

A Study on Computation Model and Empirical Examination for the Matching Degree of Cooperative Innovation Subject Motives

FAN Xia, SUN Jie

(College of Business Administration, South China University of Technology, Guangzhou, 510640, China)

Abstract

The motives matching relationship between cooperative innovation subject is analyzed, and the evaluating index system and measurement method for the enterprise and university engaged in UI motives are developed. Using concepts from geometry, the model for computing the matching degree of cooperative innovation subject motives is constructed. Finally, the model is tested by Ministry and Provincial University-industry Strategic Alliance in Guangdong with an empirical study.

Keywords: innovation subject, cooperative motives, matching relationship, matching degree, university-industry

1. Introduction

The development of the modern science and technology is gradually characterized by the combination of different knowledge domains, knowledge and skills required to innovation rapidly increasing, the innovation process has become increasingly complex. Because it is difficult to remain competitive based on their own capabilities and resources, seeking solid and reliable partner has become an important means of enterprise to achieve its strategic goals. UI is considered to be one of the most mature of the existing strategic cooperation models, their positive

effect on cooperation performance having been confirmed by some studies (Acworth E B, 2008; Yusuf S, 2008; Welsh R, 2008), but the research explored alliance how to influence the specific path of cooperation performance is still inadequate. From the perspective of the process of formation of UI, cooperation actor motivation joining to alliance is the starting point of alliance building, their motivation to participate in cooperative alliance is directly related to cooperation performance. In practice, due to different position of the university and the enterprise, the pursuit of the goal is also different, for example, enterprise are more to gaining cutting-edge technology from university and university would like to seeking fund from company. But from the perspective of resources complementary, given that the main body of cooperative system differences in background, a certain degree of motivation differences may have a certain role in promoting cooperative performance (Bonaccorsi, 1994). So how motivations matching or not between different subjects within UI will affect work performance become an urgent problem to solve researchers. This article attempts to using quantitative research method, mathematic model is established to measure motivation matching relation between actors. Finally, the model is tested

by Ministry and Provincial UI in Guangdong with an empirical study.

2. Matching relationship

Existing research about UI motives theories is relatively abundant. However, actors joining to UI tend to be complex, multidimensional, and can not explain by a single theory completely. Oliver (1990) putting forward to six dimensional model (necessity, asymmetry, mutuality, efficiency, stability and legitimacy) of cooperative motives. Necessity is concerned with meeting necessary legal or regulatory requirements that typically arise from the need to comply with higher authorities (Warren, 1967). Asymmetry is about attempting to exercise control over another entity or its resources, and as an effective way to keeping sustainable development for cooperation (Molnar, 1978). In opposition to asymmetry, reciprocity concerns cooperation and collaboration between entities rather than achieving power over them (Pfeffer, 1976). As emphasis on efficiency reflect an internal focus on such as husbanding resources, enterprise and universities improving its research and development efficiency after absorbing the other resources. Stability focuses on weakening environmental uncertainty of cooperation subject (Williamson, 1985), while legitimacy is about conforming to prevailing norms or expectations that others may have.

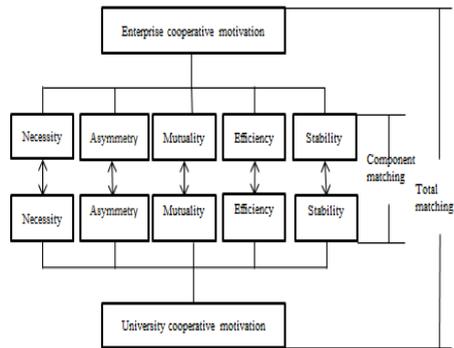


Fig. 1: Matching relationships of actors

These contingencies were fashioned to relate to either side of the subject, and therefore they are suitable for either academia or industry. At the same time refer Ankras (2013) publication for cooperative motives dividing the cooperation motive of enterprises and universities within UI based on the six dimensional model (figure 1). Because the legitimacy is not very significant in this study, therefore, abandon it in the process of the analysis. Motivation matching relationships includes two specific levels: total matching, that is, cooperation motivation of enterprise and that of college overall matching degree. Component matching, namely matching degree of each subsystem cooperation motivation of enterprise and that of university.

