scope of alliances, consciousness of competitiveness and cooperation. Relational risk is embodied on opportunism actions and normal risks. So we eliminate opportunism actions and invading others' resources from influential factors. Because investing proprietary assets will cause the change of relationship, power and scales in alliances, we embrace asymmetrical power or asymmetrical scale and configuring stock right into the item of "investing proprietary assets". In addition, the Industry-University-Research Alliance is different from enterprise strategy alliances, there is more cooperation than competitiveness in the Industry-University-Research alliance. It is a kind of non-competitive alliance. In a non-competitive alliance, members mainly aim at each others' resources, not at learning and absorbing others' resources or core knowledge. So we eliminate "consciousness of competitiveness and cooperation" and "shared knowledge and losing". Considering the characteristics of Industry-University-Research Alliance,

and through the above embracing and eliminating, we can get the risk factors in Industry-University-Research Alliance as follows: investing proprietary assets(S1), the differences among members(S2), the level of fairness in alliances(S3), shared benefits(S4), the asymmetry of information(S5), the ability of absorbing and learning(S6), the contract risks(S7), the quality of relationship(S8), the ways of control(S9), the scope of alliances(S10).

B. The Process of Identifying Relational Risk Factors

According to Delphi Method, we invite experts to give the influential degree of those above influential factors with each other, experts must use interval numbers to describe the influential degree, and the degree value is between[0,0]and[1,1],the more closer to [0,0]shows that the more weaker relationship between each other, and the degree value is closer to [1,1]shows that stronger relationship between each other. Though grating, feedback, adjusting, then we get the interval-number direct influential matrix of risk factors between each other in Industry-University-Research innovation Alliance, as following Table I shows.

TABLE I. INTERVAL-NUMBER DIRECT INFLUENTIAL MATRIX

	s1	s2	s3	s4	s5	s6	s7	s8	s9	s10
s1	[0,0]	[0.4,0.6]	[0.4,0.7]	[0.2,0.4]	[0.2.0.6]	[0.3,0.5]	[0.2,0.4]	[0.2,0.4]	[0.4,0.7]	[0.2,0.5]
s2	[0.1,0.3]	[0,0]	[0.3,0.5]	[0.6,1]	[0.3,0.7]	[0.1,0.2]	[0.3,0.8]	[0.2,0.4]	[0.3,0.6]	[0.2,0.4]
s3	[0,3,0.6]	[0,0.2]	[0,0]	[0.2,0.4]	[0.2,0.5]	[0.1,0.2]	[0.3,0.5]	[0.4,0.8]	[0.3,0.6]	[0.1,0.3]
s4	[0.4,0.6]	[0.3,0.7]	[0.4,0.6]	[0,0]	[0.3,0.6]	[0.1,0.3]	[0.4,0.8]	[0.3.0.7]	[0.3,0.7]	[0.1,0.2]
s5	[0.4,0.8]	[0,0.2]	[0.3,0.5]	[0.4,0.5]	[0,0]	[0.1,0.3]	[0.5,1]	[0.4,0.8]	[0.4,0.8]	[0.3,0.5]
s6	[0.3,0.6]	[0.1,0.3]	[0.1,0.2]	[0.1,0.3]	[0.3,0.5]	[0,0]	[0.1,0.3]	[0.2,0.3]	[0.2,0.4]	[0.2,0.4]
s7	[0.3,0.5]	[0.1,0.2]	[0.4,0.8]	[0.3,0.7]	[0,4,0.6]	[0.1,0.2]	[0,0]	[0.2,0.4]	[0.4,0.7]	[0.3,0.7]
s8	[0.4,0.8]	[0.1,0.3]	[0.3,0.5]	[0.1,0.4]	[0.2,0.4]	[0.2,0.6]	[0.2,0.4]	[0,0]	[0.3,0.6]	[0.3,0.6]
s9	[0.4,0.8]	[0.1,0.2]	[0.2,0.4]	[0.2,0.5]	[0.3,0.6]	[0.2,0.4]	[0.4,0.8]	[0.3,0.6]	[0,0]	[0.4,0.6]
s10	[0.3,0.6]	[0.2,0.4]	[0.3,0.4]	[0.1,0.3]	[0.3,0.6]	[0.2,0.3]	[0.3,0.5]	[0.2,0.4]	[0.3,0.8]	[0,0]

According to formula(1),(2)and(3),calculate the interval-number synthetic direct influential matrix T，as Table II shows.

