Technology and Social Systems : Civilization and Social and Cultural Characteristics of Technology

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Technology and Social Systems —Civilizations and Social and Cultural Characteristics of Technology—

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1. INTRODUCTION

A standard Japanese dictionary defines "technology" (*gijutsu*) as "(1) dexterity in hand work (craft), (2) means for applying theories to practical ends useful to human life (technique)," with a comparative reference to "skill (*gino*): excellence in work or art, capacity, ability [*Nihongo Daijiten* 1989].

That definition neglects another viewpoint towards the domain of living where civilization and technology interconnect. That is the view of life in which people come in contact with society, which is the field of their everyday life. The "technology" in our everyday social life permits another definition in addition to those mentioned above, singly or as group. This definition is quite familiar to learned people as well as to ordinary people of all kinds.

This paper proposes to call the other familiar aspect of technology "social technology," and to examine technology in terms of civilization studies, by investigating the ways in which social technology combines, connects, harmonizes with and opposes the contexts of modern civilizations ("Civilization" connotes a system of devices and social organizations [UMESAO and ISHIGE 1984: 18–22]). Toward that end, as a case study in the comparative study of civilizations, we shall discuss Bosch's view of Germany in Central Europe, both 19th-century individuals and firms. This is because "social technology" in this essay implies "organismic"—not "mechanistic"—management of a (small) business entity.

2. "SCIENTIFIC TECHNOLOGY" AS A CONCEPT

The term "scientific technology" (*kagaku gijutsu*) is used in Japanese today as a single word (or idea). Etymologically and historically, however, science and technology are independently developed ideas (words) and their meanings were different up to modern times. Science and technology bonded in Europe between the scientific revolution in the 17th century and the industrial revolution in the 18th and 19th centuries, and in Japan during the period from the 15-year war (World War II) in the middle of the 20th century through the period of rapid economic growth. Most people understand today's technology in association with the terms "science and engineering" or "scientific technology."

A certain comment presented in a lecture remains vivid in my memory. It was one of the main points made by ESAKI Reona (1973 Nobel prize laureate in physics) at a symposium held the year before the 1985 Tsukuba Science Exposition.

> *Kagaku gijutsu* in English is 'science and technology.' In that term the important element is 'and.' If you use the adjective form of science, as in scientific technology, which the Japanese often use in recent years, the term would be unintelligible in the English-speaking world.

Ironically, the term "scientific technology" began to appear in papers authored by Japanese, and non-Japanese as well, around the time of Esaki's lecture.[1)]

On the assumption that language represents entities, "technology" can be said to be inherently something "non-national and non-ethnic" with a structure and form that anyone (regardless of race, sex, age, or bodily strength) who understands the principles, follows basic procedures, and receives basic education and training, can master, though there may be some differences in perfection or convenience. The principles of "technology" having that nature are explained by means of science and experience.

The brakes are applied to the expansion of this so-called universality of technology, this "non-national, non-ethnic" nature of today's ever-more developing technology, and bias is injected into our physiological, sensory awareness or interpretation of technology, bringing about specific (regional or generational) deformations, by cultures, including religions, by nations and bureaucracies, by economic rationality (efficiency and profit seeking, or market orientation). I view the transition from "technology" to "scientific technology" that occurred after the mid-20th century as a trend toward "mono-linearization of civilization." Surely the term "scientific technology" has much to do with this recent "phenomenon of the equalization or homogenization of human beings in the

