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Software Industry Cluster be Disagreement on Theory and Practice

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Abstract

In the view of traditional industry cluster theory, it is easy to copy the software industry cluster pattern, or it is easy to copy another Silicon Valley, due to low reliability of the resources and the guidance factors of locations in software industry. But it is much more difficult to copy a Silicon Valley mode practically than imaginatively and the difficulties of bringing up and supporting high-tech initiatives is more than theoretic anticipation. In China, the software companies have just gathered together geographically and therefore no initiative center can be formed. All these above signify that software industry cluster is distinct from the traditional industry clusters, but the cognition of the reasons of software industry cluster is not clear yet. Furthermore, reasonable explanations of the bewilderment in the economical practice of software industry cluster are urgently needed.

Keywords: Software Industry Cluster; Motivations of Cluste

1. "Software Industry Cluster Can be Copied" Theories

1.1 Theories Based on Factors

When Castells and Hall concluded the successful experience of Silicon Valley, they pointed out the factors of high-tech activities [1] in Silicon Valley. Some of these are the close connection between colleges and the research organizations, the combination of local protection by governmental plan and the market itself, a non-aligned industrial tradition, the existence of venture capital, and a perfect conmmunication network. The influence of the market mechanism was emphasized during the development of Silicon Valley. Larson and Rogers [2] found that the main factors which led to the success of Silicon Valley are the keys to the technology, venture capital, working mobility, information exchange networks, learning type enterprises and the foundational equipment. Among all these factors, what promotes the entrepreneur to hatch new venture corporations are venture capitals and foundational equipment.

1.2 Theories Based on the Investment of Invironment Factors

Yingyi Qian believed Silicon Valley is a kind of miracle made by a sort of dispersive decision process, not by planning. Analyzed from the aspect of business institutions, dispersive decisions, individual initiative and creativity are the main influences for the development of the economy the government is just an auxiliary assistant [3]. Jinglian Woo pointed out that a beneficial system and helpful environmental conditions should be supported for the setting up of activity in Silicon Valley such as a high-tech park. There are four indispensable elements for the park where the corporations set up, such as the assemblage of the high quality professional experts (especially in the field of technology and commerce); plenty of opportunities for the enterprises of the industry to establish; ambiences for good legal systems; and supply for ample financing [4]. In the view of Kangning Xu, to establish "Silicon Valleys" in China, steps should be taken to approach the capital, persons with special abilities, institutional systems and the environment, among which institutional systems and the environment should be especially emphasized [5].

1.3. Theories Base on the Establishment of

Chunyan Jiang and Shuming Chow found that the success of Silicon Valley belongs not only to the advance

made by the conglomerating of companies, but also to the broad connection of corporations and industries. The technological foundation of a country is expressed by the quantity and quality of the administrators, engineers and researchers. Furthermore, it is also expressed by the leader of the whole industry and the close relationships network between the corporations [6]. Wenjian Chang held that the Silicon Valley effect is not just about the factors. More importantly, there is a way to combine the factors and then foster greater productivity, which is the economical, institutional and the enterprise cultures in the US. Such a combination can generate better results and higher technological levels to systematize the institutions like Silicon Valley, than to simply copy the structure of organizations and the constitutions of the factors of Silicon Valley.

2. The Bewildment of Copying Software Industry Cluster

There is a dominant pattern of merely copying Silicon Valley all over the world due to the tremendous agglomeration effect and the spillover effect brought by the huge success of Silicon Valley; but very few of them attain their aim as planned. It is much more difficult to bring up and support the high-tech creative ability than to anticipate an innovative technology center during the practice of making an industry cluster. In 20th century thousands of technopoles were built in many countries in the world, but very few of them succeeded. A lot of exponents for copying Silicon Valley hold that if a software park can be established near the colleges and research organizations, it can make the achievement of research industrialized, but it turns out that it is far away from what they predicted with great funds spent.