TABLE II. INTERVAL-NUMBER SYNTHETIC DIRECT INFLUENTIAL MATRIX

	s1	s2	s3	s4	s5	s6	s7	s8	s9	s10
s1	[0.0459,	[0.0904,	[0.1213,	[0.0716,	[0.0754,	[0.0758,	[0.0794,	[0.0754,	[0.1155,	[0.0698,
	0.6986]	0.4915]	0.7019]	0.6224]	0.7268]	0.4763]	0.7494]	0.6762]	0.8411]	0.6240]
s2	[0.0661,	[0.0209,	[0.1034,	[0.1390,	[0.0922,	[0.0395,	[0.0984,	[0.0756,	[0.0986,	[0.0683,
	0.7880]	0.4145]	0.7079]	0.7480]	0.7752]	0.4462]	0.8525]	0.7111]	0.8665]	0.6354]
s3	[0.0915,	[0.0177,	[0.0457,	[0.0606,	[0.0663,	[0.0375,	[0.0868,	[0.1011,	[0.0901,	[0.0467,
	0.7163]	0.3804]	0.5175]	0.5503]	0.6313]	0.3851]	0.6771]	0.6636]	0.7371]	0.5296]
s4	[0.1187,	[0.0075,	[0.1256,	[0.0382,	[0.0941,	[0.0428,	[0.1161,	[0.0948,	[0.1031,	[0.0549,
	0.8643]	0.5448]	0.7484]	0.6107]	0.7861]	0.4827]	0.8762]	0.7802]	0.9106]	0.6316]
s5	[0.1218,	[0.0257,	[0.0782,	[0.1039,	[0.0428,	[0.0443,	[0.1334,	[0.1109,	[0.1205,	[0.0909,
	0.9199]	0.4782]	0.7517]	0.7041]	0.7037]	0.4979]	0.9215]	0.8117]	0.9495]	0.6982]
s6	[0.0892,	[0.0337,	[0.1101,	[0.0440,	[0.0820,	[0.0183,	[0.0522,	[0.0671,	[0.0718,	[0.0616,

	0.5984]	0.3340]	0.4559]	0.4452]	0.5312]	0.2811]	0.5363]	0.4828]	0.5871]	0.4544]
s7	[0.1001,	[0.0390,	[0.1021,	[0.0859,	[0.1082,	[0.0414,	[0.0449,	[0.0754,	[0.1160,	[0.0870,
	0.7942]	0.4346]	0.7275]	0.6706]	0.7332]	0.4333]	0.6882]	0.6872]	0.8528]	0.6609]
s8	[0.1211,	[0.0391,	[0.2281,	[0.0535,	[0.0770,	[0.0614,	[0.0829,	[0.0459,	[0.1039,	[0.0881,
	0.7960]	0.4281]	0.6422]	0.5895]	0.6643]	0.4766]	0.7091]	0.5729]	0.7899]	0.6142]
s9	[0.1177,	[0.0407,	[0.0902,	[0.0690,	[0.0930,	[0.0601,	[0.1133,	[0.0918,	[0.0483,	[0.1052,
	0.8490]	0.4410]	0.6759]	0.6480]	0.7420]	0.4736]	0.8236]	0.7198]	0.7473]	0.6575]
s10	[0.0945,	[0.0537,	[0.0985,	[0.0497,	[0.0880,	[0.0577,	[0.0918,	[0.0710,	[0.0948,	[0.0313,
	0.7419]	0.4268]	0.6083]	0.5595]	0.6744]	0.4134]	0.7083]	0.6241]	0.7973]	0.4976]

Then according to formula (4) and(5),we can get the central degree and the reason degree. As table III shows.

TABLE III. THE CENTRAL DEGREE AND THE REASON DEGREE

Influential factors	s1	s2	s3	s4	s5	s6	s7	s8	s9	s10
The central degree	[1.7881,	[1.2391,	[1.7481,	[1.5796,	[1.6923,	[1.3511,	[1.5301,	[1.7101,	[1.7929,	[1.4344,
	14.3754]	11.3200]	12.3264]	13.3847]	14.4055]	9.0737]	14.2255]	13.0133]	14.8579]	12.0559]
The reason degree	[-0.1460,	[0.3660,	[-0.4594,	[0.1479,	[0.0533,	[0.1522,	[-0.0991,	[0.0922,	[-0.1333,	[0.0262,
	-1.1581]	2.5716]	-0.7489]	1.0872]	0.4680]	0.3402]	0.8597]	-0.4467]	-1.3016]	0.0481]

According to the formula (5), calculate the possibility degree matrix, as Table IV shows.

