RESEARCH ON THE COORDINATED DEVELOPMENT OF ECOSYSTEM OF CYBER-SOCIETY AND ITS MEASUREMENT

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Abstract: Similar to the general characteristics of the ecosystem, the cyber-society is also composed of a number of interrelated and interactive elements. Therefore, to promote the health, orderly and rapid development of the overall ecosystem of cyber-society, we must ensure the coordination development between the various system elements, and make their structures and functions in a dynamic balance state of mutual adaptation and coordination. Use the theories of Ecology and Synergetics, this paper considers the cyber-society as a typical ecological system, and puts forward the concept of "coordinated development of ecosystem of cyber-society" first and studies its content, requirements and measure method systemically, and then applies it to the development of China ecosystem of cyber-society. It aims to provide new theories, ideas and methods for human to understand, regulate and develop the cyber-society much better, and also make forward-looking research and exploration to realize the coordinated development of the cyber-society.

1 INTRODUCTION

The concept of "Ecosystem of cyber-society" was first proposed by Professor Zhenji Zhang in 2008 in his monograph "Ecology of Cyber-society" (Zhang and Zhang, 2008). Similar to the general characteristics of the ecosystem, the cyber-society is also composed of a number of interrelated and interactive elements, has certain functional targets, and there are certain limits with the outside world. But it is not just the network system that emphasizes on the technology people often referred to, it is a large-scale system that composed of Internet users, network infrastructures and network social environment related to the development of the cyber-society. It emphasizes the mutual relationships and overall organics between the various elements in this big system. As the only one intelligent element in the Ecosystem of cyber-society, the Internet users can achieve rational use of the network through its own control, regulation and development, and play a key role to the existence, development, and expansion of the cyber-society; the network infrastructures constitute a prerequisite for the existence of the cyber-society, and is also a necessary condition to its emergence, existence and development; while the network social environment is the concrete embodiment of the quality of Internet users' life, and the rich and full-featured web applications are helpful to realize the demands of the Internet users and promote the development of the cyber-society. Only with the coordinated development between the various system elements and their structures and functions in a dynamic balance state of mutual adaptation and coordination, can promote the Ecosystem of cyber-society as a whole to develop healthier, more orderly and rapidly, otherwise it would cause great obstacles. Therefore, how to ensure the coordination development between the Internet users, network infrastructure and network social environment has become an urgent problem we need to study and resolve.

Using the theories of Ecology and Synergetics,

this paper considers the cyber-society as a typical ecological system, and puts forward the concept of "coordinated development of ecosystem of cyber-society" first and studies its content, requirements and measure method systemically, in order to provide new theories, ideas and methods for human to understand, regulate and develop the cyber-society much better, and also make forward-looking research and exploration to realize its coordinated development.

2 BRIEF LITERATURE REVIEW

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 very little comprehensive and systematic research about the cyber-society from the perspective of ecosystem. And there is no literature that has proposed the concept of "coordinated development of Ecosystem of cyber-society" and studied its content, requirements and measure method systemically from the perspective of the ecosystem for the development of cyber-society. It is a new research area.

As a complex giant system, the Ecosystem of cyber-society includes all aspects of the cyber-society. With the change of objectives, level and scope of the research, the research about the Ecosystem of cyber-society can be divided into the following two different levels.

The first level is the macro level, which focuses on the whole Ecosystem of cyber-society, and researches its structure and function, formation and evolution mechanisms, and the ecological balance of the cyber-society from the perspective of ecosystem. For example, Professor Zhenji Zhang has described the cyber-society from the ecological point of view systematically and analyzed the structure, properties, mechanisms and other aspects of the Ecosystem of cyber-society comprehensively in his monograph of "Ecology of cyber-society".

The second level is the micro level, which researches the specific level of the Ecosystem of cyber-society. For example, Lanlan Hu proposed the concept of e-business ecosystem and discussed the coordination mechanisms between the system members (Hu and Lu, 2009); Libing Shen et al. analyzed the sustainable development of the network environment (2006), and so on.

