

# Nature Orientation: Values Shift in Accordance with Complex System Brittleness Theory

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**Abstract.** The occurrence of brittle behavior acts as a feature of complex systems. Complex systems consist of numerous simple systems by combining various hierarchical structures; they exist through the nonlinear action of coupling. The system disorder attributed to the loss of material and energy in subsystems directly adversely affects the direct receiver, thereby inducing the motivation of brittleness. Complex systems inevitably exhibit brittle behavior. As nature and human society are subsystems of a complicated giant system, there are risks of brittle behavior in nature and human society. The occurrence of brittle behavior originated from the disharmony and disorder of conventional values in the judgment of the objective relationships between human and nature, causing the discomfort of the system. However, the “nature-oriented” values modified the conventional values. Human society is open to the nature, and the output and input are basically balanced in the overall amount of material and energy.

**Keywords:** Nature-oriented, Complex systems, Brittleness, Adjustment

## 1. Mechanism of Brittle Behavior in Complex Systems

In the advent of engineering theories and research methods (e.g., information theory), cybernetics and system theory, relevant studies on complex systems have been conducted successively. Prigozin and Hakon started the study on system complexity and self-organization movement, to essentially expound the law of system organization movement change. The study on complex systems in our nation was first conducted by Qian Xuesen in the 1980 s. The paper A New Field of Science---Open Complicated giant system and Its Methodology was published in the journal Nature in 1990; it adopted systems approach to explain the rules of nature, while analyzing the intercommunity of nature and society. The nature and society can be expressed by the open complicated giant system. In 2001, Luan Enjie, former deputy director of State Commission of Science and Technology for National Defense Industry, initially proposed the study on the brittleness of complex systems and organized the project in 2002. The team led by professor Jin Hongzhang started the project, and at present, the team ’ s study on the brittleness of complex systems has pertained to the international advanced level.

“Brittleness study aims to delve into a behavior characteristic in the system; it is critical to the theoretical study on complex systems. In the generation and development of complex systems, brittleness is inherent and implicit, and it is hard to be perceived.” [1] Complex system refers to a concept corresponding to simple system, and in the sense of the word, the system exhibits sophisticated characteristics. “System science analyzes the system starting from the relationships between local and whole, and separates the system into four types in line with the complexity of the system, i.e., simple system (e.g., small and big system, several subsystems to hundreds of subsystems), simple giant system and complicated giant system, special complicated giant system (social system)” [2] The difference between simple systems and simple giant system subsystem is small number of subsystems. However, the difference between simple giant system and complicated giant system is not the number of systems, whereas the hierarchy or organizational structure in the system, which is also the major mark of the difference between the two. Besides, it is also reflected in the impact of the dynamic movement of the external environment on the system; for instance, the variation and uncertainty of the external environment of the system complicate the system. The simple system differs from the simple giant system. The subsystems of the simple system are

determined by each other, and the sum of the characteristics of the subsystems refers to the characteristics of the simple system. However, the simple giant system is different, and the subsystems covered in the simple giant system interact with each other and exhibit a robust coupling, so the sum of subsystems is not necessarily equal to the whole system, and it can be greater or less than the whole system. Moreover, they are also differences identified in the forms of composing systems between the two. The simple system exhibits a single hierarchy, i.e., the relationship between parts is the same level, while the subsystems of the simple giant system are formed as hierarchy.

