

The Research of Virtual Enterprise Partners Selection: From Harmony Perspective

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Abstract

The virtual enterprise (VE) partner selection, which is a business process throughout the whole business operation, is critical for the VE operation. But it is often affected by many factors from politics, economics, social status, psychology and culture background. And the relationship development between the host-enterprise and the guest-enterprise also is difficult to be predicated and managed. With the “Lin-Dai Enterprise Partner Selection Approaching”, the VE practitioners could get an interview from a different angle to solve these problems.

Keywords: Enterprise partner selection, Enterprise coupling, Enterprise poverty, Virtual enterprise

1. Introduction

In the VE practical field, there are a couple of issues, which puzzle the pioneers a lot:

- What is the standard to select the suitable VE partners?
- Where is the golden boundary between partners in a VE to maintain a good relationship?

- How to attract more potential partners to participate the VE business actions?

Currently, the research on partner selection could be classified in these perspective categories:

- Game theory perspective;
- Transaction cost perspective;
- Resource sharing perspective;
- Power and dependence perspective;
- Enterprise culture perspective;
- Knowledge transferring perspective;
- Ability creativity perspective;
- Performance evaluation perspective;
- Contracting perspective.

Axelrod and Keohane (1986) [1], Neale and Bazerman (1992) [2], developed and employed various models to predict bargaining outcomes. Balakrishnan and Wernerfelt (1986) reported that when there is a strong possibility of technological obsolescence, firms rely on market contracts and retain flexibility rather than vertical integration [3]. Lucy Akumu Ojode (2000) pointed out: the need for resources utilization that leads to sustainable competitive advantage drives partners to adopt the strategic alliances [4]. Marjolein C. J. Caniels (2007) argued that not only asset specificity, but also other issues coming forward from the li-

terature on power and dependence might be key factors that influence the outsourcing decision making process [5]. Li Dong and Keith W. Glaister (2007) considered that differences in national culture and corporate culture have a differential impact on aspects of international strategic alliances management [6]. Lee Shilin (2005) indicated: with the coming of knowledge-based economy, the knowledge has become a strategic resource of enterprises and it requires collaboration in nature [7]. Sakakibara (1997) found that: to gain the complementary technologies, is the most important factor to drive enterprises to cooperate for the creativities [8]. Wang Shasha (2007) believed that the wrong enterprise partner selection resulted in the enterprise contracting alliance unstable [9].

And some methods had been developed and used for the enterprise partner selection and evaluation. These are: Mathematical Programming Method (MPM), Data Envelopment Analysis (DEA), Analytic Hierarchy Process (AHP), Analytic Network Process (ANP), ABC Analysis, Fuzzy Comprehensive Evaluation, Neural network algorithm, Genetic Algorithm and Grey Decision. Etc.

However, based on our research, we found that:

- The enterprise partner selection is not a “One-Shot Action”. It is throughout the whole business process;
- The enterprise partner selection is involved not only the economic interests and needs for each other, but also the morality, the culture, the status and the psychology. Etc;

So, a new enterprise partner selection method should be developed to cover these concerns. But before we get into the core discipline discussion, we need to review several theories, which will be referred in this paper.

2. Theories and literatures

2.1. TaiJi Theory

TaiJi theory was original from ancient china song dynasty (960 - 1279)[16] [17] [18]. Shown in Fig.1, the taiji evolution picture is consisted of two symmetrical parts: the white part (positive) and the black part (negative). The white part has a black circle inside and the black part has a white circle inside also and the white part and the black part are chasing to each other with clockwise direction. It presents these several basic taiji fundamental views:

- Everything in the universe is consisted of two elemental parts, positive pole and negative pole;
- The positive pole contains the lower level negative pole and the negative pole also contains the lower level positive pole;
- The positive pole and negative pole are both in dynamic status, they are transforming to each other all the time;
- The balance of the positive and negative poles makes the object, which contains them, in a dynamic stable and harmonious status and once this balance is broken, the object will be transformed into a new system. In the new system the object tends to achieve a new balance status;
- The transforming of the positive and negative poles keep objects change and create new objects, makes the diversity of this world.

A very good example to verify this taiji theory is the research results of atomic physics [19]. The atom is the basic element to compose an object. And the atom is consisted of the nucleus and the electron. While the nucleus is with positive charge, the electron is with negative charge and they are both balanced with

the same amount opposite electrical charge. The status of an atom is dynamic as the electron is keeping moving around the nucleus with the certain orbit. Once this balance is broken by the third part force, the structure of the atom is going to reform and the attributes of the object, which the atom is composed of, is going to change.



Fig. 1: The taiji evolution picture.