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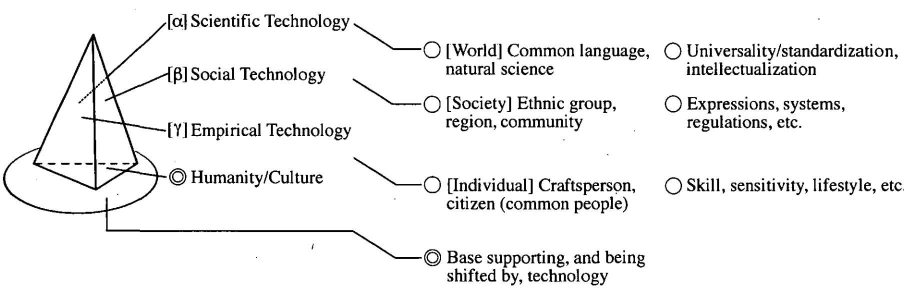
1) Kodansha's *Nihongo Daijiten* defines *kagaku gijutsu* as (1) science and technology, (2) scientific technology (technology for realizing and putting to practical use the results of natural science).

world, or in society, [which] likewise is advancing within human groups . . . and the other (comparably) advanced phenomenon of the unification of all humankind . . ." [Umesao 1991: 51–53].

3. TRIPLE-ASPECT TECHNOLOGY

Technology can be conceived as having three aspects or dimensions. Under this assumption, the world is structured as a set of triangular civilization pyramids, with the Humanity/Culture phase as the base of each pyramid. The base of a pyramid may be split by nation-states (national boundaries) or overlaid with ethnic groups. The height of a pyramid is the scale of population and does not indicate the superiority or elevation of a civilization. It is assumed that from ancient times to the present day, people's everyday life has consisted of three sides—World (nature and universe), Society (systems and rules), and Experience (body, mind, and sensation). Humanity/Culture is maintained by those three.

I take "technology" to exist in the totality of these three and also in each of the three sides—namely, scientific technology in the World, social technology in Society, and empirical technology in Experience. The "technology" that most people, including learned persons, speak of in our everyday life, while placing Humans/Culture at the base, refers to either the first or second of the definitions given above, that is, to one or the other of just two of the three sides. Social technology is overlooked.



(Drawing and caption by Oita Akira, 1992)

Figure 1.

Let us look in detail at the three sides of technology.

Scientific technology ([α]) is for the production of commercial goods; it is a productive factor comprising processes and auxiliary means in industry. It is the "technology" of science and engineering, which we see and hear, which is becoming "non-national and non-ethnic." This category corresponds to the above definition (2) in the dictionary.

Social technology ([β]) is the technology concerned with organizations and systems. It is the one which exists in the form of environments and scenes around humans; it includes the technology for operating civilizations—for example, expression, management, control, and legislation (to convey intentions and values).2) Each society, region, and ethnic group has its own organizations and manners of performance (methods for systemization) such as parliamentary democracy, communal rituals, child care and education, or customs associated with food, clothing, and shelter. This paper proposes to use the term "social technology" for dealing with the technology that is used to run organizations and systems, that is not hereditary but *a posteriori*, that people learn within the environments and scenes where they have been raised.

Empirical technology ([γ]) is the "technology" of a virtuoso3) in art, sports, theater, or music, which requires the keenest senses and body manipulations. The wisdom of old people or housewives' homemaking (e.g., cooking), for example, are included in the category of "empirical technology". The "technology for intellectual production" is also an empirical technology. This corresponds in a broad sense to definition (1) in the dictionary.

From the standpoint of the study of "technology," it is possible to make comparisons among civilizations and perform a synchronous analysis. When civilization is viewed as a system of devices and organizations, as Umesao defines it, if a given technology is assumed to be frozen in time, differences in the patterns of civilizations seem attributable to differences in [α], [β], and [γ]. From this standpoint, Japanese civilization after the 13th century resembles European civilization in all respects of [alpha], [beta], and [gamma], except for differences in the Humanity/Culture phase at the base [AMINO 1991: 64–77].