Openness refers to the primary feature of complex systems. Any behavior preventing the exchange of material, energy and information is considered a violation of objective laws. Complexity represents the diversity of the levels and forms of the system. There are various structural relations among the hierarchical structures (i.e., interaction relations). Moreover, there are considerable subsystems, thereby to some extent increasing the complexity of the system. Evolutionary emergence means that “under certain conditions, the actors interact with each other, and at the beginning of the interaction, there will be small changes, whereas the system is capable of conducting self-organization, self-strengthening, self-coordination, and then expanding, developing and qualitatively changing, which is termed as emergence in the complex systems.” [3] Evolutionary emergence indicates the relationship between quantitative variations and qualitative variations in the internal motion of the system. When the subsystems interact, the complex systems are capable of automatically regulating the range and degree of possible variations to balance them. However, with the accumulation of change energy, the interaction of subsystems will eventually cause qualitative variation. Hierarchy refers to a vital feature of complex systems. Complex systems exhibit complex structures. Subsystems are split into high-level subsystems and low-level subsystems according to their structure, and each low-level system acts as an integral part of a high-level system or an internal mechanism that emerges a high-level nature. Meantime, a nonlinear interaction is identified between the individuals of the system at all levels. On that basis, the variations of the individuals of the system may affect the development direction of the whole system, causing the sensitivity of the system. Massive amount refers to the huge amount, large number, hundreds of thousands, tens of thousands, hundreds of millions of subsystems and individuals.

Brittleness refers to a term applied in the mechanics of materials, and it indicates that when a body is pulled or struck, it breaks suddenly without appreciable deformation. When it is extended to complexity, it is defined as follows, “For a complex system S, there is a subsystem or a part  $S_i$  robustly sensitive to the environment, when  $S_i$  collapses under the disturbance or attack of internal and external factors (e.g., the information and material flow), other parts or subsystems will also collapse; as a result, the whole complex system collapses. This behavior characteristic of complex systems is termed as brittleness.” [4]  $S_i$  refers to the brittle source of brittle behavior. “For an open complex system, for the action of internal and external interference factors, the original ordered state in a part of the complex system (i.e., subsystem) is broken to form a relatively disordered state, and the original subsystem loses its ability to work normally. Then, this subsystem is termed as system collapse.” [5] Since a coupling relationship is identified between subsystems of complex systems, the collapse of one subsystem will cause the collapse of another system in which material and information exchange with the subsystem is conducted. Accordingly, a chain reaction will be performed, and eventually cause the complicated giant system to collapse, so this is the brittleness of complex systems.

## **2. There are Risks of Brittle Behavior in Nature and Human Society**

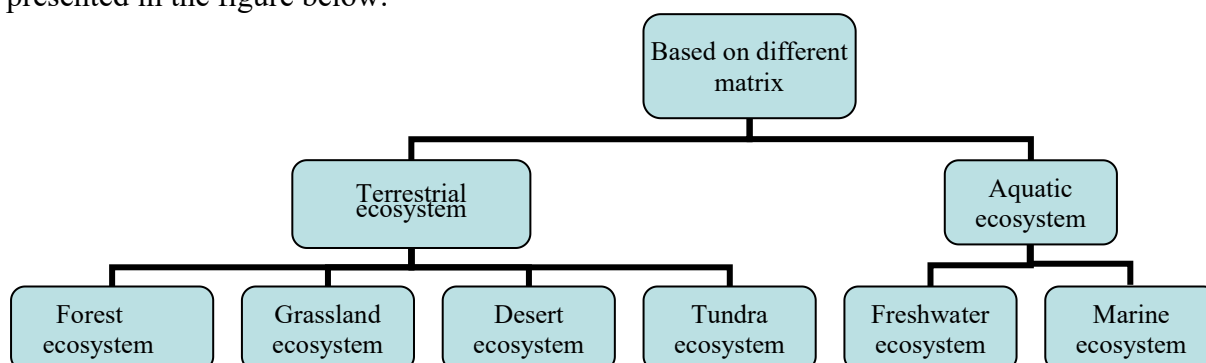
Nature and human society are subsystems of complicated giant systems. The so-called complicated giant system refers to a collection of multiple complex systems. In terms of the internal

structure of nature and human society, there are multiple hierarchical structures, between which there are multiple relationships. The relationship results from nonlinear interaction.