In addition, 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, such as the American social thinkers Manuel • Custer pointed out that the network society is a new social form of society that different from the reality , and pointed out that "the network constructs the new form of our society, and the spread of the 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" (2001); While Qi Gong considered the network society as a virtual space of human and human's life, study and work in this alternative space (2003). About the research on the sociology of network, some scholars advocate classifying it into the area of information science, while some other scholars emphasize the unique features of the network society in the media and dissemination, and claim to study the evolution of the network society from the perspective of media and dissemination, and one of the representatives is an American scholar Manuel • Custer.

The research on the social ecology started earlier. Brown who comes from American Cornell University had analyzed the human activities in social life from the perspective of the natural ecology (1979). Developed so far, the research of this discipline gradually changes into two directions: one is to analyze the phenomenon of human social life using the related theories and methods of natural ecology, such as the human activities, social development and so on, 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.

The concept of "coordinated development 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 coordinated development in the ecology. Therefore, although the concept of "coordinated development 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 significant to this research.

3 THE COORDINATED DEVELOPMENT OF ECOSYSTEM OF CYBER-SOCIETY AND ITS MEASUREMENT

3.1 Coordinated Development of Ecosystem of Cyber-society

The coordinated development of Ecosystem of cyber-society is the integration of the concept of coordination and development that emphasizes on the "holistic", "endogenous" and "comprehensive" development. It refers to the overall process that changes from simple to complex, from lower to higher, and from disorder to order between the system and its elements-the Internet users, network infrastructures, and network social environment on the basis of a virtuous cycle during the development process, in order to achieve the simultaneous growth of social, economic and environmental benefits of the cyber-society. Here, the "development" is the description of its movement direction, while "coordination" refers to the constraints and provisions on this development trend.

Analyze from the perspective of system theory, the coordinated development of Ecosystem of cyber-society mainly reflects in the following areas.

(1) Coordination of constitutes

The coordination of constitutes refers to the integrity and rationality of the various elements of Ecosystem of cyber-society, and it is a prerequisite for the coordinated development of Ecosystem of cyber-society. There is hierarchy in the constitute coordination of the cyber-society. First of all, is the self-coordination of the elements or subsystems in the same level, and then followed by the coordination between different elements in the same level, or between the same kinds of elements in different levels, or between different elements in different levels. In the network social environment as shown in Figure 1, this level takes the Internet users as the core and is an organic system that composed of the links between the Internet users and the other elements (the network politics, economy and culture). To ensure the constitute coordination, we have to make sure the self-coordination of the Internet users, material, spirit, and institution in the cyber-society, and then make sure the coordination between the Internet users and politics, culture, and economics in the cyber-society.
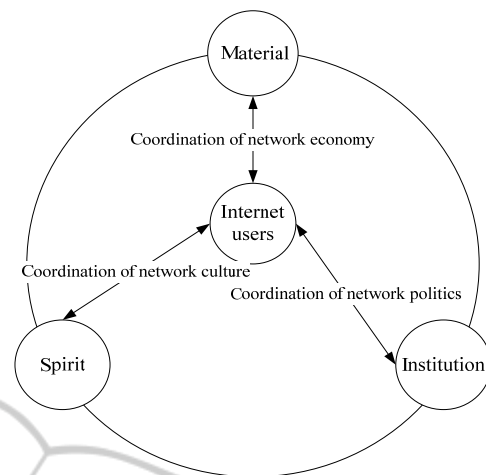

Figure 1: The coordinated development between the Internet users and network social environment.

(2) Coordination of structure

Structure is the sum of the temporal and spatial arrangement and interaction between the system elements and it is the factor that can influences the system functions and attributes best. Therefore, the structure coordination is the basic condition that ensures the normal operation of the system. The structure of Ecosystem of cyber-society includes not only the relations between the various subsystems in the scale, speed, direction of development and so on, but also includes the multi-dimensional space with hierarchy that composed of groups in different social positions and roles. The structure coordination of Ecosystem of cyber-society mainly reflects in the following aspects: the coordination coherence between the Internet users and the network infrastructure, network social environment in the development scale, speed, and direction; the rationality in the size, distribution, proportion between the Internet users and the network infrastructure, network social environment; the orderliness in the way of connection, constraint, and control between the different levels of social structure; the flexibility of the overall structure of the cyber-society, etc.. The structure coordination of Ecosystem of cyber-society is helpful to reduce the friction within the system, and maintain the balanced and stable relations between the different levels of Ecosystem of cyber-society.

