Hitotsubashi Journal of Economics 32 (1991) 49-69. © The Hitotsubashi Academy

THE TRANSFORMATION OF YOUNG RURAL WOMEN INTO DISCIPLINED LABOR UNDER COMPETITION-ORIENTED MANAGEMENT: THE EXPERIENCE OF THE SILK-REELING INDUSTRY IN JAPAN*

YUKIHIKO KIYOKAWA

Abstract

Most of the textile workers in Japan were composed of young unmarried women with rural origins, who were inexperienced workers with high job turn-over rates. Nevertheless, they could be considered to be transformed into efficient semi-skilled labor after their entry to the industry.

This was mainly realized by the following labor management policies: (1) the quality-converted piece-rate wage system; (2) the new-recruit training system under firm-specific motion studies; and (3) the dormitory system with a strong control over privacy.

It was technically educated managerial staff that promoted scientific quality and process controls as well as such labor management policies. In this sense, hence, it was technical education that encouraged a competitive edge of the Japanese textile industry in the international market.

I. *Introduction*

The textile industries in Japan played a leading role in promoting industrialization as in other developed countries. First, textile goods, such as raw silk, cotton yarn, silk-fabrics and cotton-fabrics, were major export commodities from the start of industrialization in Meiji Japan. They continuously accounted for around half (in value) of all exports up to the 1930's. The foreign exchange earned from the export of textiles provided other industries with the opportunity to import new machinery and other modern commodities from industrialized countries. Secondly, the textile industries themselves were very active in importing advanced technologies, and in developing various export-promoting policies and organizations. The accumulated knowledge and experience gradually diffused to other industries.

Such processes of development in the textile industries suggest that the textile industries

* The author would like to thank Prof. L. Grove (Sophia Univ., Tokyo) for her helpful comments and improving English expressions. He expresses his thanks also to the Mishima Kaiun Memorial Foundation and the Nomura Science Promotion Foundation which provided the financial support for this research.

were able to retain a competitive edge in the international market for a long time. Furthermore, when we compare the experience of Japan with that of India and China, we may note a special feature of the Japanese textile industries: competitiveness was maintained by shifting the composition of export commodities (1) from low to high quality, and (2) from low to high value-added products.[1] In considering the commitment and efficiency problems of Japanese labor in the textile industries, this feature may provide us with a clue to understanding some characteristics of the labor management policy in the textile factories.

It was also the textile industries that employed the largest share of factory labor in Japan. For example, in 1896, 56 percent of all 415,000 factory workers were employed by the textile industries.[2] In 1924, 55 percent of 1.29 million factory workers still worked in these industries.[3] That is, we may safely consider a half of all factory employees to be textile workers.

As is well known, in contrast to the cases of India and China, the majority of factory labor was female in Japan (59% in 1896, 54% in 1924). The ratio was particularly high in the textile industries, viz. 85 percent in 1896 and 81 percent in 1924. Accordingly this means that female workers in the textile industries accounted for about 80 percent of all female factory labor in Japan.

Among various textile industries, the silk-reeling industry provided the greatest opportunities for factory employment, e.g. 120,000 workers in 1896 and 252,000 in 1924, although the share gradually declined due to the more rapid growth of other textile industries. The next largest textile industry was the cotton spinning industry, which had grown very rapidly after the turn of the century, reaching the same size, in employment terms, as the silk-reeling industry by 1924.[4] The third was the weaving industry, which includes all sectors of silk, cotton and woolen weaving. Textile industries other than the big three, such as the dyeing and bleaching industry, the woolen and worsted spinning industry, the silk spinning industry and the knitting industry, can be regarded as minor industries in Japan.

In this paper, we shall discuss the quality of textile labor in silk-reeling filatures, not in cotton spinning factories, despite the advantage of the latter in having international comparability, and despite its experience of noteworthy technological adaptation. The main reason for this choice reflects the fact that the more typical features of disciplined labor and the Japanese factory system are observable in the silk-reeling filatures.

More specifically, first, we can consider the technology of the silk-reeling industry was a kind of appropriate technology. However, for the technology to be "appropriate," the unfamiliar factory system, modeled after the practices of Western countries, had to be more appropriately adapted to the real situation of the indigenous economy of Japan. Typically,

---

[1] For example, the reader may be reminded of the typical cases: low to higher count cotton yarn; cotton yarn to cotton fabrics; plain to striped fabrics (cotton and silk) and so forth.

[2] The first national factory survey was held in 1896. It covered all factories employing 10 workers and more. See *Zenkoku kōjō tōkei, Meiji 29/30 nen* [National factory statistics, 1896/97] (Nōshōmu-shō, 1899).

[3] The detailed on-the-spot survey for mining and industry workers started in 1924 in every 3 years. Although this survey contained precious information on workers' background, it covered only rather large factories (depended on the industries; 100 workers and more for the silk-reeling industry). See *Rōdō tōkei jitchi chōsa hōkoku Taishō 13 nen* [Report on the spot survey for workers, 1924] (Naikaku Tōkeikyoku, 1927).

[4] If we had included small workshop employing not less than 5 workers, the weaving industry was the second largest one. See *Kōjō tōkeihyō, Taishō 13 nen* [Factory statistics, 1924] (Shōkōshō, 1926).

the labor-intensive technology demanded efficient labor under strict labor management.

Secondly, raw silk is a quality-sensitive product. Quality control, therefore, necessitated strict product inspection and process control even under the less machine-dependent technology, or perhaps all the more. Thus, labor and factory management had to be arranged to satisfy the required level of product quality.

Thirdly, the information and records on factory labor at the micro level are more readily available for the silk-reeling industry than for the cotton spinning industry. Thus, we will examine the most typical example of disciplined labor under the Japanese factory system in the silk-reeling industry. But most of the conclusions obtained hereafter can be generalized, almost without modification, to the labor in all textile industries.

In comparison with the histories of the silk-reeling and cotton spinning industries in India and China,[5] workers in Japanese textile factories can be regarded as the more disciplined and efficient. This paper will clarify the factors which led to the transformation of young rural women with high job turn-over rates into such factory labor. In particular, the role of labor managemnt practices of managerial staff with technological knowledge, under given technological conditions, will be the object of attention.

II. *Characteristics of Recruited Labor*

Supply of Young Rural Women

Most of the textile labor force in Japan was composed of young women from rural areas. Fig. 1 shows a standard age distribution of female workers in the silk-reeling factories [filatures] in Nagano Prefecture in 1922. This shows that workers aged 20 and below accounted for the great majority (about 70%) of all workers, and that a typical rural girl entered a filature at age 14 to 16 and stayed for a few years.

