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A study on the corporation relationship in the industrial ecology based on the symbiotic perspective

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ABSTRACT

In this paper, author studied the corporation relationship in the industrial ecology in the symbiotic theory. Author think that these enterprise in the industrial ecology will build a symbiotic relationship in facing the uncertainty of market, and they will build a stability symbiotic relationship in their best efforts, but an effective mechanism must be established if this stability symbiotic relationship will be built. In this paper, author studied: one of them is that the conditions to form a symbiotic relationship among these corporation, and author think that the symbiotic relationship will be built depends on the symbiotic energy producing from them;another is that the choice of a symbiotic object, and author think that the choice of object depends on the degree that each enterprise obtain the market information.

KEYWORDS

The corporation relationship; Industrial ecology; Symbiotic theory; Symbiotic relationship.

INTRODUCTION

Today, an industry will develop toward a form of industrial ecology. In the industrial ecology, each enterprise in an industrial ecology will search for an effective way to achieve development[1]. In particularly, with increasing degree of economic globalization, the pattern of competition has undergone enormous changes among these enterprises, in facing the fierce global market-competition, the enterprise want to gain a competitive advantage, it will not rely on itself core competencies, but also rely on the relationship among them with the other enterprises[2]. The traditional mode of hostile competition has become increasingly outdated; the correct approach should be actively seeking integration and collaboration these enterprises between the upstream and downstream[3]. In particular, the very unique "the requests system" of Japanese manufacturing companies demonstrated the competitive dynamic and the practice of the enterprise to make vertical integration strategy[4], That business and academia profoundly recognize that it will become an effective ways to solve the problem about the weak competitiveness of individual enterprises through build a corporate relations among these related businesses. I highly agree with this view, and through studying this phenomenon deeply, we found: in an industrial ecology, these enterprises will establish a mutual symbiotic relationship of collaboration in order to enhance the ability to resist market risks and achieve the overall maximum benefit. It is a very important theoretical and practical significance that we analysis the internal mechanism to build the symbiotic relationship among them. In this paper, we will analyze it under the symbiotic perspective; we will probe the necessity and effective way to establish a symbiotic relationship among these enterprises in the industrial ecology.

THE SYMBIOSIS THEORY AND ANALYSIS METHOD

The symbiosis theory discovers and explores the objective laws of symbiosis through analyzing the phenomenon of symbiosis, and reveals the inevitable link among the symbiotic unit, or symbiotic unit and symbiotic systems, and the ecosystems and the environment[5]. Therefore, it is the basic logic that we identify the phenomenon of symbiosiss and seek a symbiosis relationship among the units through using symbiosis theory[6].

The symbiosis system refers to a system that it is formed according to some pattern among symbiosis unit in a certain symbiosis environment. After the business implementation management of supply chain, in fact, it is made a artificially Symbiosis system. In the symbiosis system, how to increase the symbiosis energy, and rational allocation the symbiosis energy, and maintain the competitiveness of symbiosis system, and stability and prevent the phase transition of symbiosis system is important[7].

In the analysis of symbiosis theory, it is a prerequisite to select the symbiosis unit, it is the basis to form symbiosis energy, it is protection to create a symbiosis environment, and the main purpose is to analyze the mode and the conditions to consistently existence and development about symbiosis system. Symbiosis unit is the basic unit of energy production and exchange to constitute symbionts or symbiotic relationship; it is the basic material conditions to form symbionts. In different symbionts, the nature and the feature of the Symbiosis unit is different, the nature and characteristics of symbiotic unit is different in analysis of symbiosis at different levels. It form the symbiosis environment in all factors other than symbiosis unit. The environment of symbiosis is the enterprise survival environment; it is the ecological environment to maintain the single business enterprise or an overall industry survival and development, it include both natural and social environment, but also include the enterprise cluster. It include: the first is a macro-level enterprise habitats, referring to the ecological environment in which the enterprise cluster running;

Another is a micro-level single enterprise habitat, refers to the ecological environment in which single business running. The symbiosis energy reflects the ability of existence and value-added of

symbiosis system, and it is the premise that the symbiosis systems improve the quality and expand the number[8].

In this paper, we will probe the conditions and process and effective model to establish symbiotic relationship between the upstream enterprise and downstream enterprise of industry chain through using energy generation mechanisms and selection mechanism of symbiosis object.

