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Operation Mechanism of the Driving Force System of Ecosystem of Cyber-society Based on the System Dynamics

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Abstract: Operation of the driving force system of Ecosystem of Cyber-society needs a scientific mechanism of intervention and regulation to solve the integration problem of a variety of organizations and forces within the Ecosystem of Cyber-society, shorten the process from uncoordination to coordination, promote the orderly operation of the driving force system of Ecosystem of Cyber-society, make the system play a strong force, in order to promote the formation and rapid development of Ecosystem of Cyber-society. We analyze the driving force system of Ecosystem of Cyber-society using the theory of System Dynamics and propose a theoretical framework, and then present its operation mechanism systematically.

Keywords: Ecosystem of Cyber-society, Driving Force System, Operation Mechanism, Life Cycle, System Dynamics.

1 Introduction

The operation of the driving force system needs certain operation mechanism, which refers to create interaction relationships between the driving forces, establish a fulcrum, platform and regulation for the driving forces, so that the driving force system can rely on the environment of the driving force system, and make the driving forces function effectively. Similarly, the operation of the driving force system of Ecosystem of Cyber-society also needs a scientific mechanism of intervention and regulation to solve the integration problem of a variety of organizations and forces within the Ecosystem of Cyber-society, shorten the process from uncoordination to coordination, promote the orderly operation of the driving force system of Ecosystem of Cyber-society, make the system play a strong force, in order to promote the formation and rapid development of Ecosystem of Cyber-society. However, since the driving force system consists of a lot of driving forces, its hierarchy is very complex with multi-levels, and different structures may emerge unexpected functions, so we need to find out an effective way to analyze it.

Currently, among the literature can be found around the world, although some scholars have put forward the concept of ecological networks from different perspectives and gradually realized the importance of this research area, there is still not much comprehensive and systematic research about the cyber-society from the perspective of ecosystem. And there is no literature that has proposed the concept of driving force system of Ecosystem of Cyber-society and studied its mechanism systemically from the perspective of the ecosystem for the development of cyber-society. It is a new research area.

The related research mainly focuses on the sociology of network and social ecology. And among them, different scholars have different views about the concept of sociology of network.

About the research on the sociology of network, some scholars advocated classifying it into the area of information science, while some other scholars emphasized the unique features of the network society in the media and dissemination, and claimed to study the evolution of the network society from the perspective of media and dissemination, and one of the representatives is an American social scientist Manuel Custer. He thought that the network society is a new social form of society that different from the reality, and pointed out the network constructs the new form of our society, and the spread of network logic has changed the operating result of production, experience, rights and culture. And it is characterized by social forms than the superiority of social action [1]; While Gong Qi considered the network society as a virtual space of human and humans life, study and work in this alternative space [2].

And the research on the social ecology started earlier. For example, Brown who comes from American Cornell University had analyzed the human activities in social life from the perspective of the natural ecology [3]. Developed so far, the research of this discipline gradually divided into two directions, one is to analyze the phenomenon of human social life using related theories and methods of natural ecology, such as the human activities, social development and so on [4][5], and the other one is to research the coordinated development between the society, economics and resources quantitatively and qualitatively based on the theory of ecology [6][7][8]. The concept of driving force system of Ecosystem of Cyber-society that proposed in this paper is a cross research between the above two disciplines. It not only emphasizes on analyzing the network space from a sociological perspective, but also reflects the theory of system dynamics in the ecology. Therefore, although the concept of driving force system of Ecosystem of Cyber-society is new, since that the research is a frontier that based on the current disciplines and research achievements, the development status and trends of related disciplines are still significant to our research [9].

The organization of this paper is as follows. In Section 2 we propose a theoretical framework of the driving force system of Ecosystem of Cyber-society, and analyze its structure, functions and characteristics. Then, in Section 3, we analyzed the operation environment and formation process of the driving forces. And finally in Section 4 we present the operation mechanism of the driving force system systematically.