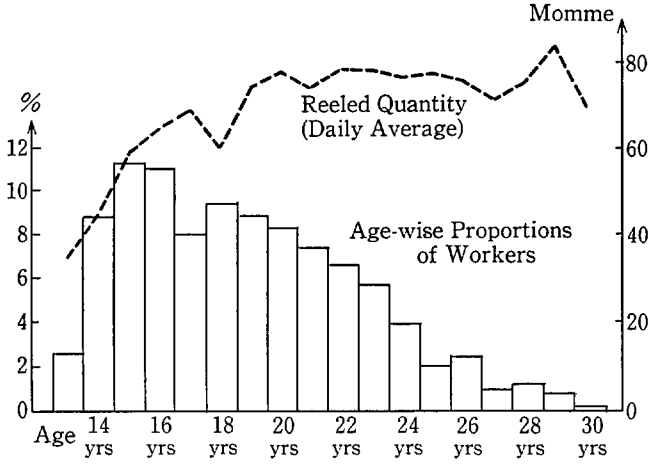
The average age, 18.8 years, may have been slightly younger than the national average. Nagano Prefecture was a major center for raw silk production, accounting for more than a quarter of the total production, and included many large private filatures. Since the large private filatures were able to recruit a large number of young unmarried women from distant areas by providing dormitories, they may have employed younger women than did the small filatures and co-operative filatures, which employed more married commuters.

As another general tendency, it should be pointed out that the mode of age distribution shifted gradually to the right, viz. an increase in the mean age, over time. This shift was in part a reflection of the higher demand for experienced hands as the market for quality raw silk expanded over time, and in part a result in the gradual reduction in the employment of child labor under 15 years of age with the application of the factory law (enacted in 1911) and the development of the education system.

These unmarried female workers can be regarded as relatively short term migrant workers whose purpose was to assist the family's budget directly, or more passively to reduce the number of mouths to feed, or to earn funds for their own marriage. The absolute majority

[5] For a more detailed discussion, see Yukihiko Kiyokawa, *"Nihon, chūgoku oyobi indo no menkōgyō hikaku kenkyū (I) (II) (III)"* [A comparative study of the cotton textile industries in Japan, China and India, Part I, II, III], *Keizai kenkyū*, Apr. 1973, July 1974, July & Oct. 1976.

FIG. 1. AN AGE DISTRIBUTION OF WORKERS AND THEIR REELING QUANTITIES
(Nagano Prefecture, 1922)



Note: 1 momme=3.746 g.
Source: Naganoken, Keisatsubu, *Naganoken kōjō eisei jijō* [Sanitary conditions in factories of Nagano Prefecture] (Mimeograph, 1924), pp. 25–27.

of these female workers, according to two types of survey data, are supposed to have been of rural-origin. The first type of survey, conducted by the employment exchange offices, reveal a prefecture-wise macro tendency in which dominantly agricultural prefectures like Niigata and Yamanashi were the main suppliers of filature workers.[6] The second type of records from large filatures like Gunze indicate that in more than 80 percent of the cases, the occupation of the female workers' parents was agriculture or a related job.[7]

In rural areas employment opportunities for young women were quite limited. Nevertheless, working at a filature has been regarded as one of the worst jobs by economic historians who have tended to emphasize the poor amenities in the filature and hardship of the job. Yet our interviews with ex-silk-reeling-hands casts doubts on this view.[8] Rural girls were said to consider the job at a filature as rather good, when compared with a housemaid or nursemaid which were the most widely available jobs for them in those days. The working conditions in the silk-reeling and cotton spinning industries were undoubtedly quite poor, but they were said to be still better than those in the weaving industry, or of a nursemaid or housemaid. We were told that many of honor graduates of primary schools often showed a preference for employment in the cotton spinning or silk-reeling industry, particularly for jobs in the large factories.

In a standard case, a girl spent a few years as a nursemaid or housework assistant staying at home after her graduation from a primary school, then went to seek employment

[6] A special survey on the migration of filature labor was conducted in 1925 by the employment exchange agencies. See *Kannai seishi jokō chōsa* [A survey on filature female labor within the jurisdiction] (Tokyo chihō shokugyō shōkai jimukyoku, 1925).

[7] Eikichi Ishida, *Jokō no soshitu* [Aptitude of female labor] (Nihon kōgyō kyōkai, 1936), p. 86. Kinnosuke Hiraoka, *Sanshigyō keizai no kenkyū* [A study of the sericulture industry economy] (Yūhikaku, 1939), p. 451.

at age 14–16. This implies that most of workers were primary graduates at the time of employment, but this was the case only after the mid-1920's. Since many school dropouts were found among those in the earlier years (around 20%), not a few filatures provided the authorized supplementary education in the form of night classes to give them a certificate. Japanese mill managers believed that such general education was quite helpful in fostering labor discipline.

Recruitment of Labor and Recruiting Agencies

It is easy to imagine that the migration of young women to distant areas had to face great social difficulties, especially when we recall that there was no freedom of migration under the long Tokugawa Rule. Furthermore, the factory system was quite unfamiliar to the people of those days. Transportation was also completely underdeveloped. Under these circumstances, the first breakthrough was the decisive role played by the Tomioka Model Filature constructed by the Government in 1872.[9] It succeeded to some extent in integrating the locally divided labor markets by taking on a huge number of trainee workers from all parts of the country.

As time went by, the migration of silk-reeling hands gradually increased, particularly after the last decade of the 19th century. This increase was mainly promoted by the development of local private recruiting agents, often called *keian*, who contributed by linking the labor demand of the filatures with what was then a closed local labor market. Most of the agents, who had private information networks in some specialized villages, held respectively an exclusive commission contracts with a specified filature. At a time when the labor market was fragmentary and market information quite imperfect, the function of those recruiting agents was of importance. The village labor market was normally dominated by one or a few agents. Although the cotton spinning companies secured their labor through the same agent system, they did not directly compete with those of filatures. We can see a pattern in which one village (or hamlet; not the administrative village) supplied all young female labor only to the silk-reeling industry, and another village to the cotton spinning industry. Since both industries to some degree required industry-specific skills, the substitutability of labor was low.

As the industry was expanding rapidly, filatures could not rely only on the sub-contract agents in obtaining the labor, since the number of agents was rather limited. Besides, information on the labor market was steadily accumulated on both demand and supply sides. These reasons encouraged male supervisors in the filature, called *kenban*, to enter the recruiting market. They engaged in intensive recruitment in the off-season, with the aid of veteran workers.[10] This pattern of recruitment became more widespread after the turn

[8] See Yukihiko Kiyokawa, "Seishigyō ni okeru kōgino jukuren rōdōryoku ikusei to rōmukanri no igi" [The importance of labor management in the formation of semi-skilled labor in the silk-reeling industry], *Keizai kenkyū*, Oct. 1989.

[9] For a more detailed discussion about the role, see Yukihiko Kiyokawa, "Transplantation of the European Factory System and Adaptations in Japan," *Hitotsubashi Journal of Economics*, Vol. 28, No. 1 (June 1987). Its Japanese version (in *Keizai Kenkyū*, July 1986) is more detailed.

[10] The reader may be reminded of the similar function played by "Jobbers" in the Indian cotton textile industry. In the case of Japanese Jobbers, however, they behaved completely as a member of the management in recruiting, and did hardly confront the top management.

of the century.

Fierce competition in recruitment activities in an effort to exploit the market sometimes led to double cheating contracts with workers, and a battle of snatching workers from other filatures. The phenomenon suggests two facts: (1) recruitment costs were not small in general; and (2) the experienced hands were precious (since the training costs were not small, and it took some time to train new workers). Hence, there was a strong demand for experienced labor particularly in boom periods, despite the easy availability of inexperienced labor from the surplus labor pool in rural areas.

