Chap. 11 : the transformation of small-scale industry into modern indigenous industry (part ii. case-studies)

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The Transformation of Small-scale Industry into Modern Indigenous Industry

Small-scale Industries in Development

A number of large-scale factories (with more than 1,000 employees) in Japan have shut down since the second oil crisis, and this can be attributed to technological innovation. The need to save energy and resources has had an effect in the areas of labour, materials usage, and energy consumption. A fierce competition to continually come up with a new product has emerged and has led to notably shortened life spans of goods. These developments have resulted in a decrease in the number of large-scale factories. High consumption levels have transformed the mass-production system into a system producing high-quality goods in small quantities to meet market needs and to diversify risks. Under these circumstances, the traditional Japanese employment pattern has been eroded, some of the effects of which have been mentioned in the preceding section on female labour.

The size and importance of the role of medium- and small-scale industry in the whole of the Japanese manufacturing industry is not widely known in the third world. Neither is it known that there is a structure linking these industries with the more internationally famous Japanese enterprises in business and technology.

The definition of medium- and small-scale industry has differed according to the period, varying in maximum complement from 10 to 20 to 100 employees. Today, government classification designates enterprises with less than 300 employees and capital of less than ¥100 million as medium- to small-scale.[45]

According to statistics, factories with fewer than 20 employees account for 87.3 per cent of the total number in Japan, employ 20.1 per cent of all workers, and contribute 12.6 per cent of the total national output.

Factories with more than 500 employees, on the other hand, comprise only 0.3 per cent (1,807 total) of all factories in Japan; they employ 20.5 per cent

of the nation's workers (2,246,000) and account for 38.3 per cent of total output. While in Japan factories with fewer than 100 workers make up 98.0 per cent of the total and employ 58.0 per cent of all workers, in the United States, the respective figures are 87.7 per cent and 25.4 per cent, and in West Germany the corresponding proportions are 72.6 per cent and 18.7 per cent. The percentages for factories in Japan employing more than 1,000 workers are 0.1 per cent and 13.4 per cent, in the United States 0.6 per cent and 27.5 per cent, and in West Germany 2.2 per cent and 38.0 per cent.[46]

Aside from the statistical significance of these comparisons, it is clear that even in highly industrialized countries, medium- and small-scale factories have a role, and that, depending on the type of technology and industry, an enlargement of scale may be unwise or impossible.

Japanese medium- and small-scale enterprises were forced to renew their equipment in search of high efficiency as they faced a serious shortage of labour during and after the rapid economic growth of the 1960s. The two oil crises forced them to confront increased costs in both labour and materials. The changes and intensification in competition forced them to renovate their operations. Some of Japan's famous enterprises that maintained a small scale as an ideal size for the development of new products also underwent this process of adjustment.

From around 1975, the upgrading of facilities by small and medium enterprises brought about a new phase. The attainment of a high technological level has given the exports of these enterprises a competitiveness in international markets. The use of ICs in the production process has minimized differences in manufacturing capability and in the quality of products among manufacturers, so that the original equipment manufacturer (OEM) system has spread rapidly to enterprises of all sizes, small, medium, and large. Whether this represents a new stage of internal structure in the national network of technology is uncertain, but we may say it is a new phase, inasmuch as in the manufacturing industry, there have always been two opposing types, one seeking stability, the other continuous growth.[47]

The need in Japan for small and medium enterprises and their significance in society will not likely change. A good example of the trend is the fact that factories with fewer than 300 workers account for 99.5 per cent of the factories in Tokyo and employ 74 per cent of all factory workers there. Also of note is that small, medium, and large factories are located strategically, in accordance with the vital technological and business relationships they share.

In terms of development, what this process represents is the dissemination and development of modern urban industrial technology. In effect, the process is one in which those who have mastered the technology of a production process (or kind of job) at a specific level have separated it from the mainstream and become independent entrepreneurs (i.e. from process subdivision to process separation).