2 The Driving Force System of Ecosystem of Cyber-society

2.1 Structure of the Driving Force System

The driving forces that affect the formation and development of Ecosystem of Cyber-society are not chaotic. However, they are an organic whole with a multi-level structure. The formation and development of Ecosystem of Cyber-society are driven by the driving forces that interact and constraint with each other, and ultimately form the multi-layered driving force system [10]. At the same time, the driving force system that affects the formation and development of Ecosystem of Cyber-society is also a unified whole and there is ongoing exchange of material, energy and information between the driving forces. If they can develop harmoniously and coordinately, then they will create a stronger driving force together to facilitate the rapid development of Ecosystem of Cyber-society. Otherwise, they will delay the historical process of formation and development of Ecosystem of Cyber-society. There are three major subsystems in the driving force system of Ecosystem of Cyber-society, namely subsystem of driving forces, stimulate subsystem of driving forces and carrier subsystem of driving forces, as shown in Figure 1. These subsystems interact with each other, and there are continuous exchange of material, energy and information between them. Meanwhile, as a constituent of the driving force system, when the driving forces function on the formation and development of Ecosystem of Cyber-society, their function mode and strength

would be different for different driving forces, and thus form the unique structure of the driving force system [11].

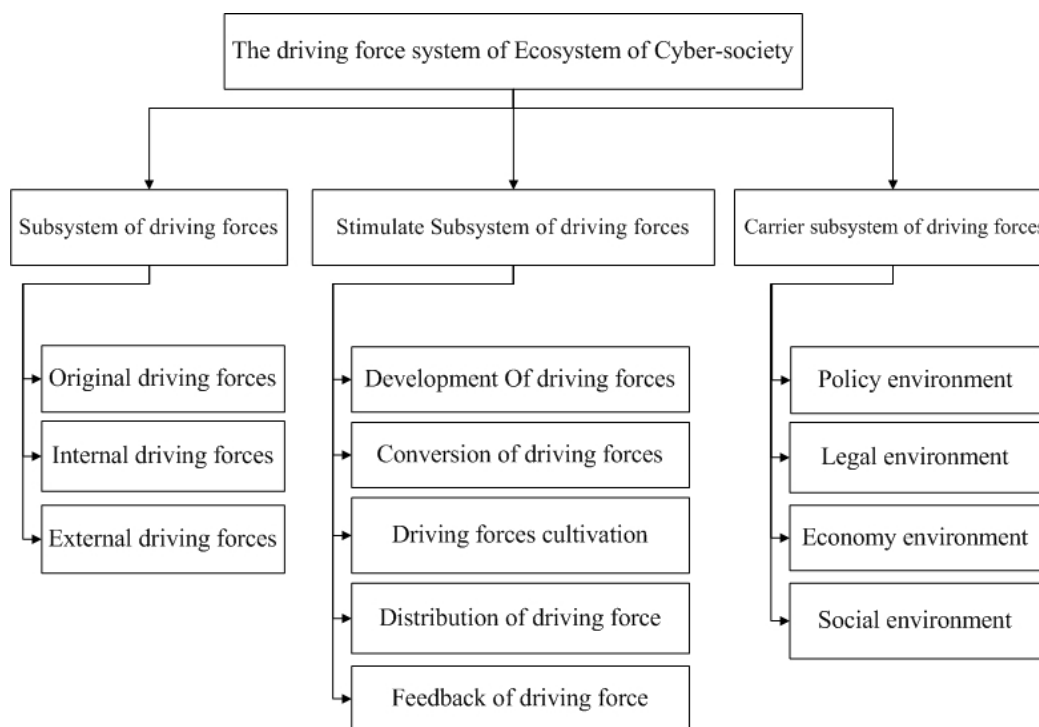


Figure 1: A theoretical framework of the driving force system of Ecosystem of Cyber-society

2.2 Functions of the Driving Force System

The driving force system that affects the formation and development of Ecosystem of Cyber-society has the following functions [12].

(1) To promote the formation of a joint force that affects the formation and development of Ecosystem of Cyber-society.

The formation and development of Ecosystem of Cyber-society is affected by a variety of driving forces together, and the driving forces vary in size, strength, and thus have positive or negative effect. Due to the existence of the driving force system, it makes the driving forces coordinate with each other, and form a joint force that advantageous to the formation and development of Ecosystem of Cyber-society.

(2) Ensure that the driving forces that affect the formation and development of Ecosystem of Cyber-society have a continuous nature.

The short-term characteristics and changes of the driving forces make the formation and development of Ecosystem of Cyber-society in the status of instability. Well operation of the driving force system can ensure the formation and development of Ecosystem of Cyber-society have a continuous driving force.

(3) To promote the optimal combination of the elements of Ecosystem of Cyber-society.