The scramble for filature hands intensified forward the end of the last century. To avoid excess competition in the recruitment market, the main center of production (Suwa in Nagano) devised a worker registration system, a kind of a monopsony organization, in 1902. While this system did not resolve the difficulties, it did often deprive workers of the freedom of shifting from one filature to another. As a result, some regions such as Niigata, Gifu and other prefectures organized the workers' self-protecting unions after 1916 to counteract the system, while the Government also established the employment exchange system in 1925 to reduce friction in the labor market. When all such factors are considered, however, we may conclude that a nation-wide labor market was steadily formed, and the market mechanism functioned properly in the long run.

Not a few samples of the contracts between filatures and workers still survive. Judging from the terms of such contracts, the standard contract period was 3 or 5 years at the earlier stage. Then 1 year contracts became more popular in this century. In the latter case, renewal was almost automatically conducted without a new contract in most cases. For the trainee, the typical contract period was 3 years (previously 5 years). The signatures on the contract were frequently those of the worker's parents, irrespectively of her literacy. This occurred mainly because the parents wanted to obtain the advance payment of her wage, which was the common practice of contract and payment in those days.

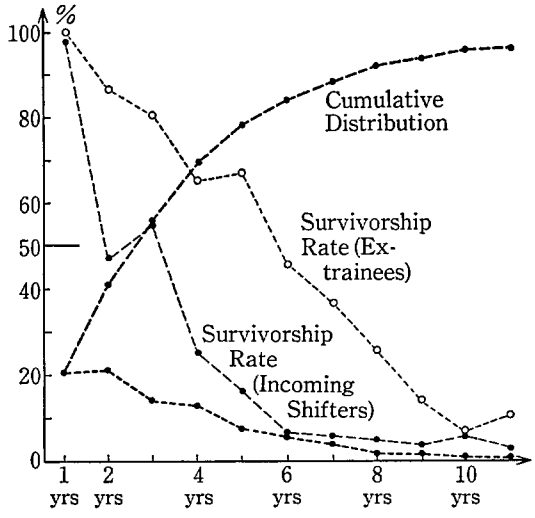
Properties of Filature Labor

The official statistics on the annual turnover rate for filature labor, which show 80 to 90 percent according to *Rōdō tōkei jitchi chōsa* for example, are misleading, since the formal contract period for most workers was 1 year. In fact many of the workers renewed their contracts and stayed in the filatures for longer periods, although in East Japan it was common to return home for 3 months of the off-season. Thus we should discuss the length of service for workers by the data of the *de facto* turnover rate.

Fig. 2 based on a cross-sectional survey by Kyōchōkai satisfies the above condition. It confirms the common understanding that the average length of service ranged from 2 years and a half to 3 years and a half, viz. the turnover rate being 30 to 40 percent. Furthermore, when we divide the workers into two groups, those trained within the same filatures and those already experienced workers transferring from other filatures, the rate of survivorship for the former was much higher that for the latter. The two main reasons given for quitting a job were (1) for marriage, and (2) for family reasons.[11] These were followed by "because of diseases," "desertion (disappearance)," and "for filature's reasons (dismis-

[11] See E. Ishida, *Jokō no soshitu*, pp. 6 & 64, and also Takashi Katsura, *Hompō seishigyō rōdō jijyō* [Labor conditions in the Japanese silk-reeling industry] (Chūō shokugyō shōkai jimukyoku, 1928), pp. 74–77.

FIG. 2. A DISTRIBUTION OF LENGTH OF SERVICE AND SURVIVORSHIP RATES (1920)



Note: The data for survivorship rates are based on the cross-sectional data, not the panel data. This survey was conducted for a subpopulation (10 filatures) of the length of service survey (23 filatures, 11,665 workers).

Source: Takashi Katsura, *Hompō seishigyō rōdō jijō* [Labor conditions in the Japanese silk-reeling industry] (Chuō shokugyō shōkai jimukyoku, 1928), pp. 77–79.

sals)." In the case of disappearances, the filature did not normally take the worker back unless she had a large amount of borrowings, since the management considered her to be a dropout or maladjusted in respect of either skill performance or work discipline.[12]

As for the absenteeism rate, the statistics are quite limited again. But the same survey used for Fig. 2 indicates that the overall absenteeism rate, calculated as the weighted average of two different absenteeism rates for dorm-staying workers (3.3%) and commuting workers (5.7%), was 4 percent. This figure suggests that the dormitory system might have contributed to forming better work discipline. Another example fo the absenteeism rate shows about 10 percent, which, however, included long-term absentees and the non-appearance after contract.[13] Even in this case, the actual vacancy of equipment was said not to exceed a few percent, since vacant positions were filled quickly by the reserve from other sections, trainees and additional recruitees. The main reasons for absence were (1) sick-leaves, and (2) temporary home visits due to funerals and illness of family members.

The turnover rate and the absenteeism rate have so far been crucial indices for measuring the stability of factory labor in the conventional concept of "labor commitment." Ac-

[12] In the cotton spinning industry as well, the desertion rate was very high. But the responses by the management were quite similar. See Gary Saxonhouse and Yukihiko Kiyokawa, "Supply and Demand for Quality Workers in Cotton Spinning in Japan and India," in *Japan and the Developing Countries* (Blackwell, 1985), eds. by K. Ohkawa and G. Ranis.

[13] For example, the company records on costs (called *Kōmu junpō*) of the Gunze Co. are available, and include the statistics on absentee rates.

cording to this concept, therefore, Japanese textile labor has to be regarded as non-committed labor, since it had a high turnover rate. Yet we are sceptical of whether such stability is really a necessary condition for efficient labor. On the other hand, the concept of job satisfaction is sometimes used to measure the commitment, as a substitute for those rates. Although this may not necessarily be equivalent, it is worth noting that statistics on job satisfaction, based on the interviews with ex-workers,[14] portray most of them as having been satisfied. This, however, still does not tell us whether job satisfaction, which must be very important though, is a necessary condition for efficient labor or not.

Working Conditions

Silk-reeling labor is characterized by long working hours. In the busy season the work day was 13 to 14 hours, which was gradually reduced to 11 to 12 hours after the mid-1920's, since the production of high quality raw silk which was the new demand after the 1920's required greater concentration. The delicate fingerwork of producing raw silk also requires sufficient light. Hence, the filature work was in principle one shift with no night work except for the very busy season.

Most filatures provided only two holidays a month. The Sunday-holiday system was quite exceptional at the earlier stage.[15] This was true even for the filature which claimed to follow Christianity in labor management, like Gunze or Ishikawa-gumi. The most popular holidays pattern was the first and 15th days of a month, or the first and third Sundays. National holidays and a few festival holidays were also granted. Furthermore, many filatures traditionally provided several days off at the boundary season between the spring and the summer crops of cocoons.

The average wage in the silk-reeling industry was slightly lower than in the whole manufacturing sector, and almost equal (or a bit lower) to that of the cotton spinning industry. The wage was a piece rate calculated on a daily basis and computed for each 10 or 15 days. But the actual payment was, with few exceptions, handed over at the end of the season. That is to say, the monthly wages for each worker had to be deposited, without interest, in the filature up to the last pay day, although some large filatures paid interest on the accumulated wages. A few advanced filatures such as Katakura or Fukyu-sha had a bonus system based on profit-sharing principles, whereas most filatures did not have even the idea yet in striking contrast to present-day Japan.

