From Systematic Way to Informational Way: The New Tendency of Contemporary Scientific Thinking

NAN Qiong[a],*; WANG Jian[a]

[a]School of Humanities & Social Sciences, Xi'an Jiaotong University, Xi'an, China.
*Corresponding author.

Received 14 October 2014; accepted 10 November 2014
Published online 26 November 2014


Abstract
Systematic thinking contains a whole set of thinking principles, methods and operation procedures. With the uprising popularity of studies on informational system science and complexity theory, information reveals a new field that the philosophy of the past has not been discovered. Wu’s works are putting forward a wholly new scientific thinking way: the Informational Thinking. We can conclude rationally from Wu’s explanations of information that the character of informational thinking way can include and surpass the basic idea of systematic thinking way.

Key words: Systematic thinking; Theoretical construction; Functional scope; Complexity information system theory

1. THE UPRISING OF STUDIES ON SYSTEM SCIENCE AND ITS DEFECTS
Since the mid-20th century, there has been a new scientific revolution, which involves the transformations in a series of subject areas, and performed as a continuously promoting and developing process. The mark is the growing up of batches of emerging disciplinary groups, which can be referred to as the theoretical studies of complex information system. In particular, the growing up of emerging disciplinary groups arose in the third scientific revolution has three stages (the course of the emerging disciplinary groups arose in the third scientific revolution can be divided into three stages). The first is early stage of the basic theory of information system (1940s—Early 1950s). Born in this stage, the major subjects involved molecular biology, general system theory, information communication theory, general control theory, etc.. The second is development stage of self-organization theory of information system (Late 1960s—Early 1980s). Those major subjects founded in this stage involved dissipative structure theory, synergetics, hypercycle theory, catastrophe theory, et al. The third is the study stage of complex information system theory (Mid 1970s—After 1990s). Those major subjects founded in this stage included fractals, chaos theory, holographic theory, virtual reality science, nano-science, quantum informatics, cognitive science, complex system study theory, et al.. (Wu, 2006)

However, there are still five defects of the interrelated research areas in 20th century. Firstly, the research programs of holism and self-organization science were extremely publicized in a one-sided and simplified way, and occupied the leading position of the interrelated research areas in the latter half of the 20th century. Secondly, although the research program of information science brought about huge transformations in terms of technology, economy and society, its meaning as a...
paradigm of research program has never been clearly revealed, and the value of information elements to the existence and evolution of things were not recognized and excavated yet either. Taking one with another, in the research style of the 20th century, the research program of information science was belonging to the research program of system science and self-organization science. Some emphatic reflections were more or less made in certain studies by some scholars; however, they were just carried on the descriptive sense of external methods, without respecting the unification and integration. Thirdly, the research program of complexity theory has been just paid more attention to since the last period of 20th century. The basic research methods and perspectives of complexity theory have not yet been expressed clearly, and its mutual relations with other scientific programs have not been revealed well too. Fourthly, the studies of the philosophy of information, shadowed by the worldwide tendency of system philosophy, were only confined to the theoretical construction areas of individual scholars. Since the agreement of general essence of information has not been reached by academic circles, the universality problem of the concept of information is suspended as some kind of skeptical thing. This situation not only influences the development of general theory level of information scientific program, system science, self-organization theory, and complexity research theory, but also without doubt affects the development process forwards to intrinsic integration of unifying comprehensive construction of those research programs. In fact, because of the particular position of the research program of information science, with the purpose of transcending the scientific horizon of the 20th century, and achieving a new comprehension in a higher level, complexity studies in the 21st century has to pay enough attention to information elements and information scientific program, and endue it with due position. Last but not the least, because of those four defects above in the research style of the 20th century, the research programs of information science, system science, self-organization, and complexity are separated from each other, and since it is not yet mature, concerning the current development situation, the research program of complexity would be hard to undertake the luxurious mission of explaining and transcending other programs reproductively.

2. SEVERAL SPECIFIC POINTS OF COMPLEXITY INFORMATION SYSTEM THEORY

From a view of the original beginning, those early-developed disciplines belonging to the disciplinary groups of information system theory are not quite the theories of complexity research. Since the research program of complexity sprung from the comprehensive basis of various kinds programs of numerous research theories, it does not simply exist in a certain program of numerous existing research theories. Such concepts as “constitute”, “construction”, “structure”, “relation”, “generation”, “emergence”, and so on, which are emphasized by complexity theory, are interlinked with the general theory of information science directly. Actually, information science does reveal the general encoding mode of information in the pattern of constructing and constituting the relational structure, and moreover, the generation of things, emergence of holistic properties should be regarded as the expression, reconstitution, regeneration or innovation of the encoded contents, patterns or procedures of information in the process of spatial interaction and temporal evolution.

