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中国技术哲学与STS论丛（第二辑）

Chinese Philosophy of Technology and STS Research Series

丛书主编 陈凡 罗玲玲

工程设计哲学

技术人工物的结构与功能的关系

Philosophy of Engineering Design

The Relationship between Strucutre and Function of Technical Artifacts

潘恩荣 著

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总　序

哲学是人类的最高智慧，它历经沧桑岁月却依然万古常新，永葆其生命与价值。在当下，哲学更具有无可取代的地位。

技术是人利用自然最古老的方式，技术改变了自然的存在状态。当技术这种作用方式引起人与自然关系的嬗变程度，达到人们不能立即做出全面、正确的反应时，对技术的哲学思考就纳入了学术研究的领域。特别是一些新兴的技术新领域，如生态技术、信息技术、人工智能、多媒体、医疗技术、基因工程等出现，技术的本质、技术作用自然的深刻性，都是传统技术所没有揭示的，技术带来的社会问题和伦理冲突，只有通过哲学的思考，才能让人类明白至善、至真、至美的理想如何统一。

现代西方技术哲学的历史可以追溯到100多年以前的欧洲大陆（主要是德国和法国）。德国人E. 卡普（Ernst Kapp）的《技术哲学纲要》（1877）和法国人A. 埃斯比纳斯（Alfred Espinas）的《技术起源》（1897）是现代西方技术哲学生成的标志。国外的技术哲学研究经过100多年的发展，如今正在由单一性向多元性方法论逐渐转变；正在寻求与传统哲学的结合，重新建构技术哲学动力的根基；正在进行工程主义与人文主义的整合，将工程传统中的专业性与技术的文化形式或文化惯例的考察相结合；正在着重于技术伦理、技术价值的研究，出现了一种应用于实践的倾向——即技术哲学的经验转向。

与技术哲学相关的另一个较为实证的研究领域就是科学技术与社会（Science Technology and Society）。随着技术科学化之后，技术给人类社会带来了根本性变化，以信息技术和生命科学等为先导的20世纪

科技革命的迅猛发展，深刻地改变了人类的生产方式、管理方式、生活方式和思维方式。科学技术对社会的积极作用迅速显现。与此同时，科学技术对社会的负面影响也空前突出。鉴于科学对社会的影响价值也需要正确地加以评估，社会对科学技术的影响也成为认识科学技术的重要方面，促使 STS 这门研究科学、技术与社会相互关系的规律及其应用，并涉及多学科、多领域的综合性新兴学科逐渐蓬勃发展起来。

早在 20 世纪 60 年代，美国就兴起了以科学技术与社会（STS）之间的关系为对象的交叉学科研究运动。这一运动包括各种各样的研究方案和研究计划。20 世纪 80 年代末，在其他国家，特别是加拿大、英国、荷兰、德国和日本，这项研究运动也都以各种形式积极地开展着，获得了广泛的社会认可。90 年代以后，它又获得了蓬勃发展。目前 STS 研究的全球化，出现了多元化与整合化并存的特征。欧洲学者强调 STS 理论研究和欧洲特色（爱丁堡学派的技术的社会形成理论，欧洲科学技术研究协会）；美国 STS 的理论导向（学科派，高教会派）和实践导向（交叉学科派，低教会派）各自发展，侧重点不断变化；日本强调吸收世界各国的 STS 成果以及 STS 研究浓厚的技术色彩（日本 STS 网络，日本 STS 学会）；STS 研究的全球化和多元化，必然伴随着对 STS 的系统整合，在关注对科学技术与生态环境和人类可持续发展的关系的研究；关注技术，特别是高技术与经济社会的关系；关注对科学技术与人文（如价值观念、伦理道德、审美情感、心理活动、语言符号等）之间关系的研究都与技术哲学的研究热点不谋而合。

中国的技术哲学和 STS 研究虽然起步都较晚，但随着中国科学技术的快速发展，在经济上迅速崛起，学术氛围的宽容，不仅大量的实践问题涌现，促进了技术哲学和 STS 研究，也由于国力的增强，技术哲学和 STS 研究也得到了国家和社会各界的越来越多的支持。