3. Computation Model

This paper intends to computing matching degree between enterprise and university within alliance employing the space geometry knowledge (Zhang Chenyan, 2007). This paper introduced a concept of “five dimensions space”, treating motivation intensity of colleges $(u_1, u_2, u_3, u_4, u_5)$ and enterprise $(c_1, c_2, c_3, c_4, c_5)$ as two spot. Defining motivation matching degree between enterprise and university use distance between two points.

At the same time, construct spherical space with the original point as center, the distance between original and universities cooperation motivation $(u_1, u_2, u_3, u_4, u_5)$ as radius. Judging these two point matching or not by certifying the enterprise cooperation motivation $(u_1, u_2, u_3, u_4, u_5)$ is located in the spherical inside or outside (figure 2).

Thus, matching degree between the cooperation subjects in UI can be conducted as follows:

$$D_M = \sqrt{\sum_{i=1}^5 (c_i - u_i)^2}$$

Defined $d \in (0, r / 5)$ shown in figure as the threshold, the value of d generally be determined by the experts. This paper classified enterprise motives participating in alliance by six dimensions of UI cooperation framework developed by Oliver. Constructing the index system of enterprise cooperation motivation intensity as follows:

(1) According to the index system of enterprise cooperative motives intensity, rating by the experts, using AHP judgment matrix method calculate enterprise each factor relative weights w_{ij} under every criteria (Pan Renfei, 2008), of which $i = 1, 2, 3, j = 1, 2, \dots, n$, n refer to the count of elements under the i criteria.

(2) At first value elements of the i subsystem by the experts, gaining the score x_{ij} of the j element under the i subsystem of enterprise, among them, $j = 1, 2, \dots, n$. Thus can calculate the intensity of the subsystems of the enterprise cooperation motivation:

$$c_i^* = \sum_{j=1}^n w_{ij} x_{ij}$$

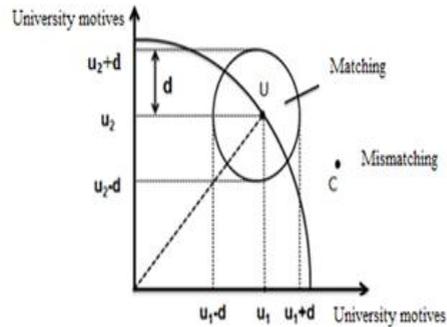


Fig. 2: Matching relationship diagram between enterprise and university (For simplicity, only with 2 dimensions)

As mentioned above, Oliver six dimensions framework is also suitable for university. According to the specific content of “five dimensions”, construct the index system of university cooperation motivation intensity. Motives intensity measurement process of university conducted as well as enterprise’. Firstly, calculating each factor relative weights v_{ij} ($i = 1, 2, 3, j = 1, 2, \dots, n$), n refers to the count of elements under the i criteria. Then computing the motivation intensity of each subsystems y_{ij} ($j = 1, 2, \dots, n$). Thus can calculate the intensity of the subsystems of university cooperation motivation:

$$u_i^* = \sum_{j=1}^n v_{ij} y_{ij}$$

4. Empirical study

4.1 Sample criteria and data collection

Guangdong province is the first to implement the Ministry and Provincial UI, promoting independent innovation province. In practice, due to different institutions background and objective, company motives are not consistent with universities, leading to low efficiency of cooperation. In this setting, this paper attempts to study underlying reasons resulted in different goal and motives

between two actors, providing some ideas for the research on alliance performance by taking Precision Manufacturing Alliance(PMA), Radio Frequency Identification Alliance(RFI), Digital-Home Network Alliance(DHN), Lead-free Electronics Manufacturing Alliance(LEM) and Pyrite Chemical Industry Alliance(PCI) as our research sample and collect data from manages of alliance by means of questionnaires. The final sample included 64 valid respondents (65% effective rate) out of 98 questionnaires. Sample overall reliability and validity is suitable for research (Cronbach's $\alpha=0.877$, KMO=0.725, $p=0.001$).