(3) Coordination of functions

Structure and function are two aspects of any system. The structure of Ecosystem of cyber-society reveals the internal relations and roles of the system, while the functions of the system show the external relations and role. The Ecosystem of cyber-society

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can only rely on the system structure to integrate the various elements into an organic whole, and to achieve the functions through the linkages between the various system elements. The function coordination of Ecosystem of cyber-society not only reflects in the role, impact and results to the Internet users or the overall cyber-society due to the presence and activities of the network infrastructure, network social environment and so on, meeting the spiritual, material and cultural needs of the Internet users, and promoting the comprehensive development of the Internet users positively, but also reflects in the smooth flow of matter, energy and information (mainly in the form of information) between the cyber-society and the network social environments to meet the needs of their own development for the overall cyber-society and its various subsystems.

(4) Coordination of input and output

Any system is in a certain period of time and space, in a certain environment, and has to continuously exchange material and energy with their environment in order to maintain system stability. The Ecosystem of cyber-society can be divided into the following two levels, that is to say the cyber-society formed by the interaction between the Internet users (such as the users, virtual enterprise, e-government, etc.), and the network infrastructure and network social environment (such as the network politics, network economy, network culture, etc.) that support the operation and development of the cyber-society. And there is the input-output relationship between the cyber-society and the network infrastructure and network social environment, that is, the flow of information. The coordinated development of Ecosystem of cyber-society not only emphasizes the coordination between the different levels within the system, but also emphasizes the stability of the input and output between the cyber-society and the network infrastructure and network social environment. It promotes the coordination of input and output within the Ecosystem of cyber-society through the exchange of information with the external environment by their own self-organization and human factors.

(5) Coordination of time and space

The Ecosystem of cyber-society has the feature of time and space, that is to say this system can not only be the cyber-society that based on the global Internet, but also can be the cyber-society that based on the regional Internet. The cyber-society in any region is also a part of the real society. The Ecosystem of cyber-society is an open system, and the coordinated development of any subsystems can

not leave their environment. They have to exchange material, energy and information with their environment and absorb negative entropy in order to maintain the sound development of the system. Moreover, the coordinated development of Ecosystem of cyber-society only refers to the coordination in a certain period, and the Ecosystem of cyber-society has different forms of structure and functions, different operation modes, and also different objectives to achieve at different stages.

Thus, we can see that there is a relationship of mutually reinforcing and inhibiting between the various elements of Ecosystem of cyber-society (Zhang, 2006). If the various system elements can coordinate and promote each other and control the factors that cause the uncoordinated between the elements to a minimum range, then the Ecosystem of cyber-society will develop healthily. While if various system elements can't develop coordinately, that is to say the entropy of the system increases continuously and at the same time the system can't absorb negative entropy from the external to keep balance, then it will threaten the normal operation of Ecosystem of cyber-society. Therefore, we need to measure the coordinated development of Ecosystem of cyber-society. Through the coordinated development measurement of Ecosystem of cyber-society, we can find out the problem, and then promote the development of Ecosystem of cyber-society in the direction, content, progress and so on by using the scientific and effective measures on the basis of complying with the development and evolution of the system itself in order to meet the needs of human development.

3.2 Construction of the Index System

Scientific construction of evaluation index system is the key to objectively reflect and measure the coordinated development of Ecosystem of cyber-society. In the context of complying with the principles of scientific, operational, practical, independence and relevance and on the basis of in reference to the related research results, such as the research on the real social, demographic, economic coordinated development, research on the coordinated development of urban ecology systems and the cyber-society (Chen, 2002; Zhang and Liu, 2009), combined with the relevant content of "National Internet Development Survey Report", "China Internet Network Security Report", and "China Informationization Almanac", this paper constructs the index system as shown in Table 1, mainly including the following three levels:

subsystems of Internet users, network infrastructures, and network social environment.