东北大学科学技术哲学研究中心的前身是技术与社会研究所。早在 20 世纪 80 年代初，在陈昌曙教授和远德玉教授的倡导下，东北大学就将技术哲学和 STS 研究作为重要的研究方向。经过二十多年的积累，形成了东北学派的研究特色。2004 年成为教育部“985 工程”科

技与社会（STS）哲学社会科学创新基地，2007 年被批准为国家重点学科。东北大学的技术哲学和 STS 研究主要是以理论研究的突破创新体现水平，以应用研究的扎实有效体现特色。

《中国技术哲学与 STS 研究论丛》（以下简称《论丛》）是东北大学科学技术哲学研究中心和“科技与社会（STS）”哲学社会科学创新基地以及国内一些专家学者的最新研究专著的汇集，涉及科技哲学和 STS 等多学科领域，其宗旨和目的在于探求科学技术与社会之间的相互影响和相互作用的机制和规律，进一步繁荣中国的哲学社会科学。《论丛》由国内和校内资深的教授、学者共同参与，奉献长期研究所得，计划每期出版五本，以书会友，分享思想。

《论丛》的出版必将促进我国技术哲学和 STS 学术研究的繁荣。出版技术哲学和 STS 研究论丛，就是要汇聚国内外的有关思想理论观点，造成百花齐放、百家争鸣的学术氛围，扩大社会影响，提高国内的技术哲学和 STS 研究水平。总之，《论丛》将有力地促进中国技术哲学与 STS 研究的进一步深入发展。

《论丛》的出版必将为国内外技术哲学和 STS 学者提供一个交流平台。《论丛》在国内广泛地征集技术哲学和 STS 研究的最新成果，为感兴趣的国内外各界人士提供一个广泛的论坛平台，加强相互间的交流与合作，共同推进技术哲学和 STS 的理论研究与实践。

《论丛》的出版还必将对我国科教兴国战略、可持续发展战略和创新型国家建设战略的实施起着强有力的推动作用。能否正确地认识和处理科学、技术与社会及其之间的关系，是科教兴国战略、可持续发展战略和创新型国家建设战略能否顺利实施的关键所在。技术哲学和 STS 研究涉及科学、技术与公共政策，环境、生态、能源、人口等全球问题和 STS 教育等各方面问题的哲学思考与实践反思。《论丛》的出版，使学术成果能迅速扩散，必然会推动科教兴国战略、可持续发展战略和创新型国家建设战略的实施。

中国是历史悠久的文明古国，无论是人类科技发展史还是哲学史，都有中国人写上的浓重一笔。现在有人称，“如果目前中国还不能输出她的价值观，中国还不是一个大国。”学术研究，特别是哲学

研究，是形成价值观的重要部分，愿当代的中国学术才俊能在此起步，通过点点滴滴的扎实努力，为中国能在世界思想史上再书写辉煌篇章而作出贡献。

最后，感谢《论丛》作者的辛勤工作和编委会的积极支持，感谢中国社会科学出版社为《论丛》的出版所作的努力和奉献。

陈　凡　罗玲玲

2008 年 5 月于沈阳南湖

General Preface

Philosophy is the greatest wisdom of human beings, which always keeps its spirit young and keeps green forever although it has experienced great changes that time has brought to it. At present, philosophy is still taking the indispensable position.

Technology represents the oldest way of humans making use of the nature and has changed the existing status of the nature. When the functioning method of technology has induced transmutation of the relationship between humans and the nature to the extent that humans can not make overall and correct response, philosophical reflection on technology will then fall into academic research field. Like the appearance of new technological fields, especially that of ecotechnology, information technology, artificial intelligence, multimedia, medical technology and genetic engineering and so on, the nature of technology and the profoundness of technology acting on the nature are what have not been revealed by traditional technology. The social problems and ethical conflicts that technology has brought about have not been able to make human beings understand how the ideals of becoming the true, the good and the beautiful are united without depending on philosophical pondering.