Welfare facilities and amenities in the filature were incredibly poor from the viewpoint of today's standard. Every large filature had dormitory buildings on the site, which usually provided such basic facilities as a medical room, a canteen and a reading room for mere forms' sake, as well as toilets, bathrooms and a messroom. In the cases of small filatures, such facilities were out of the question. However, recreation activities were popular even in small filatures. Picnics, sports festivals and a Lantern Festival dance were particularly welcomed by young female workers.

Large filatures could make the best use of their advantage of maintaining many em-

[14] See Shigemi Yamamoto, *Ah, Nomugi tōge* [Ah, Nomugi pass] (Asahi simbun-sha, 1968), p. 314. He infers that 90% of 380 ex-workers (i.e. interviewees) were satisfied with their past job.

[15] For the slow diffusion of the Sunday-holiday system in Japan, see Kiyokawa, "Transplantation," and the references mentioned in its footnotes.

ployees. For example, workers in the large filatures enjoyed insurance and other fringe benefits from their mutual aid association, subsidized by the owner. A filature night school was perhaps a most typical example of such an advantage. Some filatures opened the night classes for general education, and others provided optional lessons in needlework, calligraphy or flower-arrangement. It is broadly accepted that the management side also obtained the benefit from providing such off-duty classes in the better work discipline and the fostering of identity as a member of "factory family".

III. *Silk-reeling Technology and the Factory System*

Silk-reeling Technology

Japan already had the indigenous technology of raw silk production, called *Zaguri*, before encountering the Western filature technology. The traditional technology was less developed in the sense that it had no croisure system and was operated by hand power. As the result, the revolution speed of the reel was not regular. Moreover one-handed work for groping and feeding ends induced an uneven size. The self-completed work of each independent operator did not permit any division of labor and was confined, at best, to the putting-out system. Thus the indigenous silk-reeling technology with low productivity had exclusively produced low-quality raw silk up to the early Meiji period.

In the early 1870's, Japan imported two different types of filature technology from Europe, viz. the most advanced French system and the Italian "domestic" system. Particularly for the French technology, the Japanese Government established a magnificent model filature in Tomioka under the complete guidance and management of French staff.[16] The Tomioka Model Filature should be regarded as an idealized training factory for diffusing the sophisticated French technology throughout the country in the sense that it disregarded profitability, and its facilities were much superior to those of the standard filatures in France prevailing in those days. In the case of transplanting the Italian traditional technology, it still costed a large amount relative to the *Zaguri* shed, whilst the Italian technology enjoyed much higher productivity.

These European technologies must have been the best for univoltine European cocoons with high quality, since they could produce quality raw silk of fine size, which was strongly demanded in the European market. Yet the circumstances were quite different in Japan. Japanese cocoons of uni- and bivoltine races suffered from relatively low quality, viz. poor reelability, short length of cocoon filament and low tenacity. Japan, hence, wanted to avoid direct competition with Shanghai raw silk, since the Shanghai area in China was producing better quality finer raw silk with high quality cocoons.[17] While the European market

---

[16] Ibid.

[17] The most advanced filature technology of Europe was transferred also to the Shanghai area at the end of the 19th century. But it was little modified up to the 1930's, in sharp contrast to the Japanese case. For the more detailed information, see Yukihiko Kiyokawa, "Senzen-Chūgoku no sanshigyō ni kansuru jakkan no kōsatsu: Seishi-gijutsu no teitaisei," [Some consideration on the silk-reeling industry in pre-war China: Stagnancy of silk-reeling technology], *Keizai kenkyū*, Oct. 1975.

to which Shanghai raw silk was mainly exported preferred finer quality raw silk, the American market which Japan as a late-comer tried to explore accepted lower-quality raw silk for thicker fabrics woven by power looms.

Thus, Japan needed to modify the transferred European technologies into a technology that fitted better the Japanese market conditions. The appropriate technology which was more suitable for the coarse raw material and the product-quality demanded in the American market was developed by the end of the Meiji 20's (around 1895) through uniting selectively parts of the Japanese indigenous technology, and European traditional and modern technologies. More specifically, the standard reeling machine developed on the basis of a philosophy of appropriate technology had a wooden frame with the Italian croisure system [tavelette], and was operated by water-wheel power. Although steam power was not adopted in general because of its high costs the filature was equipped with a steam heating system, as in the French technology, to supply hot water for boiling the cocoons. The reeling system adopted the two-stage reeling method from Japanese traditional technology, which was more appropriate for a humid climate. We consider that these adaptations, which are summarized in Table 1, were possible in Japan mainly due to the relatively small core-

TABLE 1. STYLIZED JAPANESE MODIFICATIONS OF THE EUROPEAN FILATURE SYSTEM

		Standard Japanese Filatures[a]	Tomioka Model Filature	Standard European Filatures[b]
1	Average filature size	50–100	300	100–200 basins
2	Filature buildings	simple wooden	typical French	massive brick
3	Motive power	water	steam	mostly steam
4	Water heating	steam	steam	steam
5	Machinery material	wood	iron & steel	iron & steel
6	Croisure system	mostly tavelette	Chambon	mostly tavelette
7	Cooking system	combined with reeling	combined with reeling	division of labor
8	Winding system	re-reeling	re-reeling	direct reeling
9	Raw-silk size	14	12	10–12[D]
10	Dormitory system	mostly	complete	partly, many commuters
11	Main market	foreign	foreign	domestic
12	Age of workers	15–20	15–20	15–20 yrs & children
13	Employment contract	1–3	3	1 year, loose
14	Operating days	280–300	280–290	240–26 days
15	Holidays	1–3 days a month	Sunday & festivals	Sunday
16	Working hours	13–14	8–9	11–12 hours
17	Wage system	strict piece rate	time & piece rates	mostly time rate
18	Reward & penalty	very strict	loose	very loose
19	Supervisory system	strict, gang competition	typical French	reasonable
20	Night Works	none but long working hours	none	not rare in the busy season

Source: With some additions, adapted from Yukihiko Kiyokawa, "Transplantation of the European Factory System and Adaptations in Japan," *Hitotsubashi Journal of Economics*, Vol. 28, No. 1 (June 1987).

a) Average filatures in the 1st decade of the 20c.

b) Average filatures in the 2nd half of the 19c.

technology gap between the imported and indigenous silk-reeling technologies, as against the cases of cotton spinning technology and others.[18]

The Factory System

To be competitive, it was not sufficient to have chosen to adjust production technology so as to produce low-quality product which was more appropriate for the Japanese market conditions. It was also necessary to supply the low-quality product had to be supplied at a relatively lower price. In the case of raw silk production, the main source for cost savings was in the formation of efficient and cheap factory labor, since the production was labor-intensive with delicate finger work. The role of labor management, thus, was crucially important in the factory system.