Through the reliability of capital factors, industry clusters should be gathered in places where resources are abundant, traffic is convenient, and the cost of labor is low; however, the first successful software industry cluster did not meet these prerequisites. It did not because the products of the software industry belongs to intellectual property, and the requirements of knowledge structure and scientific technology is at high level, the demands for high-tech skilled labor is high, the reliance of natural resources is low, and the dependence of location point factor is not obvious. One can see that the factors of the software industry have the characteristic of great fluidity which, compared to the immigration of natural resource factors, is possible to copy in different regions. Theoretically the software industry can be easily copied. However, the results of practice show the opposite. Considering Porter's theory of a country's competitive ability, who first introduced the five competitive forces to the country's competitive ability, it is elemental to emphasize the role of the government of both country and district. It is the country which first initiates and promotes the software industry cluster, with much support offered by the government, including regions near plenty of colleges and research organizations, well designed fundamental equipment and comfortable circumjacent environment, but the cluster is just gathered geographically and no creative center like Silicon Valley is formed.

The 11 software cluster bases in China have already become the dominant industry in certain locales, such as Hangzhou, Beijing, and Dalian. These are all supported by the government, aiming to become the potential pillar industry, but the creation center which can produce new software products is not obvious, the cooperation in the industry is low, the industry cluster effect is not notable, and the developmental bewilderment is still existing in most of the software industry parks.

3. The Motivation Analysis of Sofware Industry Cluster

Based on Porter's Competence Advantage Theory, the competence advantage comes from two aspects: one is differential products or services; the other is cost advantage strategy. The former results from product innovation and the latter results from large-scale economy. For the other industry clusters, especially the secondary industry cluster, the kind of vertical cluster is asked for and the effect of clustering is realized by the industry chain cluster. However, when it comes to the software industry, there is a noticable difference; ahorizontal cluster is more suitable. Several models will be analyzed in what follows.

3.1. Cost Motivation

3.1.1. The Vertical Economical Relationship Model

In the vertical relationship, (see **Figure 1**) company A produces intermediate products M, with the cost of C_1, with the price of P_1. The other company B purchases the intermediate products M, then puts it into production to make a final product, with the cost of C_2 deducting with the purchasing cost P_1, with the price of P_2. The process is as follows:

Assumption:

1) Per unit final product needs per unit interim product.

2) According to the demand function in microeconomics, the demand of consumers for the final products meets the linear function of $D(P_2) = a - P2$, in which (a) is constant, and $a > C1$.

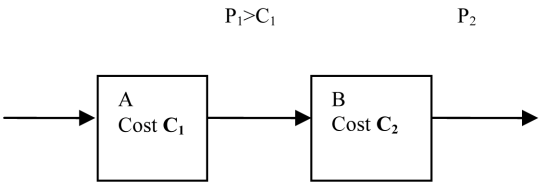

Figure 1. The model of the vertical economical relationship.

3) Company A is the upper supplier who produces the interim products for Company A. But as two individuals the two both ask for the profit maximum.

4) As two individuals, neither P_1 and C_2 would change with the P_2.

When chasing for the maximum profit, the objective function of Company B is:

$$\max[(P_2 - P_1 - C_2)(a - P_2)] \quad (1)$$

$$P_2 = (a + P_1 + C_2)/2 \quad (2)$$

demands for final products(demands for interim products)

$$q = a\text{-}P_2 = (a - P_1 - C_2)/2 \quad (3)$$

profits of Company B

$$\Pi_B = (P_2 - P_1 - C_2)(a - P_2) = (a - P_1 - C_2)^2/4 \quad (4)$$

In the same way, the objective function of Company A is:

$$\max[(P_1 - C_1)q] \quad (5)$$

$$\Pi_B = (a - C_1 - 2C_2)^2/16 \quad (6)$$

$$\Pi_A = (a - C_1 - 2C_2)(a - C_1)/8 \quad (7)$$

$$\Pi = \Pi_A + \Pi_B = [3(a - C_1 - 2C_2)^2 - 8C_2^2]/16 \quad (8)$$

3.1.2. The Analysis of the Vertical Economical Relationship Model

After vertical industry cluster, the external cost (transaction cost) of corporations decreases. The visible cost, such as transportation cost, information cost, negotiation cost and so on, would decline through the visible geographic concentration. On the one hand, companies with high internal costs have the will and motivation of forming an economical center, on the other hand, it is easier to establish the reputation mechanism when corporations have the opportunity of face to face contact, long term communication for strategy information, the connection of the input and output contracts of raw materials. It is more convenient to exchange the information between companies and more flexible to adjust the strategies cost, the supervising cost and the inspecting cost.

