II. Technology, Modernity, and Ethics

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Why is Technology a Fundamental Problem of Philosophy?

At around 9:00 A.M. on February 1, 2003, the space shuttle Columbia disintegrated in flames over Texas a few minutes before its scheduled landing in Florida, after having completed a 16-day mission in space. While the main cause of the destruction of Columbia was clarified later, the scene of its disintegration was shocking enough to make us rethink the meaning of technology in our modern world. While the technologies that make space shuttles possible belong to the advanced technologies applied in space exploration, their essential characteristics are no different from those of technologies that constitute the world in which we live. In this sense, even for laymen who are not directly related to space exploration, the Columbia accident is not an event that exists only in TV programs, but also represents symbolically the characteristics of our modern lives. Our lives proceed with many kinds of risk, which are not fundamentally different from the risks that led to the disintegration of Columbia.

In this paper, I would like to focus on problems concerning technology in our world. I shall maintain that technology poses a fundamental and challenging problem for us as philosophers, and it enables us to redefine traditional conceptual schemes if we take the philosophical problem of technology seriously.

1. Philosophy and technology in the 20th century

We find technology has played important roles in every event and situation that is characteristic of the 20th century.

Why is the 20th century sometimes called the century of wars? Because many weapons of mass destruction based on modern science and technology were invented and used, especially during the two World Wars. And, the nuclear weapons invented at the end of the Second World War have determined the fate of international politics and the meanings of subsequent wars.

How could the US acquire such power and establish such a hegemonic position after the Second World War? The answer is that it introduced innovations in diverse fields of technology that brought about the development of various industries—the fields of telecommunications, electricity, automobiles, petrochemicals, electronics, space, etc. Without such technological development, so-called globalization, in which America plays the leading role, would not have been possible.

Our everyday lives have also been deeply influenced by the development of technology. In the 1950s and 1960s, during a time of rapid economic growth, the Japanese experienced a radical change in lifestyles. Changes were made possible by the introduction of many kinds of technological product into our family life, such as washing machines, vacuum-cleaners, TVs, and cars. Our "forms of life" are now constituted from various technological artifacts.

Among what are considered to be the most important problems of the 21st century are environmental problems on a global scale, which are inevitably caused by industrialization through rapid technological development.

Given this situation, what have philosophers accomplished in the philosophy of technology in the 20th century? Can we find interesting and significant philosophical streams that focus on problems of technology?

If the main task of philosophy is "grasping problems of the times in thought," technology should have been a main target of philosophy in the 20th century.

However, the philosophy of technology is nowhere to be found in the mainstream or fields of philosophy in the 20th century, while many new areas of philosophy were established during the 20th century, such as the philosophy of language, philosophy of mind, and even philosophy of science. It is strange that problems of technology have almost been neglected in the philosophy of science, which has attained a prominent position in philosophy in the 20th century, when a close connection between science and technology has become apparent. Why is technology not regarded as a basic problem of philosophy? Why do few philosophers show any interest in technology, which plays a significant role in our lives?

1) Underestimation of technology

The simplest answer to these questions is that technology has been underestimated in the tradition of Western philosophy since ancient Greek age in the field of theoretical and practical philosophy.

In theoretical philosophy, technology has been considered to be an application of theory, and the main cognitive content of technology is considered to be found exclusively in the theoretical part. According to this view, in the case of modern technology, science constitutes its cognitive content, and this feature distinguishes modern technology from traditional arts and crafts. In this view, technology has been given only the secondary role of application, in contrast to scientific theory, which has long been the main theme of the philosophy of science.

In practical philosophy, the well-known conceptual scheme of means and end has played a decisive role. In this scheme, technology is understood as something that is related mainly to means and not to end. While what purpose or end is to be chosen is the main problem in ethics and moral philosophy, problems related to means are regarded as secondary. The Aristotelian distinction of praxis and poiesis, or the Kantian distinction of "moral-practical" and "technical-practical" are well-known hierarchical distinctions. Following this tradition, technology is given only secondary status in practical philosophy as well.

"Technology is an application of science" and "technology is a neutral means" are long-held presuppositions in the history of Western philosophy.

Meantime, it has already been indicated in many ways that this kind of characterization of technology is inadequate or false.