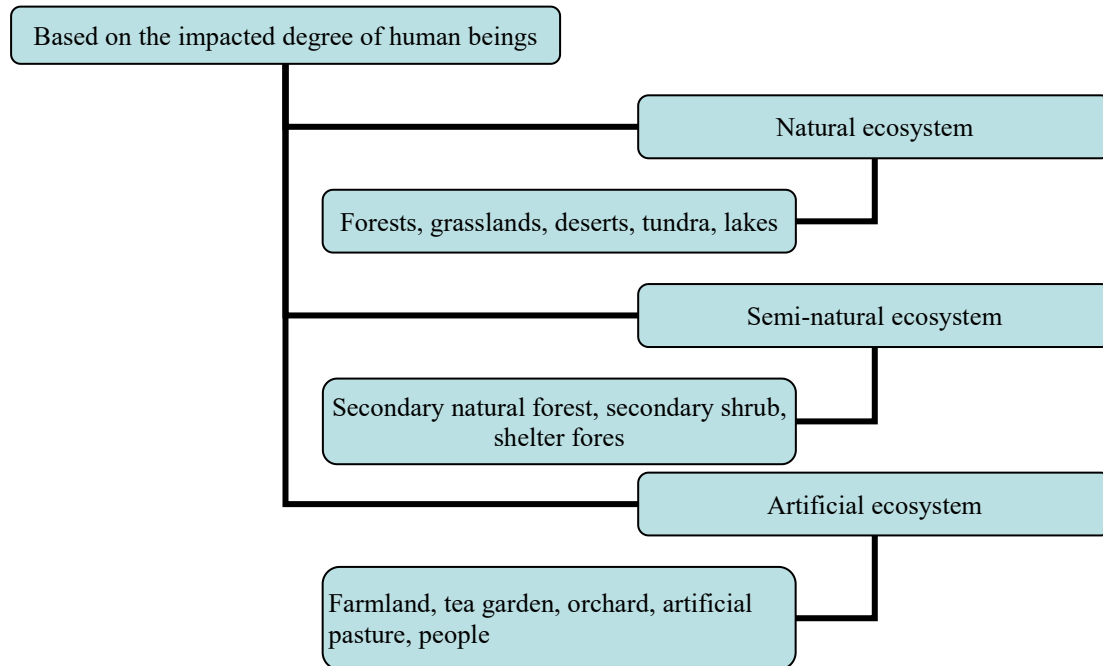
Ecosystem ecology indicates a branch subject developed from ecology over the past few years. It takes various ecosystems on the surface of the earth as the research objects and has gradually become the mainstream of ecological research. Ecosystem ecology reveals the internal mechanism and operation law of various levels and types ecosystems on the earth's surface, and tightly combines natural science with social science, as an attempt to eliminate the obstacles that cannot be communicated and coordinated by natural science and social science. Moreover, human beings have been evidently promoted to more scientifically understand nature and themselves. The concept of ecosystem was proposed by A.G.Tansley, a British plant ecologist, considering that the ecosystem as an ecological functional unit jointly formed by the continuous material circulation, energy flow and information transfer between biological components and non-biological components. Ecosystem ecology indicates that there are a wide variety of ecosystem types on the earth's surface (e.g., the astrospace, soil insects, fish and microorganisms), which are all covered in the ecosystem.

Different scholars comply with a range of classification criteria for ecosystems. In the book Ecology --- Scientific Values for Human Living Environment, Ding Shengyan split the ecosystems into different types in accordance with the nature of the matrix, the impacted degree of human beings, as well as the openness degree of system.

First, according to different substrates, ecosystems can be split into two types (e.g., terrestrial and aquatic ecosystems). The terrestrial and aquatic ecosystems can be split into the following types, as presented in the figure below:



Second, according to the impacted degree of human beings, the ecosystem can be split into three types, including natural ecosystem, semi-natural ecosystem and artificial ecosystem. Natural ecosystem refers to the natural system that human beings have not been involved in, and it can regulate internal balance by its own natural mechanism. Semi-natural ecosystem denotes the ecosystem where human beings have been involved and then adjusted the balance under the mechanism of nature itself. Artificial ecosystem refers to the ecosystem completely simulated by human beings and should be regulated by the inner mechanism of life.