The Japanese factory system in the silk-reeling industry can be characterized by both poor facilities and labor-intensified management. The former was partly equivalent to adopting the less capital-intensive technology. The latter meant long working hours and strict supervision over the production process in the filature system. Such a labor management policy was, as a matter of course, also influenced by the appropriate technology. For example, a Chambon croisure was designed to produce higher quality raw silk, whereas a tavelette croisure was appropriate for producing lower quality raw silk. To adopt a tavelette type, hence, meant the switch from the quality-first principle in the Tomioka Model Filature to the quantity-first principle. The re-reeling system based on the small reel facilitated the inspection of the quality of each worker's output, since to examine strictly the quality of raw silk in the process of re-reeling was much easier than in the case of the direct reeling system which had no re-reeling process. As a result, this choice of technology facilitated management's control over each worker.

These features (see Table 1) of the filature system in Japan were established by the end of the Meiji 30's (around 1905). In the subsequent year, however, changes in market conditions necessitated modification in some basic policies. Improvement in product quality became inevitable in the 1920's owing to the demand shift in the American market. A detailed investigation on how such adaptations were realized will be outlined in the following sections.

Most filatures were located near the supply centers of cocoons, for fresh cocoons had to be quickly dried in the filature after killing pupas. The poor transportation system in those days compelled filatures to locate in the areas close to raw materials producing regions. As a result, silk-reeling factories were scattered throughout the country except for the northernmost and southernmost regions (Hokkaido; Okinawa). Different types of filatures, such as a large or small scale and private or cooperative firms, existed in different regions. Whilst in terms of technology we consider the silk-reeling technology as scale-neutral, the average *firm* size had gradually increased and large scale firms had a decisive influence on the industry as a whole. Therefore, we shall hereafter discuss the situation of the factory system mainly in large firms.

[18] These phenomena can fully be explained by the differences of technological gap between indigenous and imported technologies. See Yukihiko Kiyokawa, "Gijutsu kakusa to dōnyū gijutsu no teichaku katei" [Technological gaps and the adaptation process of transferred technologies], in *Kindai Nihon no keizai hatten* [Modern Japan and economic development] (Tōyōkeizai shimpōsha, 1975), eds. by K. Ohkawa and R. Minami.

IV. *Labor Management in the Filature*

Required Skill Level

There exist two opposing views with regard to the skill level of reeling work. Many economic historians and professionals in the industry have maintained that to reel the cocoon is a typical example of skilled work, requiring highly nimble-fingered practices. Some economists, however, have argued that the job is an unskilled one because of the high turnover rates of reeling hands. Our standpoint is to consider reeling as a semi-skilled job, in the sense that the skill could almost be mastered in a rather short period (2–3 years) on account of the unique and strict labor management system,[19] despite the fact that the job demanded very delicate finger-work.

To understand the significance of labor management more deeply, we attempted to analyze the properties of reeling work and its skill content. For this purpose, we interviewed 22 ex-silk-instructors who graduated from the Tokyo Higher Sericulture School in the pre-war period. According to their experiences and judgements, it took 4.8 years (as the mean) for an average-talented worker to attain the ideal or matured skill level. This is supported by the consistent movement of the labor productivity increases as seen in Fig. 1.

According to these ex-silk-instructors, the key factors contributing to skill formation are followed in the order of significance: (1) individual aptitude; (2) length of service; (3) an educational level; (4) production control; (5) training; and (6) coercion.[20] That is to say, they regard the individual worker's aptitude as the most important factor. More specifically, aptitude meant skillfulness with fingers, good reflexes and sustained concentration. As these aptitudes were inborn, what the management side could do was at most to select the workers with such aptitudes through vocational aptitude tests, which were zealously studied and developed by some large firms. However, the other five factors were more controllable by management. The purpose of labor management, thus, was boiled down to how to effectively form the skilled labor by promoting the five factors.

The concept of a skilled worker in the narrow sense requires not only high productivity but also the ability to design and arrange one's own work, and the ability to adapt to unexpected events, such as mechanical troubles and abrupt changes in raw materials. In the case of silk-reeling work, those abilities were not demanded of the worker, since all such adaptations and arrangements were provided by the management. Workers were asked only to achieve stable product-quality together with high productivity under the detailed instructions from the management. In this sense they were asked to be skilled workers only in the broadest sense of the term, i.e. semi-skilled workers, who could to some extent be fostered by repeated practice under strict production control and labor descipline, as suggested by the above-mentioned factors determining skill levels.

---

[19] Compared with the job of a piecer in the Ring spinning factory, reeling hands in the filature were required much higher skill, although the features of workers in both industries were quite similar with each other.

[20] More exact results on their evaluations are found in Kiyokawa, "Seishigyō niokeru kōgi no jukuren."

The Training System

The training system for new recruits was very important in the following double senses. First, as was shown in Fig. 2, the survivorship rate for an in-factory ex-trainee was much higher than for others, even after discounting the factor of her longer contract period (2–3 years). This was presumably partly due to a strong identity of the trainee to her firm, implanted during the training period, and partly due to her high potentiality fostered by the training, which made her survivorship possible. Consequently, although the training costs had to be borne by the filature, the training system did contribute to prolonging the average length of service in the filature.

Secondly, the quality-first principle was usually inculcated into trainees through drills and lectures, since the price of raw silk varied greatly with small differences in quality. By experience the worker who paid enough caution to the quality was said to grow into the best skilled worker. In other words, the training system was quite successful in producing excellent experienced workers.

These advantages of the in-factory training system, or alternatively the insufficiency of the prevailing on-the-job-training system, came to be widely recognized in the 1910's. By the mid-1920's the in-factory training systems were widely adopted in the silk-reeling industry. Most large filatures set up their own training factory on the site, whereas smaller size filatures usually dispatched their recruits to the training centers managed by an industrial experimental station or an industrial association.

The standard training period was 6 months to 1 year. During the period the trainees usually obtained a nominal time-rate wage, but in some cases they received no wage except free room and board. The number of trainees were in general 10–20 percent of the total number of workers in most filatures. The new recruits were intensively trained using the drill method based on standardized motions, which was developed by motion studies in each filature. Hence, each filature claimed that the standard motions were unique and specific to a given filature, although the motions were not, in fact, so different from each other. At times the elementary lectures on the properties of raw materials and the machine structure were provided in the evening after the training.

When a vacancy was available due to absences, some advanced trainees filled the position as a substitute hand under the piece-rate wage system. In busy filatures, trainees were often engaged in the job of assistant, delivering the cocoons and collecting the silk waste during the duty hours, while they took lessons on reeling the cocoon after the duty in the evening.

Not a few experiences indicate that about one fourth of all trainees were unfitted by natural aptitude to become reeling hands. It is very interesting that such unsuitable new recruits could not be fully detected by the vocational aptitude tests. On the other hand there was empirically a significant correlation with good records in school. Although the reasons explaining such a relationship have not been fully clarified yet, the labor discipline that must be partly fostered in school should be considered as a prerequisite for skill formation in the case of raw silk production.[21]

[21] For the definition of "disciplined labor," see Morris D. Morris, *The Emergence of an Industrial Labor Force in India* (Univ. of California Press, 1965), p. 6.

The Incentive Wage System

A unique piece-rate wage system was developed in Japan, particularly in the silk-reeling industry. Similar competition-oriented wage systems are observable also in other textile industries. However, the silk-reeling industry represents an extreme example of this practice, since the product is very sensitive to quality differences, and since the technology requires more skill in comparison with the cases of other textile industries.

