Production Technology : Set and Units : Mass Production Systems in Traditional Japanese Handicraft Manufacturing and the Contemporary Assemblage Industry

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Production Technology: Set and Units —Mass Production Systems in Traditional Japanese Handicraft Manufacturing and the Contemporary Assemblage Industry—

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1. CHANGE IN THE BASE MATERIAL OF SOUP BOWLS AND ITS CONNECTION WITH TASTE

In a 1991 research colloquium at the National Museum of Ethnology entitled "Inheritance and Innovation in Traditional Technologies," Dr. MIYAZAKI Kiyoshi of the Faculty of Engineering of Chiba University presented a paper on changes in the form of Japanese soup bowl (*wan*) s. He said:

> "We use two kinds of soup bowls in our everyday life: one is of high quality, made of wood and lacquered, and the other is cheap, made of plastic with synthetic coating. They are similar in appearance. When soup is put in them and they are brought to the lips, however, wooden and plastic bodies present a subtle difference in the feeling of 'deliciousness'. I carried out several tests in order to find out the cause of this difference in feeling. It became clear that the greater the difference between the temperature of the outer surface of the soup-filled container—that is, the temperature of the soup the hand feels through the wall of the bowl—and the actual temperature of the soup, the better the taste of the soup. Examination of the cross-sections of these two kinds of bowls reveals that, regarding high-quality wood bowls, the wall thickness increases toward the bottom, while plastic bowls are constructed with almost an even thickness throughout the body, although there is not much difference in rim thickness. This difference results in the variation in heat transfer ratio, further acting as a cause of the feeling that plastic bowls are not delicious' in terms of taste."

Dr. Miyazaki thus emphasized that the development of plastic bowls, an

innovation in production technology, influenced even on the taste of soup. He also presented examples of remains excavated from various archaeological site in Japan to indicate that since the mid-Jomon period the cross-section of an entirely wooden but a change in the shape of the cross-section producing a thin rim and thick bottom, occurred at latest during the Muromachi period (1338–1573), and this change became part of the established shape of soup bowls.

Hearing the report, It seemed remarkable that a structural factor in wooden bowls once perfected, as it were, reverted to an ealier form when plastics replaced wood. It would seem that the discarded shape ought to have disappeared several centuries ago. If tableware designers were involved in the change, there should have been consideration of how to induce better "taste", aided by additional sensual factors such as vision and touch, as well as the taste of the food itself.

Although there were few industrial designers dedicated to making wooden bowls, tablewaare artisans at each production stage, making the most of their long experience, would be expected to pay sufficient attention to the design and functions of the parts with which they were concerned.

The user and designer must have frequently exchanged requests and proffered solutions during the transaction before adaption of the design principle which made the rim thin and the wall thicker toward the bottom of bowl. In some cases the user and designer were probably the same person, and it must not have been rare for the user's request to have taken the form of a complaint. Whatever the process, it seems certain that as a result of such consultations, an effective form was created, fitting the sensibilities of Japanese diners.

2. PATENTS FOR PLASTIC BOWLS

Patents and utility model rights for plastic tableware, including soup bowls, have been published from time to time since about 1955. It has recently been argued that during the succeeding decade, Japan modernized in ways that produced great cultural changes. Plastic bowls appeared in this period; one could say that soup bowls became a durable consumer item via the mass production system.

Applications for rights on plastic bowls were of two types reflecting interests which developed in very different directions. One type dealt with how to produce the visual features of traditional lacquerware bowls efficiently. For example, they were interested in the technique for molding bowls having a truncated cone-like bottom rim by means of pattern-draw-molding. It is not simple in the one-piece molding method to draw a form with a protrusion on the mold. Various applications filed included: grooving threads on the bowl body to screw a bottom rim into the body (FUNADO: OP 49-26364); adding a thermoplastic resin such as nylon to the composition for high-temperature molding, followed by removal, while the material is flexible, of the mold used on complicated portions and cooling without allowing deformation (HASHIMOTO: UM 58–37624); and the use of segment die-equipped machinery (YANO: UM 35–10663, –10664). Another example of

application was a method for one-piece molding of a bowl whose inside color differs from outside (DAI: UM 38–4056). A large portion of applicants were manufacturers of machine parts, dies, and the like. Their precision metal working was sufficiently applicable also to molds for plastic products. Nonetheless, even though the bowls they designed and produced all strongly resembled traditional soup bowls, mechanical drawings attached to all such applications showed a wall cross-section with uniform thickness, like those produced before the Muromachi period. These applicants were newcomers from a different industry and their technology was being constructed with no informational exchange with conventional technology.