However, this method of synchronous analysis, based on an ecological view of history, brings great difficulties to a diachronic analysis of global urbanization and technology. Urbanization here is taken as one of three features of the mono-linearization of civilizations, along with homogenization/equalization, and unification. Further research may make possible a diachronic analysis through the comparative study of civilizations. Diachronic analysis can, however, be avoided by adopting a theory of the circularity or transmigratoriness of history, although many persons, including scholars, cling to developmental or progressive theories of

2) "Technik als Umwelt des Menschen" [RAMMERT 1975: 15–16]

3) The transition from technology to scientific technology is explained as follows. "During World War I, large plants experienced a turning point in that management by master artisans disappeared. Critical factors were: as plants became big in scale, the adoption of centralized direct management systems expelled indirect management systems operated by artisans; as uniformity in skill levels and improvement in the average skill level were pursued in place of the personal artisan-like excellence in skills attained by a few people, intellectual training became as essential as skills training and emphasis was placed on group work, which reduced or eliminated the discretion of individual workers in the workshop (this is connected to the introduction of Taylorism); and engineers, rather than artisans, began to assume working leadership" [ODAKA 1987: 233–234].

history and are very accustomed to diachronic analysis. Let us approach this aporia concerning technology in the study of civilizations by turning to a case study in German technological history.

4. BOSCH—ORGANIZATIONAL ENGINEER (I)

Robert Bosch (1861–1942)[4], the entrepreneur associated with automotive ignition devices, was born in the small village of Schwabische Alp in southern Germany, the son of a wealthy farm family. His parents ran an inn and a beer brewery as well as a farm. The railroad brought this typical wealthy farm family to a turning point in their lives. Apparently considering their future in terms of anxiety over the coming age of the railroad, the Bosch family moved to Ulm in 1869, when Robert was eight.

Graduated from a business school with average grades at the age of fifteen, Robert became an apprentice to an engineer of precision machinery on his father's advice and, in part, "by coincidence." During his youth in the second half of the 19th century, traditional apprenticeship and the journeyman system were, even at a point of decline, a matter of course for ordinary men to acquire essential skills. Robert was to some extent different, however, from most artisans and machinists. He purposefully focused his studies on concrete applications of the specialized knowledge of precision machinery (somewhat like a Japanese), and was concerned with political and philosophical issues that led him to combine company management and social (welfare and labor) policies.

In the precision machinery industry of the time, world leadership was shifting from Britain to the United States. In early 1884, upon completing his journeyman phase at age 22, Bosch left for the United States to acquire further training. In the United States he first worked under an electrical engineer who had migrated from Germany and then moved to the machinery factory of the prolific inventor, Thomas Edison. In the short space of less than two years, he accumulated abundant experience, knowledge, and information.

Returning to Germany and settling in Stuttgart, he established the Bosch Precision Machine & Electrical Technology Works, investing all of his own savings as well as his share of his father's fortune. He went into business by hiring two engineers, a machinist and an apprentice, forming something like today's venture business. He undertook jobs of every kind including repair of all sorts of electrical equipment and installation of telephones, home telegraphs, and lightning conductors, all requiring knowledge of precision engineering. The company's founder promoted himself as a jack-of-all-trades.

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4) Refer to [OITA 1993: 45–60]. Bosch (or his type) seems to be a true engineer, accepted not only in his own country but in others. He also seems outstanding as an artisan in empirical technology, as an entrepreneur in social technology, and in scientific technology.

Business went well. As early as the initial year it became obvious that the company's growth would be closely related to the development of the automobile. He designed and developed a "low-voltage magneto ignition system for fixed gasoline engines" and mounted it on motor vehicles. His ignition system was proven to make combustion very effective. Through subsequent improvements and commercialization, the ignition system opened the way for genuine technical innovation in automobile engines, and enabled him to expand his small business (and the Bosch trademark) to a global scale.

Gottlieb Daimler, the foremost person in the automotive industry of the time, noticed the Bosch ignition system. The news spread to the public, and as other automotive companies rushed to follow Daimler, improvements in engine performance were spurred. In 1902, Bosch succeeded in the development and commercialization of a "high-voltage magneto ignition system with spark plugs." Superior in terms of time, accuracy and price, the spark plug (a kind of igniter or generator based on magnetism) outperformed all other models then on the market. Thanks to the spark plug, the development of gasoline engines for high-speed cruising was greatly accelerated.