3.3 Measure Method

This paper will use the gray system model to measure the coordinated development degree of the Ecosystem of cyber-society. It is an analysis method based on the grey relational analysis in the gray system theory, and analysis by comparing the distance between the reference point and the points-based (Chen, 2008). It reflects the numerical relationship between the subsystems of Ecosystem of cyber-society when used in the subsystems of Ecosystem of cyber-society. During the development process of Ecosystem of cyber-society, if there is the same change trend between two subsystems,

including the changes in size, direction, speed and so on, then it shows that the degree of synchronous changes between these two subsystems is higher and their correlation is larger, otherwise their correlation is lower (Chen, 2008; Tu, 2008).

The steps to measure the coordinated development of Ecosystem of cyber-society using the gray system coordination model are as follows.

Assume there is a time series with n factors:

$$\{X_1^{(0)}(i)\}, i = 1, 2..., N_1$$

$$\{X_2^{(0)}(i)\}, i = 1, 2..., N_2$$

... ...

$$\{X_n^{(0)}(i)\}, i = 1, 2..., N_n$$

Table1: The index system of the coordinated development of Ecosystem of Cyber-society.

Sub systems	Level indicators	Sub level indicators
Internet Users	Netizens	The number of Internet users
	Users structure	Average income levels
		The average time spent online every week
Network Infrastructures	Network Infrastructures	The number of IP Address
		The number of Domain name
		Byte count of the Internet pages
		The Number of Internet pages
		Site Number
		Network bandwidth of the international export
Network Social Environment	Network Entertainment	Usage of online music
		Usage of online game
		Usage of online video
	Access to Information	Usage of Web search engine
		Usage of Network News
	Communication	Usage of Web blog application
		Usage of e-mail
		Usage of instant messaging
		Usage of BBS
	Business Transactions	Usage of Online shopping
		Usage of Internet banking
		Usage of Network stocks
		Online payment scale
		E-commerce scale
	Network Security	Number of host controlled by Trojans
		Number of host controlled by Botnets
		Number of sites been tampered
		Vulnerability
		Number of phishing incidents

Here, $N_1, N_2 \dots \dots N_n$ are natural numbers, and their values can be equal or may not equal; at the same time we assume the $X_0^{(0)}(i)$ $i = 1, 2 \dots, N_0$ as the parent sequence, while the $X_k^{(0)}(i)$ $k = 1, 2 \dots, n$ as the child sequence. The grey relational analysis is to study the correlation degree between the n child sequences and the parent sequence $\{X_0^{(0)}(i)\}$ (Tu, 2008).

(1) Accumulate the value of each factor at different time points, and get new time series.

(2) Standardize the value of new time series:

$$\frac{X(i)}{x_k}, \overline{x_k} = \frac{1}{N} \sum_{i=1}^{N} X_k(i), k = 1, 2 \dots, n$$

Get the sequence of standard value:

$$\{x_1(i)\}, i = 1, 2 \dots, N$$
$$\{x_2(i)\}, i = 1, 2 \dots, N$$
$$\dots \dots$$
$$\{x_n(i)\}, i = 1, 2 \dots, N$$

Change it into a standard matrix:

$$\begin{bmatrix} x_1(1) & x_1(2) & \dots & x_1(N) \\ x_2(1) & x_2(2) & \dots & x_1(N) \\ \dots & \dots & \dots & \dots \\ x_n(1) & x_n(2) & \dots & x_n(N) \end{bmatrix}$$

(3) Calculate the difference sequence and its maximum and minimum using the following formula:

$$\Delta_{ij}(i) = \left| x_j(i) - x_k^{\cdot}(i) \right|$$

$$\max_{\substack{1 \le i \le N \\ 1 \le j \le n}} \{\Delta_{ij}(i)\} = \Delta(\max)$$

$$\min_{\substack{1 \le i \le N \\ 1 \le j \le n}} \{\Delta_{ij}(i)\} = \Delta(\min)$$