There are many driving forces that interrelate and interact with each other affect the Ecosystem of Cyber-society, and different combinations of the driving forces will play different roles in promoting. The driving force system can promote a better combination of the driving forces to some extent.

(4) To improve the competitiveness of the subjects of Ecosystem of Cyber-society.

The driving forces are the external forces that promote the formation and development of Ecosystem of Cyber-society. They combine into a unified whole through the driving force system and input negative entropy flow into the system continuously, thereby enhancing the competitiveness of the subjects of Ecosystem of Cyber-society.

2.3 Characteristics of the Driving Force System

The driving force system that affects the formation and development of Ecosystem of Cyber-society is an organic whole with multi-levels and multi-factors, and it has the following characteristics.

(1) Integrity

The integrity of the driving force system that affects the formation of Ecosystem of Cyber-society refers to the unified whole that constitutes by various driving forces that interrelate and interact with each other according to some law or in order to achieve a particular purpose, rather than the chaotic random combination of the driving forces. At the same time, the driving force system is not the simple summation of the driving forces, however, it may often produce new functions as a whole that the individual driving force doesn't have. It can be expressed in mathematical language as the following:

$$D = a \sum_{i=1}^n d_i \quad (1)$$

Here,

d represents the function value of the driving forces in the driving force system;

D represents the function value of the overall driving force system;

a represents the function coefficient of the driving forces.

(2) Structure hierarchy

The structure hierarchy of the driving force system that affects the formation of Ecosystem of Cyber-society refers to the hierarchical order of the status, role, structure and function of the system due to the various differences between the driving forces. The structure hierarchy is relative and changes constantly. When the driving forces form a whole with a reasonable structure, then the system will have new functions, and the functions will be larger than the overall functions of individual driving forces. Otherwise, when the driving forces form a whole with a poor structure, then it will damage the functions of the whole system. The expression that uses mathematical language is:

$$D = f(d_1, d_2, d_n) \quad (2)$$

Here,

$f(d_k), k = 1, 2 \dots n$ represents the structure function of the driving force system, and different levels of the structure correspond to different functional forms.

a represents the function coefficient.

(3) Orderliness

The orderliness of the driving force system that affects the formation of Ecosystem of Cyber-society refers to the characteristic of reasonable structure that combined through the coordination and promotion between the various driving forces. The orderliness is relative to the disorder, it shows the structure rationality of the driving force system, and also determines whether the system can function normally. The larger the orderliness of the driving force system, the smaller the obstruction to the formation and development of Ecosystem of Cyber-society and the faster the pace of development. At the same time, the orderliness of the driving force system is not

static, it shows the characteristic of dynamic changes in the long term along with the positive and negative effects on the system between the driving forces, but its overall characteristic and performance maintain stable.

(4) Openness

The openness of the driving force system that affects the formation of Ecosystem of Cyber-society refers to that the driving forces not only have to coordinate and cooperate with each other, but also have to exchange material, information and energy with the external environment continuously at the same time, in order to maintain the specific structure and functions of the driving force system. This open process allows the environment to influence and transform the driving forces, and at the same time the driving force system will also transform the external environment and make it evolve toward its own beneficial development direction. The openness is the guarantee to the orderliness of the driving force system, and just because of the openness of the driving force system, it makes the system can absorb negative entropy flow from the external environment in order to maintain or decrease the entropy within the system continuously, and thus keep the orderliness of the system and further enhanced.

3 Formation of the Driving Forces of Ecosystem of Cyber-society

3.1 Operation Environment of the Driving Force System of Ecosystem of Cyber-society

The so-called operation environment of the driving force system of Ecosystem of Cyber-society refers to the carrier subsystem of driving forces. While the environment is always relative to a center thing, the environment will be different due to different centers, and varies with the changes of the central things. The things associated with the system constitute a collection called the environment of the system.

Similarly, the operation of the driving force system of Ecosystem of Cyber-society also needs certain environmental conditions. The environment of the driving force system of Ecosystem of Cyber-society refers to the sum of the various driving forces that affect the operation and development of Ecosystem of Cyber-society. The various driving forces form an internal system with compact structure through the interaction with each other, and there is the real society outside with the sub-environment of economics, politics and culture. The environment of the driving force system of Ecosystem of Cyber-society represents the potential long-term impact of the real society on Ecosystem of Cyber-society and it is the manifestation of indirectly, more vague, and broad-brush driving forces, and provides environmental support for generating driving forces. The formation and development of Ecosystem of Cyber-society has a strong feature of dynamic, and due to the dual intertwine between the real society and the environment of Ecosystem of Cyber-society, it makes the formation and development of Ecosystem of Cyber-society in an uncertain environment. The driving force system is constrained by these sub-environment systems, and its function on the various driving forces is an important guarantee for the well operation of the driving force system.