2.2. Harmony management

With the taiji theory and oriental culture background, Xi XiMing (1987) proposed the harmony management theory [20] [21]. And the several major points of this theory are:

- The major elements between different systems and the major elements within a system are related to each other;
- These elements are under a systematic mechanism of the harmony;
- This harmony mechanism, to the maximum extent, is consistent with efficiency.

2.3. “Mate Selection Model” theory in sociology

Lee Huang and Xu Anqi (2004) had done a research on the “Mate Selection Model” [22]. The results indicated that when people is selecting mate, the behavior will be affected by the following major factors:

- The needs for each other with human nature attributes, including:

sexual, wealth, fame, and social status. Etc;

- The requirements for spiritual pursuit, including: appearance, knowledge, demeanor, temperament and conversation. Etc;
- The demand in the marriage market;
- The propinquity and homogamy between them, including: location, culture background, social status, appearance and education. Etc.

This view is supported by the social exchange theory [23], the marriage market theory [24] and the social structure theory [25].

Mates, both sides, are rational. They hope that through "exchange" tangible or intangible resources to achieve "mutual" (Blau, 1964; Homans, 1974) [26] [27]. Unmarried males and females are the market potential trading partners. However, the relationship between supply and demand in this market is often unbalanced, due to the demographic and social reasons, especially the sex ratio (Bernard & Guy, 2002)[28]. The percentage of marriages decreased steadily and markedly as the distance between residences of the contracting parties increased (James H. S. Bossard, 1932)[29]. And the preference for a partner with the same level of education can also determine and increase in same-age couple (Blossfeld & Timm, 1999) [30].

2.4. Entropy in thermodynamics and information theory

Entropy is the thermodynamic quantitative measure of that kind of a spontaneous process: how much energy has been transferred or how widely it has become spread out at a specific temperature. It is central to the second law of thermodynamics. Energy of all types changes from being localized to becoming dispersed or spread out, if it is not hindered from doing so.

The second law of thermodynamics determines which physical processes can occur and it can be stated as: the entropy of a closed system never decreases, and processes which increase entropy will occur unless prevented. Since entropy increases as uniformity increases, qualitatively the second law says that uniformity increases [31] [32].

Entropy is basically mathematically defined as a relationship between heat flow into a system and the systems change in temperature:

$$dS = \frac{\delta q}{T}. \quad (1)$$

Where dS is the change in entropy and dq is the heat added to the system. If the temperature is allowed to vary the equation must be integrated.

The defining expression for entropy in the theory of information established by Claude E. Shannon in 1948 paper "A Mathematical Theory of Communication", is an expected value, which the information contained in a message, usually in units such as bits. Equivalently, it is a measure of the average information content one is missing when one does not know the value of the random variable [33]. It is of the form:

$$H(X) = E(I(X)) \quad (2)$$

Here entropy H is of a discrete random variable X with possible values $\{x_1, \dots, x_n\}$, E is the expected value function, and I(X) is the information content or self-information of X.

Yang ZhunQi (2008) defined the organization entropy as:

$$E = |d \lg(d) + m \lg(m) + t \lg(t)| \quad (3)$$

Where d=actual production ability / predicated required volume, m=actual

communication cost / affordable communication cost, t=critical task operation time / maximum operation time. It indicated that: when the actual production is approaching to the predicated required volume, the actual communication cost is approaching to the affordable cost and the critical task operation time is approaching to the maximum operation time, the organization entropy is approaching to the mini, and this means the uncertainty is getting less [34].

2.5. Coupling in software engineering

Coupling is the degree to which each program module relies on each one of the other modules. It is usually contrasted with cohesion. Low coupling often correlates with high cohesion, and vice versa. The software quality metrics of coupling and cohesion were invented by Larry Constantine who was an original developer of Structured Design [35]. Low coupling is often a sign of a well-structured computer system and a good design, and when combined with high cohesion, supports the general goals of high readability and maintainability[36].

3. Enterprise powertry, coupling and magneto caloric effecton

In this paper, we will introduce a new concept of the enterprise powertry, which will be used to evaluate the compositive power and ability of an enterprise. Base on the taiji and harmony management theories as the ideology, with the new definition of VE coupling coefficient, which will be used to indicate the degree of a VE coupling relationship, and the reference of "Mate Selection Model" theory in sociology, we are going to accomplish this new partners selection approaching.

3.1. Enterprise Powertry

Enterprise's powers and abilities could be classified mainly into the following categories:

- Social influence abilities;
- Profit (production and service) abilities;
- Creativity and adaptation abilities.

We define the function $U(u, t)$ as the VE social influence powertry, $V(v, t)$ as the VE profit powertry, $W(w, t)$ as the creativity and adaptation powertry. Then the VE Powertry is:

$$H = H_s + H_p + H_c \quad (4)$$

Where H_s is the VE social influence Powertry, H_p is the VE profit Powertry and H_c is the VE creative and adaptation Powertry.

