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Harvard Business Review

No. 84414

HBR
JULY–AUGUST 1984

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For the past five years I have been studying productivity at Western Electric, which is, after IBM, the largest U.S. manufacturer of electronics. In the course of this study, people frequently asked me, "Why is the productivity of Japanese workers so much higher than ours?" and, "How can U.S. companies get their productivity up to the Japanese level?" This article tries to answer these questions.

I compare the performance of Western Electric workers with that of workers at five of the largest Japanese electronics manufacturers: Matsushita Electric Industrial Co., Hitachi Ltd., Fujitsu Ltd., Nippon Electric Co., Ltd., and Mitsubishi Electric Corp. Limiting this analysis of comparative productivity to large companies in a single industry has two advantages. First, the Japanese are not more productive in all sectors of the economy: output per worker in Japan is less than three-quarters of the U.S. level, and comparisons based on aggregate data can be misleading. Second, restricting the study to one industry limits distortions in the data that structural differences between the U.S. and Japanese economies might cause. A service-oriented economy, for example, might have a much different productivity rate of change than a manufacturing-oriented economy, even if the industrial sectors in the two economies were identical.

The superior productivity of Japanese workers compared with their U.S. counterparts is commonly attributed to cultural reasons. This is not true. Compared with Western Electric workers, Japanese workers are *not* absent significantly less, are *not* less likely to quit, and do *not* work harder.

The reality is that some straightforward management decisions explain the high productivity of Japanese workers. U.S. companies can make the same decisions: Hewlett-Packard does.

In the past few years many observers have offered explanations for the enormous success of Japanese manufacturers. Some analysts trace Japan's impressive industrial performance to unique cultural and historical factors, while others point to farseeing and shrewd public policies to promote international competitiveness. The author of this article compares the management practices of five Japanese electronics companies with those of the Western Electric Company. He finds simple explanations for Japan's remarkable productivity rates: personnel and investment practices designed to encourage high performance.

Mr. Weiss is associate professor of economics at Columbia University. He has also taught at New York University and, in 1982, at Nagoya City University in Japan. He is the author of numerous articles and papers on labor economics.

Myths of Japanese productivity

Let us look at the evidence for high levels of productivity in five Japanese electronics companies. To protect the confidentiality of the companies that supplied the data for the study, I do not identify them

by name. Instead I label each company A, B, C, D, or E.

Myth 1: Lower absenteeism. *Exhibit I* compares the absenteeism rates at Western Electric and Company A. These companies record absences in a similar way. Company A is exceptional in Japan because it closes its factories for three weeks each year and because it counts only days lost outside those three-week periods as absences. Other Japanese companies count discretionary vacation days as absences. As can be seen, Western Electric employees are absent less than Company A's employees.

Myth 2: Greater corporate loyalty. It is sometimes claimed that a greater sense of corporate loyalty explains the low quit rates of Japanese workers. This is certainly not true for female workers. At each of the companies I visited in Japan, the quit rate for females—who account for about half of new hires—was higher than that at Western Electric. Among male workers, the quit rate is slightly lower in the Japanese companies (see *Exhibit II*).

One possible explanation for the wide disparity in the quit rates of male and female workers is that Japanese society encourages corporate loyalty only among males. A more compelling explanation is that the steep wage-tenure profiles at Japanese companies make quitting unprofitable for male workers who intend to spend a long time in the labor force. Workers accept low entry-level wages because of the promise of high wages later on. Because almost all women leave the labor force before the age of 32, they have less incentive to accumulate tenure at these companies.

Exhibit I Absenteeism rates

	Company A	Western Electric
Production workers	6.1%	4.8%
White-collar workers	4.7	2.2
Men	4.6	2.9
Women	6.8	5.3

Exhibit II Quit rates of newly hired workers

Company B	Men	8% during first six months
	Women	24% during first six months
Company C	Women	17%–24% during first year
Western Electric	Men	10%–12% during first year
	Women	10%–12% during first year

