

Scientific information scienceize

Wu Kun (chinese) ; Wu Tian qi (english translate)

(Xi'an Jiaotong University College of Humanities and Social Science, Shaanxi, Xi'an 710049, phone code, 0086-029-82626736, wukun@mail.xjtu.edu.cn)

Abstract: *Development to today's information science is no longer just a single subject or just a kind of cross nature, cross-sectional nature of subject, but one has many levels and involves subject system of multidisciplinary fields. Levels of this subject system can be broadly divided into: the philosophy of information, general information theory, the field of information science, category of information science, a branch of information science and engineering informatics. Information science in essence is a transformation of scientific normal form; this transformation has led to a new modern sense, take information theory as modern scientific system of dominant knowledge mode.*

Keywords: science , information , scienceize

In the 20th century in wave of science and technology revolution, the birth and development of information science technology is clearly in a unique and critical position. It is exactly the development of information science and technology has led to rise and development of new technological revolution (information revolution), and the information revolution has led to rise of economy of knowledge and information, and then led to emergence of knowledge and informational society. If we scale up from a generalized science to grasp specific scope of information science, then, we have the grounds to the philosophy of information and information technology into the broad sense information science to discuss.

Development to today's information science is no longer just a single discipline or just certain discipline of cross nature, cross-sectional nature, but one has many levels and involves subject system of many subject's fields. the most general, the most common theories and methods of information science is a new scientific normal form; this new scientific normal form has a strong penetration of power, run through and transformation force. When applied relevance some information scientific principles and methods have been to open up to traditional disciplines,

they will immediately giving some traditional subjects all-round transformation of new meaning. So far, have not found which the traditional disciplines is informational concept, information scientific the most general character, theories and methods that absolute not be involved in the.

Science of our age, the science of information age is facing a development process of comprehensive informationize, the informationize process of scientific development can be more aptly be called "scientific information scienceize."

1. Information science the special status in the modern science

The information revolution, the information economy, information society is a great social practice of contemporary human development, as this great based on theory of social practice is mainly information science, as well as that a set of new disciplines of arising out with information science to cross.

The establishment and development of Information science itself is the blend a broad cross into the background of integrated development of contemporary science, especially integrate the rise and development among of modern systems science. Modern systems science itself is a disciplines groups

of accommodate very broad range, such as information theory, control theory, system theory, dissipative structure theory, synergism, hypercycle theory, mutationism, chaos theory, fractal geometry, generalized evolutionary theory, holographic theory, etc., all are a member of the discipline group. Information science is in modern systems science related disciplines, particularly on basis of information theory, control theory, systems theory, and developed on the basis much information automation technology in disciplines of theory.

As a comprehensive scientific information science of developed on basis of the modern system scientific related subjects, natural and some other system science subjects forge a indissoluble bound, the mutual penetration between these disciplines, mutual complement and the unity of link up, but also enrich and deepen the information science itself. Developed to today's information science has been able to discipline from their own point of view to many disciplines aspects of modern system science go on Holographic of radiation, thus in a great extent and scope will many disciplines of modern system science into a unified inclusion in its own. Such as general information systems theory, general information control theory, general information on self-organization theory (radiation with dissipative structure theory, synergism, hyper cycle theory, catastrophe theory, chaos theory, fractal theory, and the theory of evolution and holographic aspects, disciplines and fields of many modern system science), that have been general theory disciplines in the modern information science of. Because of this inclusive is to the modern system science many disciplines of holographic radiation nature, at the cross of the surface with information science to produce a new range of disciplines are much more wide a lot.

In accordance with the usual academic argument, information science is the whole call of variety disciplines of take information as object of main study, is a traverse nature, cross nature and comprehensive subject of study informational movement laws and that uses information theory to the object go on describe, simulation, processing, control and use, it is and life sciences, materials science,

together known as in the world's of today three leading-edge disciplines.

