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Research Article

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Understanding the evolutional path of integrated virtual worlds based on Symbiosis Theory

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ABSTRACT

Virtual world's integration involves all the companies in its industry chain. The companies are in one symbiotic system because they have both competitive and cooperation relationships. This study first develops a symbiotic system for these involved companies. Then it studies the system's two evolutional paths with and without positive incentive respectively, trying to find the evolutional rules and give some suggestions for government.

Key words: Integrated virtual worlds, symbiotic system, evolutional path, symbiotic mechanism

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INTRODUCTION

Although we are going into the era of virtual worlds' prosperity, the SNS community-based virtual worlds and 3D game-based virtual worlds are facing developing difficulties. These two kinds of virtual worlds (namely, SNS community-based virtual worlds and 3D game-based virtual worlds) will integrate with each other inevitably for two reasons. Firstly, one kind of virtual worlds can help the other one kind go through its profit dilemma [1, 2]. Secondly, the future virtual world including both 3D entertainment and community social elements will be an interesting and popular electronic model for consumers. The upstream and downstream companies such as 3D game developers, virtual world operators, software suppliers, service providers, network suppliers will involve in the new-born integrated virtual worlds [3, 4]. We proclaim their relationship is symbiotic. This article will introduce Symbiotic Theory into the research of virtual worlds, hopping to better understand how virtual world's integration evolves in the future.

THE APPLICABILITY OF SYMBIOSIS THEORY

The virtual world's operators need to put 3D technology and social interaction into the virtual world's design and development in order to create a harmonious integrated environment. The integration is a complicated process because it is an eliminating process of many unfavorable factors. Symbiosis Theory is an appropriate method for our research because it fits for studying the information transmission and energy exchange between complex populations. We will use this theory to develop a symbiotic system and analysis its symbiotic mechanism.

SYMBIOSIS THEORY AND INTEGRATED VIRTUAL WORLD'S SYMBIOTIC SYSTEM

Symbiosis is an ecological concept which came from a mycologist Antonde Bary's report in 1879. He defined it as the living state of different species of organisms. Later, the concept became more and more attractive to scholars in political science, sociology, economy and management [5, 6]. According to this theory, a symbiotic system is composed by three basic elements which are symbiotic units, symbiotic modes and symbiotic environmer ... Th symbiotic units are the energy units in the symbiotic relationship. And they are basic for the formati symbiotic system. The symbiotic modes commonly refer to the symbiotic relationships. They indicate h symbiotic unit interacts with another. The symbiotic environments contain all factors in the symbiotic system

symbiotic units. These three elements interact with each other [7, 8].
In our study, the symbiotic system of virtual world's integration is defined as a certain relationship between among all the upstream and downstream companies in integrated virtual world industry. It is compromised of the symbiotic units of integrated virtual worlds, symbiotic modes of integrated virtual worlds and the symbiotic environment of integrated virtual worlds. The symbiotic units of integrated virtual worlds refer to all the subjects involved in the integration, such as software suppliers, service providers, virtual world's developers, virtual world's operators, network suppliers and equipment providers. Each of them exchanges resource with each other. They have both competitive and cooperative relationships. The interacting ways between two involved companies in the new virtual world industry can be referred to the symbiotic modes. They are fundamental for the units' movement. The symbiotic environments of integrated virtual worlds refer to all the factors except the symbiotic units in this industry, which includes political, economic and cultural environments. The three basic elements work together for the process of virtual world's integration. If we use $\vec{R}$、$\vec{D}$、$\vec{M}$、$\vec{H}$ to represent the relationship vector, unit vector, mode vector and environment vector respectively, we can get the following equation, which is $\vec{R} = (\vec{D}, \vec{M}, \vec{H})$.A symbiotic mode of integrated virtual worlds determines the relationship between two units, including how to allocate money and how to exchange resources. Meanwhile, a symbiotic mode also reflects the relationship between two symbiotic units and their environments. The environments could be policies, legislations and market environments. The symbiotic units need the environments to promote their development. Every pair of symbiotic unit and environment has two sides effect on each other. Their interaction is shown in Table 1.

Table 1: The interaction between a pair of symbiotic unit and environments

	Positive	Negative
Positive	The symbiotic unit and environment are both incentive	The symbiotic unit is disincentive, the symbiotic environment is incentive
Negative	The symbiotic unit is incentive, the symbiotic environment is disincentive	The symbiotic unit and environment are both disincentive

A healthy symbiotic system should have a positive affecting symbiotic environment, an effective symbiotic organization and a mutual beneficial behavior developing trend. The symbiotic mode of our country is mutual somehow, which is good for the integration industry. The symbiotic system for integrated virtual worlds can be seen as a closed ecological community. The collaboration of every pair participates will increase as their competition decreases. The system will eventually stop by the mutual beneficial position where every unit's producing and exchanging capability is the highest. The operating model m of every pair of symbiotic units is shown as Figure 1.

