

On the Goal and Methods of Researches on Theoretical Informatics

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Abstract: *In order to establish and improve theoretical informatics, this paper discusses the goal and special methods of the researches on theoretical informatics. These methods include driving intellectual innovation with method innovation; unifying tool informatics and field informatics; combining multi subjects in realism breadth wise and history lengthways; combining multi levels in application, theory and philosophy; and listing some programs that are pending further discussion.*

Keywords: theoretical informatics; goal; methods; programs

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1. The type and structure of the problems in theoretical informatics

1.1 Scientific problems and their classification

Scientific problems denote that scientific main body in certain times advances the contradiction that needs to be solved and has not been solved with regard to scientific knowledge and scientific practice under the

knowledge background at that time, and they contain certain solving goals and replying region, but have no definite answers yet. Since scientific problems must arise under certain knowledge background of science and technology, we may divide scientific problems into two sorts: experiential problems and conceptual problems¹.

¹ Yin Zhengkun, Qiu Renzong. (1996). *Philosophy of Science*. Wuhan: Huazhong University of Science and

The experiential problems are problems about the substantial world. For example, apples falling to the ground, offspring resembling parents, etc. The astonishing incidents that occur in the substantial world affect our sense organs and nervous system. The problems that need to be explained, have not been explained, may be explained by using some background knowledge of science and technology constitute experiential problems. The solution for experiential problems is to incorporate amazing phenomenon into a certain concept frame namely theory. According to the consistence between experiential fact and theoretical frame, experiential problems may be divided into “conventional problems” and “unusual problems”. If scientific problems can be stipulated by certain normal form, we may use the ideal tool and experimental tool offered by normal forms to find the answers, and these problems are called conventional problems. On the contrary, unusual problems have violated the anticipation of conventional science aroused and controlled by normal form, and they can not be solved only by using the scientific background knowledge at that time, and they also can not be solved only by adjusting and developing existing scientific knowledge background, and they can be solved by establishing new scientific normal form. The goal state of conventional problems is clear, and it can be solved by developing and perfecting current scientific knowledge background. As to unusual problems, the goal state of them may be confirmed by the creativity of scientists, and scientists need to adjust and change existing scientific

knowledge background, found new scientific theory. Only scientists possess more courage to break the old restraint of normal form and possess the creative thought ability of opening up new field with great efforts can the goal state of unusual problems be solved. If we say that experiential problems are incorporate phenomenon into a certain concept or theoretical frame, then conceptual problems are about current concept frame or theory whether suitable or reliable. If experiential problems are the first level problems, then conceptual problems are the second level problems, which are higher level problems than experiential problems.

Conceptual problems are divided into internal conceptual problems and external conceptual problems. The problems of internal concept denote these have no logical self- harmonization inside a theory, or have logical contradiction inside a theory. The problems of external concept denote those can not be appeared simultaneously between a theory and other theories, including logical incompatibility among scientific theory, as well as the incompatibility of philosophy thought (ontology) and methodology, cultural tradition.

1.2 The goal and replying region of the problems in theoretical informatics

The problems in the establishment of information scientific subject are the construction of the subject systems by information concept, information principle, information theory, and what is its goal and replying region? The goal of information science is to establish the knowledge

system of information phenomenon between universe, and its replying region is out physics and material science. If we regard information scientific problem as the explanation for information phenomenon, it forms a unusual scientific problem, its asking for answer must cause crisis of the physics normal form which occupy regnant position, and arouse scientific revolution, establish new normal form of information science. If we regard information scientific problem as the sublimation of information conceptual problem, it is a high level problem, and information scientific theory budding and communication mathematics theory of Shannon form internal conceptual contradiction interiorly, and it conflicts with the system of entire material scientific exteriorly, not only showing in concept, principle and theory, but also showing in general scientific methodology and philosophy ontology. Therefore, in order to develop, information science must establish the ontology and methodology of itself.

1.3 The three bottleneck problems of theoretical informatics

In the research of contemporary information science, there are three mistaken districts in cognition. The mistaken cognitions on these three problems are always the bottleneck problems in the development of information science.