In the filature labor productivity or skill was measured according to 3 different aspects: (1) reeled quantity; (2) an effective reeling rate of raw materials; and (3) the quality of reeled products. Among the three, measurement of quality (composed of tenacity, cohesion, the number of knots, evenness, etc.) was the most difficult, but most important in relation to the product price. In Japan the re-reeling system favored this kind of difficult measurement, for it facilitated the examination of the quality for each small reel of an individual worker's output in the process of reeling up on a large reel.

The result of examination of each individual's daily performance was announced the following day in terms of scores, and then converted into the wage system for every 10 days or half month. The uniqueness of this piece-rate wage system in the silk-reeling industry was in the scoring system. First, the score was measured as a deviation from the average of all workers' performances. This may, hence, be interpreted as a variant of Taylor's differential piece-rate system if we read the average productivity as Taylor's work standard. In this case, however, the defect of wage bill increase could be avoided, since the standard was not an absolute but a relative one.

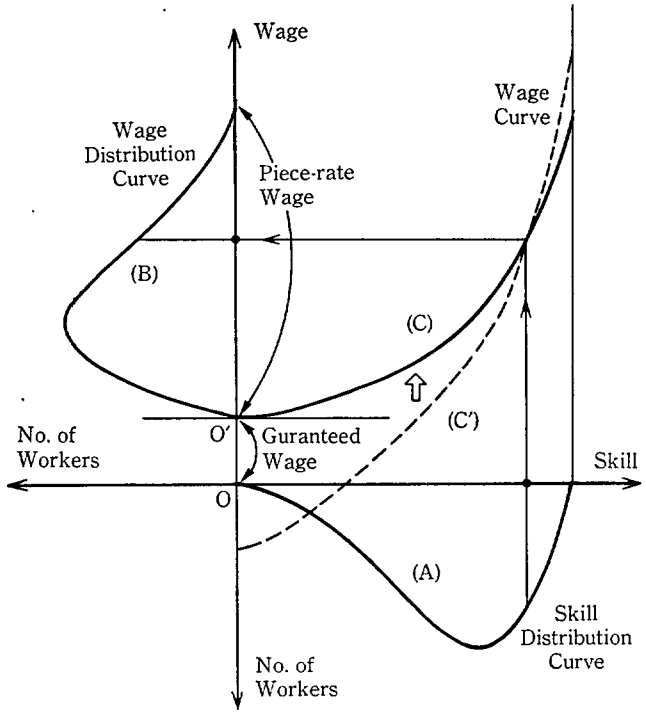
Secondly, the conversion rate of scores into wages was adjusted to satisfy the total wage bill which was set as a fixed proportion of total costs. Therefore, this piece-rate wage was a re-distribution rule of the wage fund among workers based on the mean-deviation standard. While the relative standard wage was often criticized as a "Cannibalism exploitation system" due to the failure to provide wage increases for *equal* productivity increases among all the workers, it had some justifications, too. For the reelability of cocoons profoundly depended on varieties of cocoons and their dried and cooking conditions. Furthermore, price changes of raw-silk were enormous. An absolute standard wage would, thus, have been unstable and impractical, even if it had been adopted.

It is empirically known that the skill (or productivity) distribution (A) of workers usually had a negative skewness (i.e. skewed to the left) as shown in Fig. 3, presumably owing to the skill maturation and the higher turnover rate of workers with lower productivity. On the other hand, the wage distribution (B) normally had a positive skewness. This resulted from the incentive wage system that encouraged particularly high-productivity workers by giving them unproportionately higher scores (C). In other words, such a wage scheme aimed at promoting a keen competition among workers.[22]

Especially in the earlier days, the mutual competition was emphasized by the management. For example, production races among workers or among groups of workers were often encouraged. Some low-productivity workers suffered from the negative wage (or debt to the firm) resulting from an extremely unproportionate relative wage scheme (C').

[22] We derived these curves from the data on the performance-scores and wages for each worker (monthly average). For our statistical investigation, see Kiyokawa, "Seishigyō niokeru kōgi no jukuren."

FIG. 3. A STYLIZED SKILL-WAGE CONVERSION



Note: Skill is measured in terms of the total scores of the above-mentioned 3 factors.

But these labor-intensifying policies were gradually altered in the 1920's by stressing more quality-control, rational labor management, technological progress and so forth. As a part of it, the wage scheme was also modified into the Emerson-type scheme with a minimum-guaranteed wage (C'→C). This mainly resulted from the shift in demand to quality raw silk after the development of the rayon industry. For the labor-intensifying policy did not contribute at all to producing quality silk, although competition among workers still remained an important factor.

The Dormitory System

The dormitory system was indispensable in Japan for encouraging long-distance mobility of unmarried female workers. Despite the significance of its functions, the dorm facilities were extremely poor as was mentioned in Section II. Conditions in typical dormitories are described in the survey conducted by the Nagano local government in 1923.[23]

Although the conditions were very poor from the standard of the present day, it is a controversial problem whether they were better or worse than the living conditions in rural areas of those days. For example, meat or fish was served only once every three-days (but rice and *miso*-soup at will) in an average dormitory. We consider that this was at least

[23] Naganoken, Keisatsubu, *Shinshū no seishikōjō niokeru karennaru jokōno kishukusha wa konogotokuni gozasōrō* [The actual conditions of female workers' dormitories in Shinshū, Nagano] (Mimeograph, 1924).

not worse than the meal conditions in rural villages of those days. We obtained the same conclusion also from our interviews with ex-silk-instructors who actually shared the same meals with workers' in a filature.[24]

The dormitory system, we consider, had another important function. That is, the dormitory was the place to foster group discipline, which was closely connected with labor discipline in the factory, through living together under strict time control. A competitive spirit and a team spirit were simultaneously cultivated under community-oriented management in the dormitory, at the expense of workers' privacy and freedom.

In the case of the Japanese silk-reeling industry, labor discipline was a necessary condition for fostering semi-skilled labor under strict labor management. The dormitory system contributed to alleviating what is called X-inefficiency by H. Leibenstein in the following two senses:[25] (1) the dormitory life cut off the inertia of a rural way of life and rural time-consciousness; and (2) the dormitory life narrowed down the gap between agents and principals by increasing the self-identities of workers in living together. Under the system that satisfied these two prerequisite conditions, the incentive wage scheme and the training system were able to induce the high levels of effort from the workers.