The symbiotic environment

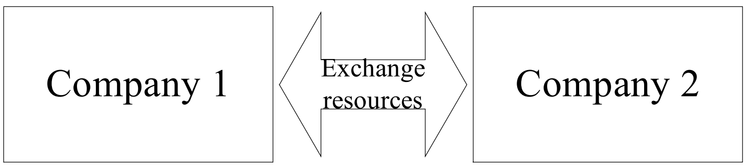

Fig.1: The operating model of every pair of symbiotic units

In the process of the virtual world's integration, the two collaborating participates will establish a long-term symbiotic relationship. The relationship developing model is shown as Figure2. In this figure, the y-coordinate represents the participating degree of the symbiotic units; the x-coordinate represents the symbiosis degree. The participating degree will increase with the increase of symbiosis degree.

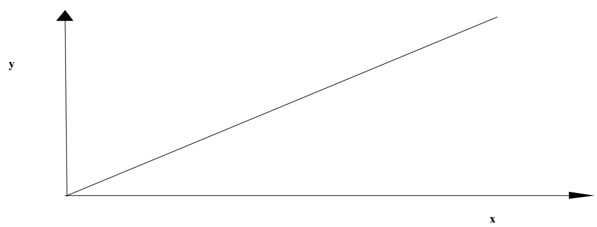

Fig. 2: The participates' relationship developing model

The process of virtual world's integrating is also a trust developing process. In collaboration's early stage, ur not positively engage in integration because of very little trust. When the cooperation goes deeper, their tr grow gradually because the increase of consumers' acceptance and companies' profit. Eventually the trust w high as the integrated market becomes mature. There will be three stages in the process of virtual world's integration (see Table 2). In the initial stage, the two cooperating companies need a contract to start up their cooperation. The contract needs to contain at least two aspects in order to ensure smooth collaboration. The first one is the establishment of reasonable interest allocation. The second one is the establishment of an effective risk prevention mechanism. In the growing stage, companies' sense of cooperation enhances little by little because of the formation of cooperating culture. In the mature stage, parties' interest and loyalty will rise rapidly.

Table 2: Three stages of virtual world's integration

	Initial stage	Growing stage	Mature stage
Integrated market	Harmonious	Competitive	Stable
Policy	None	Appearance of some policies	The formation of a mature policy system
Participation	Little trust	The growth of trust.	High level of trust and loyalty

THE SYMBIOTIC MECHANISM WITHOUT INCENTIVE

In order to do the symbiotic mechanism analysis for virtual world's integration, we need to add dynamic game model into our research model. The followings are our simplified research premises and assumptions.
(1) All companies involved in integration can be seen as units in the same economic community. We divide them into two parts which are the ones who participate in integration and the ones who do not participate in integration.
(2) In the economic community, the symbiotic units are rational and self-interest.
(3) We suppose that each symbiotic unit is apt to rational learning.
(4) Each unity is an independent decision maker.
(5) One unit in each relationship pair is dominant.
(6) The integrated companies evolves from traditional virtual world's involving companies, there has not come one integrated company yet.

The integrated virtual world industry chain is constituted by many upstream and downstream companies .Each one's value-orientation is different from another one. Accordingly, there are various behavioral paradigms. The two features for their behavioral paradigms can be concluded in the followings. Firstly, there is conflicting possibility in resource getting between every two companies in the integrated virtual world industry chain. Secondly, the interaction among interest related companies is dynamic because they have the same goal.

Whether operators of SNS community-based virtual worlds and 3D game-based virtual worlds cooperate or not depends on their consideration about interests. In order to simplify the analysis model, we set no distinction between the two kinds of operators. Obviously, the downstream operators are dominant because their attitude determines if upstream providers' products are sold. In this section what we study is the dynamic game relationship between one upstream company and one downstream operator. The payoff matrix between this pair is shown in Table 3.

Table 3: The payoff matrix between one pair of downstream operator and upstream company

One downstream virtual world's operator

One upstream company

	Cooperate	Not to cooperate
Cooperate	R_1-C, R'-R_1	-C, 0
Not to cooperate	R_2, R'-R_2-C'	0,0

Followings are the two cases:
(1) As the downstream operator is dominant, the upstream company needs to pay cost C to join in the integration. If the downstream company needs to pay R1 to buy the integrated products or service, the operator will get profit R', R'>C;
(2) If the upstream company does not want to provide the integrated products or service, the downstream operator still needs to pay R2 (R2<C) to get un-integrated products or service. He also needs to pay C' to improve his products or service.

