

Small Businesses Turning to Mechatronics

by Yasuhiro Inagawa

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Born in 1944, he joined MITI in 1967 after graduating from the Department of Law of the University of Tokyo. He served in MITI's Consumer Goods Industries Bureau and Industrial Location and Environmental Protection Bureau as well as at the Japanese Embassy in Tanzania before assuming his current post in June 1981.

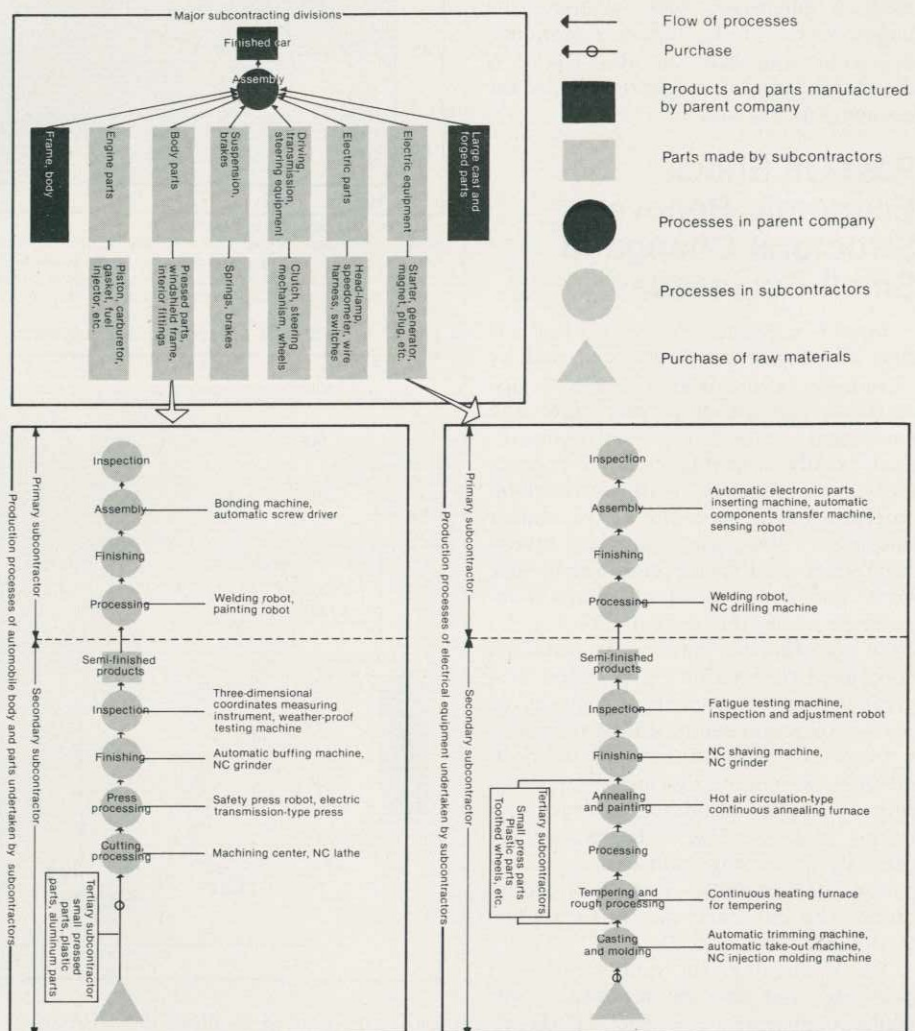
Majority of Japanese Economy

Small and medium enterprises account for as much as 99.4% or 6,230,000 of Japan's 6,269,000 private business establishments (not including those in primary industry). They employ 81.4% or 37,206,000 of Japan's total workforce of 45,720,000. Undoubtedly, small and medium enterprises play a major role in the Japanese economy.

A large part of the production activities of such big manufacturing companies as Toyota Motor and Sony is, in fact, undertaken by small and medium enterprises. Fig. 1 shows the division of labor in the production processes of the automobile between the big enterprises (parent companies), which assemble finished products, and the small and medium enterprises, which subcontract the manufacture of parts and components for their parent companies. Fig. 1 also shows the extent to which the small subcontracting firms have introduced such mechatronic machinery and tools as electronic-controlled industrial robots into their production processes. Japanese automobiles, VTRs and other manufactured goods owe their high quality and strong competitive power to the continuing efforts made by the smaller enterprises to modernize their production equipment and systems, and raise their productivity.

Under Japan's current production system, increasing importance is being

Fig. 1 Conceptual Flow Chart of Automobile Production Process



(Source) MITI and Small Business Promotion Corporation

placed on technical specialization in order to achieve high quality and precision of manufactured products. Thus, the small subcontracting firm which possesses special technology tends to become more important. Particularly in the knowledge-intensive field, many small businesses are not averse to taking risks in investing in research and development in an effort to develop new demand. Because the knowledge-intensive field deals with a minutely segmented market, even big businesses find it very difficult to branch out into this field.