Providing an entrepreneur has a clientele, it is his technological ability that assures his independence. However, if the separation is made merely in the form of a change in the place of production as simply an extension of the

subdivision of the production process, the new establishment represents in fact an affiliate of the parent company, much like a subcontractor within the plant. Furthermore, in some cases, depending on the type of industry and general business conditions, it will become necessary to master the technology of the entire production process to make the separation. In establishing independence, technology is transferred from the head shop, much as skills and knowledge are handed down from a master craftsman to his apprentice or, in the Japanese custom of *norenwake* (giving the name of one's shop to a former employee), one merchant helps another set up a business. This is easier to do with technology that needs little start-up investment (most such technology usually requires higher skills).

If the amount of initial investment is large, it becomes necessary to depend on borrowed capital, especially commercial financing. When this happens and materials and machines are leased, customarily the business starts as a processor and operates under a processing-fee system. As long as production is divided into separate small production processes, the processing fees remain low. Under these circumstances, the differences of skills, that is, the technologies of small independent enterprises, determine the differences in efficiency of production and of the use of raw materials. Many owners of small- and medium-scale enterprises are self-made men who accumulated technology and forged ahead on the road to self-reliance.

In addition to the classification of industry in terms of scale, it can be classified according to modern vs. traditional. Applying this classification, what one discovers is that most small-scale enterprises are in traditional industries and engaged in the production of consumer goods and services. While factory production uses modern technology, native industry depends on traditional technology, machines, and tools. In terms of scale, the range is from several workers to several hundred, and yet, according to one study, even in the 1930s, traditional industry output occupied a quarter of the gross industrial production.

According to statistics since the middle of the past century, 80 per cent of gross national expenditure has been for personal consumption and most of it for the consumption of traditional goods (foods, clothing, textiles, china ware, and other general merchandise). The position of small-scale industry in the national economy has been highest after agriculture.

As stated in regard to textile technology, yarn was manufactured at modern factories, while fabrics were woven in the traditional manner and places of production and sold through the historical wholesale system. Thus, the two were not in an exclusive relationship, but in a mutually supplementary, interdependent relationship, which aided the development of both. After World War II, the modernization of traditional technology changed this situation, and the scale of enterprise began to reflect the specialization in technology, though not without exception.

What is important is the formation of an interlinkage between traditional and new technologies by which traditional technology is finally modernized. It is the transition from a stage in which technology determines management

to one in which management decides the orientation and level of the technology.

For this reason, the process of technological improvement is characterized by integration of management ability and the potential of the technology. The smaller the enterprise, the more it depends on management's technological ability.

It is noteworthy that, as early as 1900, before Japanese technology became self-reliant, the products of small industries made up a high percentage of Japan's exports. Raw silk accounted for 22.3 per cent, woven silk 9.3 per cent, green tea 4.0 per cent, matches 2.9 per cent, and silk handkerchiefs 2.2 per cent; thus, manufacturers using traditional technology accounted for more than 40 per cent of total exports. The last stage in match production (i.e. packing) depended on people working at home and was so labour-intensive that even young children were used among the urban poor, especially in the large cities, notably Tokyo and Osaka.

The Village Button Industry

Taking the case of the button industry might surprise readers, but it is worthy of consideration because it represents rather an unusual case but also one that illustrates very well the diffusion of small-scale technology. The discovery in developing countries of similarly specialized technological areas could have important consequences for economic and technological development.

Buttons began to be imported around the time Western-style uniforms gained currency with the military, railways, the police departments, and similar groups. Besides buttons made of metal and bone, those made from shells, which were used for underwear, were also imported, although Japan had abundant raw materials of good quality.

Button manufacturing on a modest scale started in Japan from around 1878. They were expensive but of high quality, made by metal workers (such as goldsmiths and silversmiths) using files, whetstones, and punches. The market was extremely small, however, because of the continued dominance of traditional Japanese wear, and, in order to establish a stable industry, button makers were compelled to turn to exporting their product.

Having noticed the existence of rich raw materials in Japan, a German named Vinkerel opened a factory, complete with an array of machines for making buttons, at the concession in Kobe in 1890. He was supplying the Japanese market with "German-made buttons" manufactured in Kobe. The bleaching process used in button manufacturing had been kept confidential by the German engineers, but a Japanese processor's solution to the problem of bleaching gave Japanese buttons, which had been treated as semi-finished goods, an advantage, thus forcing the German factory out of business.