(4) Calculate the correlation degree between X_j and X_k:

$$\varepsilon_{ij}(i) = \frac{\Delta_j(\min) + \rho \Delta_j(\max)}{\Delta_{ij}(i) + \rho \Delta_j(\max)}$$

Here, ρ refers to the identification coefficient, and it can take any number between 0 and 1 (usually between values of 0.1 to 0.5). ρ reflects the difference between correlation coefficients. Coordination coefficient $\varepsilon_{ij}(i)$ is a positive number less than 1, and it reflects the correlation degree between the child sequence X_i and the parent

sequence X_0 at the period of k.

(5) Calculate the coordination degree between X_j and X_k:

$$r_{ij} = \frac{1}{N} \sum_{i=1}^{N} \varepsilon_{jk}(i)$$

(6) Construct the coordination degree matrix:

$$\begin{bmatrix} r_{11} & r_{12} & \dots & r_{1n} \\ r_{21} & r_{22} & \dots & r_{2n} \\ \dots & \dots & \dots & \dots \\ r_{n1} & r_{n2} & \dots & r_{nn} \end{bmatrix}$$

The coordination degree reflects the value of coordination level between the three subsystems of the Internet users, network infrastructure and network social environment. The greater the value is, the higher degree of coordinated development between the three subsystems is, otherwise the lower degree of coordinated development. According to the analysis on the existing research literature about the coordinated development measurement of the real social system, this paper proposes the grading standards to the coordinated development degree between the three subsystems of the Internet users, network infrastructure and network social environment. It can be divided into five levels, as shown in Table 2.

It should be noted that while the gray relational analysis is based on the data analysis of past few years, so the analysis result is the comprehensive measurement of coordinated development of years, rather than the coordinated development over the years.

4 APPLICATION RESEARCH ON THE COORDINATED DEVELOPMENT OF CHINA ECOSYSTEM OF CYBER-SOCIETY

4.1 Development Status of China Ecosystem of Cyber-Society

At the end of 2009, the scale of Chinese Internet users has reached 384 million, which has increased 28.9% compared with 2008, and the proportion in the total population has also grown from 22.6% to 28.9%. The Internet penetration rate maintains a steady upward trend. At the same time, the network

Table 2: The coordination degree grading standards.

Coordinated development degree	[0-0.39]	[0.4-0.49]	[0.5-0.69]	[0.7-0.89]	[0.9-1]
Coordination Level	Imbalance	Brink of disorder	Primary coordination	Good coordination	Excellent coordination

Table 3: Relevant statistical data of China Ecosystem of cyber-society from 2005 to 2009.