5. ORGANIZATIONAL ENGINEER (II)

In 1901, at age 40, Bosch moved to a newly built factory with 45 employees[5]. The new workspace was no longer a workshop in the conventional sense of manual industry but a most advanced factory space equipped with manufacturing facilities based on the most modern division of labor. There Bosch utilized the experience he had gained in the United States to realize time-saving rational manufacture, known today as series production, of products in quantity through division of process and labor.

At the same time, during the first decade of the century, Henry Ford was formulating the concept of his Model T. Experimenting with new production methods, Bosch planned and realized the "new factory," as an idea and as an actual extension of operations. Toward that end, Bosch's company had introduced the nine-hour workday in 1894 and reduced it to eight hours in 1906, because to Bosch "it seemed most economical, as well as most beneficial for maintaining a human

5) A medium-sized company/operation is one with a workforce between about 10 and 200 persons. Some researchers set the size at six to 50. In any case, an operation with 45 employees is a medium-sized business. YANAGISAWA Osamu maintains, "European capitalism in itself comprised small businesses (small-scale manufacturing of products) as an inherent structural condition in addition to medium-sized businesses operated by capitalists. Small businesses themselves were historically a basic element of classical capitalism. It can be said that this 19th-century element of capitalism was reproduced while diminishing in the 20th century and continued to hold a significant position in any capitalistic nation in Europe as a constituent element of capitalism at the turning point." [YANAGISAWA 1989: 14–15]

workforce." He paid above-average wages, and from 1910, office workers were given Saturday afternoons off. In addition, separate paid vacation systems for managers and other workers were established. By 1913, the company was taking responsibility for paying the premiums for workers' social insurance. These management programs were probably the first of their kind in both Germany and worldwide.

Bosch thought of the company as an organic organization made up of people as organic beings. His foresight, clearly accurate and a step ahead of his time, and his insight and intuition in searching out talents suitable for him and the Bosch firm, allowed him to gather many excellent coworkers for organizational management. Hugo Borst (1881–1967), who joined the company in 1900, created a new sales organization. Arnold Zäringer and his young assistant Ernst Durst developed an organization for mass production of precision products. Ernst Ulmer (1873–1925) worked out a very advanced "labor management", accounting system as well as the equivalent of today's corporate identity.

The genius designer Gottlob Honold (1876–1923) was a strange figure who first became an apprentice in the Bosch company, took leave to attend university, and returned to take up the post of first chief engineer. Gustav Klein (1885–1917), engineer and salesman, developed what are known today as global marketing techniques, and carried Bosch products to the world market. In addition, the first issue of "Bosch-Zünder", the company's public-relations magazine which was read and supported by many people in Germany and elsewhere, was published on March 15, 1919.

Bosch summarized his entrepreneurial credo for company management in the following four maxims.[6]

> First, provide facilities that allow rational manufacture of products. In that way it becomes possible to pay workers the best possible wages.
>
> Second, show workers and managers that you consider them your equals. Be fair, do not become conceited!
>
> Third, do not hesitate to promote able employees, even if the career is short. Promote wisely (the right person in the right place).
>
> Fourth, employees should be paid as much as possible. In addition, pay attention to the health and injury of workers, and improve working conditions. Establish various pension programs, and meanwhile dismiss those who do not maintain dignity. Be fair and generous, and above all, be true to your word!"

Although it may be misleading to draw conclusions solely from the above outline, the Bosch company of those years to some extent accurately anticipated today's ideas of corporate citizenship. Bosch the man deserves to be considered an "organizational engineer" as much as, or even more than, a "mechanical engineer."

