

A History of Japanese Industry (Final Part): Microelectronics Period (1980s and 90s)

By Tsukamoto Takeshi

The Japanese economy was mired in a slump from 1974 to 1978, but came out of the doldrums in 1979–1980 to enter a new business cycle which lasted from 1979 to 1995. A boost in the production and export of automobiles, electronic machinery and numerically-controlled (NC) machine tools led the recovery.

In the 1980s, the electric machinery and electronic machinery industries grew rapidly (see Figure). The machinery industries (electric machinery, electronic machinery, transport machinery, general machinery and precision machinery) gained importance, while the textile and mining industries lost weight, signaling changes in the country's industrial structure. Consequently, exports of machinery products (automobiles, electric machinery, electronic machinery and machine tools) expanded during the decade and accounted for more than 70% of Japan's total exports. Automobiles, which replaced steel as the largest export item in 1977, were overtaken by electric machinery and electronic machinery as such in 1995.

The development of microelectronics technology not only spurred the development of the electronic machinery industry, but also transformed machine tools, transport machinery, industrial machinery, agricultural machinery, business machines, electric home appliances, cameras, and watches and clocks into electronics-controlled products, with a micro-computer built into them as a component. New or replacement demand for these products boosted their output. The development of the electronic machinery industry expanded production in the machinery industries as a whole. An integrated circuit (IC) wafer is printed, by photo etching, with circuits equivalent to tens of thousands of components and circuits. The use of ICs in machinery 1) reduced the number of components and circuits and lowered costs, 2) made machines smaller and lighter, and 3) eliminated malfunctions resulting from faulty circuits. This vast-

ly enhanced the reliability of automobiles and machinery, and contributed greatly to the image of Japanese cars being virtually trouble-free. The IC replaced crude steel and plastics as the most indispensable industrial material.

The emergence of equipment with built-in ICs changed factory operations also. Assembly robots, welding robots, transport robots and NC machine tools left factories largely deserted of workers. With the introduction of unmanned production lines combining machining centers (MC) with transport robots, mass production of a small variety of items was replaced by small-scale production of a large variety of items. Higher integration of ICs and downsizing of machinery enabled multifunctional factory operations and constantly provided markets with upgraded new products. New electronic appliances changed office work style and home lifestyle. Personal computers, facsimile machines, copiers and word processors, first introduced into offices, have found their way into homes to become daily necessities along with electronic ovens, rice cookers, video players and CD players.

Electronic Industry

Production of ICs and IC calculators started in Japan in 1966, followed by the development of large-scale integration circuit (LSI) calculators, which prompted Japanese calculator makers to import LSIs from U.S. semiconductor makers, who soon shifted their LSI production bases to Southeast Asian countries, where wages were low, and started exporting low-priced LSIs to Japan from there, leaving Japanese LSI makers hard-pressed. However, when doubts were raised about the quality of Southeast Asian-made LSIs, following the discovery of large numbers of faulty products, Japanese calculator makers gradually shifted away from imported LSIs to domestically-produced LSIs. As a result, Japanese semiconductor makers soon regained the domestic LSI market

and expanded LSI production. They enhanced the quality and reliability of LSIs and at the same time pushed for automation of semiconductor production, which enabled them to turn out high-quality, yet low-priced LSIs.

Japan's exports of ICs started in 1973, followed by the development and production of steppers by Nikon Corp. in 1978. Canon Inc. and Hitachi, Ltd. followed suit and the three companies seized 95% of the world stepper market. Other major developments in this field from the late 1970s through the 1980s included 1) the start of mass production of 64 kilobit ICs by Toshiba Corp. and NEC Corp. in 1981, 2) Fujitsu Ltd.'s marketing of My Oasys, the first Japanese-language word processor, in 1982, which prompted other Japanese electronic companies to embark on word processor production and paved the way for the spread of word processors throughout the country, and 3) the development of the 1 megabit IC in 1985.

Japanese IC exports grew fast, and Japan's share of the world semiconductor market, which stood at 24% against 68% for the U.S. in 1980, rose to 45%, against 42% for the U.S., thus replacing the U.S. as the leading semiconductor exporting country in the world. Japan kept the top spot for seven consecutive years until 1992, with NEC, Toshiba, Hitachi, Fujitsu and Mitsubishi Electric Co. holding the upper rung of the world semiconductor maker rankings, but in 1993, the U.S. recaptured the No. 1 position.