Exhibit III Average monthly salary of high school graduates in Company C in 1981

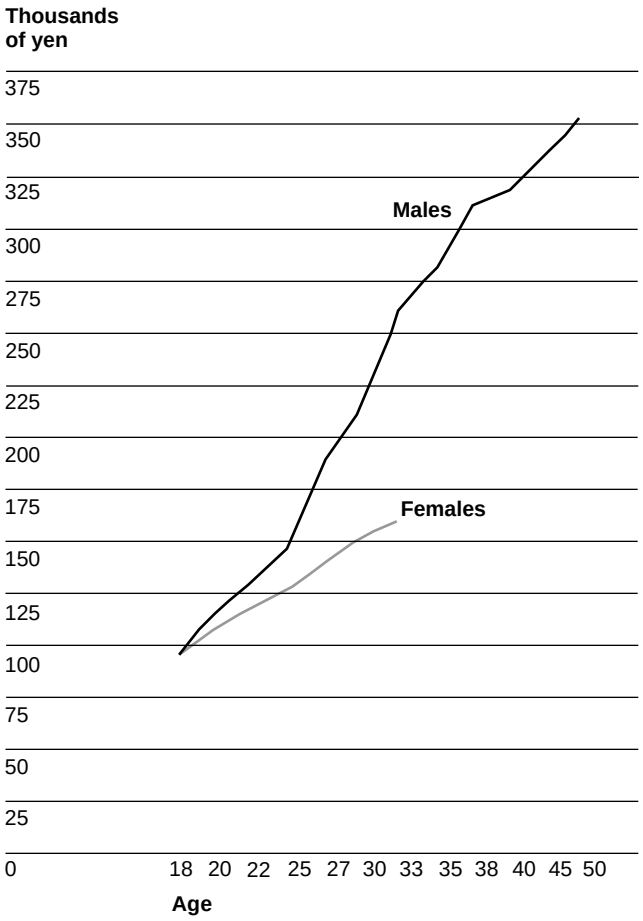


Exhibit III shows the increase of wages with age at Company C, which had the flattest wage-tenure profile of the three companies for which I could obtain good wage data. In this exhibit, points along the curves represent the average wage paid to each age group, male and female, in 1980. Note that I am not graphing the expected annual pay increase for each worker. Because average earnings have been rising rapidly in Japan, those wage increases would be far greater than *Exhibit III* implies. Recent studies have shown that for American workers, each year of tenure increases earnings by roughly 1.6%.[1] In the companies I studied, each year of tenure increases earnings by roughly 4%.

1. See Wesley Mellow, "Employer Size, Unionism and Wages," *Research in Labor Economics,* Supplement 2, 1983, p. 253. See also Joseph R. Antos, "Union Effect on White Collar Compensation," *Industrial Labor Relations Review,* April 1983, p. 461.

Exhibit IV **Quit rate of male workers at Company A**

Age	15–19	20–24	25–29	30–39	40–49
Quit rate	5.0%	2.7%	2.5%	0.9%	0.4%

Because these companies hire only workers who have just left school, a graph of wages as a function of tenure would look similar. Entry-level Japanese workers accept low wages in anticipation of higher pay as they accumulate seniority. Under these conditions, an experienced worker would be foolish to change jobs: he would lose the opportunity to make up for his low earnings as a new employee. As expected, then, the quit rate for male Japanese workers is low and falls steeply with experience.

Female employees, in contrast, normally leave their jobs when they either get married or have children. In the five companies studied, it is rare to find female employees older than 32. Because women are unlikely to receive the high salaries they would get if they stayed 30 years, they have less to lose by leaving. Also, as I have shown, their wages rise less rapidly with seniority. At Company B, 24% of the women with less than one year of experience quit in 1981. At Company C, the quit rate for female employees with less than one year of experience was 17% in 1980 and 24% in 1981. In contrast, the quit rate for new hires at Western Electric averages about 10%, with no significant difference between men and women.

Aside from the direct financial inducement to accumulate long tenure in Japan, there are indirect financial penalties for quitting. An experienced Japanese male worker who changes jobs is quite unusual. Consequently, in Japan companies may be reluctant to hire an exceptional experienced worker who has changed jobs, suspecting that the worker has an unusually high propensity to quit. The bad label attached to job changers in Japan further discourages mobility between companies. In the United States there is less stigma attached to job changes. Hence an experienced worker who quits a job in the United States suffers only a small fall in his expected lifetime earnings.[2] *Exhibit IV* shows that the likelihood of turnover in Japanese companies decreases as workers acquire more seniority.