THE ANALYSIS OF SYMBIOTIC CONDITIONS

In an industrial ecology, a most important corporation relationship is the relationship between the upstream enterprise and downstream enterprise of industry chain, in this paper, we will focus on the analysis about this corporation relationship. Which performance a behavioral characteristics as a transaction-based between the upstream enterprise and downstream enterprise of industry chain, therefore, a symbiotic relationship is a enterprise symbionts which is formed among them and performance a behavioral characteristics based on the transaction symbiotic, that the symbionts is primarily built to share their information and to ensure that its internal providers, enterprises and customers gain maximum benefit by minimum cost, to achieve the minimized overall survival cost[9].

In other words, if some enterprises want to establish a symbiotic relationship among them, which must be able to produce an effective energy among them, in this paper, we will analyze that which need what kind of conditions to produce such benefits and use what kind of the mechanism, through building a game model.

Preliminary conditions

In the market system, we will study the game relationship between two individuals, in the first, we will build a series of basic assumptions which is the rules that they must obey among these participants in the game, in this paper, and we give the following assumptions:

Each individual is self-interest, and the aim of action is to pursue the maximization interests. This interest is a comprehensive benefit, which includes both material and spiritual interests, and also includes short-term benefits and long-term interests;

The two sides of the game participants must adhere to the principle of good faith in the process of game. Both participants must be honest and trustworthy, if one party lost their promises which will be severely punished;

The game process can be repeated, and in the course of repeated games, information and credibility will be cumulative;

Assuming that the technical level is exogenous factors; the technical levels remained unchanged during a given period.

Relational model

Giving that A and B are two companies in the market, the products of cooperate A is the raw materials or spare parts production of cooperate B, the symbiotic cooperation process is a dynamic selection process among them, in this game, the strategy space between corporate A and corporate B is (cooperative symbiosis, non-cooperation symbiosis), and the strategy selection is random for corporate A and corporate B, assuming that the probabilities is p and q (p, $q \geq 0$) which select symbiotic cooperation strategies between corporate A and corporate B. The strategy space between corporate A and corporate B include four cases below:

If both corporate A and corporate B simultaneously apply the strategy of cooperative coexistence

Suppose that maximum amount commodity is Q in the trading process between corporate A and corporate B (if the production of corporate A is greater than the demand of corporate B, and they will transact according to the demand of corporate B, if the demand of corporate B is higher than the

production of corporate A, and they will transact according to the production of corporate A), the price of production determined by two corporate together is P,we don't consider the production cost of corporate A, and suppose that the transaction costs is C_0 for their cooperate of the two companies with each other, which include: negotiation costs and compliance costs and monitoring costs and risk costs[10], and the $\lambda = C_0 / Q$ is the transaction costs of per unit product in the cooperation process among them, and the proportion of the cost share in each is k_A, k_B ($k_A + k_B = 1$)according to their negotiation.

If corporate A chooses a cooperative symbiosis and corporate B choose a non-cooperative symbiosis

Corporate A want to cooperate based on remain transaction costs for the production price recipient, and suppose that it can find a new buyer. If corporate B select non-cooperative, then corporate B will search new suppliers through looking for in the market, corporate B will spend searching costs, if the searching cost of corporate B is proportional to C_0,and set the scale factor is α,and the price that corporate B purchase raw materials or spare parts is P_1.

If corporate B choose to cooperate symbiotic and corporate A choose non-cooperation symbiotic

Corporate B will build cooperation symbiotic relationship according to the demand of supplier; the conditions of supplier must be accepted by corporate B. If corporate A choose non-cooperation symbiotic, then corporate A will find a new buyers through searching in the market, corporate A will spend the search costs (marketing costs), if the cost of corporate A to search is proportional to C_0 at this time, and we assume that the scale factor is β,and the sales price of corporate A is P_2, then the price of corporate B to purchase raw materials or components must be P_2.

If both corporate A and corporate B choose non-cooperative symbiosis

Corporate A will find new buyers through search the market, the search costs what they will take is βC_0, and corporate B will find new suppliers through search the market, and the search cost which they will spend is αC_0,and the price is P_3.

We can get a different strategy payment which two sides adopt of game through analysis the strategy space between corporate A and corporate B (shown in TABLE 1).

