

Deepening study of science of complexity and crisis management

ZhangXiaoPeng

School of Public Management and Law
Dalian University of Technology
Dalian, China
xiaopengzh@hotmail.com

LiuZeYuan

School of Public Management and Law
Dalian University of Technology
Dalian, China
liuzy@vip.163.com

Abstract—The construction of a sound crisis management system has both theoretical and practical significance in crisis prediction and precaution, proper response to crisis, and aftermath rehabilitation and reconstruction. This paper briefly introduces the theory and methods of science of complexity, and analyzes the complexity of economic social system and its crisis management. It points out that economic social system has intrinsic consistency with a complex system due to its large number of subjects, its overall uncertainty, its highly openness and other features like information accumulation and application. Crisis is formed by the interaction of various subjects, levels and structures. It is regarded as the butterfly effect resulted from the change of initial conditions in a system. What's more, the continuous modification of subjects' behavioral rules also gives rise to crisis. Based on the analysis above, this paper proposes a scheme and methods for the construction of crisis management system.

Keywords—science of complexity; economic society system; Crisis management

I. INTRODUCTION

In the 1980s Science of Complexity is the science study of complex systems and complexity. It views that, the classical science, represented by Reductionism, depends on part of the scientific understanding to study the overall, and unable to explain economic, environmental management, and other complex phenomenon, as emphasized that the complexity of the study. Therefore, it stressed the integrity, which is of the opinion that characters between system and various subsystems do not have certain causal relationship, but are the result of the interaction between subsystems. It is self-organization, that systems, by the effect of the immanence mechanism, with the material, energy, information exchange, is able to adapt to constantly improve. The adaptation also is the ability that the system can actively take respond to environmental changes and continuously revise reaction process. The non-linear uncertainties cause the system showing random, nonlinear, unpredictable behaviour in principle, so that to analysis the uncertainty is very difficult. Emergence, which means the learning and growing ability and to change the structure and behaviour based on the experience for the main body, in a whole, appears new structure and more complex behaviour, resulting emergence of the phenomenon, and so on. In

methodology, it stressed that model, computer simulation, as well as comprehensive and integrated approach in order to analyze and solve complex problems.

So far, complex science still has not formed a strict scientific system, but a series of gathering thoughts. However, it is of great significance to promote the crisis management studies, particularly for construction with Chinese characteristics.

II. ECONOMIC AND SOCIAL SYSTEM IS A TYPICAL COMPLEX SYSTEM

For complex systems, scholars have given different definitions. Cheng Siwei said "the core characteristic for complex system is the components with some degree of intelligence, that is, the ability to understand the environment, to forecast their changes, and to take action against the target. These are the internal reasons for biological evolution, technological innovation, economic development, and social progress. "[1]Complex system has the following features. The system consists of a large number of the main bodies which links between each other to form a network. Every change of the main body will be impacted by the changes of the other main body, and will lead to the changes for the other main body, which are equipped with multi-level, multi-purpose structure, such as each level have become the mainstay of the previous level. These structures contribute to the realization of system functions. The system can constantly learn, recompose and perfect its hierarchical structure and function in the development process. The system is open. Its interaction with the environment can provide the ability to adapt the trend of the changes of the environment. The system is in the development of changes, and has the predictability for the future changes.

Regarding to the economic and social system, it was recognized mixed. It was known as the socio-economic system[2], it was also referred to as the social system[3]. In view of the importance of the economic system in the social system, we believe that the economic and social systems are more accurately. Economic and social systems, according to Qian Xuesen view, are the open complex giant system which composed by the people. It has the internal consistence nature with the complex systems.

Firstly are the numerous adaptable main bodies. In economic and social system, there are several kinds of main body in big amount and quantity, such as individuals,

organizations, governments and international organizations. Each main body is influenced each other. Moreover, because of the highly coupled relationship of the internal parts of economic and social system, each main body inextricably links and interacts with connection, and has strong hierarchical structure and function structure.

Second, the overall uncertainty. In economic and social system, it is difficult to conduct the reasons for its development and changes of many events only from the reality, such as skyrocketed or plummeted stock. This uncertainty is the response of the nonlinear, random, non-cyclical movements of economic and social system. It asks us to the chaos as chaotic to study and handle.

Third, the high degree of liberalization for the system. Economic and social system draws substances, energy and information from the environment, and also impacts the environmental development and changes. In reality, by the development and progress of the modern societies, information flow and energy flow accelerate the circulation of material flow; different regions and different countries link s more closely.

Fourth, the mechanism of the accumulation and use of information. Since mankind has accumulated a wealth of experience and knowledge, our society continuously develops and progress. As information differs and its use varies, this causes the diversity of adaptation to main body's action.