	2005	2006	2007	2008	2009
The number of Internet users (ten thousand) X_1	11100	13700	21000	29800	38400
Average income levels X_2	1538	1496	1522	1631	1724
The average time spent online every week X_3	15.9	16.9	16.4	16.6	18.7
The number of IP Address (ten thousand) X_4	7439	9802	13527	18127	23245
The number of Domain name (ten thousand) X_5	259	411	1193	1683	1681
Byte count in the Internet pages (GB) X_6	67300	122306	198348	438898	1010848
The Number of Internet pages (Hundred million) X_7	26	45	85	161	336
Site Number (ten thousand) X_8	69	84	150	288	323
Network bandwidth of the international export (M) X_9	136106	256696	368927	640287	866367
Usage of online music X_{10}	38.3%	34.4%	86.6%	83.7%	83.5%
Usage of online game X_{11}	33.2%	26.6%	59.3%	62.8%	68.9%
Usage of online video X_{12}	37.1%	36.3%	76.9%	67.7%	62.6%
Usage of Web search engine X_{13}	65.7%	51.5%	72.4%	68.0%	73.3%
Usage of Network News X_{14}	67.9%	53.5%	73.6%	78.5%	8.1%
Usage of Web blog application X_{15}	14.2%	25.3%	23.5%	54.3%	57.7%
Usage of e-mail X_{16}	64.7%	56.1%	56.5%	56.8%	56.8%
Usage of instant messaging X_{17}	41.9%	34.5%	81.4%	75.3%	70.9%
Usage of BBS X_{18}	41.6%	36.9%	38.8%	30.7%	30.5%
Usage of Online shopping X_{19}	24.5%	23.6%	22.1%	24.8%	28.1%
Usage of Internet banking X_{20}	14.1%	10.5%	19.25	19.3%	24.5%
Usage of Network stocks X_{21}	14.1%	10.5%	18.2%	11.4%	14.85
Online payment scale (Hundred million) X_{22}	161	320	976	2743	5766
E-commerce scale (Billion) X_{23}	0.7	1.5	2.2	3.1	3.6
Number of host controlled by Trojans (ten thousand) X_{24}	2.3	4.5	99.5	56.6	26.2
Number of host controlled by Botnets (ten thousand) X_{25}	1200	1000	362.5	123.7	83.7
Number of sites been tampered (ten thousand) X_{26}	1.4	2.4	6.1	5.4	4.2
Vulnerability X_{27}	75	87	104	101	133
Number of phishing incidents X_{28}	400	563	1326	1227	1200

infrastructures expand, the network applications enrich and functions improved constantly. Relevant statistical data are shown in Table 3.

4.2 Determine the Index Weights

Using the SPSS statistical software (SPSS will automatically standardize the data and eliminate the dimension of data) and principal component analysis (Zhang, 2006; Luo, 2004; Wu and li, 2007), we can determine the main components of each subsystem in the Ecosystem of cyber-society and the corresponding weight. The score models of each subsystem are as follows.

(1) The score model of Internet users is:

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$$F = 0.59ZX_1 + 0.59ZX_2 + 0.55ZX_3$$

Here, ZX_i represents the data of index X_i after standardization.

(2) The composite score model of network infrastructures is:

$$F = 0.42ZX_4 + 0.39ZX_5 + 0.40ZX_6 + 0.41ZX_7 + 0.41ZX_8 + 0.42ZX_9$$

(3) The composite score model of network social environment is:

$$F = 0.22ZX_{10} + 0.22ZX_{11} + 0.22ZX_{12} + 0.22ZX_{13} - 0.03ZX_{14} - 0.07ZX_{16} + 0.22ZX_{17} - 0.09ZX_{18} + 0.04ZX_{19} + 0.21ZX_{20} + 0.17ZX_{21} + 0.14ZX_{22} + 0.16ZX_{23} - 0.17ZX_{24} + 0.14ZX_{25} - 0.16ZX_{26} - 0.17ZX_{27} - 0.19ZX_{28}$$

4.3 Measurement of the Coordinated Development Degree based on the Grey Relational Analysis

(1) Calculate composite score of each subsystem for each year

According to the composite score models in 4.2, we can calculate the composite score of each subsystem for each year, as shown in Table 4. There are positive and negative in the results of the principal component analysis. It indicates that it's an above-average score if the score is positive,

otherwise it's lower than average. And as the correlation model requires that there should be a rising trend after data accumulation, so we add 3 to each composite score of three subsystems in order to ensure that all scores are positive, but also will not change the trend of time series of the system composite score at the same time, shown as Table 5.

(2) Calculate the cumulative value of three subsystems, as shown in Table 6.

(3) Calculate the standard value of three subsystems, as shown in Table 7.

(4) Get the coordination matrix between the three subsystems, as shown in Table 9.

Based on the same calculation steps, we can also conclude the correlation coefficient and coordination degree between the network infrastructures and other subsystems, and also the correlation coefficient and coordination degree between the network social environment and other subsystems, and then construct the coordination degree matrix between the three subsystems, as shown in Table 10.

4.4 Result Analysis

Through the research on the coordinated

Table 4: The composite score of each subsystem from 2005 to 2009.