TABLE 1 : The payoff matrix when corporate A and corporate B adopt different strategies

B A	Cooperative symbiosis(q)	non-cooperation symbiotic(1- q)
cooperative symbiosis(p)	$(PQ - k_A C_0, -PQ - k_B C_0)$	$(P_1 Q - C_0, -P_1 Q - \alpha C_0)$
Non-cooperation symbiotic(1- p)	$(P_2 Q - \beta C_0, -P_2 Q - C_0)$	$(P_3 Q - \beta C_0, -P_3 Q - \alpha C_0)$

Analysis of game balance

Here, we will analyze conditions that they achieve the game equilibrium between corporate A and corporate B.

If we consider this question from the perspective of corporate A, and corporate A hold the full information about itself strategies, and hold incomplete information about corporate B strategy. So corporate A will determine whether it will choose to cooperate according to the difference ΔE_A which is

the expected return E_{1A} of corporate A select Cooperation ($p=1$)and the expected revenue E_{2A} of corporate A choose uncooperative ($p=0$)

If corporate A chooses cooperative strategy, its expected return is:

$$E_{1A} = q(PQ - k_A C_0) + (1-q)(P_1 Q - C_0)$$

If corporate A chooses uncooperative strategy, its expected return is:

$$E_{2A} = q(P_2 Q - \beta C_0) + (1-q)(P_3 Q - \beta C_0)$$

If corporate A want to choose cooperative strategy, then

$$\Delta E_A = E_{1A} - E_{2A} \geq 0$$

That is:

$$q(PQ - k_A C_0) + (1-q)(P_1 Q - C_0) - q(P_2 Q - \beta C_0) - (1-q)(P_3 Q - \beta C_0) \geq 0$$

We can get the conditions that corporate A chooses cooperation strategy:

$$\beta \geq 1 + k_A q - q - \frac{q(P_2 - P) + (1-q)(P_3 - P_1)}{\lambda} \quad (1)$$

$$\lambda \leq \frac{q(P - P_2) + (1-q)(P_1 - P_3)}{1 + k_A - q - \beta} \quad (2)$$

It can be seen to make the choice a cooperation symbiotic strategy to corporate A from equation (1) and (2) that it must satisfy the conditions: under other conditions remain unchanged, if the search costs of corporate A are higher than a certain value and this value exceeds its cooperation symbiotic transaction costs to looking for new partners; the unit symbiotic transaction fee have a maximum value; the product market price is rigid; If they can not meet these conditions, these corporate will give up symbiotic cooperation strategy based on considering of self-interest.

If we consider this question from the perspective of corporate B, corporate B holds complete information about itself strategies, and holds incomplete information about the strategy of corporate A.

So corporate B will determine whether it will choose to cooperate according to the difference ΔE_B which is the expected return E_{1B} of corporate A select Cooperation ($q=1$)and the expected revenue E_{2B} of corporate A choose uncooperative($q=0$)

If corporate B chooses cooperative strategy, its expected return is:

$$E_{1B} = p(-PQ - k_B C_0) + (1-p)(-P_2 Q - C_0)$$

If corporate B chooses uncooperative strategy, its expected return is:

$$E_{2B} = p(-P_1 Q - \alpha C_0) + (1-p)(-P_3 Q - \alpha C_0)$$

If corporate B want to choose cooperative strategy, then

$$\Delta E_B = E_{1B} - E_{2B} \geq 0$$

That is:

$$p(-PQ - k_B C_0) + (1-p)(-P_2 Q - C_0) - p(-P_1 Q - \alpha C_0) - (1-p)(-P_3 Q - \alpha C_0) \geq 0$$

We can get the conditions that corporate B chooses cooperation strategy:

$$\alpha \geq 1 + k_B p - p - \frac{p(p_1 - p) + (1-p)(p_3 - p_2)}{\lambda} \quad (3)$$

$$\lambda \leq \frac{p(p_1 - p) + (1-p)(p_3 - p_2)}{1 + k_B p - \alpha - p} \quad (4)$$

It can be seen to make the choice a cooperation symbiotic strategy to corporate B from expression (3) and (4) that it must satisfy the conditions: under other conditions remain unchanged, if the search costs of corporate B are higher than a certain value and this value exceeds its cooperation symbiotic transaction costs to looking for new partners; the unit symbiotic transaction fee have a maximum value; the product market price is rigid; If they can not meet these conditions, these corporate will give up symbiotic cooperation strategy based on considering of self-interest.