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6) [Bosch 1976: 70–71] (digested by Oita)

6. THE CULTURAL CHARACTERISTICS OF SOCIAL TECHNOLOGY

Again, Bosch's principal interests were not limited to the growth of the company through the application of mechanical engineering or the consolidation of management organization or growth in profits. As mentioned previously, from the founding of his company, he regarded it as an organic organization. Although he was concerned most with his employees, including workers, engineers, and managers, he maintained that the mission and task, in other words, the social responsibility, of a company was to create valuable things in the public interest. Soon after founding the company, he laid the groundwork for a basic research laboratory and a public welfare foundation.

Bosch is a case of substance coming before form. Despite its earlier history, the founding of the joint stock corporation Robert Bosch AG came as late as 1917. The fruit of some four years of discussion, the corporation was initially set up with Bosch holding 51% of the 12 million shares, Honold 25%, and the remaining 24% divided among comanagers (Borst, Kempter, Kayser, Ulmer, and Rall). This too is an expression of Bosch's ideas of company management or, I dare say at the risk of giving a mistaken impression, his ideas of democracy within a corporate organization. For it seems that, on the analogy of an organization (corporation) as a family, Bosch allotted property according to ability and contribution.

Social technology applied to the management of a corporate organization, needless to say, has many resemblances to the family-like management style of Japan. For example, in Great Britain, where social ranking and the class system still remain today, in the 19th-century Victorian era, the managers and employees of a large or medium-sized company lived in a kind of family-like community. In Italy, which is well known for its Mafia and for the system of godparents, as well as among the Jews who, having wandered all over the world, on the one hand people seek to unite as families or larger kinship groups, and on the other hand to form or unite as what could be called a pseudofamilial company or union. Comparisons, as opposed to differences, between social technologies may be simply comparisons of cultural elements.

Yet that sort of pseudofamily management or "family capitalism" [MURAKAMI, KUMON, SATO 1979: 126–178], which was found in areas throughout the world during the early stages of industrialization, began to dissolve in the latter half of the 19th century. In Europe and America especially, the dissolution was facilitated by the circumstances of World War I which made it inevitable to assign women to such home-front sectors as communications. Once they had tasted social activity, no one could order women back to the home. Throughout social strata from laborers to managers, the functions not only of production, but also of education and life maintenance were steadily and gradually removed from the home, leading to today's conditions. Yet regardless, there is no reason to consider the pseudofamilial management style exemplified by the Bosch company an "abortive flowering" during the period of the dissolution of family capitalism.

We may consider the capitalistic "system" a form of social technology. What grew vigorously after the recent democratization storms in the East European nations and the collapse of the USSR, and what also broadly remain in today's Japan, are small production systems operated on a craft basis ("workshop economy" [YANAGISAWA 1989: 41]). In short, medium-sized businesses and pseudofamilial operations account for an overwhelmingly large share of the whole in the world today. Because these management forms are characterized by the cultural elements of each region, they constitute variations in social technology. Indeed, large-scale production (Taylor-Fordism) and plant system production, in which numerous technical innovations have been made and which are combined with mass production of compatible and standardized articles, can be said to represent modern capitalism in terms of science-technology. It seems, however, that this notion should be reexamined in terms of social technology.

7. SOCIAL CHARACTERISTICS OF SCIENTIFIC TECHNOLOGY

Civilization is a system made up of combinations of various cultural elements [UMESAO 1981: 340–344]. It is therefore our major concern to examine how Japanese, Western, and Chinese elements are combined in the context of Japanese civilization. Here it is relevant to cite E. Weigle.

> Alexander von Humboldt, around the beginning of the 19th century, used tools mostly made in Britain or France. Moreover, not only did he write his significant works in Paris, but also in French. Nevertheless, his methods of collecting data and rationally constructing concepts, his technically perfect use of tools, and his aesthetics of perception are all beautifully in harmony, which can be understood only from the standpoint of German idealism [WEIGL 1990: 37]."