However, due to information and information systems in comparison with matter and material systems, with the most general and universal character of the same broad meaning and scope, so , take information and its law of motion as the subjects of main study object that will with take matter and its law of motion as the subjects of main study object is as innumerable , and , among these subjects will be divided into levels and categories. In addition , to information and its law of motion as the subjects of main study object and to material and its law of motion as the subjects of main study object are always mutual cross and can not completely discrete , because the matter body and the informosome (direct and indirect existence, carrier matter and information, material existence way and material informational structure) it is always the inherent and specific unified. So , information science can not simply be regarded as a discipline , also , in just a traverse nature, cross nature and comprehensiveness statement such as a class nor can to it be of pertinent and comprehensive explanation. Besides , information science nor can be simply side by side with the life sciences and material science, this one aspect is because, in the modern scientific system, in the development of modern science and technology , the position and the role of information science is much important and great than the life science and material science ; but other aspect is because whether life science or material science must be according as information science that provided by the relevant theories and methods to construct their own ; there is also a the most essential reasons of third aspect , this is , life science in essence research and treatment of that is the general laws and methods of the biological genetic information occurrence, development, movement, transformation, change, recombination , the material science in essence research and treatment that is general mechanism and method of the model, function, processing, compound and

construction of information structure of general material body. So, From the informational research and informational processing in a particular point of view, whether life science or material science will be to a large extent be contained in the information science of broad sense.

2. Brief history of information science

2.1. Pre-history of information science

Human use in information, and processing there is one from in-itself to for-itself development process. Before we can understand the information from the scientific point of view it had already developed variety of processing informational technology.

Human origins are based on information processing, creation and the progress of transmission mode. Labor, language and consciousness of these is belong human fundamental factors that all possess the significance of information activities.

A number of important inventions of ancient human beings, all belong to or containing innovation of information technology. For example, language, writing, ink, paper, engraving, painting, invention and development of printing, and so on. Human information and communication technology can be traced back to earlier the original ancient period than carved stone hieroglyph. Such as "keep records by tying knots" and "make a beacon-fire for a signal" and so on are all an original communication means of informational storage and transmission.

2.2. The birth of communications information theory

The information science of regard as the modern sense is the first born from the communications field, and this is produced of communication information theory.

19th century 30s, telecommunications project started to build, wire telegraph, cable and communications have been come out after another and are widely used; Beginning of the 20th century, radio communication systems are also more widely applied. Development of communications engineering

put forward the task of quantitative description information and information systems.

In 1946, the first electronic computer developed success.

In addition, the results of theory and practical nature research of there are many areas that can provide the founding fathers of information theory to use. For example, 1864, Clausius introduced the second law of thermodynamics, "entropy" concept; 1877 Boltzmann established entropy formula in statistical physics; 1944 Schrodinger proposed negative entropy of life (information) principles and so on.

In study of information measure can be traced back to 1872, it was that year, Boltzmann proposed the concept of measurable relation between information and uncertainty measure; In 1918, Fisher studied the issue of measuring the informational amount from the classical statistical theory of angles; In 1928, Hartley and so on proposed that can be used the logarithm of possible number of messages for amount to measure contained information content in the information. But, all of these thought with regard to information and its measurement problems, did not get an in-depth, systematic exposition, nor attracted widespread attention in that time.

The real founder of communication information theory is the applied mathematician who Dr. Shannon of the American bell telephone company. In 1948, he published a paper named "mathematical theory of communication," in the "bell system technical journal," discusses the basic characteristics of the information source, the information channel, established an information system model of communication process, given Shannon's formula of the amount of information. This article marks the official birth of communication information theory.

And Shannon made the article in same year, Wiener in the process of found control theory, related to processing theory of the noise and signal in electric filter, he also independently given the mathematical formula of same amount of information with Shannon (only one negative sign short). Shannon

happened to coincide with Wiener on this point, is more for the communications information theory has opened up broad prospects.

2.3. From the information theory to information science

Information concept, information systems, information approach that possesses the universal character; make human scientific research on information problems quickly broke through the field of communication science.

After the birth of communication information theory, with the expansion of application fields, will soon be generalized. Not only have formed in succession a "technology information theory," "semantic information theory" and the "information utility theory" and the three major branches of the specific information theory, moreover, Information process, information methods have also been in the natural, social and thought almost all-encompassing in field has been widely revealed and application. There has never been what a concept of specific subject, such as the information concept has such a wide range of adaptability, permeability and across nature.

The achievement of information theory make human refreshing, and experts in many disciplines have tried to use concepts and methods of information theory to solve the difficult problem faced by in their own fields of disciplines. For example, organize, linguistics, hearing, nerves, physiology, psychology and other fields, soon introduced the information concept and information methods.

From the birth of communication information theory to the mid of 20th century 50s, London and the United States has succession held in a series of important international seminar on information theory, explored and related to the contents extremely broad. For example, in September, 1955 held in London on the third information theory international conference, topics on include: anatomy, animal health care sciences, anthropology, computer, economics, electronics, linguistics, mathematics, neuropsychiatric studies, neurophysiology,

philosophy, physics, political theory, psychology and statistics, etc.