Although Japan's educational system and its culture may inculcate stronger corporate loyalties among male employees than among female employees, these data suggest that workers' rational responses to financial incentives largely explain the pattern of labor turnover in Japan.

Myth 3: Harder-working employees. The most surprising moment of my visits to Japanese companies occurred when I first went on a factory floor at Company C. I had expected to find a breakneck work pace. I didn't. The work pace seemed slower than at Western Electric plants I had visited. I observed the same phenomenon at every Japanese plant I visited. When I asked a production manager at Company E to compare the work pace at his plant with that in Western Electric, he agreed that the employees at Western Electric plants he had visited worked faster.

Although I could not obtain quantitative measures of the work pace at the Japanese companies, other evidence confirms my impressions. Robert Hayes and Ronald Dore, among other observers, have also remarked on the slower pace at which the Japanese run their machines and production lines.[3]

Realities of Japanese productivity

If Japanese workers are not absent less than U.S. workers, do not have a significantly lower propensity to quit, and don't work harder, why are they more productive? My answer to this question is not very romantic. Superior productivity in Japan does not hinge on the "oriental" style of management or on Japanese corporate culture, but rather on the mundane decisions managers make.

Reality 1: More engineers per worker. When comparing production worker output in Japanese and American companies, it is essential to take account of the engineering support factory workers receive. Even for high-volume, low-technology products such as radios, the ratio of production workers to engineers in Japan is about four to one (see *Exhibit V*). In divisions making more sophisticated products, such as very large-scale integrated circuits (VLSIs) or parabolic receivers for satellite communications, the Japanese manufacturers I observed employ more engineers than production workers. Furthermore, the engineering effort is concentrated at plant locations. A typical manufacturing site has one or two buildings devoted to production and one or two devoted to engineering. It is common to see engineers on the production floor talking with the workers.

Among U.S. companies, Hewlett-Packard also employs a large proportion of its engineering staff at manufacturing locations and invests heavily in engi-

2. Unpublished research by Jacob Mincer of Columbia University, who used data from the Panel Survey of Income Dynamics.

3. Ronald Dore, *British Factory, Japanese Factory* (London: Allen & Unwin, 1973), and Robert H. Hayes, "Why Japanese Factories Work," HBR July–August 1981, p. 56.

Exhibit V Ratio of production workers to engineers

Western Electric		Greater than 8 to 1
Company A	Parent	1 to 1
	Local subsidiary	8 to 1
Company C	Computer equipment division	1 to 1
	Industrial equipment division	3 to 1
Company D	Radio division	4 to 1
	Computer equipment division	1 to 1
Company E	Plant 1	4 to 1
	Plant 2	Less than 1 to 1

neering. At both HP and the Japanese electronics manufacturers, the high levels and rapid increases in labor productivity arise largely from this investment in engineering. The high return on engineering effort may also explain the commonplace observation that cost reductions are strongly correlated with cumulative output. Because managers assign more engineers to high-volume than to low-volume products, it is not surprising that unit costs decline faster for high-volume products. This fall in unit cost is caused not by producing a large volume of output but by the engineering effort that accompanies large-scale production runs.

Innovations suggested by engineers do not necessarily require substantial investment in capital equipment. A high-volume producer may have a high rate of productivity increase with minimal investment. At Western Electric, for example, workers formerly used tongs to insert and remove glass tubes from furnaces. When an engineer suggested replacing the tongs with insulated gloves, productivity improved 500%.

In a study done for Western Electric, Bruce Greenwald, assistant professor of finance at the Harvard Business School, found exceptionally high rates of return on engineering effort in the company. Examining two product lines, he determined that each engineer increased the rate of growth of output per production worker by roughly 5%. Given the size of the labor force allocated to these product lines and the expected life of the products, each engineer was several times more productive than each production worker and generated savings far in excess of his or her cost to the company.