Returning to the triangular pyramids of civilization, the German idealism which is the key to understanding Humboldt is situated at the Humanity/Culture phase, the base of the (German) triangular pyramid. His legacy and the records of his activity, judged from the [α], [β], or [γ] phases, would place him not as German but French in type. What can definitely be said is that "scientific technology" is not something universal, standard, or neutral, despite the resemblances or similarities among civilizations in the scientific technology aspect (triangle as a dimension), or from the fact that their vertices point in the same direction. If this is not taken into consideration, it will be impossible to eliminate misunderstanding and failures in contemporary efforts for technology transfer and official development assistance. The "scientific technology" (triangle) which is transferred and diffused is adjacent to the Society side, the Individual side, and the Culture side which respectively make up a triangular pyramid of civilization.

To speak of the social characteristics of scientific technology is to paraphrase the idea that it is public opinion that takes the initiative in selecting technology.

Technology is formed subject to selections based on values which depend on the social environments under which it emerges. Empirical technology accumulated in a nation, region, or ethnic group decides how scientific technology is selected and used. YAMADA Keiji explains this from a different angle.

> "Technology uses natural *nomos* (law). Products of technology, however, are not those which are deduced, or necessarily introduced from scientific theories....
>
> "Invention is coincidence. There is no logical or inevitable path leading to an invention. That make it very difficult to solve today's technical problems and foresee the future development of technology. Yet it is an inherent characteristic of technology.
>
> "Three phases of selection are in operation during the process between the fabrication of a product and the acceptance of the product by society. The first is selection by objective, which involves two stages.
>
> "[In the first stage, the form and structure are chosen with the objective of achieving a goal, by consulting knowledge and experience. In the second, actual production and tests are carried out to adopt means which are useful to achieve the goal.] ....Selection in the second phase, although not concerned with the direct goal, comprises a vital factor that technology cannot neglect. This phase can be termed selection by effects. [For example, it is useless to manufacture a drug unless the drug has a palatable taste, has few side effects, and is economically profitable. These effects can be verified in a relatively short period and are, to some extent foreseeable...] Aside from these, we must be concerned with the influence of the product, which becomes evident only after a long period of time, or is the result of totally unexpected effects or events.... The third phase, selection according to influence, is the question today on a global scale... A technology and its products, once socially accepted, act as *nomos* (custom/law) for members of society. Social laws have nothing directly to do with natural laws. Notwithstanding this nonrelatedness, people are likely to try to see natural laws concretely and necessarily manifested in social laws. This belief may inevitably stand squarely in the way of appropriate selection of technology." [YAMADA 1990: 232–233]

8. CONCLUSION

Viewed diachronically, Japanese civilization has hitherto experienced two major turning points in the selection of technology. I believe it is at the third turning point today. A bold summary regarding selection by value would be that the first turning point was from the praise of life to the idealization of death, in the 12th and 13th centuries; the second, from the acceptance of foreign civilizations to the society of group delusion, during the second half of the 19th century; and the third, that Japan as an industrial society organized in family-like groups, at its current crossroads, is poised to discard agriculture while groping for an identity in international society.

A contemporary example of confusion in selection by value would be a case in medical technology in which three patients need heart transplants to survive and there are only two hearts suitable for transplant. Who is going to select which two will live and which one will die, and how? Imagine another case in which the technically superior cardiosurgeon is a Jew and the patient is a Muslim—or vice versa. How many choices and days are necessary before a decision for an operation by mutual consent is made?

Confusion in the selection by value of technology is obvious today with the era and world society at a turning point, as in the former East Germany and Soviet Union. On the other hand, in the continuation of the second turning point which was exceptionally successful in the world, Japan has hitherto acted passively, defensively, without ideology, as a merchant, like a "United Technologies of Japan," or a "nation of amalgamated civilizations." Today in the midst of the third turning point, is it possible for Japanese civilization to withstand the strains among the variety of civilizations in the world?

The direction Japanese civilization takes will depend on the accumulation of empirical technology possessed by each individual. The critical factors are which scientific technology to select by value, and how to formulate a world in which scientific technology is to be utilized and establish international rules for that purpose. Rather than social systems or social technology, what we may urgently need to reconsider is contemporary "capitalism and civilization."

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