At the same time of communication information theory be generalized develop, information theory and many disciplines in modern science, extensive cross with electronic technology, automation technology, computer technology, and a variety of traditional technical and theoretical subjects, thus greatly exceeded the scope of classical communication theory, finally formed a new discipline contains a number of the integrated system of the subject group --information science. Such as, computer science, artificial intelligence science, physics, chemistry, biology, material science, psychology, physiology, linguistics, medicine, economics, sociology, management science, astronomy exploration, geology archeology, production, life, etc., this some are almost all-encompassing in field, it can be seen the footprint of information concept and information theory everywhere, set up on the basis of different understanding to informational essence that all kinds of philosophy of information system have also been formed in succession and becoming perfect day by day.

subject of subjects group on the basis of further systematic development, to achieve synthesis of togetherness of a new and higher level, This will be general trend of next step development of information science.

3. system of information science

Developed to today's information science is a big family own many disciplines. Universalize of information concept and information principle, resulted in information theory and almost all of the generally cross interdisciplinary, infiltration and mapping between traditional disciplines. Through the development of this universal interaction, it can be said, information science areas can be in the way of radiation to open up their own piece of territory in any one of the traditional subject, Moreover, the development of information science itself can derive some new branch of science of differs from the areas of traditional subject researching completely.

Many subjects status in the family of information science are not all coordinate, and between these subjects still exist the differences in many aspects , such as, extent of theoretical abstraction, general or the scope of application, or the extent of operability and applicability, etc. According to many aspects of this difference, we have reason to use “picture 1” for the many subjects of modern information science to hierarchy and classify.

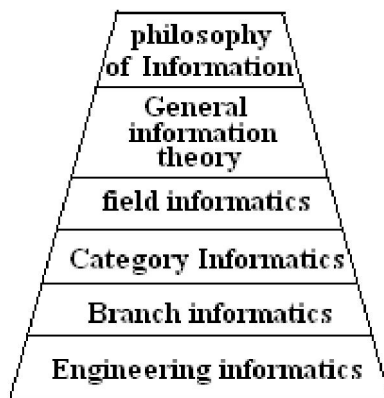


Figure 1: The hierarchical structure of modern information science system

Here some explanation to the contents of the various hierarchical structure of “Figure 1” :

First, philosophy of information is different from all other philosophy as a kind of meta-philosophy or a maximum philosophy , it take the information as a existential form of generalized, understanding way, the value of scale and evolutionary principles be explored , And the corresponding height from the meta-philosophy construct a new information ontology, information epistemology, information production theory, information society theory, information value theory, information methodology, information evolution theory, etc, under these broad areas of information philosophy can also be included a number of branches philosophy, Thus derived philosophy of information subjects of second, third, or a more deeper level. Based on the different understanding in information essence , philosophy of information may also can emerge a number of school.

Second, general information theory is the level of basic scientific principles in information science. At this level, information science to solve the problem should include: the meaning of information science, the general pattern of information systems; the general laws and mechanisms of the information production, movement, change and transformation; the general principles of information acquisition, encoding, decoding, transmission, transformation, access, processing, creation , control , use and so on. At this level, the subjects of general information theory still unable to achieve the specific unity, they are also interdisciplinary groups. Such as general information theory, information feedback and control theory, general information systems theory, information self-organization theory, chaos informatics theory, general holographic theory, information communication theory, and so on should belong to the scope of this level. Theory of this level of information science with the nature of the intermediary link, the one hand it is a summary and conclusion of general theory of information science in lower-level, other hand, it is the path to the levels of philosophy of information that the most close to the theoretical source. From another point of view, the general information theory also is bridge of the corresponding information science subjects from the traditional subject fields to open up. Can to the many subjects in information science family all as the traditional subjects in the cross process corresponding with general information theory, through theoretical conversion re-creation out of.

Third, the field informatics is the specific level of the basic principles of general information theory in several large areas of the world. Modern science in general to the whole world is divided into natural, social and spiritual three areas, while the modern scientific system generally can be divided into natural science, social science and cognitive science three parts. Is consistent with these conditions, the field informatics should also include at least natural informatics, social informatics, intelligent informatics that three parallel subjects. Natural informatics is a takes nature information for its study object, subject of information science of general laws and mechanisms of reveal nature information

operations ; Social informatics is a takes social information for its study object, subject of information science of general laws and mechanisms of reveal social information operations ; Intelligent informatics is take intelligent (including life intelligence artificial intelligence) information for its study object, information science subjects of and general laws and mechanisms of reveal intelligent information operations.