Companies may underinvest in engineering because the payoff from hiring an additional engineer is not as easily calculated as the payoff from hiring an extra production worker or buying a piece of machinery. Production engineers make their contributions at random times—for weeks or months they may just be thinking about problems. It is easy to imagine situations in which an employer loses money on an engineer for 50 weeks out of the year but this engineer's contribution during the other 2 weeks more than justifies his or her salary. Viewing hiring engineers as an investment, the inherently erratic return on that form of investment is difficult to evaluate.

Reality 2: Selective hiring. Successful Japanese electronics manufacturers hire very selectively and recruit the elite of the Japanese labor force. Each of the Japanese manufacturers I studied has long-standing relationships with high school teachers and counselors. Because of these contacts, companies only receive applications from highly regarded students. These prescreened, recommended applicants must also pass written exams and physical dexterity tests. Finally, they are interviewed to determine their willingness to learn and ability to get along well with co-workers. These practices screen out unsuitable applicants. Company C, for example, hires fewer than half the applicants for production jobs.

This careful selection contributes to the high level of technological innovations suggested by employees. Only an exceptionally intelligent and well-motivated labor force is likely to produce such an impressive record of innovation. At Companies B and D, employee suggestions in 1981 saved $1,987 and $2,160 per employee, respectively. Company C estimates a saving of 3.5% of total hours worked in the same year. Most of these suggestions were minor, yielding an average saving of about $40 per year. The suggestions rarely required large investments and could usually be implemented with discretionary funds at the disposal of first-level supervisors.

When I discuss the payoff from rigorous hiring practices with personnel officers in American companies, a customary response is: "That is fine for the Japanese, but U.S. regulations make it impossible for us to be as selective." Not all American employers, however, use this as an excuse. Hewlett-Packard, which also has an impressive record of worker-initiated innovation, maintains stringent standards for hiring production workers. HP avoids discrimination suits by following carefully formulated guidelines for the percentage of minority employees it will recruit. The company hires the best available workers within the limits imposed by these guidelines.

Reality 3: Benefits from steep wage profiles. Exhibit III illustrated that Japanese companies pay low wages to new employees and high wages to experienced workers. We have seen how this policy reduces the quit rate of experienced male workers. In addition, if the company offering those steep wage pro-

Exhibit VI Male employees at Company C

Percentage by age	**Age**	15-19	20-24	25-29	30-34	35-39	40-44	45-49	50+
		1%	6%	19%	22%	20%	14%	8%	10%
Distribution in terms of tenure	**Years of employment**	0-4	5-9	10-14	15-19	20-24	25-29	30-34	35+
		7%	18%	21%	29%	10%	5%	7%	3%

files is growing, the proportion of low-paid, newly hired workers is large, generating higher profits during the expansionary period. Until recently, employment in large Japanese electronics manufacturers has been expanding rapidly. The companies have been able to generate high profits, partially financing their growth, through savings on the low wages paid to younger workers. In effect, growth in these companies has been self-perpetuating.

This growth in employment has begun to slacken. The scarcity of new employees is shown in *Exhibit VI.* Sixty-one percent of the male workers at Company C are between 25 and 40 years of age. There are six times as many male workers with 15 to 19 years of tenure as with less than 5 years of tenure. If the current wage-tenure correlation is maintained, as Company C's work force ages, its wage bill will rise sharply. If the company does not continue to pay its older workers high wages as compensation for the low wages paid them when they were younger, the employer risks provoking serious labor problems of the sort many Japanese companies experienced in the early 1950s before the economic miracle. Managers in every Japanese company I visited mentioned the bulge in the age and tenure distribution as a potentially serious problem.

Reality 4: Substantial pay differences. Big differences in the pay that workers with the same experience and education receive over their lifetime motivate workers. This assertion may seem at odds with my finding that seniority is the major determinant of pay in Japan. On a little reflection, this seeming contradiction disappears.

Whether a wage system rewards merit depends on the effect of performance on lifetime pay—not on whether performance or seniority is a better predictor of lifetime pay. Imagine a U.S. company paying an average hourly wage of $10 irrespective of seniority, and paying its best workers $10.10 and its worst $9.90. In this company, performance completely determines pay but there is little incentive for employees to work hard. In contrast, consider the pay schedule at Company A. The principal determinant of wages at Company A, as we have seen, is seniority. Significant rewards, however, also go to good performers. A 50-year-old worker in the ninetieth percentile by pay would expect to earn twice as much as a 50-year-old worker with the same education and experience in the tenth percentile (see *Exhibit VII*). Different rates of promotion among workers account for these pay differences.

