Innovation: Japan Races Ahead as U.S. Falters

With people as her only resource, Japan is outsmarting the United States in high technology products: How does she do it?

As worries about the United States' lag in industrial productivity and innovation persist, the search for remedies inevitably leads to Japan. Japan has shown the world how to crumple competition in products ranging across the spectrum of industrial technology from steel to motorcycles to microprocessors. Long-term Japanese strategies for invading the U.S. auto market are paying off handsomely. And Japan's plans for the 1980's, built around anticipated advances in semiconductor technology, threaten to become "the most explosive economic issue between our two nations," according to a report issued in September by the House Ways and Means Committee.

The United States has an unfavorable balance of trade with Japan that amounts to $9 billion. Such data make it seem, says the House report, that "we are a developing nation supplying a more advanced nation—we are Japan's plantation, haulers of wood and growers of crops, in exchange for high-technology, value-added products."

Congressmen, business leaders, and others who visit Japan in increasing numbers return with a growing sense of urgency that the United States is lagging behind in a vital race. "We believe that Japan's rate of industrial progress and stated economic goals should be as shocking to Americans as was Sputnik," said the House report in summarizing these apprehensions.

The United States is not the only country to be concerned. The Japanese economic challenge is felt worldwide by all industrialized nations. "An over-aggressive policy of Japanese exports risks destroying the international commercial system," states a report released on 27 October by the European Economic Community. The EEC countries have seen their trade deficit with Japan rise from $7 billion in 1979 to an expected $9 billion this year, and are demanding that Japan limit its exports in fields such as automobiles, electronic devices, and machine tools.

How did all this come about? Is Japan going to turn the United States into a second-class industrial power? Do Americans have something to learn from the Japanese and if so, What?

The visitor quickly perceives certain differences between Japan's situation and that of the United States. Japan is a country of 115 million people, crammed onto a rocky island only four times the size of Indiana and almost without natural resources. Some 90 percent of energy requirements are imported, as are most other raw materials. Japanese social and industrial policy reflects these bedrock facts. The country must export to survive, and to have products to export it must make best use of its science and technology. People in industry are determined to create the circumstances that bring about creativity; Japanese seem always to be studying, sending out teams, and exploring markets. In a crowded island society, there is not much room for friction or adversary positions as a means of resolving differences. The relationships between labor and management, between industry and government, are dominated by a long-term view of events, one that has enabled Japan to bootstrap itself up from the rubble of World War II to becoming the third greatest industrial power in the world.

Japan now sees herself at the threshold of a new era of advanced technology, the whole structure of which will be determined by developments in the semiconductor field. A milestone has been the development of the 64,000-bit random access memory chip, a product of the government-sponsored Very Large Scale Integration (VLSI) Project, which combined the resources of two government agencies and five large electronics companies.

Having spent the last 30 years heatedly catching up with the West, Japan has just about run out of foreign technologies to adopt. Her intention now is to prove capable of developing indigenous new technologies, a feat that will be necessary if she is to attain her stated goal of energy security in the 1980's.

How has the country progressed from light manufacture to high technology in little more than a generation? First, Japan has a national industrial policy, whose broad outlines are formulated by the famed MITI, the Ministry for International Trade and Industry, established in 1949. Because of the easy availability of capital, provided in the form of loans from the Japan Development Bank, industries that the government wishes to encourage are able to invest heavily in production equipment and to follow policies that result in long-term gains rather than short-term profits. Since the companies are mainly financed by banks, they are not under pressure to show quarterly gains to stockholders. Accelerated depreciation of new equipment allows firms to write off costs within a couple of years.

Japan treats its industrial sector much like a giant garden where newly sprouting plants are given special support and protection, mature ones allowed to prove themselves, and those that have gone to seed carefully cut back. When a new industry is trying to establish roots, as the auto industry was in the 1960's, it is afforded all manner of tax and financial incentives, protection from foreign imports in the form of tariff barriers, and exemption from import duties on raw materials. When an industry comes of age—has proved and refined its product through domestic competition and laid the foundations of an export market—subsidies and protection are withdrawn and it is left to fend for itself—as the auto industry, with 23 percent of the U.S. auto market, is doing so well now.

The Japanese steel industry has gone through all three stages of development. Japan built up the world's most efficient steel industry by consolidating companies, making heavy capital investments in modernization of facilities, and launching an aggressive export program in the 1950's and 1960's. The industry was self-sustaining by the 1970's and was so solid that it carried on strongly through the recession that shriveled the industry in other countries. Now the Japanese steel industry is in its declining phase, and MITI is discouraging domestic investment while promoting investment in steel mills abroad.