4.2 Data analysis and findings

According to the computation model above calculate each element score (table 3). From the enterprise point of view, asymmetry is relatively strong to companies, in the first place of all dimensions, which is mainly attributed to the non-profit nature of the enterprise, holding dominant position in cooperation, and making the union operation with the direction of its strategic target. Followed by efficiency, mutuality, it is reasonable for enterprises for promoting efficiency and gaining complementary resources. Stability and necessity is relatively less valued. From the perspective of university, the value of efficiency is highest, followed by mutuality and stability, asymmetry and

necessity at the end, the rank of motives having large difference with companies. However, if compare the rank carefully, you will find most motives order just varying a little except asymmetry, which stating enterprises motives in accordance with that of universities.

Tab. 1: Overall score and ranking of motives

	Enterprise		University	
	Score	Rank	Score	Rank
Necessity	4.84	5	4.83	4
Asymmetry	5.37	1	4.76	5
Mutuality	5.17	3	5.05	2
Efficiency	5.28	2	5.45	1
Stability	5.14	4	4.84	3

Using the data collected, calculating each factor score based on elements and take it into the formula, getting the d value, threshold, D_M and other related indicators of each alliance (table 4).

Tab. 2: Indicators of alliance actor motives

	d	D_M	$\sum_{i=1}^7 c_i^2$	r^2
PMA	1.26	0.63	170.48	159.31
RFI	1.02	3.15	112.87	103.54
DHN	1.06	1.28	134.68	113.27
LEM	1.13	0.88	122.94	128.41
PCI	1.14	2.32	135.46	129.86

Actors motives of enterprises and universities in PMA and LEM are matching on the whole ($D_M < d$). On the contrary, actor motives in RFI, DHN and PCI are mismatching ($D_M > d$), and all of these alliance cooperative motives of enterprise are stronger than that of university ($\sum_{i=1}^5 c_i^2 > r^2$).

Tab. 3: Component matching degree of actor motives

PMA	RFI	DHN	LEM	PCI
[3.54, 6.06]*	[2.98, 5.02]	[4.06, 6.19]*	[3.17, 5.43]*	[4.76, 7.04]*
[4.39, 6.91]*	[2.48, 4.52]	[3.37, 5.50]*	[4.37, 6.63]*	[3.56, 5.84]*
[4.39, 6.91]*	[3.55, 5.59]*	[3.56, 5.69]*	[3.97, 6.23]*	[4.16, 6.44]*
[4.64, 7.16]*	[4.13, 6.16]	[3.77, 5.90]*	[4.40, 6.67]*	[4.73, 7.01]*
[4.87, 7.40]*	[4.27, 6.30]	[3.69, 5.81]*	[3.67, 5.93]*	[2.09, 4.37]

(Note: [3.54, 6.06]: [$u_i - d, u_i + d$] * : $c_i \in [u_i - d, u_i + d]$)