Comprehensive (1)-(4), we can conclude the conditions which meet corporate A and corporate B to select cooperation symbiotic strategy:

$$\alpha \geq 1 + k_B p - p - \frac{p(p_1 - p) + (1-p)(p_3 - p_2)}{\lambda} \quad (5)$$

$$\beta \geq 1 + k_A q - q - \frac{q(P_2 - P) + (1-q)(P_3 - P_1)}{\lambda} \quad (6)$$

$$\lambda \leq \min\left\{\frac{q(P - P_2) + (1-q)(P_1 - P_3)}{1 + k_A - q - \beta}, \frac{p(p_1 - p) + (1-p)(p_3 - p_2)}{1 + k_B p - \alpha - p}\right\} \quad (7)$$

We can get these from (5)-(6):

$$k_A \leq 1 - \frac{1-\beta}{q} + \frac{q(P_2 - P) + (1-q)(P_3 - P_1)}{\lambda q} \quad (8)$$

$$k_B \leq 1 - \frac{1-\alpha}{p} + \frac{p(p_1 - p) + (1-p)(p_3 - p_2)}{\lambda p} \quad (9)$$

If we set the symbiotic energy which is generated symbiotic relationship from manufacturing companies and the seller to be E_s ,then: $E_s = \Delta E_A + \Delta E_B \geq 0$

Expressions (5) - (9) show the internal and external conditions of corporate A and corporate B to select cooperation strategy: First, under other conditions remain unchanged; the search costs which a enterprise look for new partners through the market is higher than a certain value, and this value exceeds its cooperation symbiotic transaction costs, they will have a wishes to choice cooperation symbiotic among them; Second, when they achieve cooperation symbiotic between corporate A and corporate B, its unit symbiotic transaction costs can not exceed a certain limit, if it beyond this limit that the

symbiotic relationship will breakup; Third, if some enterprise will build cooperation symbiotic, in the process for cooperation symbiotic, the symbiotic transaction costs will be shared according to a certain proportion, and the sharing proportion can not exceed the limit of their patience, otherwise they will lose the initiative of cooperation; Fourth, the market prices of raw materials trading tends to rigid.

It can be seen from the above analysis, the transaction costs is a major factor to decision whether to establish symbiotic relationship between the upstream enterprise and downstream enterprise of industry chain, and the transaction costs will be mainly decided through the mutual communicate mechanism and the degree of mutual trust among the participation enterprise. Among them, the mutual communicate mechanism that one refers to channels - symbiotic interface that the upstream enterprise and downstream enterprise of industry chain exchange material and information and energy; another refers to the way that the upstream enterprise and downstream enterprise of industry chain communicate, when the communicate mechanism will develop toward the most favorable direction to fit the mutual interests, it will greatly reduce the cost of cooperation symbiotic enterprise which will spend through the traditional mode of supply, and the degree of mutual trust among these enterprise will gradually deepen with the increase in the number of exchanges, and it will reduce the treaty cost and monitoring costs among cooperation symbiotic enterprise, and also it will greatly reduce the production risks.

SELECTION OF THE SYMBIOTIC OBJECT

In the choice to the symbiotic object, it can be divided into two situation including relative choice and absolute choice by their completeness of information. In the relative choice, symbiotic enterprises will be sorted these limited symbiotic object, they will choice the enterprise as a symbiotic object which mostly meet symbiotic requirements. In the absolute choice, symbiosis enterprise will sort all possible symbiotic alternative objects, then they will choice the enterprise as the symbiotic object which has the most appropriate symbiotic conditions. Under the complete information, they use the method of non-competitive choose, and it includes two rules: proximity rules and correlation degree rules, under such conditions, the market information are fully transparent, companies can get all information about the market, these enterprises can sort all candidate symbiotic object directly. Under the incomplete information, they use the method of competitive choose. In this paper, we will discuss the principles of choice of the enterprise network symbiotic object, which will include complete information and incomplete information[11].