However, the vertical cluster could just make the cost of an industry whose complex production processes go down, such as automobile assembling industry and shoe manufacturing. As to the successful software industry cluster examples, no matter if it is Silicon Valley or Bangalore, neither contains the whole industry chain, but it is gathered in part of the industry chain through the supply chains which is a horizontal cluster.

3.1.3 The Horizontal Economical Relationship Model

There are two companies A' and B', which produce substitutable products, and the prices are P_1' and P_2'.

Assumption:

1) The cost of per unit production is C.

2) The demands of the production of the two companies are influenced by each other's prices, the influence coefficient is b. For the main influence of the demand is from the price of the product itself, $0 < b < 1$, $a > C$

3) The two companies are individuals chasing for maximum profit

The demand of Company A' $D_A' = a - P_1' + bP_2'$ (9)

The demand of Company B' $D_B' = a - P_2' + bp_1'$ (10)

The profits of the two companies are:

$$\Pi_A'(P_1',P_2') = (P_1' - C)D_A'$$

$$= (a - P_1' + bP_2')(P_1' - C) \quad (11)$$

$$\Pi_B'(P_1',P_2') = (P_2' - C)D_B'$$

$$= (a - P_2' + Bp_1')(P_2' - C) \quad (12)$$

$$P_1' = (a - C + bP_2')/2 \quad (13)$$

$$P_2' = (a - C + b P_1') / 2 \quad (14)$$

The equilibrium prices and the equilibrium productions are:

$$P_1'^* = P_2'^* = (a + c)/(2 - b) \quad (15)$$

$$q1'^* = q2'^* = [a - (1 - b)c] /(2 - b) \quad (16)$$

$$\Pi_A' = \Pi_B' = [a - (1 - b)c]^2/(2 - b)^2 \quad (17)$$

3.1.4 The Analysis of Horizontal Economical Relationship Model

After the horizontal industry gathered, the internal costs production cost and innovation cost decrease.

One reason is due to the external scale economy. Industry cluster will influence the relative substitutable goods and then create an industry cluster. Mass purchase and sale will help to realize the scale economy. There are more and more companies gathering in the cluster and all these companies offer different division of labor; usually, they just concentrate on their part which is their core competence. During the cooperation, working efficiency increases which brings scope economy with costs declining.

Another reason is the advantages for the gathering of talent. The labor market forms with the industry cluster and there are many different kinds of institutions which offer myriad jobs for professional talent. Therefore, a

talent pool will be established which can decrease the cost of training and managing.

Because the internal cost is the main part of the total cost, the decrease of the internal cost will make the unit cost C decline, $0 < b < 1$, and the equilibrium in this model:

$$P_1'^* = P_2'^* = (a+c)/(2-b) \quad (15)$$

$$q1'^* = q2'^* = [a-(1-b)c]/(2-b) \quad (16)$$

The equilibrium price goes down but the equilibrium production goes up. For the whole industry, the industry efficiency becomes stronger.

$$\Pi_A' = \Pi_B' = [a-(1-b)c]^2/(2-b)^2 \quad (17)$$

Through the function above, when the price equilibrium declines, the profit increases, which brings scale economical effects to the corporation.

As a software industry cluster, the same companies are gathered on the point of the industry chain, in which there are many supply chains. Then a professional talent market forms due to the demand from the cluster. The more companies gather together, the more effective the regional brand is, which makes the number of corporations in the cluster increase. This in turn makes the competition in the cluster fiercer, which makes the innovation more rapid. A case exemplified often is Silicon Valley, which is at the upper part of the software industry and produces the system software which brings high added-value. Meanwhile, companies seldom offer the system software in the Bangalore cluster, but still, it is one of the most successful software clusters for software out-sourcing in the world.