As ICs were upgraded to 4 megabits and 16 megabits, the downsizing of computers further gained momentum, spurring the production of personal computers and workstations which took the place of large general-purpose and office computers. Buoyed by the global spread of personal computers and a rapid expansion in PC demand, Japan's IC production surged, but the Japanese share of the world IC market shrank

after South Korean-made PCs began to hit the global market.

Machine Tool Industry

Japanese-made machine tools were upgraded during the 1960s and 1970s, and exports expanded steadily, with the ratio of exports to total production soaring to 40% in 1980 from 3% in 1962, 13% in 1965 and 27% in 1975. The ratio of imports to total domestic demand plunged to 9% in 1980 from 33% in 1962.

The production, export and import of NC machine tools started in 1970, and exports of machine tools outpaced imports in 1972. Introduction of numerical control for machine tools dramatically expanded Japan's production of machine tools, and Japan, which ranked fourth in world machine tool rankings, next to the U.S., Germany and the Soviet Union in the 1970s, became the world's largest machine tool maker in 1982.

Under the Temporary Law for the Promotion of Electronic and Machinery Industries, enacted between April 1971 and March 1978, machine tools were designated as an industrial item eligible for government assistance, along with ICs, computers and automobile components. A program for enhancement of the metal machine tool industry, formulated in its wake, set targets 1) for

upgrading NC machine tools and lowering production costs and 2) raising to about 50% the ratio of production of NC machine tools to total production of machine tools in value terms in each company. Under the Temporary Law for the Promotion of Specific Machinery and Information Industries enacted in 1978, a machine tool enhancement program was formulated, and the production target of NC machine tools in value terms was set at ¥183 billion. In fact, however, production of NC machine tools in value terms totaled ¥200 billion and had already topped the production target in 1979. NC machine tools, which accounted for only 7.8% of total machine tool production in 1975, rose to 51% in 1981 and further to 67% in 1985. Exports of machine tools expanded rapidly in the 1980s, and NC machine tools accounted for 65% of the total. Major machine tool makers, such as Yamazaki Mazak Corp., Mori Seiki Co., Okuma Corp., and Hitachi Seiki Co., boosted production of NC lathes and MCs, and Japan's machine tool production in value terms reached \$9 billion, accounting for 26.5% of the world's total market of \$33.9 billion. NC lathes and MCs made up half of



Man-made artisan: Skilled "hands" of machining center turn out many kinds of products in small quantities

Photo: Hitachi Seiki Co. Ltd.

Japan's machine tool production.

Robots doing welding, painting and inspection work, unmanned forklifts, and robots used in automated warehouses accounted for about 70% of robots used throughout the world in the years 1984-1990. In the 1980s, electronically controlled robots were painting automobiles and assembling electronic components. Behind such developments in the industrial machinery industry lay advances in the electronic industry, with the automobile, electric and electronic machinery industries owing their progress to developments in the machine tool industry.

Automobile Industry

In the decade 1960-70, automobile component makers were grouped under Toyota, Nissan and other makers of finished cars. The car makers notified affiliated components makers of their decision to cut purchase prices for components according to a fixed schedule, and urged them to reduce the prices of their products and lower costs as part of streamlining efforts. This approach bolstered Japanese automakers' international competitive position.

Japan's automobile exports totaled \$11.5 billion in value terms in 1977 and automobiles became the leading Japanese export item, replacing steel, exports of which totaled \$10.5 billion.