3.2 Formation Process of the Driving Forces of Ecosystem of Cyber-society

The so-called formation process of the driving forces of Ecosystem of Cyber-society is just the process that the stimulate subsystem of driving forces functions. The function process of the stimulate subsystem of driving forces consists primarily of the following five sessions, namely develop, transform, cultivate, allocate and feedback, as shown in Figure 2.

(1) Source develop of driving forces

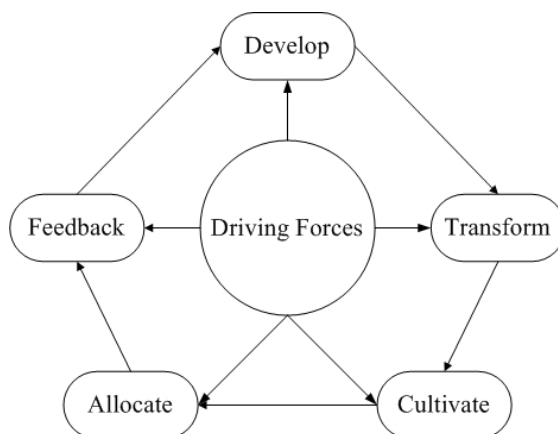


Figure 2: The function process of the stimulate subsystem of driving forces of Ecosystem of Cyber-society

The subjects' participation and use of Ecosystem of Cyber-society are the main reasons that lead to the formation and rapid development of Ecosystem of Cyber-society. In other words, there would be no Ecosystem of Cyber society without the subjects' participation and use no matter how quickly the development of modern science and technology is. The motives of the subjects' behavior are reflected in the interest and benefit, and both of these two aspects are also the major incentives that attract the subjects of Ecosystem of Cyber-society to involve in the network social life. The network economy has also been considered as the eyeball economy, and it means that one will be able to succeed in the competition of Ecosystem of Cyber-society if he can attract the attention of Internet users, seize the interest of Internet users, and meet the benefit of Internet users. The saying of eyeball economy may be not correct, but there is one thing for sure that the Internet users' interest plays a huge role in the formation and change of the current network pattern of Ecosystem of Cyber-society.

(2) Transform of driving forces

The interest and benefit are the sources of driving forces of Ecosystem of Cyber-society, and they are just the potential driving forces. Only if they are transformed into real driving forces, then they can promote the network social behavior of the subjects to meet their needs, and really play an important role as driving forces.

(3) Cultivate of driving forces

The driving forces not only need to be developed and transformed, they are also need to be cultivated and maintained, in order to facilitate the formation and sustainable development of Ecosystem of Cyber-society. Meanwhile, for the driving forces in different levels and different types, the focus of cultivation is also different. It will greatly promote the rapid and healthy development of Ecosystem of Cyber-society to seize the key influencing forces.

(4) Allocate of driving forces

In order to promote the formation and health development of Ecosystem of Cyber-society, we not only have to develop, transform and cultivate appropriate driving forces, but we also have to allocate these relatively independent driving forces to the parts of Ecosystem of Cyber society that need them most, and make them related with each other and combined into a rational structure, then the driving force system can promote the formation and development of Ecosystem of Cyber-society as an organic whole role.

(5) Feedback of driving forces

As a closed loop feedback system, the session of feedback can guarantee the good functioning of the driving force system. After the first few sessions, the Ecosystem of Cyber-society has

obtained some driving forces. However, they are still need the session of feedback to coordinate and make sure that they are adequate. The session of feedback will collect the information about whether these driving forces promote the benign operation and healthy development of Ecosystem of Cyber-society, and then make judgments and give feedback to guide the driving force system to adjust the direction and strength of the driving forces or adjust the combinations between the driving forces, and thus maximize the overall objective of the formation and development of Ecosystem of Cyber-society.