V. *Managerial Staff and Technical Education*

The Function of Supervisors

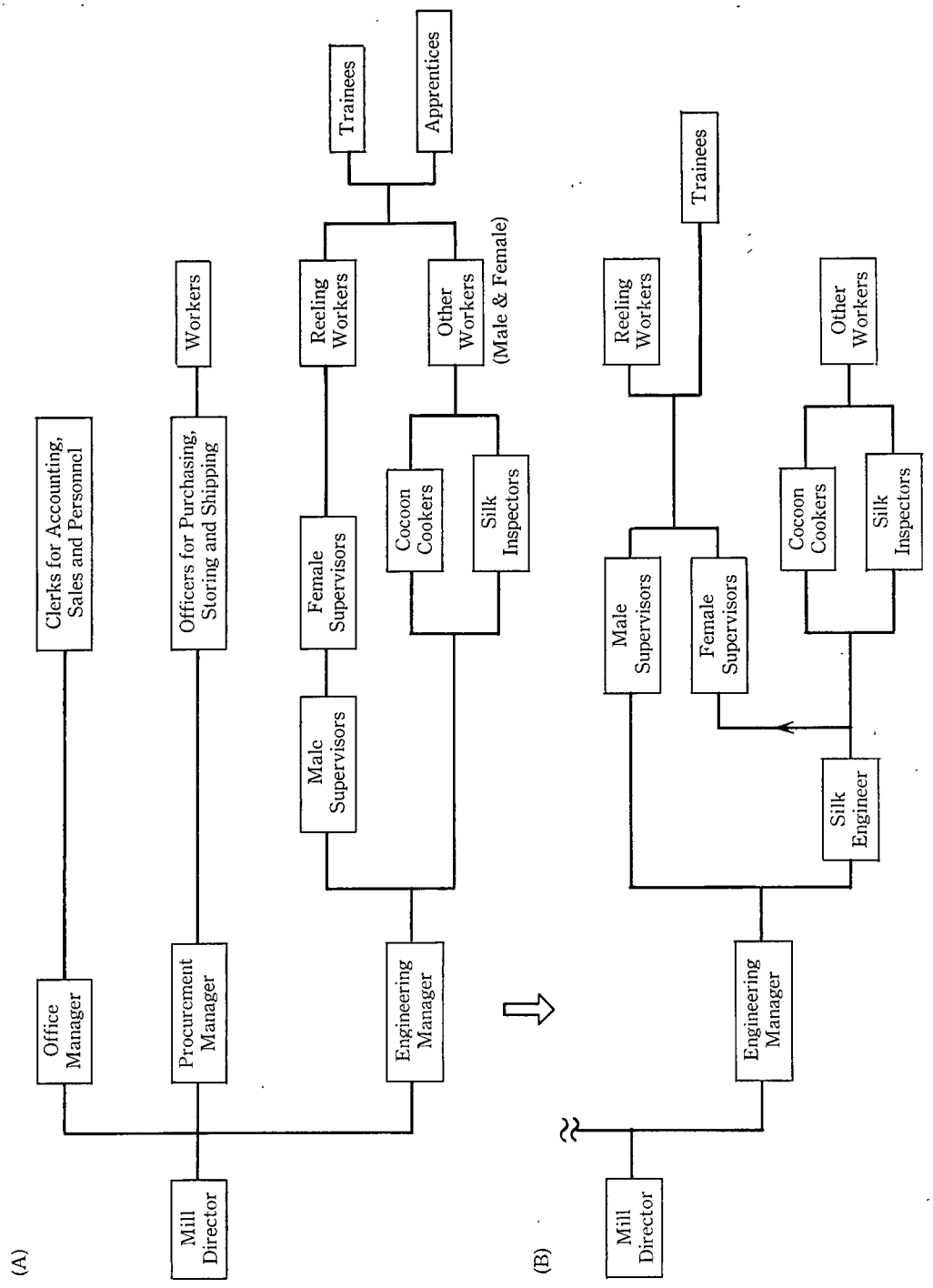
As is shown in Fig. 4, the managerial organization in a filature was rather simple. Most of control was placed in the hands of supervisors *cum* middle management staff. Particularly in the earlier days, the discretionary power of labor management was concentrated in male supervisors who were a synonym for labor-intensifying management. However, their scientific knowledge of cocoons and raw silk was insufficient, and moreover they were not able to demonstrate a model performance of practical skill for reeling, since most of them were only primary school graduates who had worked their way up from assistant boys. It was, hence, female supervisors with education and experience who were eagerly waited for with great hope, when quality control and training for new recruits became crucial in subsequent years.

The supervisor's job was also a tough one with long working hours. Prior to the beginning of operations each day, they examined the revolving speed of reels, the temperature of reeling basins, the supply conditions of steam and water and so forth. Whenever the variety of cocoons was switched, the trial reeling was conducted in advance by a supervisor to determine the optimal number of reeling cocoons per thread, the appropriate revolving speed of a reel, the appropriate cooking time of cocoons, and other such detailed technical specification. During the working hours, they walked along the production line to advise

[24] Yamamoto also reaches the same conclusion. See Yamamoto, *Nomugi tōge*, p. 314. It should be emphasized the fact that the managerial staff shared everyday the same meals of breakfast and lunch with workers' in most filatures, since this was, we consider, very important in driving labor management policies. The reader may be reminded of an opposite extreme situation in India.

[25] Harvey Leibenstein, *General X-Efficiency Theory and Economic Development* (Oxford Univ. Press, 1978), Chaps. 1 and 2.

FIG. 4. CHANGES IN MANAGEMENT ORGANIZATIONS IN THE FILATURE



Notes: 1) The change is supposed approximately from the first decade of this century (A) to the 1920's (B).
2) This information was mainly collected from my interviews and some company history records.

on the timing of end-feelings, the degree of twisting, and the cocoon arrangements in a reeling basin. For reeling-hands who faced difficulties, the supervisor adjusted the reeling speed by changing the size of a transmission gear from a shaft. After the end of the work day, they checked the machine to give instructions for repairs and maintenance and prepared various arrangements for the following day's production.

The supervisors had further important functions as liaison-officers. They coordinated the operations in the cocoon-cooking section and reeling section to produce assigned quality, judging from the results in the quality inspection section. The recording of workers' performed scores and attendances was also their responsibility. Some of them were further asked to be housemistresses of dormitories, whereas some others were asked to teach supplementary classes in the evening.

Among these various works for supervisors, a particularly important one was training new recruits in the training factory, since in-factory trainees were a candidate pool for the best semi-skilled workers, as was pointed out in Section IV. Normally 5 to 10 trainees were assigned to one supervisor or silk-instructor, called *seishi kyōfu* [silk-reeling female instructor], and trained intensively by a drill method based on standardized motions. In the training process, it is broadly agreed that technically educated instructors who had learned how to coach and had studied sericultural science as well attained much higher performances than instructors of worker-origin who relied on a rule of thumb method.[26] Thus the demand for female supervisors with technical education increased year by year, particularly in the 1920's.

Supervisors were usually posted at the rate of one for 25 to 50 workers in the production line. The number of male supervisors gradually decreased, whereas that of female supervisors increased.[27] Among the female supervisors, the supply of technically educated supervisors steadily expanded after the mid-1920's. As a supervisor belonged to the lower-middle management staff, she/he obtained a salary, not a wage, of ¥20–25 per month in the 1910's (¥30–35 in the 1920's). This salary was fairly high, particularly for woman in those days. It was higher than that of teachers who had graduated from a teacher's college, and was said to be approximately equal to that of the workers with highest earnings in the filature.

The Supply of Educated Managerial Staff

Since the labor management policy in the Tomioka Model Filature was too idealistic, it did not provide specific model for other filatures to follow. Still many private filature modeled their own principles of supervising workers and their wage systems from Tomioka, transforming the elements to take account of actual circumstances. In subsequent years they further developed management practices through learning by doing, and established by the end of the Meiji 30's a pattern of Japanese labor management, which is characterized as the quantity-first principle and labor-intensifying management under male supervisors.

