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The Current State and Future Prospects of the Machine Industry in Hokkaido

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Abstract

Following the two oil crises the economy of Hokkaido showed a tendency to decline. The reasons pointed out by many economists are that the economy depends largely on government budget or subsidia for construction roads, bridges and harbors, together with chemical, pulp and iron industries which require much more oil and electric power.

In order to propmote the economy in Hokkaido, machine industry, electronic industry and new technology must be developed, because these industries belong to intensive knowledge industries and low oil consumption industries.

The aim of this paper is to clarify the current state of machine industry in Hokkaido and the role of Hokkaido industry against all Japan and the type of industry suitable for Hokkaido in an attempt to form a view point of precision engineering, including the integration of technology, and industrial investment.

1. Foreword

The machine industry is now one of the industrial pillars of the Japanese economy. Its production output has reached a level of over 35% of the total maunufacturing output and is still growing. The machine industry productivity per unit of energy input is very high, 43 times higher than in the steel industry, 19 times higher than the chemical, 12 times higher in the paper and pulp, and 9 times higher in the average of the manufacturing industries at large. Thus, this industry has high a value-added and low energy consumption, and furthermore, it is a knowledge intensive industry with relatively high labor absorption as a secondary industry. In a resource impoverished industrial nation such as Japan, the machine industry has come to fill a prominent position in the ranks of economy.

In Hokkaido, the pace of importation of industrial products has accelerated since 1970 and has reached 2 trillion yen, resulting in a unfavorable trade balance. After experiencing two oil crises and a continual rise in its propensity to import, the economy of Hokkaido which was known as the "5 Percent Economy" is now only responsible for 4 percent of Japan's GNP. Given these difficult economic circumstances, Hokkaido has been striving to increase its economic self-sufficiency by promoting the establishment of manufacturing plants, particularly those of the knowledge intensive industries. What follows is a description of current state of Hokkaido and its prospects for the fufure.

2. Projection of the Hokkaido Machine Industry Production Output

Figure 1 is a categorically divided projection of annual production output of Japanese machine industry. Production output showed a marked upward swing from 1970, and up to 1979 it has continued to expand at an annual growth rate of over 10%, exceeding that of the manufacturing industries at large. The growth rate of transportation machinery and electric machinery is especially remarkable.

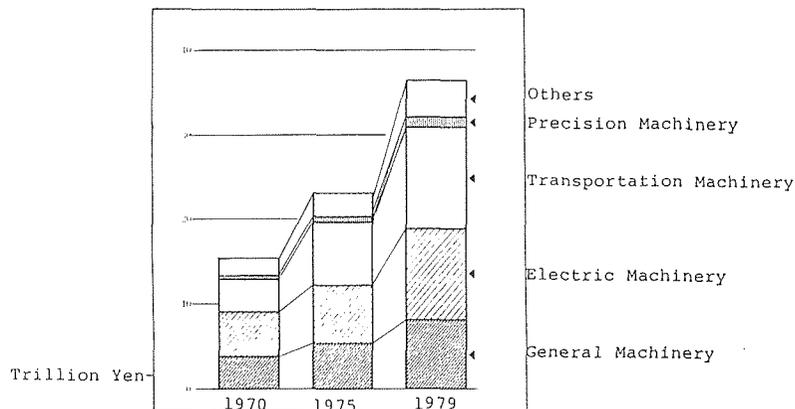


Fig. 1 Projected Production Output of Japan's Machine Industry

Figure 2 shows the categorically divided projection of annual production output of the machine industry in Hokkaido at the same period of time. (MITI Sapporo Bureau, "The Present State of Regional Technology"). As can be seen, the production output of the machine industry in Hokkaido is less than 1% of the overall production output of machine industries of Japan and its share is decreasing, year by year.