	2005	2006	2007	2008	2009
Internet Users (X_1)	-1.39901	-1.01291	-0.72761	0.51531	2.624217
Network Infrastructures (X_2)	-2.4116	-1.82661	-0.53348	1.415571	3.356124
Network Social Environment (X_3)	-2.81256	-2.54656	1.385872	1.42078	2.552455

Table 5: The corrected composite score of each subsystem from 2005 to 2009.

	2005	2006	2007	2008	2009
Internet Users (X_1)	1.600985	1.987088	2.272394	3.51531	5.624217
Network Infrastructures (X_2)	0.588402	1.173392	2.466516	4.415571	6.356124
Network Social Environment (X_3)	0.187444	0.453444	4.385872	4.42078	5.552455

Table 6: The cumulative value of three subsystems from 2005-2009.

	2005	2006	2007	2008	2009
Internet Users (X_1)	1.600985	3.588073	5.860467	9.375778	14.999995
Network Infrastructures (X_2)	0.588402	1.761793	4.228309	8.64388	15.000004
Network Social Environment (X_3)	0.187444	0.640888	5.02676	9.44754	14.999995

Table 7: The standard value of the cumulative value of three subsystems from 2005-2009.

	2005	2006	2007	2008	2009
Internet Users (X_1)	0.225966	0.506428	0.827158	1.323317	2.117130144
Network Infrastructures (X_2)	0.097345	0.291472	0.699533	1.430046	2.481604549
Network Social Environment (X_3)	0.030929	0.105748	0.829426	1.558865	2.475032246

Table 8: The absolute difference Δ_{1k} between the Internet Users and other subsystems.

	2005	2006	2007	2008	2009	min	max
Δ_{12}	0	0.086336	0.000995	0.235350	0.493095	0	0.493095
Δ_{13}	0	0.205642	0.197306	0.430586	0.552940	0	0.552940
min	0					0	
max							0.552940

Table 9: The correlation coefficient λ_{1k} and coordination degree r_{1k} between the Internet Users and other subsystems.

	2005	2006	2007	2008	2009	r_{1k}
λ_{12}	1	0.762034	0.996414	0.540170	0.359255	0.731574
λ_{13}	1	0.762034	0.996414	0.540170	0.359255	0.731574

Table 10: The coordination degree matrix between the three subsystems.

	Internet Users (X_1)	Network Infrastructures (X_2)	Network Social Environment (X_3)
Internet Users (X_1)	1	0.731574	0.576270
Network Infrastructures (X_2)	0.731574	1	0.738298
Network Social Environment (X_3)	0.576270	0.738298	1

development measurement of China's three subsystems of Internet users, network infrastructures and network social environment from 2005 to 2009, we found that the coordinated development degree between the Internet users and network infrastructures, and the coordinated development degree between the network infrastructures and network social environment are in the level of "good coordination". It indicates that the development of network infrastructures supports the development of Internet users and network social environment well, and the growth of Internet users and their utilization level of Internet are in the bearer level of network infrastructures. While the coordinated development degree between the Internet users and network social environment is in the level of "primary coordination", and it indicates that there is a phenomenon of lack of coordination between the Internet users and network social environment to a certain degree. This kind of mismatch may come from the threaten that brought by the network security to the network social environment, or the growth rate of Internet users can not meet the utilization capability improvement of the network applications, and so on. Overall, the current development between the China's three subsystems of Internet users, network infrastructures and social environment is in the state of coordination.

5 CONCLUSIONS

By using the theory of the network sociology, social ecology and synergetics, this paper first proposed the concept of "coordinated development of Ecosystem of cyber-society", constructed a relatively complete index system, and carried out qualitative and quantitative analysis on whether there is coordination on the development speed, direction and scale between the three subsystems of Internet users, network infrastructures and network social environment, and then apply it to the development of China ecosystem of cyber-society. As a new research field, this paper will lay the foundation for further study of the future. While at the same time, there are still many deficiencies yet to be revised and improved due to the limitation of relevant research data we can learn from.

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