4 Operation Mechanism of the Driving Force System of Ecosystem of Cyber-society

4.1 Operation Life Cycle of the Driving Forces of Ecosystem of Cyber-society

The resources within Ecosystem of Cyber-society can be allocated optimally and achieve the Pareto optimal through the good operation of the driving force system of Ecosystem of Cyber-society, and thus promote the continuous escalating and innovation of the formation and development stages of Ecosystem of Cyber-society. The operation life cycle of the driving force system can be divided into the following three stages, namely initial stage, integration stage and mature stage, and each stage has a different operation mechanism which plays a leading role, as shown in Figure 3 [13].

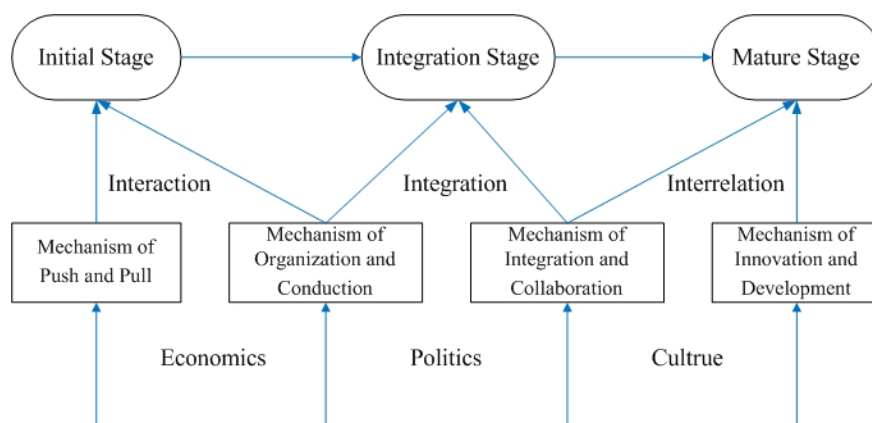


Figure 3: The operation lifecycle of driving force system of Ecosystem of Cyber-society

It has been discussed earlier in this paper about the promotion role that the sub-environment of economics, politics and culture plays on the formation and development of Ecosystem of Cyber-society. It needs to be noted that the force of economics, politics and culture has to infiltrate into the system through the driving force system during the formation and development process of Ecosystem of Cyber-society and then function continuously. The promotion force that the driving force system giving to the Ecosystem of Cyber-society under the interaction between economics, politics and culture should be appropriate and it can be understood specifically from the direction, size and cooperation between the driving forces [14].

(1) Direction of the driving forces. To judge whether the direction of the driving forces is appropriate, we can see whether it is consistent with the overall goal and direction of the development of Ecosystem of Cyber-society. Positive driving force is conducive to the formation and rapid development of Ecosystem of Cyber-society, while negative driving force will inhibit the formation and development of Ecosystem of Cyber-society. Therefore, the force of economics, politics and culture that based on the deep roots of development needs of the subjects of Ecosys-

tem of Cyber-society should be positive, should be conducive to meet the basic survival needs of the subjects of Ecosystem of Cyber-society, should be conducive to increase the high-level needs and satisfaction degree of the subjects of Ecosystem of Cyber-society, and also should be conducive to the coordination between the individuals and groups of Ecosystem of Cyber-society.

(2) Size of the driving forces. As to the positive driving force, its size and strength determine the formation and development speed of Ecosystem of Cyber-society to some extent, that is to say, the larger the value is, the faster the system develops, and vice versa. The "interest" and "benefit" of the subjects promote the formation and rapid development of Ecosystem of Cyber-society, but the increase of interest level and the expectation of benefit pursuit must adapt to the reality of the development of Ecosystem of Cyber-society, and this needs the driving forces to adjust. The Ecosystem of Cyber-society with inadequate driving forces is dull and lack of energy, while the unlimited and vigorous expanded pursuit to the interest and benefit would cause disorder and concussion of Ecosystem of Cyber-society. An appropriate driving force can combine the satisfaction of the subjects interest and the good running order of Ecosystem of Cyber-society together. It can not only activate the driving force of reasonable interest pursuit of the subjects of Ecosystem of Cyber-society, but it can also control the various driving forces and activities that affect the formation and development of Ecosystem of Cyber-society within reasonable limits.

(3) Cooperation between the driving forces. Only if the force of economics, politics and culture can complement with each other, coordinate their actions and optimize the allocation of various needs and interest pursuit of the subjects of Ecosystem of Cyber-society, then it can give appropriate positive driving force to the formation and development of Ecosystem of Cyber-society, and thus effectively promote the formation and development of Ecosystem of Cyber-society.