III. THE COMPLEX ANALYSIS OF THE CRISIS CAUSES

There are many different saying for the crisis causes. By the analysis of the economic and social system using complex scientific application, we can see that the crisis is the main adaptable main part of economic and social system, which continuous develop, evolutes between the two main bodies and the main bodies and environment, so that the system divide and emerge all the time.

First, crisis is the result of the main body's adaptable interaction in the economic and social system. According to Qian Xuesen review, the evolution of economic and social system is promoted by the external environment and internal environment. Judging from the external environment, the natural environment of recession and the destruction of ecosystems bring a heavy blow to economic and social system, resulting in the normal movement confusion, changing the structure and function. The economic and social system also affect the natural environment, mainly for mankind own interests, the over-exploitation of natural resources damages ecosystems, and induce natural disasters, especially the era of globalization, national, regional and social exchanges between the increasingly close, external competition, the impact will make normal economic social structure tension or confusion of the normal structure, and in serious cases result in the collapse. From the internal environment, economic system, political system, cultural system etc. is influenced each other. If a system goes crisis, so does the other system(see figure 1).

Second, the crisis is result of the interaction between complicated economic and social system structure and the level of the different interests. Since mankind itself is a

complex system, economic and social system which consists of people from is much more complex. Among them, there are various links among the levels, various subjects of interests, individuals, so that the affects are also different. These effects nonlinearly intertwine and integrate affecting the economic and social together, which play an important role in the economic and social system. This leads to the complicated crisis phenomenon. At present, the crises are classified into four categories, namely, natural disasters, accidents disasters, public health emergencies, social security incidents. All of them have closely relationship with human. Some people even think that, natural disasters are all caused by human and no one has no collections with human. Therefore, it is a social phenomenon rather than a phenomenon of natural disasters, which is reflected by the political, economic, cultural and social awareness of the contradictions. As for the accident disasters and public health emergencies, surely these are the result of man-made. The social security incidents are the special manifestations of social relations. In the pursuit of economic interests, political interests, members of the different levels of social demand vastly different. For our country at present, in the critical period of the comprehensive construction of a well-off society, and for Chinese reform opening up and market economy, some people access to the results of the reform, but the other part to assume all or part of the cost of reform. The latter feel unfair. It is bound to lead to the antinomy and conflict and between the members of society and trigger social security incidents.

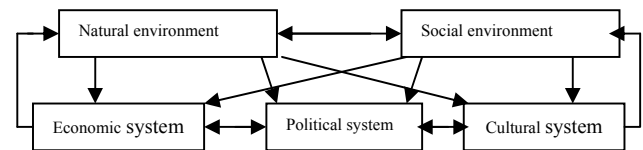


Figure 1. Interaction between economic social and environment

Third, the crisis is the "Butterfly Effect" caused by the changes of the initial conditions of economic and social system. Butterfly Effect refers to that things have a strong and sensitive dependence for the initial conditions. People compare it to "When a few butterfly incite wings occasionally in the jungles of Brazil, in the United States may set off a tornado in Texas." Economic and social system as a typical example of non-linear systems, the overall nature of the conduct and behaviour and the partial one have non-addition, with greater the dependence of initial conditions. It is difficult to predict changes in the development and future projections. The crises initial conditions are formed by adaptability the interaction of the suitable main bodies and the other, the interference constituted by the various uncertainties. Many studies have shown that Butterfly Effect is important reason for the incident.

Fourth, the crisis is the result that the main body of economic and social system constantly revises the rules of conduct. In accordance with the Complex Adaptive System(CAS) views the acts of the main system can be explained as to stimulate - the rules of reaction [4]. Namely: IF (if) stimulate S, THEN it responds to R. In order to adapt

to the other main bodies, "learning" and "accumulated experience" are constantly needed to correct the interaction mode. When getting the information in the outside world, to adapt needs no amendment. If the rules are not suited, then to amend the rules is needed. When several main bodies amend the rules, the network formed through the interaction to form a limited production process, and then to form a new principal and new rules. So the emerging phenomenon appears. "Minority rules and laws form complex systems, and cause the new emerging phenomenon by the ever-changing." [5] Therefore, the source of the emerging system is the process of system limited production. Emergence is irreversible. It has positive effects, but also negative effects which has the cost of certain missing of system that constraint the system potential for the further development. The emerging phenomenon indicates the mechanism of the incident from a side depict. For example, in recent years, the unexpected incidents happen more and more increasingly seriously, in many fields. These are impartibly with conflicts from China's economic and social development in the developing process. For example, the masses improve the equality and democracy awareness, legal system awareness and strengthen their own interests and aspirations of the requirements. While China's political system reform lagged behind, "learning" and "grow" the speed obviously can not meet the requirements of the masses, these results in the emergence of some negative effect phenomenon. "It can be said that the masses emergencies to some extent are the penalties to the bureaucracy, policy failures, and shifting-dragging policy." [6]

IV. COMPLEX SCIENCE AS A GUIDE TO BUILD CRISIS MANAGEMENT SYSTEM

In conclude, it is a good choice to guide a complex scientific theory as a direction, deepen crisis management studies, and construct conditions for the crisis management system.