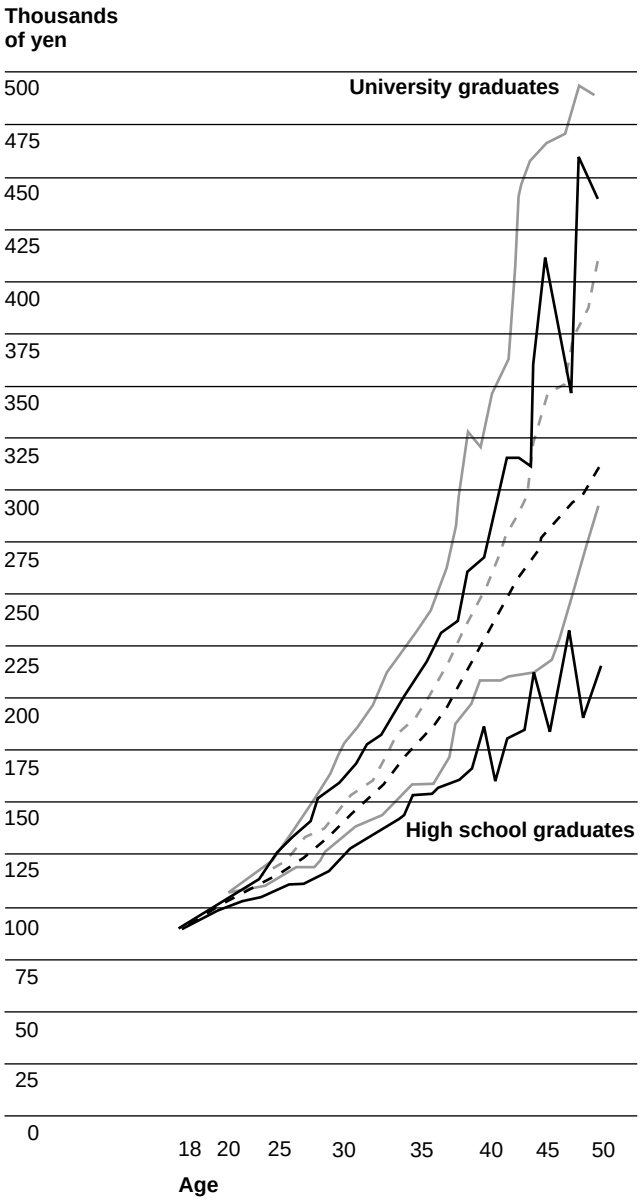
These pay and promotion differences encourage workers to contribute suggestions to improve productivity. Although the direct monetary reward for suggestions is small, suggestions markedly affect merit rating and hence lifetime earnings. Not only do workers think hard about innovations, but because participation in training programs is rewarded with higher earnings and more rapid promotion, workers are motivated to participate in those programs. At Company E's communications equipment works, the average employee voluntarily participated in 1.1 training courses in 1981.

The steep wage-tenure profiles seen in *Exhibit III* provide another reason for the high participation rate in training programs. By reducing quit rates, steep wage-tenure profiles make training a more profitable activity for both workers and employers. There is also a feedback effect: a company with a well-trained work force has an added incentive to reduce turnover and, consequently, is more likely to offer steep wage-tenure profiles.

Reality 5: Unique capital structure. The principal stockholders of Japanese companies are normally other companies. Individuals hold less than 10% of the stock in 97% of the companies listed on the first section of the Tokyo Stock Exchange, which includes the 1,005 largest publicly traded companies in Japan.[4] Suppliers and customers are apt to be more interested in having the company in which they own stock produce a high level of output at a low price than in maximizing its operating profits by producing a lower output at a higher price. Those suppliers and customers, in other words, generally prefer to max-

4. Koji Matsumoto, "The Secret of Japanese Management, Resulting in High Productivity," *Journal of Japanese Trade and Industry,* No. 1, 1982, p. 30.