Now this management principle often gave rise to troubles, since it required highly labor-intensive work and a long workday. To improve it, however, educating the super-

[26] See, for example, Kumajiro Tamura, *Seishikōjc yōseihō* (Gifuken Seishi Dōgyōkumiai, 1916), pp. 52–54. This book provides the data of a result of a quasi-experimental design.

[27] Factory-wise statistical data on supervisors are available in the filature survey, called *Zenkoku (kikai) seisjhi kōjō chōsa* [The national survey on filatures], held in some specific 10 years.

visor class was the only possible solution. This was because all control over daily production and on the spot discretion in decision-making were placed in their hands, as was pointed out previously. Symptom of modernizing this system first appeared immediately after the turn of the century.

In 1902 the Sericultural Institute (*Sangyō-kōshūjo*), which had already started training sericulture instructors in 1890, opened also two different two-year training courses to produce silk-reeling experts for both male and female students. The course for male students was at the higher-educational level and was aiming to produce mill directors, silk-reeling engineers and professional government officials, whereas the course for female students was at the middle-educational level and aimed to provide educated supervisors with practical training to the filatures.

In response to the strong demand from the industry, both classes provided simultaneously the intensive courses for the re-training of mill managers and female supervisors on active duty, to have trained more than 300 managers and supervisors, respectively, up to 1914. In that year, the Sericultural Institute was reorganized into the Tokyo Higher Sericulture School to enrich the comprehensive sericultural education. The technical education system for the silk-reeling industry was largely enriched in the 1910's by the establishments of various new institutions.

Among them we consider the training institutes for female supervisors as the most important and influential technical education for modernizing filature management, particularly labor management. In the 1910's, Gunze Co. opened a full scale own school for training female supervisors, whereas local governments or industrial associations also established similar intensive training centers in Nagano, Gunma, Gifu and Kyoto Prefectures. In the cases of graduates from Tokyo Higher Sericulture School, who had sufficient scientific knowledge and practical training after two-year schooling, one third of them served as the instructors for producing female supervisors in those institutions, whilst two thirds were directly welcomed as leading supervisors in filatures.[28]

Thus, the supply of female supervisors with technical education gradually increased after the 1910's, and they were replacing on-the-job-trained female supervisors as well as male supervisors. This replacing speed was accelerated in particular after the mid-1920's,[29] since the seriplane test was then introduced to produce high quality raw silk. The quality silk was strongly demanded by the demand shift which followed the development of the rayon industry. That is to say, the previous quantity-first principle had to be switched to the quality-first principle under more scientific labor management. This could be promoted only by supervisors with technical education.

Japanese labor in the textile industries was unskilled female labor of rural origin and characterized by short length of service. Labor management was, hence, decisively significant in transforming it into semi-skilled disciplined labor. In other words such a transformation allowed for the extraction of the potentiality of labor under specific labor man-

[28] A detailed analysis based on the information of alumna directories of the Tokyo Higher Sericulture School can be found in Yukihiko Kiyokawa, "Gijutsu chishiki o yūsuru kantokushasō no keisei to shijō eno tekiōka" [Formation of the educated supervisors class and market adaptations], *Shakai keizai shigaku*, Sept. 1988.

[29] The turning point is detected by the switching regression method in Kiyokawa, *op. cit.* It is claimed there that a turning point existed in-between 1921 and 1924.

agement policy. Discipline of filature labor was rather easily attained under labor-intensifying management in the earlier days, viz. by the end of the Meiji 30's. But it was not until the subsequent years, particularly the mid-1920's under more scientific and systematic labor management policies that the rural unskilled labor was regularly transformed into semi-skilled disciplined labor in the filature. The rationalization of labor management was largely promoted by supervisors with technical education. In this sense the development of the silk-reeling industry in Japan, we consider, was profoundly dependent on the development of technical education.

VI. *Concluding Remarks*

As was confirmed in the previous sections, young female labor in silk-reeling filatures was disciplined labor, despite the handicap of being rural in origin, unskilled, and with a high turn-over rate. What is more, judging from the industry's competitiveness in the international market, they could even be considered to be efficient semi-skilled labor.

The quality of factory labor in Japan, we consider, was potentially not so different from that in India and China. Nevertheless, the fact that such transformations of young rural women were realized rather smoothly in the relatively early days was in particular due to the strict and rational labor management. Labor management in the silk-reeling industry was usually composed of three Japanese policies: (1) the incentive wage system including the evaluation of product-quality, (2) the new-recruit training system under firm-specific motion studies, and (3) the dormitory system with a strong control over privacy. Particularly the first and third policies were of great significance.

It was truly a characteristic of this Japanese labor management which promoted, often emphasized too much, mutual competition not only among workers but also between groups in production. This was partly a reflection of the keen market competition among firms. To survive the competition, each filature had to increase, by its own measures, the labor productivity of workers under labor-intensive appropriate technology on the one hand, and had to react swiftly to the changes in market conditions (e.g. the demand shift from low to high quality raw silk) on the other hand.

In other words, the gradual switch of production policy from a low-quality low-cost to a high-quality high-cost type was inevitable for the Japanese silk-reeling industry. This could be realized directly by intensifying quality control and production-process control, and indirectly with the quality improvement of raw materials and technological innovations in the industry as a whole in the long-run.

Since such factory control, therefore, required a managerial staff with scientific and technological knowledge of cocoons and raw silk, the supply of supervisors with technical education was unconditionally welcomed. In the case of Japan, the demand for managerial staff with technical education was rather smoothly satisfied by the expansion of formal technical education from the earlier days. An increase of managerial staff with technical education not only promoted scientific quality and process controls, but also transformed a labor-intensified management into a more rational form, particularly after the mid-1920's. For example, the unique quality-converted piece rate wage system is a typical product of the combination of such labor management and quality control.

Almost all the features described above can be generalized for all other textile industries in Japan. That is to say, although a history of the silk-reeling industry provides a typical and extreme example, its characteristics are common to almost all textile industries, since they were features of a Japanese factory system employing a large amount of female labor.

The experiences of the Japanese textile industries, we consider, offer important suggestions for building up a factory labor force in the process of industrialization, particularly when compared with the experiences of the Indian and Chinese textile industries. The Japanese case proves that the conventional concept of labor commitment is neither a necessary nor a sufficient condition for forming efficient factory labor. What is of greatest significance in the process of the industrialization or the diffusion process of the factory system is to remove various *X*-inefficiencies. In other words, the problem is not one of labor quality itself, but of realizing the potential aptitude of inexperienced labor. It should be noted that labor management can play a dominant role in achieving such results.

The Japanese experience suggests to us that a rational labor management supported by sufficient technological knowledge contributed most to extracting the potentiality of unskilled rural female workers. In this sense, the provision of technical education for managerial staff from early days was a key variable in gradually modernizing labor management, in parallel with the successive introduction of technological innovations. What was more important as a background factor in the case of Japan was keen market competition among firms, which encouraged labor management to function effectively.

HITOTSUBASHI UNIVERSITY