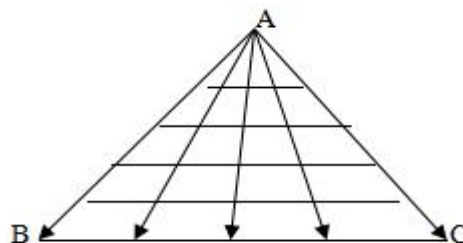
Third, according to the openness degree of the system, the ecosystem can be split into open ecosystem, closed ecosystem as well as isolated system. Open system is an ecosystem with open system boundary, allowing the input and output of energy and information, as well as the internal materials exchange with the outside world to maintain the orderly state of the system. Closed system refers to an ecosystem exhibiting a closed system boundary, whereas the boundary only prevents the exchange of matters between the system and the outside of the system, which also allows the input and output of energy. Isolated system represents an ecosystem exhibiting completely closed system boundary; it is completely isolated from the outside world, so it cannot prevent any input and output of both energy and matter.[6]

In terms of the classification of ecosystem, there exist various types and multiple levels of ecosystems, and there are exchanges and communication of material, energy and information between levels of different types and between levels of the identical type; as a result, the ecosystem acts as a complex system with multiple elements, multiple layers, multiple functions as well as polygons. As the subsystems of respective hierarchy of the ecosystem have their own internal constitutional biological factors abiotic environment, biological factors are various and the environment is changeable, which is one of the reasons for the complexity of the ecosystem. Moreover, the ecosystem exhibits multiple levels. From the basic cells, individuals, colony to populations and communities, the subsystems at different levels comply with their internal operation rules, complicating the whole ecosystem. In terms of the function of ecological system, ecological system is a complicated giant system that covers the unity of opposites relationship between human and nature, while presenting the fusion and separation of natural ecosystem and human ecosystem. However, the unity of opposites, fusion and separation between natural world and human society exactly complicate the ecosystem. Natural world and human society are subsystems of complicated giant system, whose subsystems themselves are complicated, changeable, as well as nonlinear.

Ecosystem consists of two parts (i.e., the natural ecosystem and the human social ecosystem). As one of the higher organisms in nature, human beings' practice and behavior affect the operation of the entire ecosystem. Both nature and human society are sub-systems of ecological macrosystem; besides, the material, energy and information of their sub-systems should exchange and flow smoothly. However, the control of human subject consciousness often considers the existence of the society a superior existence form. Thus, human beings have long overrun the nature, which make themselves closed; as a result, he society gradually becomes a closed system and even an isolated

system. This finding is specifically revealed in two aspects. First, to develop themselves, human beings seek resources from nature unlimitedly, causing the failure of material exchange between natural ecosystems and human social ecosystems. Material exchange is critical to maintain the ecological balance, and human beings' unlimited exploitation and utilization of the natural world (e.g., minerals, forests, grasslands and other natural resources) dramatically decrease and destroy resources; meantime, the human beings do not remedy the nature, thereby causing the blocked exchange of materials. Second, the human ecosystem exploits natural materials to produce numerous industrial products, producing considerable waste products in the production process, many of which are thrown into the nature without disposal, thus increasingly contradicting the two major systems in the material and energy exchange. In this case, the society becomes a closed system of one-way energy flow which only claims from the nature but does not feed back to the nature. Accordingly, the closed system will eventually become disordered and die out abiding by the law of entropy production. In other words, the social ecosystem will act as the source of brittleness. For the barriers of material exchange and energy flow, the brittle behavior will be stimulated in certain scenarios; correspondingly, the social ecosystem and natural ecosystem will collapse as well.