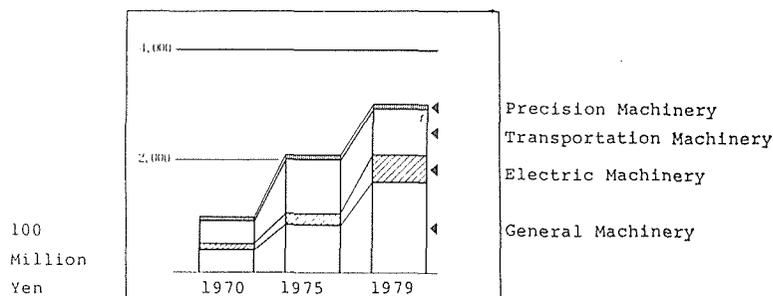


Fig. 2 Projected Production Output of Hokkaido's Machine Industry

The reason for this is that the ratio of high-growth sectors, such as transportation machinery and electric machinery is small. General machinery accounts for approximately 50% of the machine industry in Hokkaido.

3. The Current Production Structure of the Machine Industry in Hokkaido

Hokkaido has several industries that are dependent on the natural resources, of the region for example, the steel and paper & pulp industries. As a result, according to published surveys, the ratio of capital (machinery) equipment, in Hokkaido and that of technicians machine experts is above the national average.

However, although these industries introduce new technologies on their own and therefore require technological development ability, they do not require large numbers of subcontractors or concentrated regional technology and there cannot truly be called regional industries. A larger part of the regional machine industry in Hokkaido consists of small firms based on contract work and repair work. According to the survey report of the Bank of Hokkaido, "The Current State and Themes of Machine Industry of Hokkaido", the following can be said about the machine industry of Hokkaido.

- 1) It is strongly inclined towards specialized industries, such as shipbuilding and agricultural machinery, which are now performing sluggishly.
- 2) In each category, the share occupied by incidentals such as parts and accessories is quite large.
- 3) Repair work occupies anywhere from 30% to 50% of the machine industry, in Hokkaido which is much higher than the national Japanese average of 12%.
- 4) Normally, the production is in small lots of 10 to 100 pieces per lot, making it difficult to improve the cost efficiency and production control techniques.
- 5) Production cooperation within machine industries in Hokkaido and with other related industries leaves much to be desired.

Next, we will consider the characteristics of the machine industry in Hokkaido from the aspect of production scale and system. Normally, the machine manufacturing and assembly industry can be divided into the following categories.

- 1) Diversified small-quantity custom order production: Individual Production.
- 2) Large scale production: Mass Production.
- 3) Batch production: Large Lot Production.
- 4) Specialized subcontract production: Shipbuilding, Construction, ect.

The machine industry in Hokkaido falls mainly into categories 1 and 4, with categories 2 and 3 practically non-existent. The characteristic is one of the drawbacks of the machine industry, in Hokkaido for it has an adverse effect on production control. The goals of production control can be summed up as "the completion of the required amount of parts of required quality within the time limits set". In the case of the machine industry, in Hokkaido all three elements, quality, quantity and time, are difficult to be satisfied. As many consumer customers have pointed out, problems of quality and time are particularly acute.

The reason for this lies in the basic structure of the machine industry, in Hokkaido where diversified small-quantity custom order production occupies the largest share of this industry. In this form of production, the specifications and volume vary with each order. In addition, as the production details vary with each order and production orders are to be completed within a relatively short time, the problems presented in Table 1 arise. As a result, standardization and unification of technology, as well as effective production

Table 1 Diversified Small-quantity Custom Order Production

Technology Standardization & Unification		: Highly difficult.
Production & Sales Planning	Progressivity	: Nearly non-existent, mainly order contracts.
	Stability	: Frequent sudden changes in plans.
	Repetition	: Normally, repeat orders are non-existent.
Leeway for Errors in Planning and in Results		: Absorption by way of product stack is difficult. : Excessive stocks sometime unavoidable to meet deadlines. : Overtime and work on holidays is frequent. : Time allowances are usually made when setting deadlines.

planning is difficult to achieve. Fundamentally, these production control problems are inherent in custom order production systems, making maintenance problems regarding quality and time inevitable.