For example, in almost every textbook of the history of technology we find the statement the thesis that technology is an application of science is false. The steam engine, which became a driving force of the industrial revolution, was made possible not on the basis of a scientific theory, rather the theory of thermodynamics was made possible by the steam engine.

As to the thesis that technology is a neutral means, we find clear counter evidence in our commonsense experience.

The National Rifle Association (NRA) in the US opposes gun control, maintaining "Guns do not kill people. People do." However, most Japanese people do not find this slogan persuasive. Namely, it is natural for us to think that a man or a society without guns is different from a man or a society with guns. In other words, we know that technological artifacts are not neutral means.

Of course, historians' understanding and commonsense understanding are not absolute. However, we could say philosophers are being negligent if they accept such a problematic conceptual scheme without examining it.

2) Overestimation of technology

Of course, not all philosophers in the 20th century underestimate technology. Several radically criticized the traditional way of viewing technology and gave technology a central place in philosophy. The representative of this kind of philosophers is Heidegger.

As is well known, Heidegger criticized the anthropological and instrumentalist view of technology, and emphasized that technology constitutes an essential element of the meaning and the way of appearing of Being.

Surely Heidegger indicated very clearly that technology must be regarded as a central theme of philosophy, especially in our age. In spite of this significant insight, we cannot conclude that Heidegger committed himself to a philosophical analysis of various concrete technological phenomena, and contributed to the development of the philosophy of technology.

According to Heidegger, technology has acquired a dominant status in the modern world, and no element in modern civilization is outside the influence and control of technological rationality, so it is now out of the question for us to control technology socially, politically, or ethically. Heidegger's conclusive statement concerning this point is the following:

> No individual, no group of human being, no committee whose members are influential politicians, researchers, and engineers, or no conference constituted by leading people of economy and industry can put the brake on and orient the historical process of the atomic age. No merely human organization is in a position to establish the rule over the movement of this age. (Heidegger 1959, p. 20f.)

This statement is a typical and extreme expression of technological determinism, according to which any efforts to criticize and change the technological process are doomed to fail. If this is the final philosophical statement, it would be meaningless to analyze philosophically concrete phenomena related to technology. In the case of Heidegger, we can find no place in which the philosophy of technology has a positive sense, either. This is a consequence of an overestimation of technology.

In this way, we find two seemingly opposite views concerning technology in the philosophy of the 20th century. Although these two views seem to be opposite, they have a common feature in that there remains no positive place for the philosophy of technology in both. If there is to be any kind of philosophy of technology in a positive sense, it is necessary to criticize and change the traditional way of conceptualizing technology. In this sense, to make the philosophy of technology possible we must begin to remake and redefine the traditional way of philosophizing.

2. The Multidimensionality of technology

Let us begin with the fundamental question of what technology is.

One of the most important and general reasons we create technology is to free ourselves from various types of work. However, if we examine this familiar aspect of technology more closely, its ambiguous character becomes apparent.

1) Artifacts as co-actors

According to cognitive theories of artifacts, artifacts are considered to be not only the result of intelligent human work but also the cause of intelligent behavior by human beings. To solve a problem, such as keeping out of the rain, we make an artifact, such as a roof. Once we make the roof, we can entrust the work of solving problems (keeping the rain off our heads) to the roof without worrying again about how to solve the problem. R. Gregory calls this role of an artifact "potential intelligence" (Gregory 1981, p. 311ff).

Not only intelligent behavior but also many social activities are made possible by artifacts. For example, in order to have people drive slowly at one place effectively, we not only install a traffic sign that says "Go Slow," but we sometimes construct speed bumps every few meters on the road or design the road to have many artificial sharp curves. The second method is more effective than the first one because drivers cannot drive in any way other than slowly on the road, independent of their intention.

In this sense, artifacts can be considered to play a co-actor role, making possible intelligent and social behavior.

It is important to characterize technological artifacts as co-actors. In particular, it is important to see that the intelligence and sociality of human beings depend upon what kind of co-actors we have, because this insight helps us to avoid designing inhuman environments and to design "things that make us smart" (Norman 1993).

However, we should not forget that this is only one aspect of artifacts.