The answer to the question of how this was possible is to be found in the thorough division of the production process. Production at the factory was broken down into more than two dozen microprocesses, each of which

became a separate job performed by a worker "manufacturing" at home. Moreover, as far as possible, no machines or equipment were used except those traditional tools and methods that demanded little in terms of skill. The next step was to reduce the processing costs to an extremely low level. This was identical to the business control exercised by the merchant over his scattered manufacturers. The button manufacturers unified and managed their individual microprocessors in the same way.

The simplification of work and the low processing costs did not lead to the independence of the microprocesses, but rather promoted side jobs at home. What originally had been a modern urban industry was transformed into an industry that depended on the labour of lower-class urban citizens working at home. It then penetrated into suburban agricultural areas in search of cheaper labour; the target was enlarged from the urban informal job class to the rural informal job class. Although, in order to master the whole technology for a basic production process (or several major processes), as opposed to a single, small process, it was necessary that the worker become an apprentice of a "manufacturer," those who mastered the technology presented little threat of breaking away and becoming independent manufacturers, as their products were component parts rather than finished commodities.

The enlarged production of shell buttons brought profit to the merchant manufacturers. The shortage of raw materials caused by greater production and the conversion to and dependence on imported materials changed this situation, however. The sharp fluctuations in the price of raw materials brought on speculation and hampered distribution. When to this was added an increase in demand resulting from an economic boom, wholesalers and manufacturers were no longer able to undertake strict inspection of goods, and, as a result, the mass production of inferior-quality goods started. Holding down processing fees to too low a level can lead to this sort of situation.

In general, since the Meiji Restoration had done away with certain business restrictions, the problem of the mass production of inferior-quality goods was seen in almost all the traditional industries and technologies. The situation was the same for new technologies that had been transformed into traditional-type technologies. When the change of raw materials occurred, that is, the addition and development of new technologies, the old structure of the business world had to be reformed. To protect the common interests in each sector of business, the master-apprentice system of control had to be transformed—democratized—into a system of control by an association (see Takeuchi 1979; Takechi 1979).

The areas where rural industrialization developed were those in which commercialization of agricultural production was advanced. For example, the cases taken up in this study were in the southern part of Osaka and Nara prefectures, where cotton-growing and food-oil production had been active. The development of a modern cotton-spinning industry brought about the substitution of locally produced cotton with cotton imported from India, and

the development of a modern food-oil industry, centred in urban areas, ruined the traditional oil-making industry in this area (Sasama 1981).

Kagawa Prefecture was another area where the button industry developed as a cottage industry after the traditional salt making (by the salt-field method) and sericulture lost their viability. The transition from the traditional salt-making and sericulture industries to modern button manufacturing was possible because of the long experience with producing for a broad market (Yasuoka 1981).

The successful and lucrative export of Christmas lights by farmers in Kagawa Prefecture during the chaotic period immediately after World War II is another example of the sort of adaptability that made possible the successful transition to new industries as the old ones lost their viability.

Similarly interesting accounts exist concerning other sectors, such as the clock industry, which developed in parallel with sericulture and which contributed to establishing the habit of punctuality among farmers, an important element in the foundation of modernization. Also important were the early glass industry (Kikuura 1979), the eyeglass industry (Ueda 1979), and the development of bicycle industry technology (Takeuchi 1979; Ueda 1980).

Regrettably, and surprisingly, the third world participants in our discussions showed no interest in the fact that an industry like the bicycle industry, though there are fewer component parts than in the watch industry, for example, could be used as a technological indicator if all parts are manufactured domestically, as was true in Japan. The complete domestic production of bicycles, when combined with engine technology, constituted the precondition for motor-cycle technology. The bicycle was useful as an index of technological convergence in Japan, and, as such, could be considered the first gateway for a newly industrializing country. High-quality ball-bearing manufacturing, in particular, is a good index.

Before moving onto the next section, it will perhaps be useful to elaborate briefly on this last point. Ball-bearing production is directly connected with the production of specialty steel, the material from which ball-bearings are made. A tremendous amount of technology must be accumulated before it is possible to manufacture bearings of a specific size with the same consistent quality. And the smaller the size, the higher the technology must be. Usually, it is not necessary to aim at such high-level production right off, and it is advantageous to depend on imports for precision-made, highly machined parts.