Specialized subcontract production (shipbuilding, large-scale forging and casting) is the other system which is representative of the machine industry in Hokkaido. Here, large-sized single unit production takes place. The cost is high and the manufacturing period long, and therefore much time and money can be spent on planning and design technology. However, most of the work is contract work, making full-scale automatization and rationalization of production facilities difficult. Much of the actual work is done outside of the company or by subcontractors, which indicates that production control in this area has some outdated characteristics. This is outlined in Table 2.

Table 2 Specialized Subcontract Production

Technology Standardization & Unification		: Introduction of characteristic techniques highly possible, however, impractical on the whole because specifications change with every new order.
Production & Sales Planning	Progressivity	: Exists, for post-estimation orders are the general rule.
	Stability	: Although deadlines are sometimes shortened, cancellations are infrequent.
	Repetition	: Orders with identical specifications are highly infrequent.
Leeway for Errors in Planning and in Results		: Time-lags are usually absorbed by overtime, work on holidays or increased labor force. : Finished and semi-finished product stocks as safety cushions are normally impractical.

Under these conditions, Isuzu Motors Limited is constructing factories in Tomakomai which are scheduled to begin operation in 1984. However, the inadequacies of the machine industry in Hokkaido are surfacing with regards to production technology and production control, making it difficult to call this a direct cooperation project. The production scale and system of the automotive industry, as well as its primary and secondary subcontractors

falls under the categories of large scale production (mass production) and batch production (large lot production)—refer back to items (2) and (3).

Automobile production, unlike custom order production (1) and specialized production (4), is repetitive with stress on meeting deadlines, lowering production cost, and maintaining stable product quality and quantity. As a result, highly advanced production control technology geared to meet these demands is required. Thus, although difficulties in the areas production orders and design are small, much improvement is required in production technology and production control technology.

Many different production scales and systems are operative in the machine industry, according to the precise industry involved. However, with the advance of mass production machine industries, inadequancies of the machine industry in Hokkaido are surfacing in regards to production technology and production technology, with outdated production techniques becoming in Hokkaido especially apparent. If we include product development and design technology, Hokkaido lags even further behind.

4. The Present State of the Machine Industry in Hokkaido in Terms of Production Facilities

Figure 3 describes the state of capital of machinery equipment within the machine

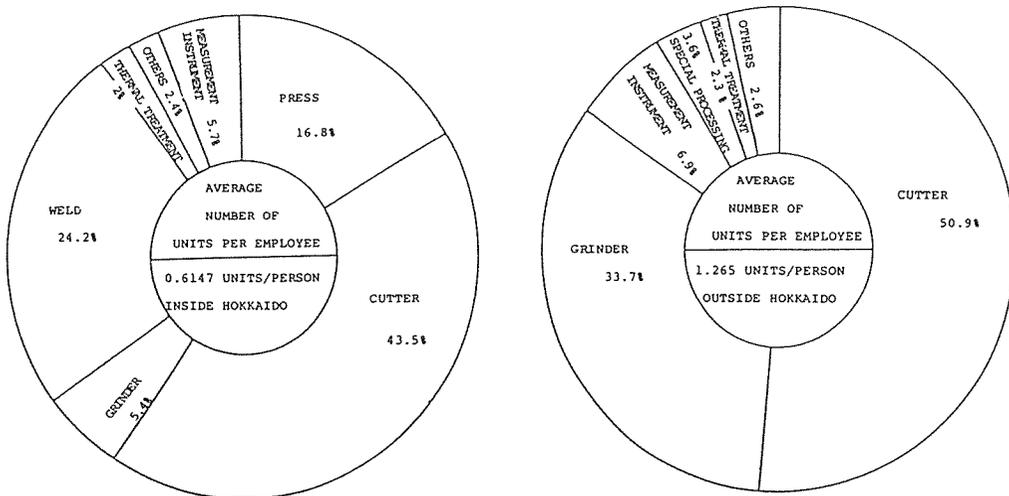


Fig. 3 Categorical Distribution and Ratio of Capital (Machinery) Equipment Utilized in the Diversified Small-Quantity Custom Order Production Industries Inside and Outside Hokkaido (Within Japan)