The government has also seen to it that the Japanese do not sacrifice autonomy in exchange for foreign technology. Purchase of technology is done largely through licensing agreements in which measures are taken to ensure that foreign interests will not gain control over infant industries. When Texas Instruments wanted to set up a branch in Japan in the

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mid-1960's, for example, they were allowed to do so only on condition that the concern would be 50 percent owned by Sony for the first 3 years, and they had to allow Japanese electronics firms access to a Texas Instrument patent essential for the development of their integrated circuit technology.

Government policies affecting industry—tax, trade, tariff, regulatory, and so on—are generally better coordinated in Japan than they are in the United States. The overall approach is regarded by some observers as more pragmatic and less ruled by abstract principles. For instance, U.S. antitrust laws would prohibit much of the kind of business collaboration that in Japan is regarded as necessary to ensure the health of a whole sector. As one writer put it, "anti-trust and other policies are a means to an economic end, and not part of a higher morality."

On the management level, the Japanese brand of success rests on two pillars: long-range planning and quality control. Since Japanese firms are not required to show profits every quarter and are permitted to operate with a high debt/equity ratio, they are free to engage in unusually long-range strategies and can afford to take heavy losses in anticipation of ultimate gains. Their marketing tactics are aimed at acquisition of market share rather than immediate profits. Thus, throughout the 1960's, the Japanese were setting up distribution networks for their cars in the United States, often giving away dealerships at a cost of millions of dollars. The gamble was that Americans would eventually turn to smaller, high-quality cars. This was a gamble Detroit automakers could not or would not take because of their preoccupation with immediate consumer demand.

Emphasis on quality was the result of a decision made a generation ago, which did not really bear fruit until the 1970's. In the early 1950's, when their industry was being rebuilt from scratch, the Japanese were deeply impressed by the lectures of two Americans, statistician W. Edwards Deming and management consultant J. M. Duran.

The Deming approach to quality control emphasizes locating and correcting flaws in materials and processes so that defects are prevented to begin with—a method that has proved far more efficient than end product inspection and correction of defects. The Japanese have incorporated this approach in their own system of quality control circles. A QC circle is a group of about ten workers and foremen, who meet several times a month to identify and find solutions to production problems in their area. The workers, who have a good grounding in mathematics from high school, are taught statistical techniques to help identify and analyze problems. QC circles, which embrace the majority of workers in most major manufacturing concerns, are a uniquely Japanese institution, combining their twin fondnesses, in the words of one observer, for "statistical navel-gazing and human relations." They also derive philosophical justification from the Japanese belief in the perfectibility of human nature. The movement, as it is called, has proved effective in both improving production and increasing the workers' sense of identity with company goals.

The success of QC circles in Japan depends on a labor-management environment significantly different from that ordinarily found in U.S. firms, where such a movement is easily sabotaged by suspicious labor and jealous middle management. In Japan, unions are formed within companies rather than across trades, which enables both sides to perceive that they have common goals. The Japanese system of lifetime employment confers absolute job security. Japan is a family-centered society; the company is an extension of the family, and the nation is an extension of the company, so loyalties are congruent rather than conflicting. At every level the emphasis is on cooperative as opposed to adversary relationships, which creates quite a different climate for problem-solving than is found in the United States, where adversary roles are often seen as a requirement for reaching equitable solutions.

The paternalistic labor-management relationship also means that in Japan, unlike the United States, there is no worker resistance to automation or other measures designed to streamline or modernize production. Since employment is guaranteed, workers have no reason to resist automation—indeed, they perceive measures that increase efficiency to be in their best interest. Thus Japanese concerns have been free to explore the potential of robotics, and at present the country employs half the world's supply of working robots.

Japan's extraordinary record has prompted a good many Americans to explore ways in which her successes might be duplicated on this side of the world. Whereas before there was a tendency to underestimate Japan, the inclination now is to romanticize her accomplishments, as in *Japan as Number 1*, a rosy and widely read chronicle written last year by Harvard professor Ezra F. Vogel.

Cultural and institutional differences between the two countries, however, raise doubts about the degree to which Japan can be emulated. For one thing, the whole country has manifested a unified dedication to economic growth. Philip Trezise of Brookings Institution suggests that the national energies that once went into defense have now been rechanneled, so that economic advancement for Japan, which has a negligible defense establishment, has become, so to speak, the moral equivalent of war. The cultural homogeneity of Japan, which is still quite xenophobic, contributes immeasurably to this singleness of purpose. Institutionally, the economy is dominated by large, vertically integrated companies even though most of the work force is in small companies. Academia has made little contribution to the knowledge base of industrialization, and the bulk of research and development is applied research, carried on by private industry rather than financed by the government. Thus there is considerably more emphasis than in the United States on problem-focused research.