After ensuring that the product will meet the needs of its intended market, and after carrying out world-wide market research to locate reliable suppliers of the most cost-efficient parts, bicycle production may be undertaken at much less cost than what is required to import finished bicycles, and there will be a larger market for these less-expensive bicycles than for imported finished bicycles. As with watches, technology in bicycles in Japan started with repairs and the production of replacement parts. Those engaged in bicycle repair (and production) were former blacksmiths, lathe operators, pump

makers, and makers of Japanese watches. Miyata Eisuke, a late-Meiji-period gunsmith, was so skilled he was able to make all parts except tires, rims, spokes, and ball-bearings. But he later abandoned complete production in favour of subcontracting to parts makers for reasons of profitability—not unlike the button merchants who organized separate manufacturers to carry out the various microprocesses composing button making.

The Transformation of Technology in the Process of Industrialization

Industrialization, especially the process from technology transfer to self-reliance, should be a process accompanied by transformation. This may be called the adolescent period of technology transplantation.

The degree of technology transformation ranges from a single machine in operation to the change of an entire system. One of the most rudimentary examples can be found in the first British spinning machine Japan imported. The machine had been designed to fit the height of British workers; consequently, because Japanese workers were shorter, they could use it only by looking upward and stretching their arms, which tired them quickly and diminished their efficiency. The mere installation of a footstool solved the problem, reducing worker fatigue and increasing productivity. Such a minor modification can sometimes greatly enhance efficiency and induce extremely important results.

In the effort to hit upon the most appropriate equipment for silk reeling, first an Italian big-frame, direct-reel type reeling machine was introduced at a factory in Tsukiji, Tokyo; this type required 60 workers to operate. A decision was then made to introduce at the Tomioka factory a French-type reel machine with a small frame and a rereeling method requiring 25 workers on one unit. Ultimately, all French-type joint spinning and reeling equipment was replaced with the Italian kennel-type machinery. As Okumura Shoji, a technological historian, states:

> A thorough, comparative study of each owner-country's technology should have been made before introducing the machines, but it was impossible to do so in the short time since Japan had opened its doors. As a result, the Italian type, French type, and their imitations spread, and it took approximately 20 years to standardize with the most appropriate one.[48]

Technological transformation in Japan took one of the following two paths: (1) modernizing traditional technology, (2) making modern technology traditional.

With the second, the production line was subdivided into individual processes, and workers were instructed to move from one to another to become skilled in each major production process and, thus, to master the overall technology. These major production processes were then divided into smaller

ones and separated from the production line to become subcontracted work. Defining the subcontracted portion as type 2a and the non-subcontracted as type 2b, much like the relation between cotton spinning and weaving, what is described is a system under which the former process is undertaken by a factory equipped with modern machines and the latter process by a cottage industry using, in this example, traditional hand-weaving machines. Because the functions were shared, interdependent, supplementary relations were established, and both could develop.

The first path, modernizing traditional technology, involves type 2b. A change in the energy source from human power to water power and from water power to electricity is an example. In the ceramic industry, the energy source was changed from charcoal to coal, and from coal to electricity (or, all three were used separately for each relevant process).

In the transformation of technology in Japan, there was competition for market share among the bases of traditional technologies (such bases depending on the local supply of basic resources). With modernization, the market was no longer limited to the domestic market. Here we see the transformation of technology to meet the existing market conditions. We also see here that it is not mandatory to adopt the most scientifically advanced technology in order to profit in terms of development. Indeed, we can see the necessity of an alternative technology (i.e., a modernized traditional technology or an endogenized modern technology) and how it should be concretely applied.

Regarding the problem of development, commonly, long-term policies are proposed on the basis of macroscopic analyses of industrialization, but this has not solved the fundamental question of development. The reason for this is simple: there has been no practical analysis of the initial conditions, the conditions for starting. These conditions have never been the same for all countries, all areas, all seasons, or all industries. What the broad analyses provide are only the general data regarding the results and not the conditions for beginning development.

The problem lies in the alienation between long-term theory, with its universal applicability but lack of immediate practicality, and short-term theory, which is concrete but not universally appropriate. The only solution is to gather concrete case-studies and from them attempt theorization.