TABLE IV. THE POSSIBILITY DEGREE MATRIX

	s1	s2	s3	s4	s5	s6	s7	s8	s9	s10
s1	0.5	0.5795	0.545	0.5245	0.5012	0.6412	0.508	0.5301	0.4904	0.5575
s2	0.4305	0.5	0.4633	0.445	0.4223	0.5599	0.4298	0.4493	0.4116	0.4775
s3	0.455	0.5367	0.5	0.4801	0.4565	0.5997	0.4638	0.4851	0.4455	0.5137
s4	0.4755	0.555	0.5199	0.5	0.4768	0.6162	0.4838	0.5051	0.466	0.5328
s5	0.4988	0.5777	0.5435	0.5232	0.5	0.6388	0.5067	0.5286	0.4892	0.5558
s6	0.3588	0.4401	0.4003	0.3838	0.3612	0.5	0.3694	0.387	0.3502	0.4164
s7	0.492	0.5702	0.5149	0.5162	0.4933	0.6306	0.5	0.5214	0.4826	0.5485
s8	0.4699	0.5507	0.5149	0.4949	0.4714	0.613	0.4786	0.5	0.4604	0.5281
s9	0.5096	0.5884	0.5545	0.534	0.5108	0.6498	0.5174	0.5396	0.5	0.5667
s10	0.4425	0.5225	0.4963	0.4672	0.4442	0.5836	0.4515	0.4719	0.4333	0.5

According to the formula(6),calculate the ranking vector $\omega = (\omega_1, \omega_2, \cdots \omega_n)$ = （ 0.1153,0.1065 ，0.1104,0.1125,0.1151,0.0996,0.1141,0.1120,0.1163,0.1090）

So we can get the ranking for the central degree：

$$[1.7929,14.8579] \underset{0.1163}{\succ} [1.7881,14.3754] \underset{0.1153}{\succ} [1.6923,14.4055] \underset{0.1151}{\succ} [1.5301,14.2255] \underset{0.1141}{\succ} [1.5796,13.3847] \underset{0.1125}{\succ}$$
$$[1.7101,13.0133] \underset{0.1120}{\succ} [1.7481,12.3264] \underset{0.1104}{\succ} [1.4344,12.0559] \underset{0.1090}{\succ} [1.2391,11.3200] \underset{0.1065}{\succ} [1.3511,9.0737]$$

that is: $S_9>S_1>S_5>S_7>S_4>S_8>S_3>S_{10}>S_2>S_6$.

At the same time, by formula (5) and (6), we can calculate the reason degree ranking matrix and the reason degree ranking vector as Table V shows.

TABLE V. THE REASON DEGREE RANKING MATRIX

	s1	s2	s3	s4	s5	s6	s7	s8	s9	s10
s1	0.5	0	0	0	0	0	0	0	0	0
s2	1	0.5	1	0.7706	0.9612	1	0.9003	0.9034	0.8017	1
s3	1	0	0.5	0	0	0	0	0	0	0
s4	1	0.2294	1	0.5	0.7638	0.8294	0.6978	0.6731	0.579	1
s5	1	0.0388	1	0.2362	0.5	0.5243	0.4826	0.3942	0.38	1
s6	1	0	1	0.1706	0.4857	0.5	0.4631	0.3411	0.3491	1
s7	1	0.0997	1	0.3022	0.5174	0.5369	0.5	1	1	1
s8	1	0.0966	1	0.3269	0.6058	0.6589	0	0.5	1	1
s9	1	0.1983	1	0.421	0.62	0.6509	0	0	0.5	1
s10	1	0	1	0	0	0	0	0	0	0.5

So we can get the ranking reason degree：

$$[0.3660,2.5716] \underset{0.1426}{\succ} [0.1479,1.0872] \underset{0.1252}{\succ} [0.0922,-0.4467] \underset{0.1132}{\succ} [0.0533,0.4680] \underset{0.1061}{\succ} [0.0262,0.0481] \succ 0$$
$$\succ [-0.0922,-0.8597] \underset{0.1217}{\succ} [-0.1333,-1.3016] \underset{0.1043}{\succ} [-0.4594,-0.7489] \underset{0.05}{\succ} [-0.1460,-1.1581]$$

That is: $S_2>S_4>S_8>S_5>S_6>S_{10}>0>S_7>S_9>S_3>S_1$.