On the other hand, the corporate

activities of smaller businesses, in many cases, face economic and social handicaps because of their weak management ability and financial position. The smaller businesses have many problems which are not visible on the surface.

For instance, small subcontracting firms are utilized by big firms as a buffer to absorb the impact of changes in the economic situation. Therefore, the position of the subcontractor is apt to become unstable. Because of changes in demand, the area of competition between the big and the smaller businesses is widening and causing increasingly

serious problems. For instance, the competition between superstores and small and medium retail stores has become a big issue. The establishment of new superstores by big capital enterprises has been restricted as a measure to give small and medium retail stores time to adjust themselves to competition. Many problems concerning the realignment of spheres of business activities between big enterprises and smaller businesses have appeared in other sectors, as well.

The basic thinking underlying Japan's economic management is that small and medium enterprises still constitute the largest sector of the Japanese economy, so encouraging their continued vitality is the major key to the development of the economy as a whole.

Post-Oil Shock Economic Recovery: Structural Change in Small Businesses

Japan's economic recovery after the first oil crisis of 1973 was achieved by raising the productivity of the economy. A major portion of private plant and equipment investment, which contributed greatly to raising national productivity, was made by small and medium enterprises. The main aim of the smaller businesses' plant and equipment investment after the first oil crisis was to save labor and conserve energy. Capital investment after the second oil crisis of 1979 was for the purpose of installing equipment for small-lot production of a great variety of products to replace the mass-production equipment of the past.

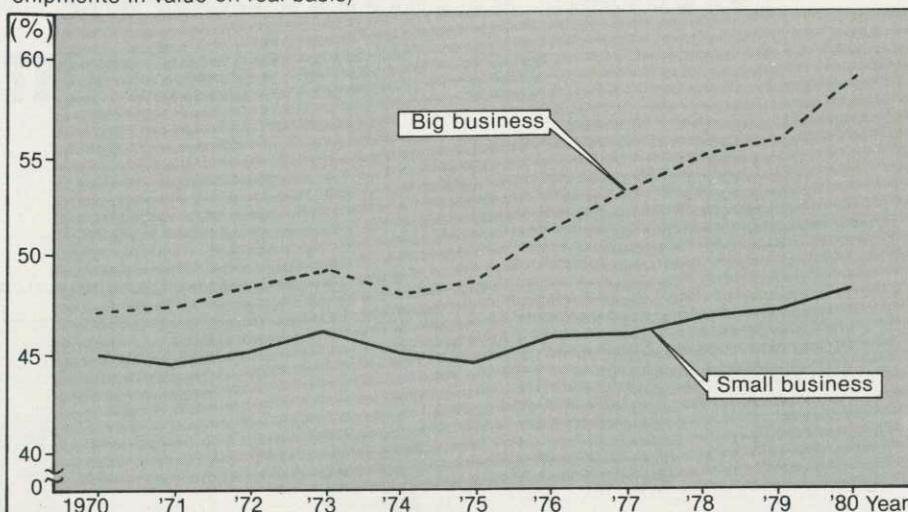
In the course of adjusting to the post-oil crisis situation, the industrial structure of smaller businesses changed, resulting in an increase in the component ratio of processing industries (sophistication of assembly and fabrication) among the small and medium manufacturing industries (Fig. 2).

The momentum for sophistication of assembly and fabrication, which was stalled temporarily after the first oil crisis, picked up speed after 1975. This trend was conspicuous particularly in big enterprises. The rising ratio of processing industries in Japan's overall industrial structure is popularly interpreted as resulting from the diversification of the economic society, which created sophistication and segmentation of demand. However, from the standpoint of manufacturing technology, this was brought about by innovative technology that has made small-lot manufacture of a great variety of products possible.

This structural change was achieved at considerable sacrifice. Quite a few small and medium enterprises either went