4.2 Mechanism of Push and Pull

The formation and development of Ecosystem of Cyber-society is a dynamic process, and influenced by various driving forces during the process of dynamic development. Combined with the mechanism analysis of each driving force, the joint effect in the process of formation and development of Ecosystem of Cyber-society can be shown as Figure 4. Here, the ball represents the Ecosystem of Cyber-society, the x -axis represents the time stage of the formation and development of Ecosystem of Cyber-society, the y -axis represents that the formation and development of Ecosystem of Cyber-society is a tough climb process with load, and F_i represents the various driving forces, $i = 0, 1, 2, \dots, n$ [15][16].

The roles that each driving force plays in the formation and development of Ecosystem of Cyber-society have different directions and sizes. According to the theory of Mechanics, the Ecosystem of Cyber-society will be in the state of fast forward development when the positive driving force is larger than the negative driving force, while the Ecosystem of Cyber-society will be in the state of uniform development when the positive driving force is equal to the negative driving force. And the Ecosystem of Cyber-society will be in the state of stagnation or even retrogression development when the positive driving force is smaller than the negative driving force. Thus, it will greatly promote the formation and development of Ecosystem of Cyber-society by increasing the positive driving force and making full use of various driving forces.

4.3 Mechanism of Organization and Conduction

The mechanism of organization and conduction refers to the formation process of the joint force that affect the formation and development of Ecosystem of Cyber-society through the cross

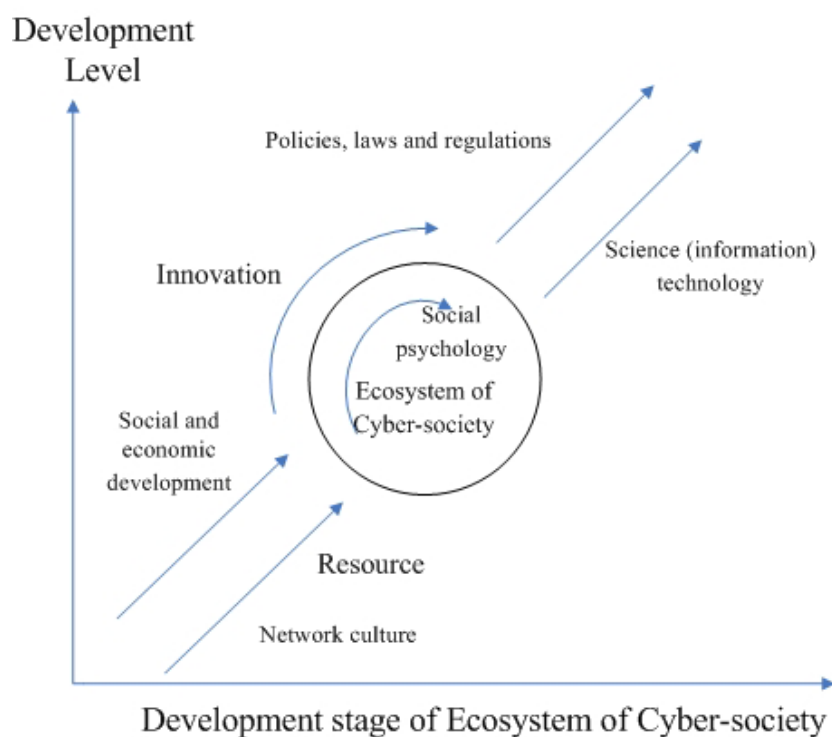


Figure 4: Composition forces model of the formation and development of Ecosystem of Cyber-society

combination and strength coordination between the various driving forces within the driving force system.

The various driving forces interact and influence with each other, thus form a joint force for the formation and development of Ecosystem of Cyber-society. During the process of the formation and development of Ecosystem of Cyber-society, the joint force it gets is not the simple accumulation of each driving force, however, there will be a new force with new quality due to the interaction and its size is often larger than the simple sum of the driving forces. As shown in Figure 5, the various driving forces first act on the Ecosystem of Cyber-society in accordance with their respective different mechanisms, and thereby combine into a new force through the interaction between them, then this new force will combine with other forces, and the cycle continues, eventually form the integrated force that promotes the formation and development of Ecosystem of Cyber-society.