Modern western technological philosophy history can date back to over 100 years ago European continent (mainly Germany and France). German Ernst Kapp's Essentials of Technological Philosophy (1877) and French Alfred Espinas' The Origin of Technology (1897) represent the emergence of modern western technological philosophy. After one hundred year's de-

velopment, overseas research on technological philosophy is now transforming from uni – methodology to multi – methodology; is now seeking for merger with traditional philosophy to reconstruct the foundation of technological philosophy impetus; is now conducting the integration of engineering into humanity to join traditional specialty of engineering with cultural forms or routines of technology; is now focusing on research on technological ethnics and technological values, resulting in an application trend——that is, empiric – direction change of technological philosophy.

Another authentic proof – based research field that is relevant to technological philosophy is science technology and society. With technology becoming scientific, it has brought about fundamental changes to human society, and the rapid development of science technology in the 20th century has deeply changed the modes of production, measures of administration, lifestyles and thinking patterns, with information technology and life technology and so on in the lead. The positive impacts of science technology on the society reveal themselves rapidly. Meanwhile, the negative impacts of it are unprecedented pushy. As the effects of science on the society need evaluating in the correct way, and the effects of the society on science technology has also become an important aspect in understanding science technology, the research science of STS, the laws and application of the relationship between technology and the society, some newly developed disciplines concerning multi – disciplines and multi – fields are flourishing.

As early as 1960s, a cross – disciplinary research campaign targeting at the relationship between science technology and the society (STS) was launched in the United States. This campaign involved a variety of research schemes and research plans. In the late 1980s, in other countries especially such as Canada, the UK, the Netherlands, Germany and Japan, this research campaign was actively on in one form or another, and approved across the society. After 1990s, it further flourished. At present, the globalization of STS research has becoming typical of the co – existence of multiplicity and

integration. The European scholars stress theoretical STS research with European characteristics (i. e. Edingburg version of thought, namely technology – being – formed – by – the – society theory, Science Technology Research Association of Europe); STS research guidelines of the United States (version of disciplines and version of Higher Education Association) and practice guidelines (cross – discipline version and version of Lower Education Association.) have developed respectively and their focuses are continuously variable. Japan focuses on taking in STS achievements of countries world – wide as well as clear technological characteristic of STS research (Japanese STS network and Japanese STS Association); the globalization and the multiplicity of STS research are bound to be accompanied by the integration of STS system and by the concern of research on the relationship between science technology, ecological environment and human sustainable development; attention is paid to the relationship between the highly – developed technology and the economic society; the concern of research on the relationship between science technology and humanity (such as the values, ethnic virtues, aesthetic feelings, psychological behaviors and language signs, etc.) happens to coincide with the research focus of technological philosophy.

Chinese technological philosophy research and STS research have risen rapidly to economic prominence with the fast development of Chinese science technology; the tolerance of academic atmosphere has prompted the high emergence of practical issues and meanwhile the development of technological philosophy research and STS research; more and more support of technological philosophy research and STS research is coming from the nation as well as all walks of life in the society with the national power strengthened.

The predecessor of Science Technological Philosophy Study Center of Northeastern University is Technological and Social Study Institute of the university. Northeastern University taking technological philosophy research and STS research as an important research direction dates back to the advocacy of Professor Chen Chang – shu and Professor Yuan De – yu in 1980s.

The research characteristics of Northeastern version has been formed after over 20 years' research work. The center has become an innovation base for social science in STS Field of "985 Engineering" sponsored by the Ministry of Education in 2004 and approved as a key discipline of our country in 2007. Technological philosophy research and STS research of Northeastern University show their high levels mainly through the breakthrough in theoretical research and show their specialty chiefly through the down - to - earth work and high efficiency in application.

Chinese Technological Philosophy Research and STS Research Series (abbreviated to the Series) collects recent research works by some experts across the country as well as from our innovation base and the Research Center concerning multi - disciplines in science technology and STS fields, on purpose to explore the mechanism and laws of the inter - influence and inter - action of science technology on the society, to further flourish Chinese philosophical social science. The Series is the co - work of some expert professors and scholars domestic and abroad whose long - termed devotion promotes the completeness of the manuscript. It has been planned that five volumes are published for each edition, in order to make friends and share ideas with the readers.