With the assumptions of $U(u, t)$, $V(v, t)$ and $W(w, t)$ being continuous, the VE Powertry is:

$$H = \iiint_{\Omega} f(u, v, w) dt \quad (5)$$

Where u , v and w are the parameters of social influence, profit, creative and adaptation powertry with the time (t) change.

3.2. Enterprise coupling and coupling coefficient

We define the enterprise coupling as: the changes in one enterprise (host) will cause the corresponding changes in another enterprise (guest). It indicates the tightness of the relationship between the host-enterprise and the guest-enterprise currently or in the past under a static status. These changes could be classified mainly into three categories: strategy alignments (Sa), product & service alignments (PSa) and technical support alignments (TSa). The coupling types between the host enterprise and the guest enterprise are shown in Table.2.

With different enterprise coupling type, we define the corresponding enterprise-coupling coefficient (μ) as following:

1) Under linear coupling

$$\mu = \frac{1}{n} * \sqrt{\frac{\lambda_{sao} + \lambda_{psao} + \lambda_{tsao}}{\lambda_{sai} + \lambda_{psai} + \lambda_{tsai}}} \quad (6)$$

2) Under quadratic coupling

$$\mu = \frac{1}{n} * \sqrt{\frac{\lambda_{sao} * \lambda_{psao} + \lambda_{sao} * \lambda_{tsao} + \lambda_{psao} * \lambda_{tsao}}{\lambda_{sai}^2 + \lambda_{psai}^2 + \lambda_{tsai}^2}} \quad (7)$$

3) Under cubic coupling

$$\mu = \frac{1}{n} * \sqrt{\frac{\lambda_{sao} * \lambda_{psao} * \lambda_{tsao}}{\lambda_{sai}^3 + \lambda_{psai}^3 + \lambda_{tsai}^3}} \quad (8)$$

Where

λ_{sao} is the guest enterprise strategy alignment ratio;

λ_{psao} is the guest enterprise production and service alignment ratio;

λ_{tsao} is the guest enterprise technical support alignment ratio;

λ_{sai} is the host enterprise strategy alignment ratio;

λ_{psai} is the host enterprise production and service alignment ratio;

λ_{tsai} is the host enterprise technical support alignment ratio;

$n = 1, 2, 3$

3.3. Enterprise magneto caloric effect

Why did the AAA enterprise quickly “fall in love with” BBB enterprise at first sight, but kept hanging around with CCC enterprise, which looked very similar to BBB enterprise? With the “Mate Selection Model” theory in sociology as a reference, we found that when an enterprise, especially a virtual enterprise is selecting a business partner, the behavior will be affected by the following major factors:

- The needs for each other with their business attributes, including: production & service ability, technology level, facility and property status. Etc;
- The requirements for social influence and responsibility pursuit, including: public image, community contribution and welfare involvement. Etc;
- The demands in the business market;
- The claims for the creative and adaptation abilities;
- The convenience of the communication and the acceptance for the culture difference.

We define the enterprise magneto caloric effect as: the development tendency under a dynamic status of a relationship between one enterprise (host) and another enterprise (guest). Correspondingly, the enterprise magneto caloric effect coefficient (ω) is defined as:

$$\omega = \iiint \left(\alpha (\mu - \mu_0)^2 + \beta \right) - (\kappa t + \varphi) d\mu dt \quad (9)$$

It is a volume with the parabolic surface, which enclosed by:

$$\omega(\omega, \mu) = \alpha (\mu - \mu_0)^2 + \beta \quad (10)$$

$$\omega(\omega, t) = \kappa t + \varphi \quad (11)$$

Where: α is the service type adjustment coefficient; β is the initial expectation and trusty to the partner; μ_0 is the curve peak corresponding; μ value in the ($\omega - \mu$) coordinate system; κ is the trusty coefficient with the partner; φ is the partner performance feedback.

Host Enterprise (Cause)	Guest Enterprise (Effect)	Coupling Type a
Sa or PSa or TSa	Sa	Unary linear coupling
Sa or PSa or TSa	PSa	
Sa or PSa or TSa	TSa	
Sa	Sa & PSa or Sa & TSa or PSa & TSa	Unary quadratic coupling
PSa	Sa & PSa or Sa & TSa or PSa & TSa	
TSa	Sa & PSa or Sa & TSa or PSa & TSa	Unary cubic coupling
Sa	Sa & PSa & TSa	
PSa	Sa & PSa & TSa	
TSa	Sa & PSa & TSa	
Sa & PSa or Sa & TSa or PSa & TSa	Sa or PSa or TSa	Binary linear coupling
Sa & PSa or Sa & TSa or PSa & TSa	Sa & PSa or Sa & TSa or PSa & TSa	Binary quadratic coupling
Sa & PSa or Sa & TSa or PSa & TSa	Sa & PSa & TSa	Binary cubic coupling
Sa & PSa & TSa	Sa or PSa or TSa	Ternary linear coupling
Sa & PSa & TSa	Sa & PSa or Sa & TSa or PSa & TSa	Ternary quadratic coupling
Sa & PSa & TSa	PSa & TSa	Ternary cubic coupling
Sa & PSa & TSa	Sa & PSa & TSa	

Note: Sa: strategy alignments; PSa: production and service alignments; TSa: technical support alignments;

Table 2: Enterprise coupling type.