We suppose the proportion of companies who join in the integration is X ((0 ≦ X ≦ 1)). Accordingly, the proportion for the un-participating companies is 1－X, then we get the followings:
The interests Expectation of the participating upstream companies: U1=X•(R1－C) －(1－X) •C
The interests Expectation of the traditional upstream companies: U2=X•R2+(1－X)•0
The average interests Expectation: average[E (U)]=X•U1+(1－X) •U2=X[X•(R1－C) －(1－X)(C－R2)]
We use differential equations to count the dynamic velocity of the ones who join in integration:

$$\frac{dX}{dt}=X(U1-\text{average}[E(U)])$$
$$=X\{X\cdot(R1-C)-(1-X)\cdot C-X\cdot[X\cdot(R1-C)-(1-X)(C-R2)]\}$$
$$=X\cdot(1-X)[(R1-R2)\cdot X-C]$$
$$=(R1-R2)\cdot X\cdot(1-X)[X-C/(R1-R2)]$$

According to previous assumptions, we get R1-R2>C 且 R'>R1>R2+C', then we get the phase diagram for the dynamic differential equation (shown in Fig. 3)

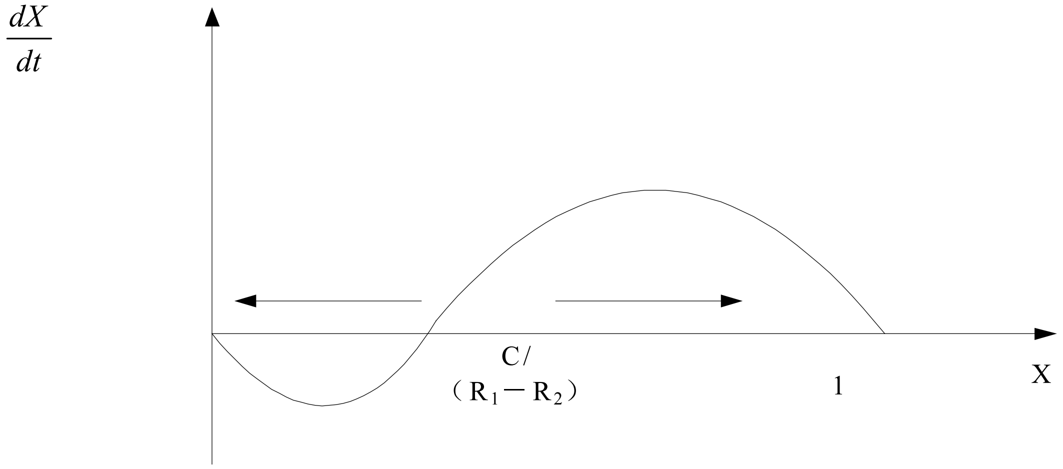

Fig. 3: The phase diagram for upstream companies' dynamic differential equation (without positive incentive)

Figure 3 shows that when proportion of upstream collaborating companies is $X\in\{(C/(R_1-R_2),1\}$,we get (dX/dt)>0, That means when the number of integrating companies reaches a certain point and the benefit seems obvious, the forerunners transformation will play a demonstration effect for all the other companies in the integrated virtual world industry. As traditional companies know more and more about integration, the number of companies who choose to provide integrated products or service will increase and converge to 1 eventually. Obviously, when $X=1,(dX/dt)\mid_{X=0}=0,d\{(dX/dt)\}/dX<0$ the differential dynamic transformation will go stable. Furthermore, in this model, when R1-C>R2, the game model has Nash equilibrium, which means the cooperation between the operators and upstream companies is their optimal strategy. This shows that the upstream companies in this economic community will evolve into integrated ones gradually. Of course when $X\in\{0,C/(R_1-R_2)\}$,we get(dX/dt)<0 ,then the integrating population will decrease. This decrease will lead to the failure of integration. There are three reasons for it failure. Firstly, consumers are still satisfied with the present technology service at present, so the companies have no motivation to reform. Secondly, companies feel the present cooperation so good that they do not want to look for new partners. Thirdly, users lock in effect baffles upstream companies to transform into integrated one.

THE SYMBIOTIC MECHANISM WITH POSITIVE INCENTIVE

Whether the upstream companies would like to transform toward integration depend on the external environment, including policy and market environment. We will put positive incentive into our analysis and see if the positive incentive plays an important role in companies' transformation into integrated products' providers.

The followings are our simplified research premises and assumptions.
(1) All companies involved in integration can be seen as units in the same economic community. We divide them into two parts which are the ones who participate in integration and the ones who do not participate in integration.
(2) In the economic community, the symbiotic units are rational and self-interest.
(3) We suppose that each symbiotic unit is apt to rational learning.
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The integrated virtual world industry chain is constituted by many upstream and downstream companies .Tl various value-orientations. As a result they have various behavioral paradigms accordingly. The two features behavioral paradigms can be concluded in followings. Firstly, there is conflicting possibility in resource getting between every two companies in the integrated virtual world industry chain. Secondly, the interaction among interest related companies is dynamic because they have the same goal.