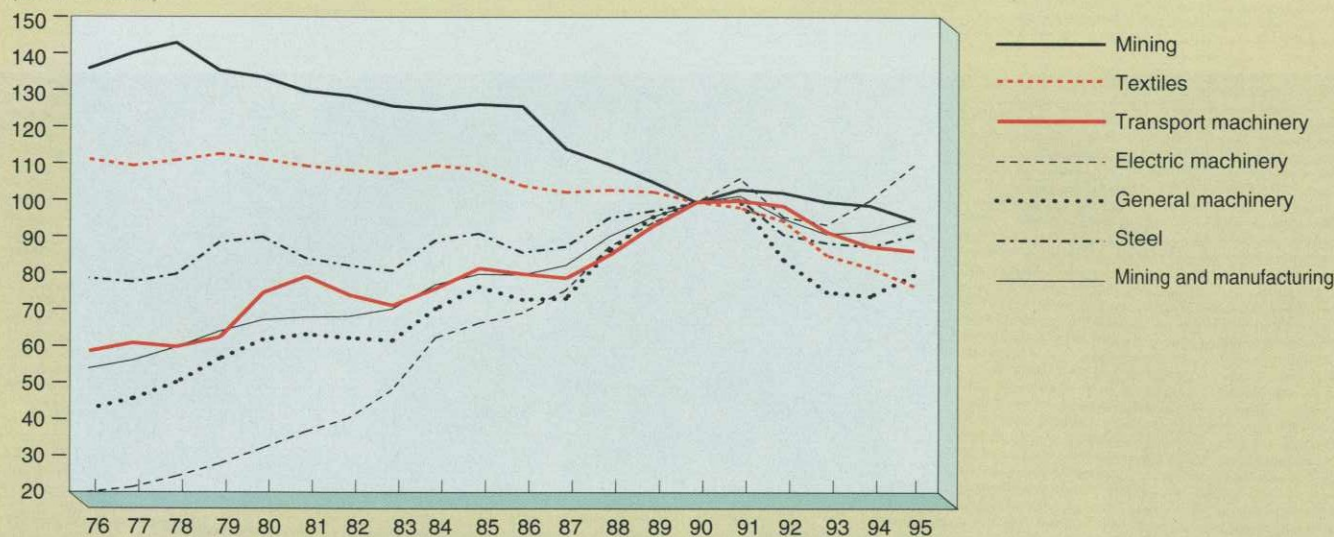
The oil price hike in 1979 boosted U.S. demand for Japanese cars, which were highly fuel-efficient and rarely gave trouble. In 1980, Japanese car



Photo: Hitachi Seiki Co. Ltd.

Indispensable laborers: Made-in-Japan NC lathes penetrate into the world market

Figure: Changes in index of mining and manufacturing production (1990 = 100.0)



Source: Ministry of International Trade and Industry Statistics

exports including passenger cars, buses and trucks, topped 11 million units for the first time, making Japan the world's leading car producer. Japan's car exports continued to expand at an annual rate of about 6 million units, and captured 23.1% of the U.S. market in 1988. Car demand in the U.S., Europe and Japan accounted for 80% of total car demand in the world, and car production and demand continued to increase in the 1980s and 1990s. As new high-performance models were constantly launched, this generated steady replacement demand. A shift in consumer tastes from traditional large cars to small cars and to recreational vehicles also created replacement demand. With car ownership further expanding, a typical Japanese household began to own two or more cars in the 1990s, which was another factor in increased demand. Responding to changes in consumer taste, all nine Japanese car makers were involved in stiff competition to develop new models. Electronic devices were installed in many car components, not only the engine. Toyota, Nissan and Mazda took equity stakes in affiliated small companies doing pressing, welding and sheet-

ing jobs, to strengthen partnerships and provided them with necessary expertise on the introduction of state-of-the-art equipment. Automobile component makers are now synonymous with electronics machinery companies.

Multinational Companies

Japan's exports, led by those to the U.S., grew fast in the 1980s, and the country's current account surplus and foreign currency holdings expanded dramatically. Since 1986, when the yen's value against the dollar rose to ¥160 from ¥260, an increasing number of Japanese companies have moved their production bases and factories abroad, a development signaling the transformation of major Japanese companies into multinational corporations.

Automakers including Toyota, Nissan, Honda, Mitsubishi, Mazda and Suzuki set up operations in the U.S., Europe, Southeast Asia and China.

Overseas production of transport machinery accounted for 17.3% in 1994, compared with 5.6% in 1986. In volume terms, overseas production of transport machinery increased to about 4.65 million units in 1995 from about 350,000 units in 1980, and topped

exports which totaled about 3.8 million units. Automobile exports have been on the decline after peaking at 4.57 million units in 1995.

Electric machinery and electronic machinery makers also shifted their production bases overseas, with overseas production bases of electric home appliance makers rising to 312 in 1994 from 200 in 1988. The ratio of overseas production of electric machinery rose to 12.6% in 1994 from 7.4% in 1986.

Rationalization of manufacturing industries and the shift of their production bases abroad led to a decrease in exports and an increase in reverse imports, which in turn reduced employment in manufacturing industries. The domestic unemployment rate has been in the 3.4% range since 1996, a relatively high level for Japan, and hit an all-time high of 3.5% in May 1997. High-tech industries' multinational operations have also been adversely affecting employment in Japan.

Tsukamoto Takeshi is professor emeritus of Tokyo University, and has authored several books such as Politics and Economy of the World Today (1991) and History of World Economy (1972).