During the process of interaction between the various driving forces, there will be part of the forces being reduced or offset because of various practical conditions limit. Therefore, in order to speed up the formation and development of Ecosystem of Cyber-society, the relationships between the various driving forces have to be coordinated as much as possible in order to increase the joint effect, which need to optimize the organizational structure of the driving force system or use regulations, as shown in Figure 6. By optimizing the hierarchy of the driving force system, making the driving forces all in their places and out of their functions, the joint force can conduct layer by layer orderly, effectively reduce the deadweight loss during the process of force conduction, and thus make the formation and development of Ecosystem of Cyber-society got stable promotion.

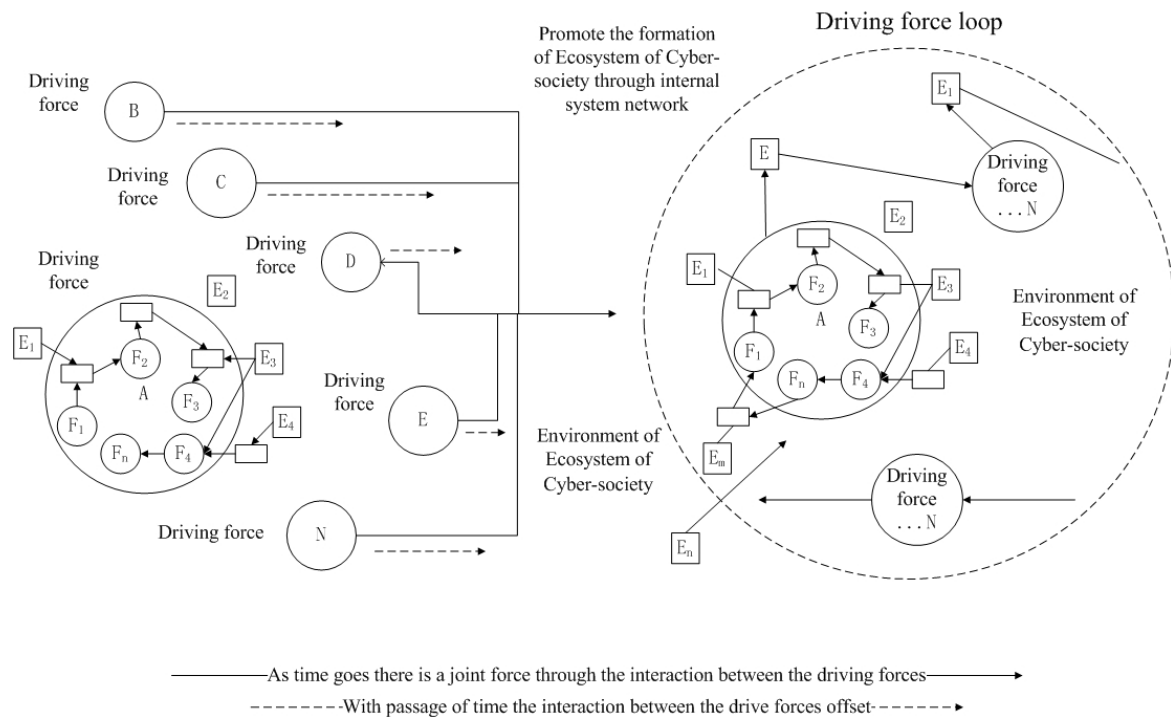


Figure 5: Cross combination of driving forces to the formation of Ecosystem of Cyber-society

4.4 Mechanism of Integration and Collaboration

The collaboration generally refers to the relationship of mutual adaptation between two or more interacting species in the process of evolution. To understand from a broad concept, the collaboration can refer to the coordination in the process of long-term mutual adaptation between species and species, or between species and environment. Similarly, this collaboration relationship also widely exists in the Ecosystem of Cyber-society. During the process of the formation and development of Ecosystem of Cyber-society, there are interrelationships between the various subjects, or between the subjects and the environment. And only to form a coordinated and mutually reinforcing relationship between them, then they can promote the formation and development of Ecosystem of Cyber-society effectively.

The formation and development of Ecosystem of Cyber-society is not a simple question, and we should consider the formation and development objectives of Ecosystem of Cyber-society from the height of the overall socio-economic development, and take the development of Ecosystem of Cyber-society as an important element of real economic and social development. The so-called mechanism of integration and collaboration of driving force system of Ecosystem of Cyber-society refers to that make clear the positive role of Ecosystem of Cyber-society in the real economic and social development, take the Ecosystem of Cyber-society as an important part of the real society, make the development of Ecosystem of Cyber-society integrated into the overall development of the real society, strengthen the linkage between Ecosystem of Cyber-society and the real society, maximize the efficiency of resource allocation and utilization, and thus form a integrated force to facilitate the formation and development of Ecosystem of Cyber-society.