The publication of the Series is certain to flourish researches on technological philosophy and STS in our country. It is just to collect relevant theoretical opinions at home and abroad, to develop an academic atmosphere to? let a hundred flowers bloom and new things emerge from the old, to expand its influence in the society, and to increase technological philosophy research and STS levels. In all, the collections will strongly push Chinese technological philosophy research and STS research to develop further.

The publication of the Series is certain to provide technological philosophy and STS researchers at home and abroad with a communicating platform. It widely collects the recent domestic and foreign achievements of technological philosophy research and STS research, serving as a wide forum platform

for the people in all walks of life nationwide and worldwide who are interested in the topics, strengthening mutual exchanges and cooperation, pushing forward the theoretical research on technological philosophy and STS together with their application.

The publication of the Series is certain to play a strong pushing role in implementing science – and – education – rejuvenating – China strategies, sustainable – development strategies and building – innovative – country strategies. Whether the relationships between Science, technology and the society can be correctly understood and dealt with is the key as to whether those strategies can be smoothly carried out. Technological philosophy and STS concern philosophical considerations and practical reflections of various issues such as science, technology and public policies, some global issues such as environment, ecology, energy and population, and STS education. The publication of the Series can spread academic accomplishments very quickly so as to push forward the implementation of the strategies mentioned above.

China is an ancient country with a long history, and Chinese people have written a heavy stroke on both human science technology development history and on philosophy history. "If China hasn't put out its values so far, it cannot be referred to as a huge power", somebody comments now. Academic research, in particular philosophical research, is an important part of something that forms values. It is hoped that Chinese academic genius starts off with this to contribute to another brilliant page in the world's ideology history.

Finally, our heart – felt thanks are given to authors of the Series for their handwork, to the editing committee for their active support, and to Chinese Social Science Publishing House for their efforts and devotion to the publication of the Series.

Chen Fan and Luo Ling – ling

on the South Lake of Shenyang City in May, 2008

献给我的父亲潘福贵先生和母亲柯玉妹女士

Philosophy of Technology: From External Approach to Internal Approach (Preface)

For a long time the philosophy of technology has been a rather marginal field, not only within mainstream philosophy but also for mainstream engineering (if there is something like 'mainstream' engineering). One of the reasons for it being marginal with regard to mainstream philosophy is that the latter field has been dominated in the second half of the twentieth century by an analytic approach, whereas most work in the philosophy of technology was performed from a perspective of continental philosophy. However, the dominance of the continental approach in the philosophy of technology is just one of the two striking differences if one compares the development of the philosophy of technology with that of its 'natural' twin field, namely the philosophy of science, a field that in the same period referred to above has grown into a well-respected discipline of its own. Whereas most work done in the philosophy of science has had an internal focus, i. e., analyses the nature of scientific knowledge and how it is produced and justified, the philosophy of technology as had an external approach in the sense that its main focus has been on the way technology is used and how this (massive) use affects modern life in all its facets. Moreover, much of the research done within the philosophy of technology has been conducted from a rather negative stance towards technology: the effects of modern technology on the human life world were considered to be problematic, even alienating humans from their proper relation to one another and from nature. This negative attitude, of course, was among other things in-

spired by the dangers of nuclear technology (the risk of an all – out destructive nuclear war) and the negative impact of the massive use of new technologies on the natural environment (Rachel Carson' s *Silent Spring*).