Object choice under incomplete information

Incomplete information which is discussed in this paper is: First, the market information is incomplete: The market information is often closed, and the dissemination of information is delayed; Second, the information which enterprise access is incomplete: the companies can not obtain sufficient and complete market information. So, in this incomplete information situation, in the process to establish a symbiotic relationship inter-enterprise, when these companies choice the symbiotic object, they must establish an effective competition mechanism, and choice a enterprise as a symbiotic object which can mostly produce the cooperation symbiotic effect in these limited number of alternative partner.

When we choice the symbiotic object in competitive means, we usually use the comparison means of symbiotic energy. According to the basic principles of the symbiotic theory, when they establish the symbiotic relationship among these enterprises, the symbiotic energy E_s will be generated among each of the participating enterprises. Assumptions, in the process to form the symbiotic systems, there are n of the participating enterprises, then, we can get a group of symbiotic energy data during any one review period for the central enterprise.

$E_{st} = \{E_{sti}\}\ (i = 1 \sim n)$

If in the process to form a stable symbiotic system, they will compete-cooperate through m times, they will obtain $n \times m$ of symbiotic energy data, then they will select the enterprise as a symbiotic object which generate the most symbiotic energy through comparing them.

Namely: the symbiotic object is them which must meet the following conditions:

$E_{sx} = \max\{E_{sti}\}(t = 1 \sim m, i = 1 \sim n)$

Candidate enterprise x is the optimal symbiotic partner for the center enterprises to be selected. In these objects, they have different characteristics based on different symbionts. In a symbiotic relationship formed by the center enterprise and the buyer, the buyer object generally has the following characteristics: First, it can provide reliable quality products, second, it can provide a reasonable product price, third, it has enough customer loyalty, forth, it has a strong scientific and technological innovation abilities, fifth, it has a strong cooperation symbiotic consciousness, sixth, it has an enough product capacity. In a symbiotic relationship formed by the center enterprise and the seller, the seller object generally has the following characteristics: First, it has a strong customer loyalty, second, it is a enterprise of product-dependent, third, it has a strong cooperation symbiotic consciousness, forth, it has the sufficient product satisfaction. In a symbiotic relationship formed by the center enterprise and the same industry, the same industry generally has the following characteristics: First, it has a strong technological complementarities with the central enterprise, second, it has a certain market compatibility, third, it has a strong cooperation symbiotic consciousness, forth, it has a common development aspirations, fifth, it must face a common market pressures.

Object choice under complete information

Complete information which is discussed in this paper is: First, market information is complete: the market information is open to all individuals, and its dissemination is in a timely; second, the enterprise gets the complete information: the enterprises mastered the full and complete market information. Therefore, in this full and complete information condition, in the process to establish a symbiotic relationship inter-enterprise, when the companies choose a symbiotic object, they will use a non-competitive means, and they will select the enterprise as the symbiotic object which can generate the best symbiotic effect among a large number of alternative partner. This non-competitive selection method which includes the rules of proximity choice and the rules of correlation degree choice.

The rules of proximity choice

Proximity reflects the relationship of quality parameters among these symbiotic unit in their same generation or different generation, also refers the possession of the symbiotic unit. to a common features of ancestor.

If the ancestor of the feature vector of the symbiotic unit is $\vec{H} = (H_1, H_2, \cdots H_n)$, for a two-dimensional symbiotic unit, if the symbiotic unit A share the ancestor of the characteristics is: $\vec{h}_a = (h_{a1}, h_{a2}, \cdots h_{am})$, the symbiotic unit B share the ancestor of the characteristics is: $\vec{h}_b = (h_{b1}, h_{b2}, \cdots h_{bm})$,if we express proximity with μ ,there are:

For the symbiotic unit A: $\mu_A = \frac{\sum_{i=1}^{m} h_{ai}}{\sum_{k=1}^{n} H_k}$

For the symbiotic unit B: $\mu_B = \frac{\sum_{j=1}^{m} h_{bj}}{\sum_{k=1}^{n} H_k}$

If $\mu_A = \mu_B$, the symbiotic unit A and the symbiotic unit B is the same generation individual, if $\mu_A \neq \mu_B$, the symbiotic unit A and the symbiotic unit B is the different generation individual. The proximity is higher, and the retention rate is higher to the ancestor features of symbiosis unit, and the subrogation is higher. The influence of the proximity to the symbiotic relationship can be described with the relative proximity, if the relative proximity is R_{AB},then $R_{AB} = \frac{\mu_A}{\mu_B}(\mu_B \neq 0 \leq 1)$, if the critical value of the relative proximity is R_0, then if they will form a symbiotic relationship, it must meet: $R_{AB} \geq R_0$, the relative proximity R_{AB} is more larger and the symbiotic relationship is more stable, the symbiotic energy produced by the symbiotic system will also be more greater.

