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NEW AND EMERGING SCIENCES AND THEIR IMPACT ON DEVELOPMENT AND CULTURE

by

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1. Introduction

Development of technology has a chance factor along with it pursuing an inevitable course. As technology grows, there are cases where it has brought about change not only in the field concerned, but in the custom of society, habits, and ways of thinking of the people.

The invention of the mechanical clock is a case in point. People became able to know the precise time by the clock whether it be in cloudy weather or at nightCraftsmen of the 13th century put all their efforts toward the development of mechanics so that energy would flow uniformly through a device. Thus, the mechanical clock which appeared in the middle of the 14th century transformed a long-established thinking of the European people. It used to be thought that a machine worked as long as an external force was applied to it constantly. In the mechanical clock, however, the machine continued to work by an internal-driving force.

Moreover, the introduction of the mechanical clock implanted concepts of mathematical forecast, regularity, and fixed quantity in people. It became possible to organize work in a coordinated effort, and thus enabled organizations to rise and develop. Mechanical precision affected the lifestyles and even values of people.

2. Features of modern technology.

In the latter half of the 19th century, technology came to involve not only the machines, but the manufacturing process, and the organization which comprises all of the processes, giving rise to a technology called management engineering. This was applied in the assembly line system for the mass production of automobiles in the early 20th century.

In the meantime, human resources and scientific information were accumulated, leading to carefully planned scientific researches which replaced individual innovative talent more than ever. The characteristic of 20th century industry was that they built upon the discoveries and inventions of the 19th century and expanded on them. Technology became increasingly specialized and subdivided, linking up inseparably with science. Consequently, the transfer of technology became important in giving impact on society.

The driving forces of technology in the 20th century were the mass production system, transportation and communication, as well as profit. In transportation, the emergence of the automobile and the aeroplane was enabled by the invention of the internal combustion engine. In introducing the mass production system, the automobile industry, scales of production were enlarged for steel, rubber, plastics and petroleum. These were immediately applied to various other purposes. Thus, the chemical industry which requires a higher and more complex accumulation of knowledge developed. As these industries utilized electricity centrally produced energy replaced the traditional noncommercial energy of steam engines. Electricity gave rise to the heavy industries, and then came to be used in the homes, developing the production of appliances such as the radio and television. During the present century, the chemical industry made rapid progress, leading to the production of everything from fertilizers to synthetic detergents and fibers as well as antibiotics.

3. Emerging technology

In the 1980s, high technology, such as information processing, microelectronics, biotechnology and new materials was developed successively. Technical innovation continues in the industrialized society, and the driving force behind it comes from the interaction among the sciences, technology, and other elements.

The rapid develoment of physics represented by quantum mechanics made it possible to clarify the structure of matter at the atomic and molecular levels. New functions of matter at the micro-level based upon the interaction of electrons and photons are being gradually uncovered. Consequently, each phenomenon occuring at the atomic and molecular levels can now be basically interpreted by the behavior or electrons.

Scientific research, not only in physics but in chemistry and biology has advanced remarkably. These disciplines have merged into one continuum of knowledge. As a result, understanding of life has deepened, and biotechnological developments such as the creation of more effective protein molecules and breeding methods at the cellular level have become possible.

Methods of measurement, evaluation control and synthesis at the atomic and molecular levels have advanced rapidly as well. Consequently, the development of new materials and microtips has been accelerated. In electronics, the limits of high density and high speed are being pursued, making information processing and diversification of high quality information possible.

In the respective fields of new materials, electronics and biotechnology, the significance of software such as data bases, design and simulation has increased. New engineering emerged as new raw and functional materials and elemental devices with a large capacity were made available. Technological innovation is progressing in a spiral structure, with new technology leading to new materials.

The fruit of basic studies underwent a long process of applied studies, research and development before new products were manufactured and brought to the market, in the past. Today, the results of recent technology are immediately industrialized and appear on the market. After all, basic research in current technology is directly connected to the market.

Computer technology has played a key role in technological innovation. However, it is facing a turning point today. Although the computer has made remarkable progress in information processing, the inferential function for knowledge processing is lacking in the computer and awaits development. Artificial intelligence, AI, which is to take a central role in knowledge processing is expected to reach a more accomplished stage during the 1990s. AI will no doubt have a very broad range of applications and have a diverse impact on the industrial world.

Furthermore, an information network service, such as the value-added network, VAN, grows newly out of the integration of the computer and communication services. Whereas telegram and telephone are merely the media for a mutual exchange of messages the new information network service will permeate and connect together the various areas of social systems such as medicine, civil administration and education. Of course, in spreading the information network system, it will be necessary to understand the concrete needs of the users and to make it easily available to everyone.

With the advances in informatization, international exchanges will increase more than ever, and social and cultural interfaces among countries will become necessary in face of the inevitable friction. Need for trained personnel capable of international coordination will increase greatly. The future society will be an intellectual or an informatized society in which technical groups of information-, communication-, and knowledge-processing bodies are systematically linked together. As activity seeking for knowledge yields value, there will be conflict concerning the possession of intellectual property.