First, fully understand the complexity of crisis and crisis management system. As a social phenomenon, crisis management is a complete and complex system. Based on complex scientific understanding and management of the crisis, a holistic thinking is requested, to think crisis management in system level. Otherwise, it is impossible to understand the nature of this problem and to carry out the effective management. The relationship between the crisis management system and economic and social system should be thoroughly studied, so as to discover the rules which can lay the foundation for crisis management system for science construction. Second, the study of initial conditions should be attached importance to. Butterfly Effect has given us the inspiration that to value the initial value or the study of initial conditions. Otherwise, some insignificant information or events, under certain conditions, in the role of a variety of factors, could have a profound impact on the part of economy social system, or the overall situation, and sometimes even lead to serious consequences. In crisis management, it is necessary to strengthen information systems, in particular the construction of an early warning system. That is to say, to the norm, or unexpected incidents,

and the various factors to monitor the superficial events of all kinds of information, for scientific analysis and forecasting, and take effective measures to strengthen monitoring, This is to prevent, control, crisis incident, reduce its losses.

Third, an in-depth analysis of the elements which constitute a crisis management system. A study of the main system of Crisis management, operation rules and their relationship should be taken to grasp its self-organizing, adaptive rules, which can find the rules to prevent, control, crisis and reduce its negative effects better. It is necessary to scientifically analyze the crisis management subsystem interaction with the environment rule, through fully grasping the information, control and the use of information, making it a better impact to the environmental.

Fourth, the development and evolution of the crisis management system should be regarded as a "learning" and "Adaptation" process. In accordance with the CAS theory, the result of the main complex system to "learn" and "evolution" is building blocks. These blocks through interaction with other subjects produced " $1 + 1 > 2$ " nonlinear gain, then the whole emerges greater than the sum. This is useful for our to analysis, improve the functions of crisis management system.

Fifth, the analysis of crisis management system should be used by the comprehensive integration of the seminar office system. The comprehensive integration of the seminar office system is the machine system mainly integrated and made by the high-tech with the core of computer; expert system; knowledge and information system [7], which constitute a system of highly intelligent people - machines with system. In building crisis management system, it makes experts, and technical personnel, policy makers, etc. as decision-making system, in order to conduct collectivity discussions on the crisis, and to put forward the best solution; it is necessary to make full use of modern technology, operations research, decision-making on science crises in-depth analysis; to combine the computer, simulation, simulation technology to study the crisis management system, through simulation of the individual's behavior, and to interpret the various factors associated with the interaction and evolution of the situation, to form "emergence" in a virtual environment; and thus from a perceptual to rational, from micro to macro, from the part of the overall, it makes the crisis of understanding more profound, more effective measures in effect; to use modern information network, the decision-making program have feedback from new situations and new problems, and forecast changes in the development of new results, to conduct the next decision-making, to eliminate the negative impact of crisis events better.

REFERENCES

- [1] Cheng Siwei, "virtual economy and financial crises," *Management Science Journals*, vol. 2, Feb. 1999, pp.2-4.
- [2] Fang Mei kei, "Complexity of the socio-economic system," *Journal of Capital Normal University*, vol.1, Jan.2003, pp.101-103.
- [3] Qian Xuesen, Yu Jingyuan, and Dai Ruwei, "A new field of science - open complex system and its methodology," *Natural Magazine*, vol. 1, Jan. 1990, pp.3-5.
- [4] Holland, J.H, "Implicit order - creating complex adaptive," Shanghai: Shanghai Science and Technology Education Press, 2000, pp.9-10.

- [5] Holland, J.H,"Emerged,"Shanghai:Shanghai Science and Technology Education Press, 2001, pp.5-6..
- [6] China Institute administration team."Groups of China's transition unexpected incidents main characteristics, the reasons for the government and Countermeasures,"Chinese Administration, vol.5, May.2002 ,pp.8-10.
- [7] Zhang Hongbao,"Qian Xuesen Open complex giant ideological study",unpublished.