The theory of ultimacy, equal ultimacy, and finality of the consequence of system evolution, which has been illustrated by Bertalanffy, is an idea of simplicity of consequential invariance of macro evolution, when the theory of bifurcation and chaos, which was illustrated in the self-organization theory of nonequilibrium, is an idea of complexity of consequential variability of macro evolution. The edge of chaos illustrated in the complexity theory and the eternal novelties appearing in the holistic emergence that adapting randomness interactively and flowing without end are interlinked with the basic idea of universal connection and perpetual changing of dialectics. Therefore, from the view of dual-dimension of complexity theory and information science, the system concept of “element + relation” illustrated by Bertalanffy has not yet reveal the complexity characteristics of “system”, the unscrambling of which should integrates organizations interaction, network feedback chains, holographic mapping, mutual transformation of space-time of fusion of inherent (the inner change of time and space), unity of direct existence (matter) and indirect existence (information), compatibility of order and disorder, autonomic individuality of elements, etc. Furthermore, in order to illustrate the specific mechanism of generational maintenance and evolution of complexity structure, it is necessary to investigate the information feedback theory of Wiener, hypercycle structure theory of information codon of Eigen, multiple interactions loopback structure theory and macro and micro dual-emergence theory of Moran, multi-coordination order parameter theory of Hawking, dual-evolution theory of matter and information of the philosophy of information unitive and complementarily.

From the dimension of information activities, we can reveal the general mechanism of complex self-organization behaviors more profoundly: a) Differentiation: the decoupling of original system information connection; b) Convergence: the exploring of new information pattern; c) Nucleation: the generation of information codon; d) Upgrowth: ergodicity constructing of information feedback loop of information codon
indication; e) replication and diffusion: the quantitative expanding of information pattern; f) Variation: the innovating of information pattern; g) Selection and evolution: the complex development of information pattern. Hence, in our opinion, absolute reductionism and holism are all extreme, rigid, simple research methods, while the structuralization theory of information science to code elements and their order is a kind of specific approach and method of integrating the reductionism and holism organically. Nano-Sciences and technologies of virtual reality are models of integrating the reductionism and holism organically, which are based on the using relevant theories of information science reasonably. So, self-organization is an evolution process that generating new patterns, which can also not apparently be explained rationally in the active level of matter (quality or energy). At its essence, pattern is a kind of relation, framework, a kind of way of organization, structure of order, which only can be explained by information activities. We can describe it with these following items: Dynamic behaviors of self-organization system are one result caused by the constructive activities of persistence and complicated recombination of information patterns; appropriate openness is the essential condition to import relevant information of system evolution from environment; Inner-randomness and autonomous uncertainty of elements are the inner motives for the system to explore; Inner-feedback, long-ranged coherence or nonlinearity are the general mechanism of constructing systemic holistic framework of information, holistic network of information, and holistic holographic relation of mapping. Based on above, there are four necessary research aspects in constructing the unified complex information system theory:

a) To deepen the theoretic study of the philosophy of information. Since information phenomenon has a general character in philosophical ontological level, the research program of information science plays a very unique role in the comprehensive development process of contemporary complexity theory, information and system science; however this general character, and this unique role only can be revealed profoundly in the level of general philosophy theory, which first and foremost calls for a further study on the theoretical philosophy of information.

b) To deepen the general theoretic study of research program in information science. Re-unscrambles and reinterprets the general theory of research program of information science, based on the general character of information revealed by the philosophy of information; By comparative studying on the research programs of system science and complexity, we can reveal the more basic characters of the research program of information science, which can also better illustrate the related basic characteristics of research program of complexity specifically.

c) To deepen the study of research program of complexity. We should lay much more stress on the clear representation of research program of complexity, and use it to unscramble other research programs reproducitively and comprehensively. The specific contents include basic methods and principles of the research program of complexity, the Comparative Study of the research program of complexity, information science, system science, and self-organization.

d) To construct the unified theoretical system of complexity information system theory. Based on the specific studies above, it is a useful approach to unscramble the research programs of system science and self-organization reproducitively and comprehensively from the comprehensive perspective of the research programs of complexity and information science, which helps to achieve the construction of the unified theoretical system of complexity information theory.

3. INFORMATIONAL THINKING: THE NEW APPROACH OF SCIENTIFIC THINKING

System, levels, structure, functions, these categories are just playing their roles in a direct existent way and a state of substance, they just make the original description of the material world more scientific, and more modern. But information is different; it essentially reveals a new field that the philosophy of the past time has not been discovered.

Information brought an immeasurable future to the philosophy. Information not only exerted an influence on philosophy in the individual characteristics, individual factors and aspects, but also made up for the vacuum field that can be bridged by speculation in previous dialectical philosophy. The discovery of information provided a new scientific basis and method for more in-depth understanding of the relationship between spirit and matter, subject and object, as well as revealed the evolution approach and pattern of the universe and society more scientifically. Information brought about a new revolution for philosophy. In modern times, any philosophical system that takes no account of information link or underestimate the role of information link would ill-adapt to our age. (Wu & Li, 1987).