From the perspective of the functions of the driving force system of Ecosystem of Cyber-society, the mechanism of integration and collaboration includes the overall coordination between the driving force system and Ecosystem of Cyber-society, while from the perspective of the collaboration between various driving forces, the mechanism of integration and collaboration

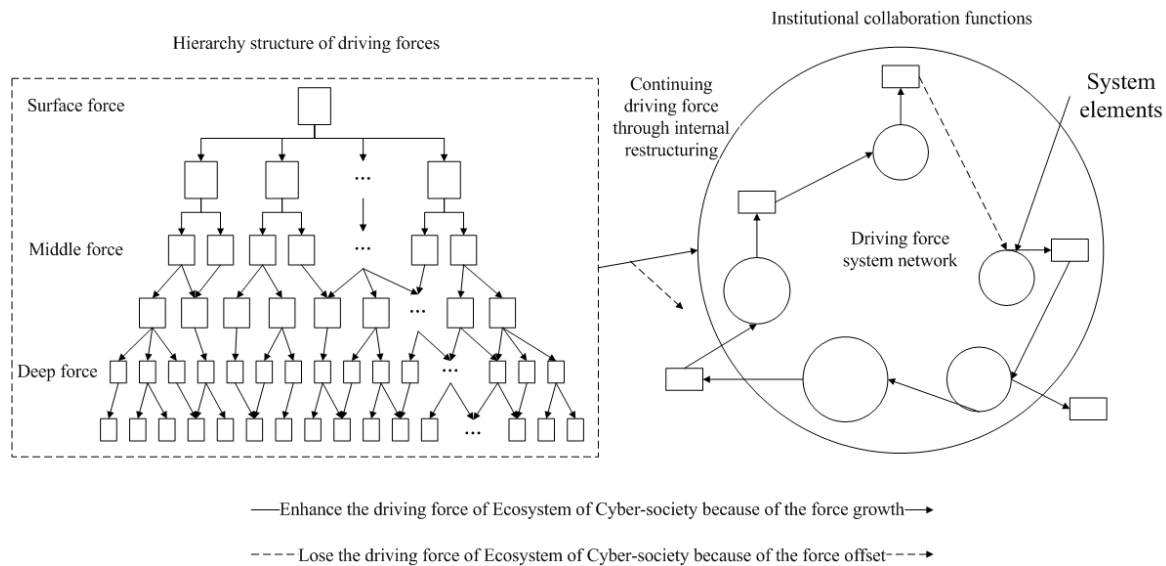


Figure 6: Organizational conduction of driving forces to the formation of Ecosystem of Cyber-society

also includes both of the collaboration within the system and outside the system, as shown in Table 1.

Table 1: Contents of the mechanism of integration and collaboration of driving force system of Ecosystem of Cyber-society (EC)

Scope of integration and collaboration	Contents of integration and collaboration
Internal collaboration	Social psychology and EC
	Innovation and EC
	Network culture and EC
External collaboration	Resources and EC
	Network culture and EC
Overall collaboration	Social and economic development and EC
	Policies, laws and regulations and EC

5 Conclusions

We propose a basic theoretical framework of the driving force system of Ecosystem of Cyber-society and present its operation mechanism using the theory of System Dynamics in this paper. The driving force system of Ecosystem of Cyber-society is constituted by the subsystem of driving forces, stimulate subsystem of driving forces and carrier subsystem of driving forces, which is a virtual manual system with the characteristics of integrity, structure hierarchy, orderliness and openness. Its operation mechanism mainly includes the mechanism of push and pull, mechanism of organization and conduction, mechanism of Integration and collaboration, and mechanism of innovation and development.

The formation and development of Ecosystem of Cyber-society is the function result of a variety of driving forces together. There is no one single driving force can independently control the formation and development of Ecosystem of Cyber-society. Only through the coordination

between the driving forces within and outside the system, then it can generate new driving force structures and joint force, improve the operation efficiency of the driving force system, and thus promote the fast forward development of Ecosystem of Cyber-society with its powerful functions.

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