Fig. 2 Progress in Sophistication of Processing

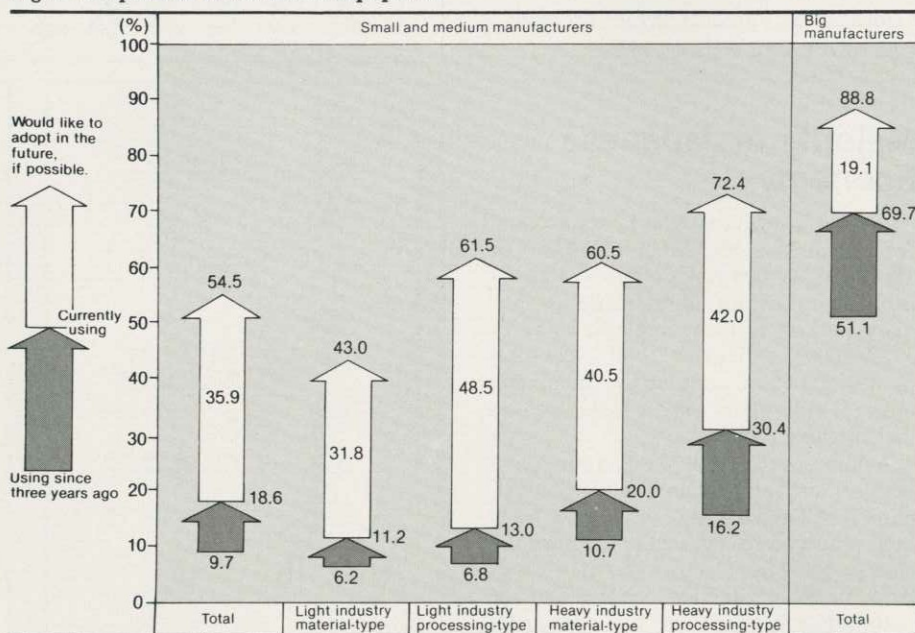
(Changes in composite ratio of processing-type industries, shipments in value on real basis)



(Source) MITI and Bank of Japan

(Note) Processing-type industries refer to clothing and other textile goods, furniture and furnishings, publication, printing and related industries, rubber goods and other manufacturing industries (categorized as light industry processing-type manufactures) and metal goods, general machinery, electric machinery, transport machinery, and precision machinery (categorized as heavy industry processing-type manufactures).

Fig. 3 Adoption of Mechatronic Equipment



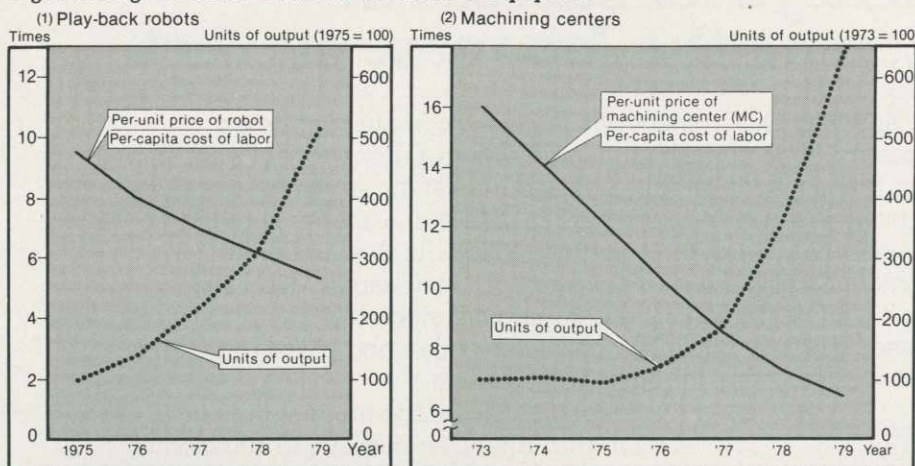
bankrupt or had to close down because they were unable to make a technological response to the changing business climate or to fend off intensifying competition. On the other hand, there was a vigorous move to start business in growth industries. About 80% of the increase in value of shipments made by small processing industries was realized by new enterprises which had ventured into this sector. The fact that small and medium enterprises vigorously branched out into the growth industries and carried out structural change is one of the reasons why the Japanese economy was able to maintain mobility and flexibility even after the two oil crises and achieve a relatively good performance.

Introduction of Innovative Technology for New Development

Many innovative technologies have been introduced to meet changes in demand after the oil crises, such as mechatronic machinery and tools. Industrial robots and other mechatronic equipment are being extensively employed by small and medium enterprises (Fig. 3).

The diffusion rate of mechatronic equipment among small and medium enterprises is 19% (as against 70% in the case of big enterprises). It is predicted that about 55% of smaller businesses will introduce mechatronic equip-