In 1955, as the School Lunch Program expanded, a large resin processing company, employing young industrial designers as originators, applied for a utility model right on a school lunch set consisting of a bowl, plate, and cup (HISATOMI: UM 31–5984, EKUAN: UM 31–5985). Yet no consideration was given in the set to the thermal insulation of the bowl. During that period in the tableware industry, those who were making approaches to thermal insulation were only those who were concerned with metal tableware.

The second type began with attempts around 1960 to replace wooden soup bowls with plastic ones, based on the traditional form. The sole promoter was Abe Kenzaburo, owner of a long-established shop dealing in lacquerware in the town of Inagawa, Akita Prefecture, famous for Kawatsura-style lacquerware. The shop is currently engaged in the production (coating and finishing) and sale of lacquerware. Abe, worrying about the year-by-year decrease in the number of skilled craftspersons making wooden bases, conceived a plan to replicate a wooden mold created by a local master of wooden base making, and mass produce plastic bowls, in cooperation with the Akita Prefectural Industrial Technology Center. He applied for a number of utility model rights in succession on the processing of plastic bases, stating: "Whereas in the case of wooden bowls it is usual to form the wall of the bowl thinner toward the rim in order to improve the touch and appearance, molding plastics into a similar shape not only makes processing difficult, but also generates a drawback of fragility. The bottom rim requires a master machining technique due to its structure, presenting a disadvantage in terms of production cost" (Abe: UM 37–24434, –24435). Other than Abe, no other published claimant of a patent or utility model right on soup bowls or similar soup containers has insisted on making the cross-section of the bowl wall "thinner toward the rim." Bowl bodies of his design are frequently used for medium-grade Kawatsura lacquerware.

3. LACQUERWARE PRODUCTION FORMS AS TRADITIONAL INDUSTRY

This paper is not concerned with artistic lacquerware handicraft items that are produced as singular items, even when there are similarities in the production

process. My interest is in marketable mass-produced items manufactured for the purpose of everyday use. To many Japanese people, soup bowls as daily tableware are consumer goods. The production of lacquerware is a light industry involving two different types of composite processing technology, for the making of the wooden bases and for the coating.

Except for aesthetic artistic handicrafts, handicraft products are produced without exception on the basis of manufacturing efficiency. The level may be relative, but the industrial principle is "large quantities of better products at lower prices." If the quality of some products is within a comparable range, those which are better in cost performance become predominant. To secure profits but keep prices low, production costs should be held down and productivity improved.

A 1958 group study organized by IKEURA Masaharu and others at the Kainan Prefectural High School in Wakayama, entitled *Kuroe Shikki Kigyo no Shiteki Kenkyu* (Historical Servey on Local Lacquerware Firms in Kuroe), utilized historical materials that had been preserved by local people involved in the industry, and also presented an overview of the industrial structure of local firms, based on an oral survey carried out by their students. This valuable study is a record of the period when "nearly a thousand related businesses active around the Kuroe, Funao, and Hikata districts formed a citywide collective production block operated by an orderly cooperative organization" [WAKAYAMA KENRITSU KAINAN KOTO-GAKKO 1959: Preface]. Kuroe Lacquerware is recognized under the Traditional Industry Promotion Law and has a long history.