Wu’s works are putting forward a wholly new thinking way: Informational Thinking. We can conclude that the character of informational thinking includes and surpasses the basic idea of systematic thinking rationally from Wu’s explanations of information as following fields.

a) The revolution in philosophical ontology field. Information reveals a new world of indirect existence. It makes a new division for existing fields of the world, thereby establishes a new philosophical ontology conception of dual-existence of matter and information, leading to the fundamental transformation in philosophical
ontology, and thus changing the specific unscramble way of the basic problems of philosophy; furthermore, it also raises a fundamental overall shift in all other areas of philosophy; System thinking just emphasizes the integrated principle of inspecting the properties of things, and merely provides a new way to describe the existence, so it never leads to the change of dividing way in existing fields. Consequently it differs from the results in the revolutionary change of philosophical ontology, and just has a few similarities to lead all-round transformation of philosophy.

b) The revolution in philosophical epistemology field. Information thinking establishes an information intermediary theory of philosophical epistemology, and interprets the process and mechanism of noogenesis all-roundly in the multi-stage intermediary constructional and virtual sense, while System thinking just pays more attention to grasp the process of cognition activity on the whole, and is unlikely to make a substantial contribution to specific mechanism of intermediacy and procedure of noogenesis.

c) The revolution in philosophical and scientific theory of evolution field. Information thinking puts forward a kind of dual-evolutionary theory of matter and information forms; thus, it changes the human views of evolution. System thinking is impossible to provide this kind of dual-evolution perspective.

d) The revolution in philosophical and scientific theory of space-time field. Information thinking reveals the information condensation mechanism of time-space conversion in the interaction of things, and thus builds a brand new time-space view of space-time inner fusion (the inner change of time and space); System thinking is impossible to clarify the specific mechanism of the space-time inner fusion.

e) The revolution in the field of value philosophy. Information thinking puts forward the dual-value theory including matter value and information value from dimension of nature-in-itself, so as to provide the value of the Tao of nature and sustainable development theory with a theoretical basis; System thinking is impossible to rise information to the scale of basic value.

f) New interpretation of social development theory. Information thinking provides the brand new explanation on social essence and social evolution scale, and provides information civilization development of human information economy and information society with some interpretation principles; System thinking does not have interpretive function in this area.

g) New cognition of the essence of human practice and productive activities. Information thinking makes a brand-new explanation on human practice and human production activities, which regards human practice as the process of purposeful information of subject realizing in object, and draws a new conclusion that human production can only be information production, and that human productivity can only be information productivity from the law of conservation of matter and non-conservation of information. But system thinking does not have this kind of analysis perspective.

h) Integrative functions for existing scientific research program. Information thinking is able to get the reductionism and holism, as well as determinism and no determinism unified, to make elements, relations, structures and the nature of dual-emergence united very well, and to unit the contents of many aspects, such as the organizations interaction, network feedback chain, holographic mapping, mutual transformation of space-time inner fusion, the unity of direct existence and indirect existence, the compatibility of order and disorder, the emergence of autonomous individuality of elements and the overall behavior. It can also reveals the nature of the self-organization behavior, and the specific process and mechanism of the occurrence of self-organization in details, thus to more comprehensively cover the basic idea of the research program of complexity, and to provide a interpretative dimensions of information science for researchers in complexity theory. So it seems that information thinking is precisely able to take on the historical mission of integrating many traditional and modern scientific research programs, and to change them into a unified one. In contrast, system thinking does not have such functions.

i) The intensity of transformation to the existing science and philosophy. In this respect, the possible role of information thinking cannot be matched by system thinking either. Being the most general and universal, the theory and method of information thinking way and information system science is a new scientific paradigm, which has a strong permeable, penetrative and transformative power. When some of the related principles and methods of information system science are expanded to apply to the existing traditional disciplines, when using the new information thinking way to re-examine and to do research on the traditional theories and contents of disciplines, those traditional disciplines would gain some new meanings of all-round reformation or interpretation. Science in our age, or science in the information age, is facing a comprehensive information-based development process, which can be called “information scientization of science”.

j) Information thinking not only includes system thinking rationally but also has the surpassing character. From Wu’s definition of information thinking, we may conclude that the character of information thinking can include and surpasses the basic idea of system thinking rationally. The definition is:

When people regard information as a kind of basic existence differing from quality and energy, then comprehend, define, and cognize its essence, way of existing, meaning and value, they would get an idea of general comprehension,
definition, and cognition about information, which can be referred to as the information idea. And according to the relevant comprehension, definition, and cognition, the way and method of grasping and describing the essence, features, and properties of existing things in their interactive patterns of organizational structure and relational network, and their patterns of evolitional procedure and process, the way and method of decoding the contents of indirect existence of historical state, actual relation, and future tendency of things, when the structure, relation, procedure, and process of existing things are viewed as carriers or codes of information, and the way and method of re-symbolizing the real objects or information artificially, and endowing them with the specific representative relationship are together constitute the information knowing way and information thinking way, which is called information thinking. (Wu, 2005, p.424)

REFERENCES