But the most significant differences probably have to do with attitudes and style. Foreign visitors are invariably struck by the cohesiveness and spirit of cooperation that appears to pervade every aspect of the way the Japanese conduct their business. Business relationships and relationships between government and industry are characterized by a high level of trust. Unlike in the United States, the bureaucracy in Japan is regarded as competent and well-intentioned. The Japanese simply do not believe in adversary relationships as a means for resolving differences—as evidenced by the fact that Japan has fewer than 12,000 lawyers, compared with 500,000 in the United States. Disputes

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which in the United States would end up in court are resolved in Japan through their custom of consensual decision-making. Major decisions in both government and industry are culminated only after extensive consultations with all interested parties—a procedure referred to as *nemawashi*, or "root-binding," a reference to the fact that in moving a plant all the roots have to be carefully pulled together first. Nemawashi means that the Japanese take an unconscionably long time to make decisions about anything, but once a decision is made there are few difficulties in carrying it out.

Given the radical differences in culture and style, some observers believe it is fruitless to try to apply elements of the Japanese way to American industry. But others contend that since that country got most of her ideas from the West, there is no reason why the West can't profit by them too. The Japanese themselves are already demonstrating that Japanese-style management can bring results even in the United States. A prime example is the San Diego branch of Sony, which, with American employees, has been able to achieve a 200-day record of producing defect-free television sets—even better than the quality record of the Japan-based operation.

Interest among Americans in the Japanese management style includes consensus decision-making, and quality control circles in particular. The movement started taking hold in the aerospace industry—a natural for QC circles because of the high level of technical knowledge and concern for quality among its employees and also because of its strong tradition of labor-management cooperation, according to Robert E. Cole of the University of Michigan. There are now about 100 American firms experimenting with QC circles, including General Motors and Honeywell Corporation.

Lockheed Missile and Space Company of Sunnyvale, California, was the first American firm to introduce QC circles, in 1974. As a result, according to Cole, defects declined by two-thirds, worker morale and job satisfaction improved, and the company estimated the program had saved it $3 million by 1977. Cole warns, however, that QC circles are not easy to introduce in American industry. Labor unions are often antagonistic, regarding the program as an attempt to exploit workers, while middle managers may sabotage the program because they see in it a threat to their authority. Also, the absence of a long-term commitment by the firm to the workers means less worker dedication to circles. Cole thinks that monetary prizes for good suggestions might stimulate the necessary team spirit.

Embassy of Japan Photo

A Matsushita TV assembly line

Japan has willingly relinquished its dominance in the transistor radio market in favor of higher technology products such as color television and videotape recorders.

On the level of government strategies, there is increasing talk of the need for a national industrial policy. When congressmen visit Japan, as they have been doing in increasing numbers, they all come back talking about more tax breaks for industry. House Ways and Means Committee members have introduced two such bills. One, introduced by Jim Jones (D-Okla.), would permit accelerated depreciation on new equipment such as masks for semiconductor production. The other, sponsored by Charles Vanik (D-Ohio) (hitherto known as a critic of big business), would afford tax breaks to companies that contract with universities to develop specific industrial processes.

Japan has proved herself remarkably capable of absorbing foreign technologies, but now that she has reached full technological maturity, the question that is currently fashionable is: Are the Japanese capable of genuine innovation?

The Japanese are regarded as superb engineers and craftsmen, and ingenious adapters, but are thought to be rather lacking when it comes to original concepts. Whether or not this generalization is true—similar charges have been made about their culture for the past thousand years—the Japanese themselves are highly sensitive to it.

The Japanese system in many respects appears designed to inhibit true creativity. The country's research and development budget takes a little over 2 percent of the national income, not out of line with the expenditures of other industrialized nations. But in the United States half of all R & D money comes from the government, while in Japan 70 percent of the expenditures are in private industry. This means a heavy emphasis on applied or market-centered research. "The basic mechanism of Japanese allocation of R & D has been the market, and the guiding incentive, private profitability," according to Merton J. Peck of Yale University.*

Another apparent drawback is Japan's system of higher education which is not one of her strong points (although the Japanese system of primary and secondary schools is first-rate). There is little organized collaboration between universities, and academia has little integral connection with industrial R & D efforts. Few people enter graduate programs; rather, postgraduate training is given by the company when a person enters the work force. Thus, while the country is overflowing with engineers—Japan has as many as does the United States in a population half the size—it has only about one-tenth as many research scientists.

Finally, if creativity requires individual freedom for its expression, it does not receive much encouragement in Japan, where teamwork is the rule and

*In *Asia's New Giant*, Hugh Patrick and Henry Rosovsky, Eds. (Brookings Institution, Washington, D.C., 1976).

pressures for conformity irresistable. "The nail that sticks out gets hammered down," is a Japanese aphorism.