(1) They establish deductive system and investigate the way completely leaving from the concept, and stick like a limpet in information definition and tolerance problem;

(2) When establishing informatics in each field and theoretical informatics theory, they copy the mathematics pattern about

communication of Shannon and think that there is no information science if no quantifying and no modeling with mathematics;

(3) They dread for likely falling into idealism and the wallow of agnosticism on information scientific philosophy and think it is just safe in theory if only become information is explained material property.

We divided the development of entire information science into five periods: prehistoric informatics and project informatics, field informatics, theoretical informatics and unified informatics. For receiving the climax in the 4th period of development of information science, we must correct the idea in modern information scientific research and the mistakes on method in theoretical knowledge and actual research. The author thinks that there are three major approaches:

(1) We study information with the power of movement of information and the rule of information process as center;

(2) We describe the movement of information of itself with algorithm and program;

(3) We structure the principle of information philosophy which adapts the characteristic of information time.

Information science should be a huger group of subject than all material sciences. Because the production of information is a process with the production of material product as basic, and at the same time it contains special character, process and rule of information product. At present, informatics in numerous fields is revealing the particularity of information in every different field. Based on the information

technology of their support, various products are developed to service society and benefit human. But the abstraction of general information concept, process and rule and the conclusion in philosophy look quite stagnant. As pointed by a expert: the scientists in information society can not actually give a recognized definition for information, there is no presentable informatics theory besides the communication information theory of Shannon which are established on the base of formalized description in mathematics².

We consider that the root above-mentioned phenomenon lays localization of scientists received from the patterns of mathematics and physics subjects, the restraint of thinking method of reductionism, and no position of information in material scientific philosophy system. Informatics is a subject different from the normal form of physics, it studies the relations between alternative and the abstractness logic, and its task is opening up the rules different from physics, even contradicted. Continue to use traditional method, normal form and the idea of philosophy to study information science.

(1) Can not regard the definition of information as the only starting point of information scientific research

There are some decades of kinds about the definition of information as yet, but there is no one recognized by academic circle. The colleagues of information scientific circle regard the definitions which are not recognized as the obstacle of in-depth research so that can not overstep. The

scientists of biological informatics has offered Gene Information Services all over the world, various products of information field emerge in endlessly, and the editions update constantly. For a decade, we steer clear of the entanglement on concept of "information", and constantly lead the research of life informatics thorough. In scientific history, the development of physics did not firstly define the concepts such as power, energy and work scientific, accurate, and then just put forward basic theory of physics, method and knowledge system. The concept about energy, it spent more than 200 years until the relations of conversion concerning various types of energies are made clear from 16 century to 19 century to formally establish a scientific concept³.

We consider that the root above-mentioned problems doesn't lie the difficulty of grasping and describing in the definition of information, but lies the researchers' restraint caused by the pattern of research starting from the definition in idealistic concept. So we may completely adopt information concept as basic concept which need not define, then push the research of information handling process and the exploration of information rule, constantly deepen the cognition of information, the information concept will become scientific sooner or later. Certainly, it does not exclude discussion about information concept of partial researchers in different levels and different aspects, carry out unceasing, but it does not be the prerequisite of the work of most of

² Liu Guozhi. *Systems Science*. (2001). Shanghai: Shanghai Science and Technology Education Press.

³ T. Stonier. (1997). *Information and Meaning*. UK, Springer, P8-9.

information scientific researchers.

(2) Can not apply mechanically the normal form of physics and the formalize method of mathematics to the research field of information science.

Shannon called the information theory advanced by him “mathematics theory about communication”⁴. The information theory of Shannon is the description about information carrier of physics in itself. With its opposite, the informatics of the category of natural science mostly research the dynamic and static semantics of information, the informatics of the category of social science lay particular stress on the research of dynamic semantics of information⁵, both of them have the nonmaterial objects of research and its task is to reveal the objective rule different from physics, even contradicted. Therefore it is impossible that we attempt to normalize the theory about information handling with the pattern of informatics of Shannon. So, we can not apply mechanically the normal form of physics and the formalize method of mathematics to the research field of information science.