The report describes the structure of the lacquerware industry in Kuroe around 1955. Basically, the industry consisted of two major groups, concerned respectively with the manufacture and the sale of lacquerware. The sales group had a subsidiary group, the decorative art business. The Manufacturing group was divided into a woodworking group and a coating group. The woodworking group produced wooden bases for coating (lacquering). The coating group was divided into primary-coating and finish-coating subgroups; as a rule, it produced plain-color bowls. A second group, concemed with sales, consisted of wholesalers (the core of the group), peddlers, and a special category of brokers handling made-to-order products. Decorative art constituted yet a third business group. It included various types of pictorial designers who used gold and silver inlays and other materials for decoration, and artisans engaged in rattan weaving and in woodcarving. These professions, excepting the woodcarving business, had long been under the control of the sales group, especially of the wholesalers. Under instructions from the sales group, the decorative art business group worked to add ornamental designs to lacquer objects matching market demands, in other words, matching the popular trends of the time. Woodcarving, a business that started after 1928 when the carved tray was created, was subcontracted by the finish-coating subgroup.

The aforementioned groups dealt directly with the production and distribution of lacquerware. On their peripheries were various other businesses including

lumbering, lumber sales, and lacquer refineries. Also included were businesses selling necessary items such as materials for wooden base processing, tools (brush, spatula, etc.), coloring materials, and adhesives. In addition, various kinds of financial businesses participated in making up a large group consisting of all of the above businesses. Except for the sales group (especially wholesalers), these groups consisted of small cottage industries. Their financing sources were mutual financing companies (50 percent), credit unions (30 percent), and other financiers including pawnbrokers (20 percent), whereas the sales group, like the lacquer refinery, used commercial banks for loans.

In the transfer of products, especially within the manufacturing group, artisans worked independent from process to process; and after each production process, goods were sold to the subsequent artisan as commercial items. Among other skills, wooden base making was highly specialized, being divided according to such factors as the form of the container, round or square. There were artisans who specialized even in lumber gathering or planing. In this system, the unprocessed materials bought by most artisans were semi-finished products, the value of which they improved for resale through their own processing functions. This cycle was successively repeated. While some artisans undertook processing work on subcontract basis, such as the primary-coating business within the coating group, these were exceptional cases.

The entire flow was controlled by the wholesalers in the sales group. Although engaged in sales as their main purpose, the wholesalers took under their control groups of artisans, classifying them according to technical levels and types of processes, and also intervened in, and supported in various ways the transfer of goods among particular groups. The wholesaler acted as an intermediary and made arrangements so as successfully to link certain artisans of similar level with each other. They did so with the aim of obtaining a quantity of products of uniform quality whenever necessary. By cleverly controlling combinations of artisans, the wholesaler produced high-quality or medium-grade products through different routes. By maintaining several routes, the wholesaler became able to line up a variety of goods to meet market needs. One should not suppose that all lacquerware-producing areas throughout Japan had identical business organizations. Nevertheless, similar systems were found in other major lacquerware producing areas, such as Aizu and Wajima [YOSHIDA 1976: 72–86].

In this system, which can be called a wholesaler-controlled crafts industry, artisans were, in general, managed by wholesalers. There are two points to be noted. First, each production process was independent and run by an independent accounting system. This mechanism on the one hand implied a major risk for artisans because they would lose not only their wage, but also the cost of purchasing semi-finished products if they were to fail in their part of the processing that would add value to the semi-finished products. On the other hand, the mechanism functioned to reflect the result of the work in the selling price, helping to improve the technique practiced in each process. In order to ship semi-finished products as

commercial goods, artisans, in finishing their part, had to take into consideration the convenience of those who worked in the following process, that is to say, their customers. In their respective processes, in which processing technologies were naturally specialized and sophisticated, artisans needed only to understand their own part and have a rough idea of the adjacent functions, especially of the next process. Even so, products were produced steadily. It is supposed that the woodworking and painting groups had almost no exchange of technical information, but merely allowed products to move according to the intermediary hand of wholesalers.

Second, as artisans worked not on a piecework basis, but on the basis of the prices for their products, the entry and exit points for the commercial goods—semi-finished products—were, as a rule, different. In some cases, value-improved semi-finished products were resold to the vendor; however, the entry and exit points in such cases were the same only by chance. If a certain technical level were secured, the wholesaler, the technical manager, should have considerable freedom to choose the exit, i.e. where to sell, according to circumstances.