Fourth, category Informatics is the field informatics re-differentiation out large categories of information science subjects. For example, under the natural informatics can subdivide out the physical informatics, bioinformatics, celestial informatics and geology informatics.....; under the community informatics can subdivide out the economic informatics, political informatics, culture informatics and humanistic informatics..... ; under the intelligent informatics can subdivide out the language informatics, cognitive informatics and human - machine informatics.....

Fifth, branch informatics is category informatics re-differentiation out some of the appropriate domain more narrow information science subject. For example, under the bioinformatics can subdivide out the microbial informatics, plant informatics, animal informatics, ecological informatics..... ; under the economy informatics can subdivide the economic management informatics, commodity informatics, economic information communication and information industrial economics..... ; under the cognitive informatics can subdivide the identification informatics, sense of beauty informatics, decision-making informatics and value informatics..... Branch informatics under some categories it may also have a multi-level branch of scene. For example, under the economic management informatics can subdivide the accounting informatics, statistical informatics, financial informatics and economic decision-making informatics and so on. In addition, between the various categories subjects and between the various branches subjects, also possibly through way of mutual cross produces some information science subjects that underlying integrated. For example, economic decision-making

informatics is two-level branch of information science subjects of mutual crossing formed by decision-making informatics (branches subjects of the categories of cognitive informatics which under belongs to field of intelligent informatics) and economic management informatics (branches subjects of the categories of economic informatics which under belongs to the field of social informatics).

Sixth, engineering informatics is specific engineering that apply principles and methods of information science to the object world go on direct effect , that is a subject of obtain, identification, encoding and decoding, transmission, transformation, processing, create, access, control, and the role of implement information , with the production and use of the corresponding tool equipment-related of the skills and methods. Such as microelectronics, computer engineering (including hardware production, software design and computer application technology, etc.), communications engineering (including cable communication, wireless communications, satellite communications and fiber communication engineering, etc.), automation and networking systems engineering, database theory , system design engineering that various types of symbolic language for computer use, etc , all belong to the scope of engineering informatics, biological engineering, nanotechnology, and such as a number of material engineering and energy engineering relevance with the information engineering technology should also fall within the scope of engineering technical informatics. apparent , engineering technical informatics itself is also divided into levels, at least you can distinguish the basis of technical engineering and application engineering at two levels , the former is a subject with regard to the skills and methods of the general information tools and equipment production and use , while the latter is a subject with regard to the skills and methods of the applicable to some specific departments or industry information tools and equipment production and use. Previously listed a number of subjects are established in the former sense. the subjects established in the latter sense are so many, for example,

forecast meteorological information system engineering, medical diagnostic tests information systems engineering, space intelligence information systems engineering, environmental pollution monitoring information control engineering, electron banking information system engineering, office

automation information system engineering, etc., be too numerous to mention.

If we to launch relatively above 6 levels of the information science, we will entitle to such "Figure 2" described in a hierarchical levels and interaction model of modern information scientific system.

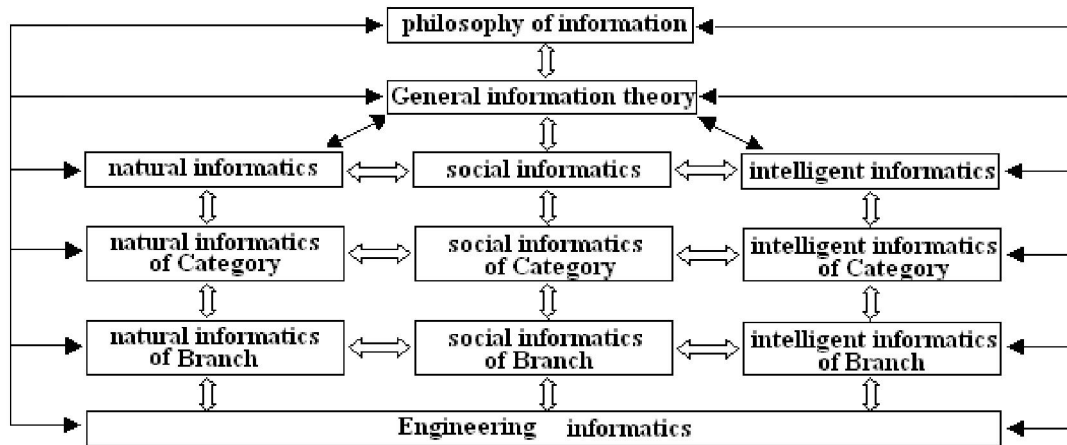


Figure 2 : Hierarchical levels and model of interaction of modern information science systems