4. Technological impacts in industrial society.

Among the high technologies, some seem to have more impact on culture while others do not. In general, however, no substantial impact on culture is exerted, but only peripheral effects which merely promote the spreading of the core of an existing culture. This might be compared to the introduction of the printing technique into Europe.

Wood block printing was invented in China in the 11th century, while movable metal type printing was first used in Korea in the 14th century. After Gutenberg's printing press came up with the Latin Bible in Mainz in 1456, this spread rapidly throughout Europe. The main interest of printers lay in making copies of the Bible which was in greatest demand. Parts of the Bible soon began to be printed in the respective languages. As it became available throughout society, religion became a center of controversy. One of the forces leading to the Reformation was the dissatisfaction against the Church's misuse of its authority.

Scholars were able to examine and question the documentary evidence on which the Church based its authority. The reform was to correct the direction the Roman Catholic Church was taking but did not actually reform the essence of religion itself.

Audiovisual information can illustrate events with more detail and impact than writing. We see in various countries the efforts to use such means as cassette tapes, for instance, to educate the public. As long as human beings are the subject of a culture, its essence will only change gradually and tradition will remain unchanged for a long time.

On the other hand it is the means of expressing and spreading culture that are changing dramatically. With the extension of the telecommunication systems, we now have information instantly as well as new audiovisual media. For instance, in Japan, there is a certain religious group that broadcasts sermons once a month by a communications satellite. This strengthens the solidarity of its followers very effectively.

What is taken up on television becomes news immediately. Some crimes are committed only for the sake of being televised. Historical events are decided by the media today, rather that the actual import of the event itself. As the media take up one event after another, each news becomes extremely short-lived. Thus an overflow of information can conversely lead to an insufficiency of information. Because television carries more information that written words, one has to distinguish what is essential and true, and what is not. In order to do so, organizing knowledge regarding particular issues in one's own mind becomes necessary. As computers are best suited to reorganizing information, the gap among the amount and kind of information one has may be determined by how much technology he can utilize.

It is generally thought that new technology simplifies and unifies the world; however, to my mind, it can also contribute to diversifying, stratifying and complicating the world more by broadening the choices an individual has. Therefore, the unification of the world may come about by a complementation and alliance of the various classes preceded by the coexistence of the respective religions and values.

5. Technological impacts in a developing society.

There is clearly a cultural gap between the industrial and developing societies. The latter may seem to be more simple and passive at a glance, however, such character was forced upon these societies by the industrialized society at the early stage when it began to expand overseas, and is not the original nature of a developing society. Today, developed countries often compel the developing to accept "technology transfer". The fact that some developing countries show resistance to development and industrialization is proof that this is sometimes forced upon them. The historical background of such a gap between the two societies may be considered as follows.

Firstly, the European monocultural technology destroyed the indigenous traditional ways of developing societies, where people lived in small groups, adapted to the environment, and had their own view of labor and wisdom for checking excessive population growth or diseases. However, as a result of modern technology being applied indiscriminately and pursuing only economic efficiency, labor and economic activities may have become simplified, but the traditional culture was disrupted.

Secondly, the industrial society developed synthetic goods instead of primary products; synthetic fibers instead of cotton or wool, plastics instead of leather, synthetic rubber instead of natural rubber, and synthetic detergent instead of soap with or wool, plastics instead of leather, synthetic rubber instead of natural rubber, and synthetic detergent instead of soap with natural oils. Consequently, the economic conditions of countries producing primary products deteriorated.

Thirdly, it is well known that even if advanced technology is transferred to a site lacking the technical bases, it cannot be utilized. This lack of technological infrastructure comprises the total capacity of that society to develop, educate experts and enforce policies on science and technology. New technology becomes established in places with sufficient infrastructure, and therefore it concentrates in a particular region or group of people. For instance, the "green revolution" in Asia involved widespread and rapid adoption of semi-dwarf rice varieties. However, the agricultural productivity and the income level of farmers did not increase on the whole.

Plant breeding techniques have been developed in the developed countries, and can be utilized anywhere in the world. The International Rice Research Institute (IRRI) released a variety known as the IR8 in 1966. This rice plant was of short stature, with thick, sturdy stems that resisted lodging, and yielded three times more than earlier taller varieties in favorable environments. To exploit the genetic potential of IR8, two major inputs, nitrogenous fertilizer and water were necessary. Hence, introduction of the semi-dwarf variety was accompanied by the rapid expansion of irrigation facilities and improved water control. This needed more expensive investments, and innovative technology was adopted by relatively rich and educated farmers.

6. Sociology of technology transfer

The engineering and economics of the developed countries was what produced developing societies around the globe. Today, it is unfortunate that the governments of developing countries have no choice but to seek advanced technologies for development in relation to high growth.

Technological transfer is an international task of assisting developing countries in their economic take-off by supplying capital, expertise and knowledge. It is the redistribution of intellectual resources produced by mankind and the diffusion of technological innovation. The purpose of transferring technology to developing countries is to establish advanced technology, and thus its success depends on the harmonization of the new technology and the existing cultural environment; basically, it is the social capability to accept technology starting with human resources.