In comparison with contemporary industrial plant systems, small business units of artisans can be compared to very capable industrial robots, and the distributor, to the control device that turns the robot on and off and controls the conveyor belts running among the robots. The distributor is certainly the controller of the movements, but is not a robotics engineer. To fulfill the task, the controller needs only to precisely understand what job the robot carries out and how much ability and efficiency it has. If these conditions are met, the controller is free from the need to have any thorough knowledge of individual technical know-how. That wooden bowl-making know-how was not reflected in most plastic bowls but was definitely due to the fact that the developers' interest was focused on the lacquer coating technology, leading to neglect of the woodworking technology situated in another line.

The structure of the dyeing and weaving industry of the Nishijin district in Kyoto is quite complicated with respect to the internal divisions of labor. The planner-distributor, called the *orimoto*, controls technical issues. Under their control, a variety of groups practicing certain crafts—such as yarn dyeing, putting warp yarns in order (*seikei*), looming, and pattern drawing—form a production line, and each group participates in the chain-like trade activities, selling semi-finished products as completed items in their respective stages. There were various other types of large handicraft manufacturing groups, and in certain industries, small brokers play a supplementary role as a profession, earning margins by doing intermediary work dealing with semi-finished products among artisans, toward the end of higher prices at the wholesale level [TOKYO TOSEI SHIRYOKAN 1957: 3].

4. THE TECHNOLOGICAL SYSTEMS OF GUILDS IN EUROPE

Craft guilds were groups of artisans in European society. Comparison

between the craft guilds and the Japanese systems explained above presents several differences. A guild was an association comprising the artisans or merchants belonging to an occupation. These free citizens, who came out of urban backgrounds, were assured economic privileges by the ruler of the district. Each craft master, taking a limited number of apprentices allowed by the city council, could produce and sell products. The guild officers within an occupation had the right to conduct periodic inspection of what the members of the occupation had done and to confiscate or destroy products judged to be below the norm [HARVEY 1986: 79]. Masters were not allowed to shorten the apprentice training period specified by the city government or union to maintain solid technical traditions. In many cases, an apprentice was obliged to create a masterpiece to prove the completion of his apprenticeship [HARVEY 1986: 98–104]. In the guild system, individual artisans were responsible for the process consistently from the preparation of raw materials to the finish of products. Comprising the inspection program, the guild system took explicit responsibility for products. In Europe, the esteemed brand names are those of manufacturers, while the names of distributors or production areas (depositories) are highly regarded in Japan. This may be taken as an illustration of cultural differences in the production systems.

5. TECHNOLOGY AS A SET AND AS UNITS

In the guild programs, technology is considered an inseparable sequence, a 'set' in which materials are processed into products. A technician is one who possesses a set and/of techniques. This kind of technology is also found in Japan. Examples include the master carpenter, master paper mounter and/or oriental painting restorer (*hyogu-shi*), and stonemason.

In a technology system where techniques have evolved as a set, products of a superior technician are guaranteed to involve meticulous skill and extremely high quality. If, however, the technician is poor in some procedures, the quality of his products is likely to be limited to his poorest technical level. This system is best suited for made-to-order products.

However, in the Japanese production systems for lacquerware and other products, the sequence of processing technology had been broken down into appropriate 'units' of technical factors, each unit was specialized, and the sequence was then reorganized chiefly by the distributor. In that system the distributor was at the same time an engineer in charge of process control. Impeccable technology was hardly to be expected from that production mode because no technician was in charge of the entire production process. If the right route was selected, however, it was possible to produce a lot of products at a constant quality level since components of almost constant quality were mass produced in every processing stage. If every 'unit' was at a low level, or if the route contained a considerably low-level process, no merit was gained, but otherwise it was a substantially effective system for mass production.

In that kind of production system, mass consumption in the general market was taken into account. Historically, such production systems appeared on the basis of the establishment of cities in modern times. This is indicated by the fact that a craftsperson's labor was not rewarded by wage but by the price charged for the products to the next processor, including the cost of the material [ENDO 1985: 402–403].