Brittle behavior in natural ecosystem and social ecosystem often causes serious consequences. According to the mechanism of brittleness behavior in complex systems, once the brittleness source is motivated, the subsystem, being the closest to it, will become the direct receiver, and the latter will transmit this behavior to the indirect receiver, thereby exerting domino effect. The stronger the brittleness connection, the greater the impact will be. Moreover, in terms of system structure and function, the occurrence of brittle behavior will cause the disorder of system structure and function, as well as the poor operation, eventually causing the whole complex system to collapse. After the subsystem at the top of the system structure is disturbed, the brittle behavior of the system will spread to respective subsystem in the multi-level structure from the top down, as presented in the figure below:



The brittle behavior of natural ecosystem and social ecosystem directly induces system function obstruction, structure disorder and even system collapse. The value idea and practical action of industrial civilization stimulate the occurrence of brittle behavior of the system. Since the system cannot obtain “negative entropy flow” from the surrounding environment to resist the risk of entropy production, the overall system crisis will be triggered. Brittle behavior of ecosystems is directly manifested by The outbreak of today' s ecological crisis and the occurrence of globalization trend and extreme weather as well as frequent natural disasters. If the crisis state of material exchange and energy flow between the two major systems cannot be addressed, and the negative entropy flow cannot resist entropy production risk of the ecosystem, the ecological crisis will be more adverse, even threatening the survival of human beings and life on earth.

### **3. Regulation of Nature-Oriented Values to the Relationship Between Human and Nature**

Conventional values increase the risk of brittle behavior in complex systems, since it causes the disharmony and discontinuity of the objective relationship between human and nature, thereby triggering ecological crisis and crisis of humanity. “ Ecological crisis represents a concept specifically exploited to demonstrate the relationship between human activities and nature. It primarily refers to the phenomenon that unreasonable human activities endanger human existence by causing the destruction of basic ecological processes, i.e., ecological structure and function and the collapse of life support systems. ” [7] Such a relationship between nature and human pertains to the alienated objective relationship, and the development of the objective activities between human and nature and their products will not be sustainable. Thus, the consequences attributed to the defects of conventional values will be the ecological crisis and crisis of humanity.

Delving into the problem of modernity refers to reflecting on modern culture of human beings. Some people consider cultural crisis the cause for the malpractice of modernity. Albert Schweitzer thought, “ our culture is in a serious crisis. ” [8] Moreover, the crisis is manifested in “ the excessive excess of its material development over its spiritual development. ” [9] He considers that culture is the perfect ideal of human beings, especially the reverence for life, instead of the infinite pursuit for material things. The reverence for life is to spread the goodness of human nature, and the goodness is the fundamental of human beings. Professor Lu Feng also elaborated the cultural crisis that “ People always have the pursuit for infinity, and the pursuit for infinity can be orientated to both the spirit and the material. No significant danger is identified in the pursuit of the infinite combined forces of countless people if they aim at the spiritual world; if aiming at the material world, they will create a world of material desires. However, human beings’ lust for material goods may spoil the planet and make it uninhabitable. ” [10] If human culture points to the material, its soul and cultural characteristics will be lost; finally, people’ s disidentification with their own essence is lost, so people cannot be called human beings, which is the loss of people’ s own essence.