Exhibit VII **Distribution of basic salary of male employees in Company A in 1981**



imize the operating profits of their own businesses rather than the operating profits of the company in which they own stock.

Similarly, a bank owning stock in one of its customers may prefer to see the customer expand by buying more equipment and increasing its bank debt, rather than by hiring more workers, even if the latter course would be more profitable for the company. The bank, in this case, is primarily interested in its own operating profits.

It seems plausible that in many markets these patterns of interlocking directorships improve the allocation of resources. In some respects companies with interlocking directorships can mimic the resource allocation decisions of vertically integrated companies. In markets not perfectly competitive, vertically integrated companies, by using the true cost of resources rather than market prices to make production decisions, are often more efficient than their competitors.

One manifestation of these ownership patterns is that Japanese production workers are supported by extensive investments in equipment. Walking through U.S. and Japanese factories that make the same products, I was struck by the high level of investment in equipment per employee in Japanese factories. This equipment is not more technologically advanced than machinery in American factories—there is simply more of it.

Another reason why the Japanese invest more in equipment per worker is that in Japan machinery is a more flexible factor of production than is labor. The expected useful life of a piece of new equipment might be 8 years, while the expected tenure of a newly hired worker might be 35 years. Therefore, buying machinery may be safer than hiring workers.

Incidentally, the high investment in equipment contrasts sharply with low investment in plant. Although the factories I visited were clean, they were old, multistory facilities. The high cost of land and construction in Japan largely explains this low investment in plant.

Lessons for American managers

We should not be distracted by tales of unique and wondrous management practices, nor awed by stories about the samurai culture of Japanese companies. Despite the obvious appeal of anecdotes and generalizations, the reality underneath them is often much duller. Dull explanations, however, often have the advantage of being correct. American managers need not throw up their hands in surrender or beg for protectionism in the face of "Japan, Inc." Straightforward choices that Japanese managers have made concerning personnel and investment policies explain the high productivity of Japanese electronics manufacturers. These choices could be made by managers in the United States.

The practices of the Japanese companies I studied that U.S. manufacturers could adopt to improve productivity are:

Invest more resources in attracting an elite labor force.

Career patterns—Japan and the West

A description of the working career of employees of large Japanese firms will give the reader a notion of what might be called a "career type." Rarely is a worker confined to only one job during his working life with a company. Rather, he would have a series of closely related jobs, and this series would determine the breadth of his skill and how much his wages would increase. Career types can be distinguished by their extent and structure—whether they are external or internal, whether or not they have a high ceiling, and whether a ceiling occurs early or late in the career. The features that are found among Japanese workers in large firms are work careers within the firms (internal) that have late and high ceilings—here called the "internal promotion type" of career pattern. This is the essence of what we identify as "white-collarization.". . .

This description of career types and wage determination also explains why Japanese blue-collar workers in large firms have as stable employment as white-collar workers in the West. Staying with the firm never implies staying on the same job. Instead, flexibility and frequent internal mobility over a wide range of jobs is the rule, thus giving workers an opportunity not only to acquire a range of skills, but also to understand the total production process. Even though engineers, who are white-collar workers, are assigned the task of developing more efficient ways of carrying out production, the white-collarized blue-collar workers are also capable, indeed eager, to improve the handling of their jobs. This capability provides the very foundation of small-group activities on the shop floor, and it is this small-group activity that has attracted attention as the source of Japanese productivity. A frequent explanation of these activities is in terms of these workers' loyalty to their companies. However, without their technological background—that is, their having developed skills over a wide range of jobs—Japanese industry never would have been as successful as it is in improving methods of performing jobs over such a long period.

From Kazuo Koike "Internal Labor Markets: Workers in Large Firms" in Taishiro Shirai, editor *Contemporary Industrial Relations Japan* (Madison: University of Wisconsin Press, 1983).

Screen applicants thoroughly to ensure that employees are the best available.

Establish contacts with feeder schools that can steer the best applicants toward the company.

Support employees through heavy investments in engineering, equipment, and on-the-job training.

Encourage frequent contact between engineers and production workers.

Motivate workers through pay and promotion policies that reward high performance.

Reduce quit rates of well-trained workers by instituting pay policies that deter employees from leaving.