(3) Can not seek the answers for information ontology, information epistemology and information axiology under the frame of traditional material philosophy

The things about the existence of information, the value of information and the scientific status of information rule are impossible to get the answers in the view of philosophy of traditional materialism (it is

called physical materialism or material materialism), that is in the frame of material philosophy. The information science calls the philosophy of information⁶. When human society entered information society, the value of information is easily accepted. The knowledge products performance higher value than material products, its role as the technologists represented advanced productivity has been got general recognized in society. Reflecting to the level of ontology and methodology in philosophy, the epistemology about information (what is the thought mode of informatics) and the ontology about information (what is the relation of information and matter) make important instructional sense for the research of entire information science. These problems passing through discussion, communication and cooperation of philosophers and information scientists can be complied with the requirement of times, promote the development of dialectical materialism.

2. The development goal of theoretical informatics subject

2.1 The standard of establishment and maturely development about theoretical informatics

Nowadays, theoretical informatics is very small and weak, very immature, but it is a research field that has an up-and-coming future. Generally, whether a research field can become a subject approximately depends the standards: (1) Proper subject definition and research object; (2) The

⁴ G. E. Shannon. (1948). *The Mathematical Theory of Communication*. BSTJ,VOL.27.

⁵ Tian Aijing. (1948). Discussion on the ideas and ways special in the information society. *Medical Information*. VOL. 12(9), P26-27.

⁶ Tian Aijing. (1999). The Birth of a new view of nature and the end of traditional philosophy. *Electronics Engineer*, 1999(98), P39-42.

representative figure of character; (3) The classical works of subject; (4) The corresponding organizational system in university; (5) The professional publication of subject; (6) The studying fund; (7) The professional researcher; (8) The related course combination of cultivating graduate student; (9) The mature theoretical system of subject⁷. The mature process of theoretical informatics subject can have own particularity, but the measured standard and the standard formed by general subject should be mutual. Refined and sublimed from plenty of knowledge about information, the key of theoretical informatics is knowledge's theorization, systematization, resting with the structure of narrow logical system.

2.2 The certification about rationality of theoretical informatics needs new rules

There are two outstanding contradictions about the research of theoretical informatics, first is traditional material scientific ideological resource, including specific subject theory, general scientific method and philosophy epistemology, it can only consult, and can not copy; second is that current powerful subject organizational system and administrative organizational system are happy to accept information technology and products, and they refuse to recognize the rationality of information theory, because general concept, principle and method about information phenomenon is antipathy with material phenomenon, even conflicting. So in order to establish theoretical informatics must demand: modify "game rule" in

scientific circle, adjust the distinguished standard of scientific subject. It will first set up the prestige of information scientific paradigm, and prove own rationality with new paradigm.

2.3 Theoretical informatics needs the promises of philosophy ontology

What is called information science needs the promises of philosophy ontology is require the promises of philosophy: information phenomenon is a kind of actual existence, which is said, information has the position of ontology on philosophy. If saying that information is a kind of actual existence, we can not say: information is only a kind of surface phenomenon, it is a kind property of material in the final analysis; so we also can not say: as long as the structure and function of material is studied drastically, the problem of information is also solved naturally; we can not say furthermore, the knowledge of quantitative description about material is just scientific, but the discussion of surrounding algorithm and program about information is only philosophy trend of thought, or a kind of thought art (if not saying that it is pseudoscience). We believe that the determination of philosophy ontology's position about information promote information scientific normal form to more quickly replace the leading role of material scientific normal form.

⁷ Wang Jianhua. (2004). Higher Education as a Discipline. *Higher Education Research*. 2004(1), 69-74.