From the "Figure 2" you can clearly see that, modern information science system has the basic characteristics of overall systemic, hierarchical structural nature and general interaction nature, etc, also, the entire system hierarchical structure also with the hierarchical structure of the human know object world is has the isomorphism relationship. From this can be seen, information science is not just a narrow subject that applicable to the corner of the world. The development of information science itself is from such a angle of information mode for human faced the world whole and its different areas give holographic perspective, through this perspective, information science will from their own nature and in norms scales for the areas of the world whole and its different areas make corresponding interprets.

It must be emphasized, such a magnificent system, until now has not yet been systematic established, some of these relevant subjects has not put forward, or merely put forward a name, or although there is a lot of discussion, but have not yet to form a system. Of course, many subjects in this now have a full

development or are being established, in development. Which the most active ought belong to the theory and practice in the levels of engineering technical informatics, is exactly this level of the excellent work has brought about emerges of information science, can it leads to profound changes of the information revolution, information economy, information society, information age and a series.

4. Relationship between the information science and traditional science

For subject nature of information science, and the relationship between it and other traditional subjects, people tend to use cross-subjects, cross-sectional subjects, and a new branch of science, multiple subjects and other formulation give explanation. Although these formulation is not regards as irrelevant, but, just stay in these statements is still far from revealing information science itself with the meaning and value of comprehensive radiation and overall transformation to traditional science.

From mentioned above the information scientific magnificent system of view , information science in essence is transformation of a scientific paradigm , this transformation has led to emerges of the modern science system of a brand-new in the modern sense, take information theory as the leading understanding way. As mentioned above , this system is re-creation out by the general information theory through the

comprehensive theoretical reconstruction of the traditional science system. So , information science is a model of the modern scientific system, but not just a single subject of area or branch.

We can use “picture 3” to indicate such all bearing paradigm shift relationship between information science and traditional science.

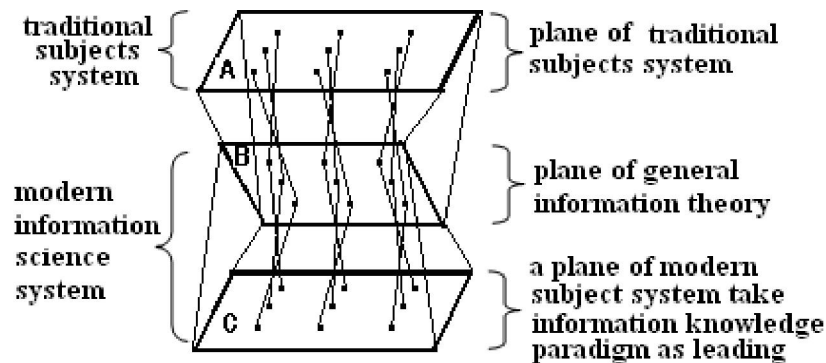


Figure 3 : The all bearing paradigm shift relationship between the information science and traditional science
(The point of the plane marked rallying point of the theory of accordingly subject)

“ A ”plane of the “Figure 3”represent the plane of traditional subjects system , their represents range of subjects including the philosophy, mathematics, natural sciences, social sciences, cognitive science, and their corresponding categories, branch subject, cross and traverse subjects, etc.

“B” plane of the “Figure 3”represent the plane of general information theory , it is provide the theory intermediary from traditional

subjects system to modern subjects system carries out the paradigm shift.

“C” plane of the “Figure 3” represent the plane that a modern subject system take information knowledge paradigm as leading , their represent range of subjects including the philosophy of information, natural informatics, social informatics, intelligent informatics and their corresponding categories, branch subject, and engineering technical informatics, etc.

About the Author:

Wu Kun (1953 -), male, Hebei Laiyuan people, Xi'an Jiaotong University, School of Humanities and Social Sciences Professor, Doctoral Advisor .is mainly engaged in philosophy of information, natural philosophy, complexity theory and other areas of research.