In enterprise symbiotic systems, the proximity is a parameter which is used to measure the degree of intimacy of the relationship within the symbiotic enterprise. I believe when it is used in the rules of proximity choice, then it means that these enterprises involved in the establishment of a symbiotic relationship are similar enterprises, and they derive from the same parent company as subsidiaries company or far-generation subsidiary company. The proximity is bigger, the more the company accesses the resources from the parent company, the relationship is more closely with the parent company. The proximity is smaller and more alienated relationship between subsidiaries and parent company, and then the subsidiary is more independent out of the parent. For a two-dimensional symbiotic system, if the proximity of the two companies is closer, then they will belong to the same level subsidiary, and they will stand the same competitive position, and they should establish a stable cooperative symbiotic relationship; if the proximity of two companies has a large difference, the genetic relationship between them is weak, it will bring about a greater competitive position difference, and the cooperative symbiotic relationship established by them will have a greater volatility. This rule of proximity choice is generally used in the selection process of the symbiotic unit in the same industry competitors.

The rules of correlation degree choice

The correlation degree is a parameters which represent the relationship of qualitative parameters among the heterogeneous symbiotic unit, it is usually represented with the main quality parameters of the symbiotic unit, it is ∂^m, for a two-dimensional symbiotic unit X and Y ,there are:

$$\partial^m = \frac{Z_X^m}{Z_Y^m} = \frac{f(Z_Y^m)}{Z_Y^m}(Z_Y^m \neq 0)$$

The ∂^m is bigger and the correlation degree is higher between the symbiotic unit A and the symbiotic unit B.

In an enterprise symbiotic systems, the correlation degree can be used to measure the impact and the degree of compatibility among the symbiotic enterprise in the products and the services, I consider that we can calculate it which is generally the proportion contributed by the operating income of the enterprise in the enterprise symbiotic unit. When we use the rules of correlation degree, it means that the participant to establish the symbiotic relationship is the heterogeneous enterprise, but they must contact in substance or technical. The correlation degree is greater and the degree of dependence is greater among these enterprises, it will be more likely to establish a stable symbiotic relationship among them. The rule of correlation degree choice is generally used in the choice of supply chain symbiotic enterprise unit. When these enterprise choice the symbiotic object in the correlation degree, some of them have the natural interrelated relationship, for example, in the same industry cluster, the upstream and downstream enterprises, as well as complementary products manufacturing enterprises, they have a strong correlative relationship, and they have a larger correlation degree, they can become a natural symbiotic object, although there is no natural relationship in geographical relationship among some enterprise, but they also can establish a symbiotic relationship through continuous communication and culture mutual relationship and improve the correlation degree.

CONCLUSIONS

The mode of the relationship among these enterprises in an industrial ecology depends on the transaction costs among them. Whether the symbiotic relationship among these enterprises in an industrial ecology will be established, it depends on whether this symbiotic relationship can effectively reduce the transaction costs among them, and whether the transaction costs of being reduced can compensate the coordination costs to maintain the symbiotic relationship. In an intense competitive market environment, the uncertainty greatly increases transaction costs, and the coordination costs will be reduced, and it make the symbiotic relationship to be established among these enterprises in an industrial ecology.

However, they need select a good symbiotic object if they want to build an effective symbiotic relationship. When they select an object to establish a cooperation symbiotic relationship, under the complete information, the enterprise will adopt the degree of closeness enterprises and correlation rules to select a symbiotic object, and they will be selected to build symbiotic relationship which is the high degree of closeness or the strong correlation. Under the incomplete information, companies will use competitive selection rules, and they will select it as symbiotic object which should produce the largest cooperation symbiotic energy, they only select the most appropriate enterprise through a reasonable way, that they will establish an effective and stable symbiotic system.

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