In reality, because there are many factors that show various aspects at different times, there is an opportunity to develop a new relationship between human beings and artifacts. The speed bumps constructed on the road, which are very effective for making people drive slowly, are nothing more than obstacles when a fire engine must travel as fast as possible on the same road. In this case, the artifacts are used against the original intent of designers. This kind of situation is far from being exceptional. It is quite usual for artifacts to be used against the original intent of designers.

2) Otherness of technology

Edward Tenner discusses various cases of this kind in his interesting book *Why Things Bite Back*. Contrary to the prediction that making paper copies will become unnecessary because of electronic networking, offices are still full of paper. In another case, introducing cheaper security systems in a certain area caused malfunctions and user errors, which decreased the level of security. "Things seemed to be fighting back" (Tenner 1996, p. ix). The most shocking case of this kind is a serious accident such as the disintegration of a space shuttle. As artifacts behave contrary to the original intent of designers in these cases, I would like to call this character the otherness of artifacts.

What is important to confirm here is that the character of the co-actor and that of the otherness are inseparable. In the above case, speed bumps on the road can effectively make people drive slowly because they are obstacles. We cannot make these bumps stop being obstacles when a fire engine passes. If we regard this character of speed bumps as a defect, and improve them so that they can be easily moved, then the effectiveness of the Go Slow function is decreased at the same time. There is no artifact that has no element of otherness, or there is no artifact that has no possibility of fighting back. In other words, there is no perfect design or perfect technology.

This character of otherness plays not only a negative role but also a creative role in the process of invention. In fact, artifacts acquire a new meaning in the process, in which they are used in an unintended way. The Internet is a good example. Although originally designed for military use, it has now become a new form of communication in our everyday lives. It is said that the typewriter was originally designed as a prosthetic device to help people with sight deficiencies, but it played a central role in offices, and its original purpose became marginalized (Ihde 2002, p. 106). Automobiles are another example. Before automobiles were invented, produced, and widely used, there was no urgent social need to travel along a road faster than the speed of a horse-drawn carriage. Only after the mass production of automobiles was possible, and they became popular, did traveling at the pace of a horse drawn carriage become a problem to be solved by automobiles.

It is sometimes said that necessity is the mother of invention, or form follows function. However, what the actual history of invention shows is that these sayings are false. Form, for example, does not follow function, but form follows form. Henry Petroski emphasizes the role of form in the process of the evolution of new designs, and describes it in the following way:

> Whatever its intended function, an object's form alone often suggests new and more imaginative forms, as the stick did the fork and the shell the spoon. (Petroski 1992, p. 51.)

According to Petroski, the starting point of the evolution of technology is not a definite purpose or function, but rather some form of object, whether natural or artificial. On the basis of its form, the object evokes some function, and is used in some way. In the process in which objects are used, various defects will become apparent and motivate the improvement of their forms and to design various new forms. This is the fundamental process of the evolution of designs, which can be found in every case, from forks and spoons to nuclear power plans and space shuttles.

In this way we can find where the traditional characterization of technology fails. In the traditional view, whether focusing on the instrumental or deterministic aspect of technology, artifacts are regarded as something that continues to embody a unique definite meaning or function, and the creative aspect of the otherness of artifacts is not fully taken into consideration. Thus, first of all, we must focus on this aspect of the otherness of technology in an appropriate way, in order to develop a philosophy of technology in a positive sense.

3. Technology as an application of the unknown

Technology always produces some artifacts that have some form that cannot be reduced to a definite function and shows an aspect of otherness contrary to the original intent of designers. Only because of this aspect of otherness, can technology realize continuous creative evolution. Creativity and otherness of artifacts are inseparable. However, as this aspect of otherness is also an origin of failures, we cannot forget that technology necessarily fails.

As latent failures as well as creativity are features that cannot be foreseen, the demand to take the aspect of the otherness of technology into consideration means nothing but a demand to foresee what cannot be foreseen. Is the concept of technology, which includes such a paradoxical demand, really possible? In the last part of this paper I would like to show that this concept of technology is not only possible but is also necessary.

First, I would like to take up an interesting story that Galileo Galilei introduces at the first part of the *Dialogues concerning Two New Sciences*. In this story, Galileo shows impressively that events can happen contrary

to expectations; in particular a precautionary measure can have a disastrous result (Galileo 1914, p. 5).