Fig. 4 Change in Relative Price of Mechatronic Equipment

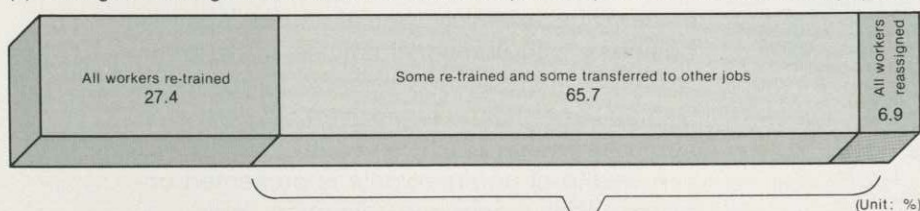


(Source) Ministry of Labor, MITI and Japan Industrial Robot Association

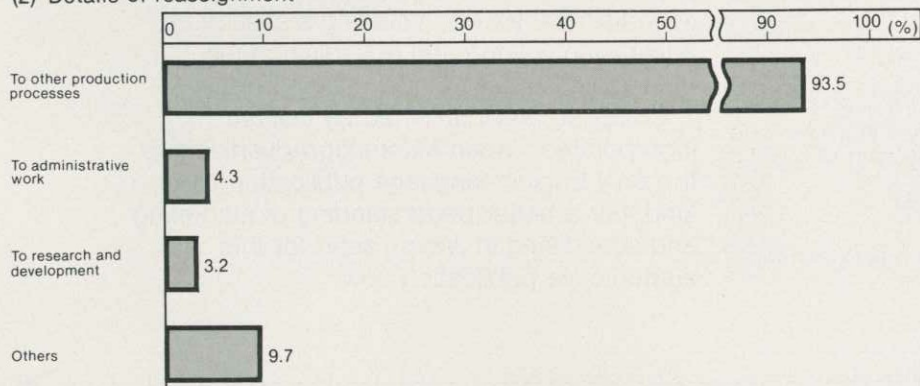
(Note) 1. Calculations for each year were made by the three-quarter moving average method.
2. The robot price was calculated on the assumption that the robot requires peripheral equipment and accessories equal in cost to the price of the robot proper.

Fig. 5 Progress in Information Control and Skilled Worker Job Reassignment

(1) Changes in assignments of skilled workers upon adoption of mechatronic equipment



(2) Details of reassignment



(Source) Small and Medium Enterprise Agency and Japan Small Business Corporation

ment within the next three years or so. The diffusion rate is close to 40% in the case of the heavy processing industries, including precision machinery. About 70% of small and medium enterprises are enthusiastic about installing mechatronic equipment in the future.

The rapid diffusion of mechatronic equipment is attributable not only to such social factors as the increasing demand for small-lot production of a variety of commodities and the chronic shortage of skilled workers, but also largely to the fact that prices of machinery and equipment have fallen in relative terms as a result of technological progress. As shown in Fig. 4, the annual cost of robots and machining centers during their serviceable life is approaching the annual cost of labor.

The adoption of mechatronic machinery and tools has produced outstanding results, such as a sharp rise in productivity and improvement of quality and precision of products. On the other hand, it has also led to some undesirable problems. For example, as a result of the competition to install mechatronic machinery and tools, some companies are putting in equipment which does not necessarily improve their earnings. In the division of labor between big enterprises and their small subcontracting firms, there has appeared a change in the lineup of subcontracting firms, because big enterprises tend to choose subcontractors endowed with more sophisticated technology.

Accordingly, there is a possibility smaller firms might be segmented into

many grades according to their technical levels.

It is also feared the introduction of industrial robots may result in an increase in unemployment. However, according to a survey on employment problems conducted in December 1981, the small and medium enterprises that had adopted mechatronic machinery were not dismissing workers. They assigned their skilled workers to the operation of the mechatronic machinery and tools introduced (Fig. 5). Because the operation of mechatronic machinery and tools can be handled mostly by junior and senior high school graduates, it seems that the enlistment of highly educated staff to operate mechatronic equipment is not necessary. These circumstances show that the shortage of skilled workers and ease of operation of the machinery and tools, made simpler by the progress of technology, are, so far, the major reasons behind the adoption of mechatronic machinery and tools by small and medium enterprises.

Among the issues which the introduction of mechatronic machinery and tools raises, the problem concerning subcontracting terms can be resolved between big enterprises and small businesses with wisdom and ingenuity. However, employment problems that might arise in the future and how to cope with them need careful study. If machinery and tools possessing great production capability should be introduced particularly at a time when the nation's economic growth rate has dwindled, not only would competition for survival among enterprises intensify but job opportunities for workers would diminish.

There are fundamental factors that must be taken into consideration when employment problems arising from the diffusion of mechatronic equipment are discussed. It may be possible to maintain the current employment level by sacrificing improvement of productivity that could be realized through the introduction of mechatronic equipment. This, however, would make it difficult for Japan to sustain overall economic competitiveness. Moreover, it would be difficult for Japan to achieve economic growth that would bring about an increase in national income. From the standpoint of national economy, we must avoid by all means curbing the current move towards mechatronization. Instead of restraining the tide of mechatronization, we should promote the development of new industrial sectors on the basis of an expanded productivity resulting from the introduction of mechatronic equipment and an expanded national income therefrom, and should try to increase employment opportunities in those new industrial sectors. ●