Here we suppose one upstream company can get B (the amount of financial support from government) to produce the integrated products or service. Then we get the following pay off matrix (see Table 4). It should be different from the one before.

Table 4: The payoff matrix between one pair of downstream operator and upstream company

One downstream virtual worlds' operator

One upstream company		Cooperate	Not to cooperate
	Cooperate	R1-C+B, R'-R1	-C+B, 0
	Not to cooperate	R2, R'-R2-C'+B	0,0

Accordingly, we get the following differential equation for traditional upstream companies.

$$\frac{dX}{dt} = X \cdot \{U1 - \text{average}[E(U)]\} = (R1-R2) \cdot X \cdot (1-X) \cdot [X-(C-B)/(R1-R2)]$$

In this situation, the upstream company's evolutional paths will be different because the relationship between B and C is different. When $C-B \leqq 0$, it equals that the financial support which upstream companies can get from government is higher than their cost to produce integrated service or products. The phase diagram for its dynamic differential equation is shown in Figure 4. This figure indicates that the phase diagram will converge to the point X=1, which means the upstream companies will join in virtual world's integration no matter what exactly their transformation path is.

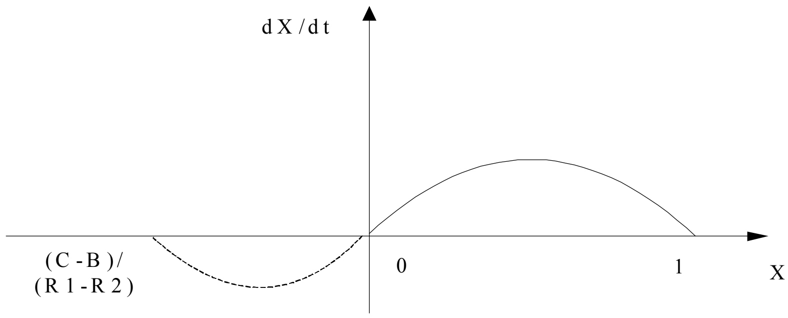

Fig. 4: The phase diagram for upstream companies' dynamic differential equation ($C-B \leqq 0$)

When $C-B>0$,it means the financial support from government is so lower than what the upstream companies need to pay when they are producing integrated products or service. They will be not active to join into virtual world's integration because of this unobvious potential profit. The phase diagram in this situation is shown in figure 5.

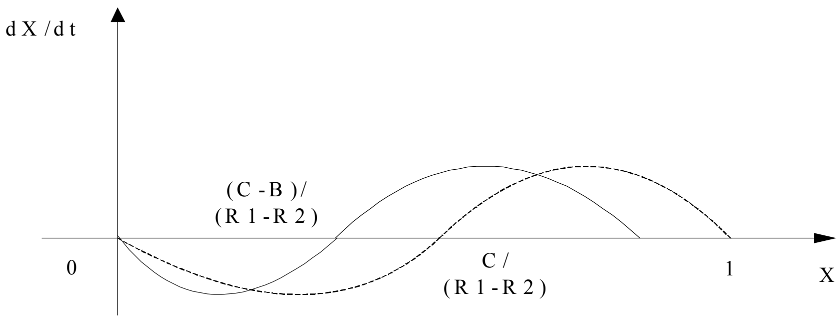

Fig. 5: The phase diagram for upstream companies' dynamic differential equation ($C-B>0$)

What we can see from figure 5 is that upstream companies need some positive incentive to step i integrated market. Government's financial support plays an important role in these companies' transfor Furthermore, the possibility for their transformation is high when$(C-B)/(R_1-R_2)<X<1$.

CONCLUSIONS

We proclaim that all the companies involve in virtual world's integration constitute a symbiotic system. The symbiotic system's evolutional paths with and without positive incentive were explored respectively in our study. The research shows that government's financial support for integration will change the pay off matrix and upstream companies' evolutional path of the symbiotic system compared with the symbiotic system without financial support. If the sum of potential profit and government's financial support is much higher than the profit for traditional production, the upstream companies will be more inclined to join in the integrating economic community. In this situation, the process of virtual world's integration will be promoted. On the contrary, if the sum of potential profit and government's financial support is only a little bit higher that the profit for traditional production, they will still join into integration eventually but the velocity will be much lower. Therefore, it takes effort to promote virtual world's integration. First, government should introduce relative incentive policies to encourage upstream enterprises to join in the integration. Second, regulation system should be established to protect a health cooperation relationship between any pair of upstream and downstream company. Third, the punishment system should be established to suppress any kind of dishonesty acts in virtual worlds' integrating process.

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