> A large marble column was laid out so that its two ends rested each upon a piece of beam. A little later it occurred to a mechanic that, in order to be doubly sure of not breaking in the middle by its own weight, it would be wise to lay a third support midway. This seemed to all to be an excellent idea; but the sequel showed that it was quite the opposite, for not many months passed before the column was found have cracked and broken exactly above the new middle support. (Galileo 1914, p. 5.)

Of course, there was a cause that makes our surprise vanish. One of the end beams had over a long time become decayed and sunk, while the middle one remained hard and strong. As a result, one half of the column remained suspended in the air without any support. If the precautionary measure had not been taken, the column would have not broken, because no matter how the original beams might have sunk, the column would have moved with them. Petroski calls this case an excellent paradigm of the design process, and draws from it the following moral:

> Any design change, whether in geometry or material or process, can introduce new failure modes or bring into play latent failure modes. Thus it follows that any design change, no matter how seemingly benign or beneficial, must be analyzed with the objectives of the original design in mind. (Petroski 1994, p. 57.)

According to Petroski, what is most important for design is to start not on the basis of successful cases in the past, but rather on the basis of past cases of failure. The basic principle of design is not to aim at having a success but rather to aim at avoiding a failure. If there is a product of a successful design, it only means that a possible failure has not appeared so far. Any technology, no matter how successful it seems, cannot evade the possibility of failure. In this sense, we cannot say engineers can have knowledge that is verified conclusively and grasp a certain truth, even concerning the successful artifacts designed by them. The element of the unknown cannot be eliminated in the process of technology. What is important for engineers is not how certain they are about what they know, but how careful they are about what they do not know.

In this way, it becomes apparent again how one-sided is the view of technology as an application of science. According to this view, the essential character of (modern) technology is to be found in scientific knowledge, i.e., something that can be characterized as known in science independent of the process of application. However, as far as engineers cannot eliminate a possible failure but rather can bring new latent failure modes into the process of design through the application of scientific knowledge, that means, as far as the known in science is inseparable from the unknown in the process of application, we could say technology is an application of the unknown as well as that of the known. In fact, a Japanese historian of technology, Tetsurou Nakaoka, calls this essential character of technology the "application of the unknown," and indicates that the most important responsibility of engineers is "to detect symptoms that appear from the unknown sources and respond to them promptly" (Nakaoka 2001).

"To detect symptoms that appear from the unknown regions and respond to them promptly;" this is easy to say, but very difficult to do. The difficulty is illustrated by the story of Galileo and also by the disastrous space shuttles accidents. But, what Nakaoka particularly emphasizes is the behavior of scientists and engineers in the case of Minamata Disease in Kumamoto Prefecture, Japan, one of the most disastrous cases of disease caused by pollution in the middle of the 20th century.

In the case of Minamata Disease caused by toxic effluents from Chisso's chemical factory, various symptoms had appeared in fishes, birds, cats, and dogs, before the symptoms of accumulations of organic mercury appeared in human beings. No engineer could find significant implications in these phenomena. Instead, even after Minamata Disease had appeared to the public, many scientists and engineers were for the opinion that there was no scientific evidence for a causal relation between the symptoms of patients and the effluents from the factory. This attitude was one of the important reasons that cessation of mercury-polluted effluents from the factory was delayed substantially.

In this case, the quest for certainty hindered scientists and engineers from detecting symptoms of risks, and from responding to them promptly. Why did scientists and engineers maintain such an attitude? Clearly,

it was because they had the firm belief that they required knowledge that could be conclusively verified. However, can we regard the concept of knowledge that hinders us from detecting risks as responsible? A responsible concept of knowledge in such cases should rather be one that prompts us to rethink how we deal with phenomena about which we can never have conclusively verified knowledge. It is not the search for certainty but rather the search for possible failures that makes a responsible concept of knowledge possible.

In this way, we cannot but put into question the fundamental presupposition of modern epistemology since Descartes, in order to make a responsible concept of knowledge possible, especially for engineers. From what I have said here, many of you may have already thought of the falsification thesis of Karl Popper or the pragmatic theory of knowledge of John Dewey, in which we could find many valuable implications for the development of a philosophy of technology. Surely there remains still much to learn from the philosophical accomplishments of the 20th century. In this sense, I would like to emphasize again that taking philosophical problems of technology seriously means remaking and redefining the philosophical thinking that was dominant in the 20th century.