4. Virtual Enterprise partners selection frame work

The new virtual enterprise partner selection model is consisted of five major sections: outsourcing tasks planning, partner benefit prelocation, partner poverty evaluation, cooperation under run-in period and operational partner.

4.1. Outsourcing Tasks Planning

While the enterprise outsourcing tasks centralized attribute is with the taiji positive nature, the opposite is with the taiji negative one. To achieve the system maximum efficiency, these issues should be aware to:

- The balance between DIY and outsourcing;
- The balance between risk and protection;
- The balance between different partners;
- The balance between different periods.

And these are the foundation to build up a harmony system.

4.2. Partner Benefit Prelocation

Rather than taking a long difficult business bargain for own enterprise maximum interests or lower costs, this new model suggests that the host-enterprise should consider the guest-enterprise interests first and try to get the balance between profits and costs. With an attracting partnership benefit package, the host-enterprise could have much more guest-enterprise candidates to select and get the quality partners as the return.

4.3. Partner Poverty evaluation

Based on the taiji and harmony manage-

ment, we understand that the guest-enterprise as the service-provider partner should be poverty compatible to the host-enterprise.

$$H_{\text{guest-enterprise}} \approx H_{\text{host-enterprise}} \quad (12)$$

And with the 1:n (host to guest) relationship, the data analysis shows that the guest-enterprises are tend to rely on a bigger host-enterprise to form a business alliance. And normally, these conditions are the major factors to affect their decisions:

1) Outsourcing task budget

If the host-enterprise profit powertry $V(v,t) = V(m(a,\dots,g),t)$ and $m(a, \dots,g)$ is the outsourcing budget, then at least one of the task bid price

$$\theta = \partial(\partial E / \partial V) / \partial(a,\dots,g) \geq D_{\min} \quad (13)$$

Where D_{\min} is the minimum profit requirement of the potential guest enterprise.

2) Social Influences and Responsibilities

If the host-enterprise social influence powertry

$U(u,t) = U(l(a,\dots,g),t)$ and $l(a, \dots,g)$ is the social related effection, then at least one of the factor

$$\delta = \partial(\partial E / \partial U) / \partial(a,\dots,g) \geq R_{\min} \quad (14)$$

Where R_{\min} is the minimum social related effection requirement of the potential guest-enterprise.

3) Knowledge Transferring and Ability Creativities

If the host-enterprise the creative and adaptation powertry

$W(w,t) = W(n(a,\dots,g),t)$ and $n(a, \dots,g)$ is the knowledge and creativity spilling-over, then at least one of the factor

$$\varepsilon = \partial(\partial E / \partial W) / \partial(a \dots g) \geq S_{\min} \quad (15)$$

Where S_{\min} is the minimum knowledge and creativity spilling-over requirement of the potential guest- enterprise.

Similarly, the potential guest-partner's production and service powertry, social influence powerty, creativity and adaptation powertry, also need to meet the corresponding minimum requirements of the host-enterprise.

4.4. Cooperation Under Run-in Period

Under this section, the cooperation between the host-enterprise and guest-enterprise must be simple and primary. And the outsourcing tasks should be unimportant, not urgent and easy to be verified. With sample testing and performance feedback checking, the both sides could know more about each other and decide how to develop their relationship.

4.5. Operational Partner

The relationship between the host-enterprise and guest-enterprise in this stage should be stable and productive. With the partner relationship evaluation, including: Enterprise coupling and magneto caloric effecton evaluation, the host-enterprise could understand that:

- The current relationship status between them;
- How important role this relationship plays in the host-enterprise's business operation under current period;
- What is the relationship development tendency with current cooperation conditions.

And through the partner relationship alignment, the host-enterprise could either change the enterprise coupling type or adjust the corresponding alignment ra-

tio to get the different enterprise-coupling coefficient (μ), which will make the enterprise magneto caloric effecton coefficient (ω) is in the rising curve and approaching to the peak. However, in the practical field, with some security concerns, the host-enterprises often lower down this cooperation relationship to avoid their profits, technologies and social influences over-revealed.

5. Conclusion

In this paper, we proposed a new virtual enterprise partner selection framework. It is helpful for the VE practitioners to get a deeper and predictable understanding to their business cooperation relationships with the partners from a different angle.

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