3. The research method of theoretical informatics

3.1 The research of theoretical informatics must drive intellectual innovation with method innovation

To solve the special contradiction of theoretical informatics faced with, we must blaze ideological resource of information science's own, and put forward scientific reasonability standard of our own. The putting forward and discussing of new normal form is relied on the in-depth research for particularity of information phenomenon. This kind of research must have the methodology of new suitable information phenomenon characteristic. "Scientific creation first needs to create method", creating the method of informatics is prerequisite condition of the establishment of information science's own. Normally, the method of scientific research divides into three levels: philosophy knowledge method, general scientific method and specific subject method⁸. Because of the particularity of information phenomenon, we can not continue to use the methodology system of material science, and we must break through on the three levels such as philosophy ontology, general scientific methodology and informatics department specific method at the same time. In order to solve the problem of physics normal form "incompatibility", we can not "act in a Procrustean way" to cater for it, and we should suggest new ontology, try new methodology, establish informatics theoretical structure based of information and intelligent concept and started with

⁸ Li Shanjian. (2002). *Overview of the Scientific Method*. Beijing: Science Press, 2.

basic information law. So we must adopt cross-layer synthetic method. Also since information phenomenon is concerned with universal evolution whole journey, we must adopt "cross-layer synthetic method", realize the summary of information in numerous fields for universal evolution whole journey, and realize large-span synthesis with information evolution which is longitudinal and existing information species subject which is horizontal.

3.2 Unifying tool informatics and field informatics

The synthetic method is a kind of scientific thought method and research technique of combining every component or various essential factors of study object in thought into organic unified whole on the base of analysis with scientific summary and summary, revealing and holding thing nature and basic law in general. Now, the task that we are faced with is studying and holding information in whole, from the organic connection aspect of information phenomenon, breaking parts into the whole, changing parts into the whole, changing the simple to complex, revealing and assuring the ultimate quality and basic law of information phenomenon, founding theoretical informatics, establishing complete information science, establishing the foundation for the founding of unified science contained material and information science.

3.3 Combining multi subjects in realism breadth wise and history lengthways

The interdisciplinary synthesis is "the interdisciplinary synthesis of the whole

journey of universal information evolution”, on time and space biggest span in order to carry out across science synthesis for the field informatics. The span on time is the comprehensive research of universal evolution history longitudinal crossing historical stage, from Big Bang to the form of life, the appearance of human, even the digital globe village. The span on space is the synthesis of the interdisciplinary field on the current stage of universal evolution.

Because the different angle of large span and panoramic observation, it is very easy to find regularity which is hard to see in unitary subject or in little span research. The biggest span studying conclusion is easy to possess the biggest scope of “universal adaptability”. For example, putting the relation of existence and consciousness discussed in human cognitive process into entire life world to observe is the relation between living material and alive information; adding no life information processes in nature and the artificial information process such as computer to unified consider, it will become the most general relation of material and information problem. Therefore, in generally speaking, the relation of thought and existence, material and spirit should be the relation of material and information.

3.4 Combining multi levels in application, theory and philosophy

Multi levels informatics are “application” informatics, “theory” informatics and “philosophy” informatics. The multi levels synthesis is about application, theory and philosophy, it accumulates ideological resource on above-mentioned three levels at the same time, drives the innovation of

research content with the innovation of research technique, lets them interact, confirm mutually, mutual to rely on. Among of them, it is the special method of the specific subject in application field informatics on the first level, it is the common and general method of each informatics on the second level, and it is the philosophy knowledge method that has universal meaning on the third level.

It was confirmed by our research, taking information philosophy as basic idea, taking general informatics as theoretical guidance, taking field informatics technology and product as practice link, the studying result on three levels may be really mutual to rely on, reflect and connect, form an open growing new knowledge system.

4. Some problems needed more discussion

Though domestic and international scholars have carried on a lot of researches around basic theory of information science, it is still not deep enough as a whole, the construction of subject is in primary stage of development About the theoretical informatics or the general of information scientific, at present, there are many more problems which still have not solved than problems which have solved

- (1) The problems of information theory in personal work, study and life.
- (2) The problems of information theory in informatization of unit, industry and nation.
- (3) The information problem in material science.
- (4) The information problem in

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| <p>humanities.</p> <p>(5) The information problem in social sciences.</p> <p>(6) The theoretical foundation of computer software science.</p> <p>(7) Informational energy and evolution of life information.</p> <p>(8) The architecture of theoretical informatics and entire information scientific</p> | <p>knowledge.</p> <p>(9) Information science and systematic science, control theory.</p> <p>(10) The challenge and countermeasure faced by traditional materialism philosophy.</p> |
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