Regarding lacquerware manufacturing as tableware industry, although it had a preceding history, production areas were formed during the Edo period in the vicinity of cities with substantial economic capacity for consumption: in the case of Kuroe, the cities were Wakayama, Osaka, and Tokushima; for Kawatsura, they were Kakunodate and Akita; and for Wajima, Kanazawa. Through the sales of their products, distributors collected information on market needs. They employed their subsidiary group of decorative-art craftspersons for the making of products adorned with value-adding decoration and distributed them outside their territory. These value-added commodities became domestic and foreign trade items that helped the management of modern feudal lands, the principle of which was independent accounting. Local industries consolidated a secure footing with such commodities.

Machine parts die manufacturers adapted their precision die making technology to manufacture the base for plastic bowls. That can be regarded as the replacement of a unit link. In this case, the careless route change, done without a system manager, resulted in the production, from the viewpoint of the technology of soup bowl manufacture, of defective goods, although the technology itself was excellent as a unit.

6. THE UNIT STRUCTURE OF INDUSTRIAL TECHNOLOGY IN MODERN JAPAN

The systematic arrangement, linking units for the configuration of a whole set, is found also in today's Japan. Similar to that arrangement is the technology management system practiced by large enterprises which, having themselves engaged chiefly in assembly work, control many independent parts manufacturers, known as affiliated companies. It is not rare that parts manufacturers having outstanding technology sell (deliver) parts to multiple parent firms meeting their respective requirements.

Japan is reputed to be the nation that most extensively popularized the US-originated branch of applied mathematics known as quality control after World War II. Quality control was introduced in 1946, under the guidance of the Private Sector Communications Office of the General Headquarters of the U.S. occupation forces, with respect to the fabrication of communications equipment to be delivered to the U.S. Army. After the establishment in 1949 of the Industrial Standardization Law, which became the foundation of the Japan Industrial Standard (JIS) program, quality control rapidly became popular from around the

mid-1960s.

A 1962 report on quality control for small businesses compiled by the Ministry of International Trade and Industry stated, "Japanese small businesses need to produce inexpensive and quality products in terms also of international competitiveness. For that end, quality control must spread throughout the small business sector. Unfortunately, however, Japan's current state is far from that goal," and accordingly the government "requests that appropriate measures be taken for the diffusion of quality control among small businesses" [TSUSHOSANGYOSHO 1962: 1]. Yet a survey carried out by the ministry in 1958 to examine the degree of standardization among small businesses showed that 340 out of 642 responding factories recognized the effects of the introduction of quality control. Areas in which the respondents reported that quality control was highly effective included reduction of qualitatively non-uniform products, production costs, and customer complaints, as well as increase of sales volume [TSUSHOSANGYOSHO 1962: 4]. The need to take appropriate measures for popularization was due to its introduction as a theory of applied mathematics. Almost no preparatory education concerning mathematics that helped in comprehending the theory was given even in university engineering courses, much less in the curriculum at technical high schools that supplied small businesses at the time. In response to the report, beginners' courses were held throughout the nation and simple handbooks were increasingly published. Accordingly, quality control had spread extensively by the beginning of the 1970s.

From the Edo period, Japan had established technological systems made up of units including even distributors. In this sense the industrial sector was ready for the application of quality control theory, and that was one of the conditions contributing to its quick diffusion. Since the times when traditional handicrafts predominated, quality control based on individual craftspersons was executed. The introduction of applied mathematics acted to improve precision considerably and brought prominent effects.

Automobiles, consumer electrical appliances, electronic equipment, etc. account for large and important parts of contemporary Japanese industry. Manufacturers of all these industrial products put together parts produced by a variety of methods, rather than creating products from raw materials. These businesses may be appropriately termed assemblage industries. These contemporary industrial technologies can be said to be maintained by a combination of the know-how of the unit-based traditional technology management system and quality control, a branch of applied mathematics. Moreover, along with the growth of new industries, or assemblage industries, the time has come to reevaluate the unit-based technology management system.

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