3.2 Innovation Motivation

3.2.1 Model of Innovation Motivation

Assumption:

1) Before the industry cluster formed, the companies are as dispersive distribution, there is lack of connection between the companies, and the innovations are separated.

2) After industry cluster formed, the cluster innovation model is used.

3) Each company has the same level of knowledge and technology.

Based on Jin Xiangrong's research (2001), the model of company innovation is:

$$E_i = w_r \cdot v_r$$

$$v_r = \delta \cdot i^{\theta} \cdot i_c^{\gamma}$$

w_r : the quantity of the elements input directly by the company

vr : innovation productivity per unit element

δ : constant

i : the quantity of company's private knowledge

i_c : the quantity of the public net's knowledge

θ: the elasticity of company's private knowledge

γ: the elasticity of public net's knowledge

Before the cluster formed, the public knowledge net is useless; the elasticity of public net's knowledge is 0, which leads to the single company's innovative advantage:

$$E_i = w_r \cdot \delta \cdot i_0^{\theta}$$

$i_0 1$ is the quantity of knowledge of the single company

The whole innovation advantage produced by n companies is:

$$E_i^n = (n\, w_r) \cdot \delta \cdot (n\, i_{01})^{\theta} \quad (18)$$

After n companies gather, the advantage of innovation is:

$$E_i^C = (n\, w_r) \cdot \delta \cdot (n i_{02})^{\theta} i_c^{\gamma} \quad (19)$$

After clustering, some knowledge spillover to form the public knowledge i_c, the excess knowledge of the n companies is $n\, i_{02}$

$$i_{01} = i_{02} + i_c \quad (20)$$

the knowledge is divided into exclusive knowledge, ni_{02} and non-exclusive knowledge, i_c

$\omega = i_c / i_0^1$ stands for the level of the knowledge spillover

$$i_c = i_{01} \cdot \omega \quad (21)$$

$$i_{02} = (1-\omega) i_{01} \quad (22)$$

$$i_{02}^{\theta} \cdot i_c^{\gamma} - i_{01}^{\theta} = 0 \quad (23)$$

$$i_c^{\gamma} = 1/(1-\omega)^{\theta} \quad (24)$$

When $E_i^c = E_i^n, i_c^{\gamma} = 1/(1-\omega)^{\theta}$, there is no difference after the cluster, there is no motivation of cluster.

When $E_i^c > E_i^n, i_c^{\gamma} > 1/(1-\omega)^{\theta}$, the innovation of cluster is more than before, there is motivation of cluster.

3.2.2. Analyze of Innovation Motivation

At the beginning of the cluster, the source of public knowledge is from the individual companies' spillover, $\gamma = 0, \omega = i_c / i_{01}$. As the companies gather, the cooperation and connection deepen, the learning effects influence the public knowledge; ic' i_{01}-i_{02}, i_c is the increased public knowledge, and this is not on the premise of losing the private knowledge; $\omega = i_c / i_{01}$ does not change. When $i_c^{\gamma} > 1/(1-\omega)^{\theta}$ there's motivation for the companies gathering.

Software industry cluster is the hotbed for the companies to study and innovate. The companies learn from each other and cooperate in R&D, offering their services. When the companies are near, the competition is a pressure to force the company to keep on innovating. Compared to other industries, in the software industry it is easier to realize the spillover effect because software industry is a typical knowledge intensive industry. Inno-

vation is the most important motivation for the software industry cluster.

4. Conclusions

As the software industry developed, the increasing speed of software industry in China is over 30%. It is necessary to find a proper way for the software industry development.

This paper analyzes the motivation of software industry which is divided into two factors, cost factor and innovation factor. Through this, the game relation between the companies in the cluster is clarified. And the essence of software industry cluster is the software supply chain clustering, not the industry chain clustering. All the companies on the supply chain share the information and core technology, which integrates the core competitive power of each company. Due to the cost advantage and the innovation advantage, a single company is not just belong to a supply chain but a point in the supply chain net. A lot of supply chain gathered to software industry clustering.

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