It is not my intention to start speculating here about whether its continental approach, its external focus or its negative stance towards modern technology, or a combination thereof, has been the main obstacle for the philosophy of technology for growing into a mature sub – disciple of mainstream philosophy in the second half of the twentieth century. Let me turn instead briefly to the relevance of philosophy of technology for 'mainstream' engineering. A rough comparison with the philosophy of science and its relation to science is telling again. Although it would surely be an exaggeration to claim that in the period under consideration the philosophy of science has had a major impact on the development of science, it is fair to say that there has been a strong interest from the sciences in the philosophy of science, in particular in the philosophies of the particular sciences that emerged towards the end of the twentieth century (philosophy of physics, of chemistry and of the biological sciences). The same is not true for engineering (the engineering sciences) and the philosophy of technology. There has been little interest in engineering in the philosophy of technology. In a way, this is not really surprising given the at times even hostile attitude of philosophers of technology towards modern technology (and by implication to the developers of modern technologies, that is, the engineers). But also the external approach to technology may have contributed to this state of affairs; apparently the work done by engineers was not considered to be relevant or important by philosophers of technology.

In my opinion, several developments around the turn of the century may be interpreted as sings that the situation with regard to the philosophy of technology is changing. Let me highlight some of them. First of all, there are attempts to develop, in analogy to the philosophy of science, a more internal philosophy of technology. If, instead of focusing on the societal consequences of modern technology, the black box of technology is opened up and

concentration is directed toward how technologies are generated or on how they come to be, then one of the first things that presents itself as specific for engineering, when compared to science, is engineering design. Roughly, engineering design may be characterized as translating human needs into technical functions and these in turn into physical structures. Engineering design plays a crucial role in creating the world of technical artifacts which is a world of human making. In my opinion we are witnessing nowadays the first beginnings of what may be termed the philosophy of engineering design as part of the birth of an internal philosophy of technology. A clear sign of this the *Handbook of the philosophy of technology and the engineering sciences* edited by Anthonie Meijers (Elsevier, 2009). Another development worth mentioning here are the ABET 2000 accreditation criteria for engineering curricula. These ABET criteria require that engineering students are confronted with the moral implications of technology and learn how to deal with them as part of their professional training. Yet another interesting development that marks a strong turn toward an internal philosophy of technology is the emergence of what is called Value Sensitive Design (VSD). VSD aims at displacing the locus of moral discussions about technology from the use phase to the design phase and is based on the ideas that during the design of technical artifacts engineers make all kinds of design decisions that are morally relevant and that therefore they should take into account the relevant moral values (such as privacy) when designing new technical artifacts and systems (for instance, when designing new means of communication).

Whether or not these developments will lead the philosophy of technology on to a path of a mature discipline remains to be seen, but the signs are very hopeful. Given the pervasive influence of technology on modern life, our society is in urgent need of a mature philosophy of technology, that is, a discipline that clarifies the nature of technology, of what it is and how it comes into being. Such an understanding is in my opinion a fruitful, if not necessary starting point for addressing issues that concern a critical (moral)

assessment of the role of technology in modern society.

The foregoing brings me to the content of this book by En Rong Pan. This book shows that Pan has a keen eye for these important developments and that he wants to contribute to the emergence of this internal kind of philosophy of technology. I find it very gratifying and encouraging that Chinese scholars are participating in and contributing to this move toward a new philosophy of technology that takes technology serious, not treating it only as a black box, but by looking at and studying what goes on inside this black box. I have had the pleasure and privilege of working together with Pan when he was a visiting PhD student for one year at the department of Philosophy at Delft University of Technology. From supervising his work during this year it became clear to me that not only that he has an excellent sense for what are interesting and important problems in the philosophy of technology, but also that he is an innovative thinker who brings new ideas to the field and who through his pragmatic approach may help in bridging the gap between the philosophy of technology and the world of engineering. For instance, in studying the issue of the 'logical gap' between the structure and function of technical artifacts, he not only demonstrated his pragmatic attitude by analyzing this problem in terms of a concrete industrial example, but brought in also new ideas from object oriented programming in order to tackle this problem. His inspiring and thought – provoking work in this domain is part of this book (see chapter 5, 6 and 7). Unfortunately, I do not master the Chinese language, which means that other work by Pan contained in this book is not accessible to me. But I am sure it will be of the same quality as the work he did during his stay in Delft, which means that this book will turn out to be an important contribution to the establishment of an internal philosophy of technology.

Peter Kroes
Delft University of Technology
Delft, November 2010