Technology transfer aims at fostering the capability to create indigenous economic wealth, and not to merely acquire wealth. The requirement of personnel training is basic to the success of such transfer, and thus modernization through education is important.

Transfer of a new, composite technology has been conducted by teaching a systematic knowledge, without consideration of the particular cultural environment. In this case, the adaptation of the technology to the society and vice versa are necessary because advances in science are so rapid that they will not wait for the society to develop the social capability to adapt to them.

Generally speaking, developed countries are short of workers, have high wages and sufficient capital so that a great deal of effort is put into capital-intensive technology with higher labor-productivity; that is, more labor-saving engineering has been developed. On the other hand, developing countries are short of capital and have an excess of labor force. Thus, when mature technology, completed in developed countries, is transferred to developing countries, it is better that they select a labor-intensive, advanced technology.

The rise of the Asian NICs today has sometimes been attributed to the transfer of plants and equipment that became useless in Japan due to its energy-saving structural reforms necessitated by the Oil Shock.

Recently in China, rice production has increased remarkably. This is due to the introduction of hybrid rice produced by the cytoplasmic male sterility technique developed in Japan as a labor-intensive, high technology. In 1987, cultivation of the hybrid rice rose to about 10 million ha, corresponding to 30% of the total rice cultivation area in China.

Because necessary investment and high-level technical labor are arranged by technological policy in research institutes of developing countries, they begin to put into practice, somehow, the technology supplied by a developed country. Intensified scientific research is carried out, but these experiences are often not shared, and do not contribute to the activity of the institute as a whole so that even if good results were obtained, further research does not follow.

To overcome such difficulty, conditions have to be prepared to diffuse and gradually extend the introduced and accumulated technology into the surrounding areas. This process aims at transferring the technologies from modernized sections to the indigenous sections. However, such secondary transfer is rare in most developing countries excepting the NICs.

The technical assistance, knowhow and training developed countries had selected and supplied the developing countries thus far were thought to be most suitable for the latter. However, often these advanced technologies did not take root because of differences in cultural and social habits as well as the economic system of the developing countries having an abundant supply of labor.

6. Development and transfer of appropriate technology

Then, what is the kind of technology that developing countries are ready to accept? What technology minimizes friction with the community to which it is transferred and does not damage its culture and value system?

The response to this was "Appropriate Technology" taken up in the 1970s. The reason for this discussion was not only the

the difficulty of transfer, but there was also much thinking on the quality of self-reliance and autonomy in each community. In the 1970s, a change from quantity towards the improvement of quality took place.

Those who advocate appropriate technology hope to take a different approach to modernization than that taken in the West; they aim to improve the traditional techniques into appropriate techniques. Technical innovation is of course a factor of social advancement, and the transfer of emerging technology can bring about a social change. In order to increase public acceptance of a reform, proper policies must be prepared, and what finally determines the adaptability and assimilability of new technology is education and the fostering of social capability.

Early in the Meiji era, Japan raised the level of the social infrastructure in the peripheral regions. This was a very important industrialization policy in Japan, which was oriented to draw participation of the people in decision-making, based on the regional culture and social custom of decentralized small communities. The friction with traditional culture, indigenous techniques or social customs was dissolved within a relatively short period in Japan. This was attributable to the way in which the change was initiated rather than in the techniques themselves. Then, increased chances for education and training accelerated the spread of new knowledge and skill in the region and raised the general level of techniques. Training in this case was carefully administered, taking into consideration the interest and experience of the trainees, and a self-motivating type of education was carried out. The Japanese government established a supplementary education system in 1892, and set up regulations of apprentice schools which modernized craftsmen and workmen scientific training.

Next, work opportunities were provided for trainees so by government policy so that they could maintain their technical level. In 1898, the Craft Guild Act for Stape Products was passed. The Craft Guild was an organization of cottage industries aiming at the improvement of techniques. This may be called one of the protective technology transfers.

Furthermore, the regional industrialist took a highly community-oriented attitude and played an important role in the development of policies for growth in the local economy. Thus, positive and innovative industrialists were a big factor in local growth.

In the rice culture of modern Japan, improvement and introduction of new varieties, as well as the completion of irrigation and drainage facilities were dependent on the landlord. Those who lived with farmers and desired an income increase in the village took the initiative and risk to introduce new technology. The method of using semi-dwarf varieties of rice, for instance, was developed during this priod. Later, IRRI adopted the IR8, which resulted in the green revolution.

After the Second World War, such innovation occurred again in the local machine industry, which contributed greatly to precision processing and quality control of machine parts in the present-day automobile industry of Japan.

7. Strategy for technological transfer

Simulation of these Japanese innovations by developing countries may be unsuitable in the early stages of industrialization. However, according to the experiences of industrial countries, innovation and creation of appropriate technology has not come from research institutes, but rather are generated by the specific requests of the manufacturing plant and the shop-floor. The local politics and economic pressures greatly influenced such organization. The role fulfilled by existing social infrastructure might be valued as a historical lesson.

Success of the appropriate technology is dependent on whether or not the society is properly shaped to accept new technology and knowledge. In order to successfully transfer and establish new and emerging technology, the significance of stratification ought to be considered.

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