The primary aspect of inherent problem of human beings refers to human nature. The wrong understanding of the relationship between human and nature causes serious ecological crisis and cultural crisis, and the direct direction of a series of crises represents the crisis of humanity. What is the definition of people? How people should know themselves involves thinking about human nature is considered the basis of human values. “ As the basis of meaning and value, human nature broadly impacts the existence of the human world, people’ s social life as well as the creation and development of people themselves. ” [11] If people set their survival as material existence and don’ t pursue spiritual value, then people’ s living practice is basically set on the “ evil ” road. The satisfaction of material desires requires constant acquisition, while spiritual value pursues the “ great love ” spirit of dedication. According to Marx, man is the objective being. The essence of man is also the existence of objects, which are expressed by objects. The object of human beings is nature, so human beings confirm their existence and manifest their essence through nature. Thus, today of the natural world is the product of the objectification of human nature. The reality of ecological crisis tells us that human beings are not friendly, and human beings’ unfriendliness is reflected in the relationships between human and nature as those between master and slaves. Human beings are high ruler, and nature is the object to be enslaved and only has the value of providing services for human beings. This unfriendliness is a type of evil and distortion of the nature of man, and it is also the result of the pure pursuit of materials. Human beings should gain insights into the relationships between human and nature in line with the standards of truth, kindness and beauty, whereas the reality of ecological crisis proves that the standards has not been really confirmed. Besides, the treatment of nature appears to be the opposite side. Cao Nengqin made a profound elaboration on the relationship between human nature and nature, “ natural world is the work and

reality of human beings, the truth of nature refers to the truth of human nature, the goodness of nature represents the goodness of human nature, and the beauty of nature indicates the beauty of human nature. Likewise, the false of nature pertains to that of human nature, the evil of nature represents that of human nature, and the evilness of nature is that of human nature. As revealed from the occurrence of ecological crisis, nature has become a type of false nature (the real nature is a harmonious and balanced nature) under the oppression and exploitation of human beings, and it has become an evil nature and an ugly nature. Accordingly, only the false nature, the evil nature and the ugliness of human nature can be revealed in the mirror of nature.” The reality of nature suggests the true and false, good and evil of human nature, manifesting human objectification. The ecological crisis in nature exactly manifests the crisis of humanity.

The transformation of values from conventional to modern should be theoretically supported, and the transformation from “absence” of nature to “presence” of nature is achieved, which not only requires human beings’ wisdom and courage, but also requests to treat the inherent laws of the natural world and the laws of human development with a scientific and rigorous attitude. The values that negate the interaction between nature and human will inevitably cause a series of ecological consequences, and the first step to correct the wrong idea is to ascertain the real relationship between human and nature as well as the objective state of the relationship. As a matter of fact, human history and natural history refer to the history of the relationship between human and nature, and their dialectical unity requires human nature to be “true”, “good” and “beautiful”, i.e., the unification process of human and nature. The brittleness theory of complex systems and the law of entropy change in natural science are inevitable in the material world; they apply to both nature and human society. They specify the material energy transformation relationship between human society and nature and have important enlightenment for the relationship between human society and nature.

“Nature-oriented” indicates that human society opens itself to the nature, and the content is that the output and input coexist and keep a basically equal overall amount. Input refers to taking in energy and raw materials required by the society from the nature; output means that the society directly and indirectly compensate energy and raw materials to the nature, and the overall amount of output and input are basically equal in material and energy. The “nature-oriented” relationship between matter and energy requires the transformation of ideas, ethics and culture in practice, as an attempt to dock values transformation. The building of ecological civilization requires the natural orientation of values. The transformation from conventional values to ecological civilization values requires theoretical support, the practice of new ecological values, ecological ethics as well as ecological culture. The practical principles and objectives of ecological civilization building should be shaped in an all-round and multi-angle manner. The community of shared future between human and nature is taken as the practice trend, the co-evolution between human and nature acts as the practice ethics, and the “friendship” between human and nature is adopted as the practice culture. The values transformation of the relationship between human and nature in ecological civilization is achieved, and then the ideal vision of harmony between human and nature is achieved.

#### 4. Summary

Complex system brittleness theory in natural science is inevitable for material world, and it applies to both nature and human society. It specifies the material energy transformation relationships between nature and human society, reveals the objective laws of natural world as well as the mystery of the movement and variations of the natural ecological system movement. It can evidently inspire the relationship and status between the human society and nature, while effectively connect the amendment of conventional values and the “nature-oriented” values.

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