C. Analysis

From the reason degree ranking, the relational risk influential factors in the industry-university-research alliances as follows: the ways of control(S_9), investing proprietary assets(S_1), the asymmetry of information(S_5), the contract risk(S_7), shared benefits among alliances(S_4), the quality of relationship(S_8), the level of fairness in alliances(S_3), the scope of alliances(S_{10}), the differences among alliances(S_2) and the ability of absorbing and learning(S_6). Among those factors, the most important influential ones are: the ways of control (S_9), investing proprietary assets (S_1), the asymmetry of information (S_5), the contract risk(S_7), shared benefits (S_4). The ways of control (S_9) is the first important factors of relational risk in the industry-university research alliances that is similar to before researches.

Usually the ways of control include formal control and informal control. Alliances can use formal controls to establish perfect procedures and policies so as to normalize the actions of members and reduce relational risk. While informal control mainly is based on constructing the organizational normalization, value and culture, common targets in order to normalize the actions of members and reduce relational risk.[18] Investing proprietary assets(S_1) is a comprehensive factors. It can affect relational risks from many points such as: scales, power and stocks right. So it ranks the second. The asymmetry of information (S_5)is the key problem to the industry-university-research alliances although members have common benefits as a tie and they emphasize trusts among members. It is not possible for members fully to know others' technology, culture and knowledge and so on. It is hard to evaluate how hard members work and how much they contribute to alliances. If the evaluation is not appropriate, members are easy to feel unfair, and target relational risk. Because of the asymmetry of information and uncertainty of marketing and technology, contracts must have dilemma parts, and there are contract risks. In order to avoid contract risks, alliances try to use careful and strict contracts.

But this kind of careful and strict contracts will weaken trusts among members. Shared benefits among alliances (S4) can efficiently reduce the negative mediation of the impacts of differences of aims and cultures among alliances on relational risks. The scope of alliances (S10), differences among members (S2) and the ability of absorbing and learning (S6) are ranked the last three. A few research refers to the scope of alliances when do research on influential factors of relational risk. Meanwhile, the ability of absorbing and learning is not so important because that there are more non-competitive characteristics than competitive ones in the industry-university-research alliances. But why differences among members ranks so behind? It betrays the present conclusions. Jay & Mark(1994)thought the relational risk in enterprise alliances came from three points as follows: potential opportunism actions, potential opportunism actions, deference targets and conflicts on benefits among alliances, proprietary of assets[16]. And

other experts also pointed out differences of targets and culture would affect relational risk. At this point, we regard that it is true that the differences of targets and culture will affect relational risk, but its degree of influence is weaker than others so that it is ranked behind.

What's more, the difference among members is constricted by the ways of control and shared benefits when it affects relational risks. So we can conclude that the differences among members is a kind of influential factors for relational risk, but it could be a kind of indirect influential relationship and the influential degree is weaker in the direct influence.

Considering of the reason degree ranking, the reason influential factors in the industry–university research alliances are: the differences among members(S2),shared benefits(S4),the quality of relationship (S8),asymmetrical information(S5),the ability of absorbing and learning(S6)and the scope of alliances(S10).These reason influential factors have great influences on others than others do them. The result influential factors in the industry-university-research alliances are: the contract risks(S7), the ways of control(S9), the fairness of alliances(S3)and investing proprietary assets(S1).These result influential factors have been more influenced from others than they do others.

According to the above analysis, we suggest as follows:(1)The ways of control is the most important influential factors and meanwhile it also is a kind of result influential factor, so alliances should make full use of common benefits to balance the differences among members, in the industry-university-research alliances specially for the differences of targets, as we know the differences include aim ones and cultural ones. The main entities of the industry-university-research alliances are enterprises, research departments, governments, media organizations. These entities, as a non-competitive alliances, weakens the influences that the cultural differences play on relational risk;(2)Use "investing proprietary resources" as a tool, try to enhance the quality of relationships among members. Proprietary resources investing can be seen as a kind of promise and enhance trusts among members. It can enhance the quality of relation and reduce relational risk (3), and make full use of the power of governments and professional organizations. Governments and professional organizations can be an information bridge among members, and reduce the asymmetry of information.

IV. CONCLUSIONS

The present research about relational risk in the industry-university-research alliances focus on the preliminary identify qualitatively. Considering that the complicated influences among factors in the industry-university-research alliances, it is hard to describe actually, this article choose interval numbers to describe the relationships among influential factors and use the mathematical method, apply the interval numbers DEMATEL to rank factors. According to the central degree ranking and the reason degree ranking, we identify the first five key influential factors. Furthermore, we identify six reason influential factors and four result influential factors. This article only identified the influential factors, the reason influential factors and the result influential factors. As for these influential factors how to arise the relational risk will be the next research direction.

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