According to the definition, total matching is a sufficient condition of component matching and component matching is the essential condition of total matching. Given actors motives of enterprises and universities in PMA and LEM are matching on the whole, so the factored motives of these two alliances are matching undoubtedly. As we can see from table 5, regarding RFI, mutuality of two kind actors are matching ($c_3 \in [u_3 - d, u_3 + d]$), necessity, asymmetry, efficiency and stability are mismatching ($c_1 \notin [u_1 - d, u_1 + d]$, $c_2 \notin [u_2 - d, u_2 + d]$, $c_4 \notin [u_4 - d, u_4 + d]$, $c_5 \notin [u_5 - d, u_5 + d]$). Among of them, necessity and asymmetry of enterprises actors are stronger than that of colleges ($c_1 > u_1 + d$, $c_2 > u_2 + d$), efficiency and stability of enterprises actors are weaker than that of colleges ($c_5 > u_5 + d$). In DHN, all of factors are matching contrary to the total matching relationship is not obvious, which verify logic relationship of the total matching and component matching exactly. Necessity, asymmetry, mutuality and efficiency are matching in PCI ($c_1 \in [u_1 - d, u_1 + d]$, $c_2 \in [u_2 - d, u_2 + d]$, $c_3 \in [u_3 - d, u_3 + d]$, $c_4 \in [u_4 - d, u_4 + d]$), but the stability of enterprises actors are stronger than universities' ($c_5 > u_5 + d$).

5. Conclusion

This paper compute the cooperative motives intensity precisely on the base of identifying motives matching relationship of enterprises and universities in UI, reflecting the total and component matching conditions that the reason why participate in alliance. The analysis not only demonstrates the matching relationship of industry and university, but also dissects the potential reason of matching relationship, which are beneficial to enterprises and universities employing more specific solutions to fitting the other

actor and promoting the improvement of cooperative innovation efficiency.

Acknowledgement

The work was supported by the National Natural Science Foundation of China (Grant # 71473086, 71233003); Key Projects of Philosophy and Social Sciences Research, Ministry of education (Grant # 12JZD042) and the National Natural Science Foundation of Guangdong Province in China (Grant # S2013010011823). The authors also want to thank anonymous referees for comments affecting the final text.

References

- [1] Acworth E B. University-Industry Engagement: The Formation of the Knowledge Integration Community (KIC) Model at the Cambridge-MIT Institute. *Research Policy*, 37(8), 1241-1254, 2008.
- [2] Yusuf S. Intermediating knowledge exchange between universities and businesses. *Research Policy*, 37(8), 1167-1174, 2008.
- [3] Welsh R, Glenna L, Lacy W, et al. Close enough but not too far: assessing the effects of university-industry research relationships and the rise of academic capitalism. *Research Policy*, 37(10), 1854-1864, 2008.
- [4] Bonaccorsi A, Piccaluga. A Theoretical Framework for the Evaluation of University-Industry Relationships. *R&D Management*, 24(3), 229-247, 1994.
- [5] Oliver C. Determinants of Interorganizational Relationships: Integration and Future Directions. *Academy of management review*, 15(2), 241-265, 1990.
- [6] Warren, R. L. The Interorganizational Field as a Focus for Investigation. *Administrative Science Quarterly*, 12,

- 396-419, 1967.
- [7] Molnar, J., Comparative Organizational Properties and Interorganizational Interdependence. *Sociology and Social Research*, 63, 24-48, 1978.
- [8] Pfeffer, J., & Nowak, P. Joint ventures and interorganizational interdependence. *Administrative Science Quarterly*, 11, 398-418, 1976.
- [9] Williamson, O. E. The Economic Institutions of Capitalism: Firms, Markets, Relational Contracting. *New York: Free Press*, 1985.
- [10] Ankrah S N, Burgess T F, Grimshaw P, et al. Asking Both University and Industry Actors about Their Engagement in Knowledge Transfer: What Single-group Studies of Motives Omit. *Technovation*, 33(2), 50-65, 2013.
- [11] ZHANG Chenyan WU Bing LIU Zhongying. The Computation Model for the Fitting of the Flexibility in Enterprise Knowledge Management System to the Environment Uncertainty. *Chinese Journal of Management*, 7(4), 393-397, 2007.
- [12] PAN Renfei, ZOU Lele, HOU Yunbing. The method of Uncertain AHP Based on Expert Credibility and Its Application. *Systems Engineering*, (10), 101-106, 2008.