It is not yet clear, though, that any of these factors constitute serious impediments to innovation. After all, little in the way of innovation in the United States can be traced to basic academic research, and research directors in U.S. companies do not necessarily place high value on doctorate-bearing employees.

While the Japanese are not known for the kind of original work that produces Nobel prize winners, there are many ways in which they have proven themselves to be innovative—in their resourceful marketing strategies, institutional adaptations, improvements on imported technologies, and rapid deployment of new technologies. Although many of the grand concepts underlying development—such as economies of scale—have also been borrowed from the West, they have been molded to fit the culture in such a way as to appear to be uniquely Japanese.

Whether the formula that has proved so successful so far will now catapult Japan into an era of more radical innovation is open to speculation. But there is little reason to suppose that the country is going to rest on her laurels. The export trade is lifeblood to Japan which has so little in the way of indigenous natural resources. For the country to thrive she must make optimal use of science and technology.

Japan's success is no mere surface phenomenon; it springs from the nature of her society and the hazardous conditions of her existence. Clearly there is no simple recipe that can be followed wholesale in the West. Because of the very different structure of American society and the conflicting demands made on government, the United States cannot hope to emulate their comprehensive approach to economic development or the close working relationship that exists between Japanese government and industry. But just as the Japanese once learned so much from the United States, it may now be this country's turn to consider which elements of the Japanese experience could be adapted to set its own economy on a happier course.

—CONSTANCE HOLDEN

What to Do When the Well Runs Dry

In western Kansas, depletion of the Ogallala aquifer is forcing a change in growing corn by irrigation

In western Kansas, the summer of 1980 will be remembered for the intense heat that struck by the time the corn was pollinating and caused sharply reduced yields. For some farmers in the driest part of this dry region the summer also brought home warnings that the water is running out.

In much of the western third of Kansas a prosperous feed grain economy depends on irrigation water from the great underground reservoir of the Ogallala aquifer. Now, signs of depletion are on the increase.

In the town of Leoti in west central Kansas, for example, wells that had been pumping water at the rate of 500 gallons a minute were this summer down to 300. The municipal water system for the town of over 2000 lost pressure and hours of water use had to be severely restricted.

Leoti Mayor Skip Harkness says, "The aquifer in this whole part of the state is deteriorating. We'll have enough water for a while, but we can't meet peak demand." Leoti recently increased its water storage capacity and faces the expensive prospect of going farther afield to buy water rights, sink new wells, and pipe water in. But the decline of the water table is inexorable and that reality faces the whole region.

For a century or more, farmers assumed that western Kansas was too dry and too hot to grow anything but wheat and feed grains that require much less water than corn. For the last two decades, however, western Kansas has been a highly productive outpost of the corn belt. The feat of growing corn in this semiarid region was made possible by heavy irrigation with water drawn from the Ogallala which underlies parts of the high plains states from Texas to Wyoming.

The national significance of this irrigation agriculture is suggested by the fact that 40 percent of grain-fed beef sent to market in the United States are fattened in an area of six high plains states dependent on the Ogallala.*

The situation varies from place to place according to the thickness of the aquifer and the local history of water use. But engineering studies indicate that underground water in the region may be depleted in 3 to 20 years.

In extreme cases in Texas, exhaustion of the aquifer has resulted in the land going back to sagebrush. What lies ahead for most of western Kansas is not a reversion to buffalo grass and scrub but a transition from irrigated corn agriculture to the raising of less water-intensive crops and, perhaps ultimately, to dryland farming of wheat and grain sorghums.

The transition could be abrupt and traumatic if farmers keep pumping, so to speak, to the last drop. If they husband water supplies for irrigation and make the most of options for different crops and new farming techniques, the change will be more manageable.

Crucial in the period of adjustment will be the alliance between farmers and the state's agricultural research establishment, based on the agricultural experiment station at Kansas State University (KSU), and the extension service's county agents. Also essential will be a degree of planning and cooperation among farmers that will in some ways run counter to traditions of self-reliance and individualism on the old frontier.

Even at best, however, the impact will be heavy on the expanded economic infrastructure created by the corn economy. The availability of corn and other feed grains in the region encouraged establishment of large feedlots where great numbers of cattle are fattened. In recent years meat-packing companies have invested heavily in slaughtering and packing facilities close to the feedlots. This is not to mention the wide range of businesses and services needed to support intensive raising of corn by irrigation.

For individual farmers, raising irrigated corn has been more profitable than any alternative crop. The shift away from irrigated corn growing will cut total production and inevitably reduce farm

*Texas, New Mexico, Oklahoma, Colorado, Kansas, and Nebraska.

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