parts industry in Hokkaido (characteristically a diversified small-quantity custom order production) in comparison with that of the rest of Japan (“Survey of Machine Parts Industry in Hokkaido”, Sapporo Trade and Industry Bureau, 1982). There are 1.265 unit/employee of capital machinery outside of Hokkaido, while inside, there are only 0.615 units/employee, roughly 50%.

The breakdown of machinery in the machine parts industry is as follows. Cutting tool machinery 43.5%, welding machinery 24.2%, press machinery 16.8%, measuring instruments 5.7%, grinding tool machinery 5.4%. The mainland on the other hand, has a breakdown as follows. Cutting tool machinery 50.9%, grinding tool machinery 33.7%, measuring instruments 6.9%, special processing equipment 3.6%, thermal treatment facilities 2.3%, ect. Comparing the two geographical areas, we find that on the mainland, the distribution capital of machinery utilized is geared toward high precision and high value-added production and is centered around cutting. On the other hand, the capital of facilities in Hokkaido basically centered around cutting, welding, and pressing and are oriented toward repair and material production for construction related industries.

When we look at these facilities independently, with cutting equipment, a mere 0.2514 units/employee are available in Hokkaido, which is only 39% of the 0.644 units/employee recorded on the mainland. In terms of content, most of these facilities in Hokkaido belong to the low-function machinery bracket such as boring, planning and shaping. With grinding equipment, Hokkaido has 0.031 units/employee, 7.2% of the mainlands 0.427 units/employee. With measurement devices, Hokkaido has 0.033 units/employee or 39% of the mainland's 0.0878 units/employee. Furthermore, 66% of the measuring devices are hardness measuring devices and other higher level devices such as three dimensional measuring devices are less common.

In summary, machinery industry in Hokkaido is characterized by relatively low precision added with low value. The capital/labor ratio is low in Hokkaido and the production is limited to low-function machinery, making fundamental changes virtually impossible.

5. Manufacturing Industries in Hokkaido and the Northern Region Concept

Currently, a "Northern Regions Concept", aimed at economic and cultural interaction of regions having similar geographic, climatic, and cultural backgrounds is being discussed in Hokkaido. It is hoped that northern countries can assist each other for the betterment of each other's economic and cultural positions.

Table 3 is a comparison of the manufacturing industries in Hokkaido with that of

Table 3 Manufacturing Industries and Attitudes of Different Nations

COUNTRY	LAND AREA km ²	POPULATION (MILLION)	SCIENTIFIC TECHNICIANS	R & D PERSONNEL	TOTAL PRODUCTION VALUE X 10 ⁹ \$	VALUE ADDED X 10 ⁹ \$	R & D EXPENDITURE X 10 ⁹ \$	NUMBER OF PATENTS	WAGES \$/HOUR	WORKING TIME HOURS/WEEK	ELECTRICAL POWER GENERATED 100 KWH
DENMARK	43,069	494	—	5,137	21	9	0.03	15,086	7.41	33.0	25,438
FINLAND	337,032	4.71	165,794	7,162	32	11	0.34	7,614	4.08	38.5	38,577
NORWAY	324,219	3.87	80,800	6,080	26	8	0.45	13,740	7.03	38.6	83,989
SWEDEN	449,964	8.20	—	16,657	62	27	1.17	56,908	7.39	33.0	96,250
SWITZERLAND	41,288	6.26	254,000	16,230	—	—	1.69	91,440	6.28	44.4	48,231
CANADA	9,976,139	2,299	621,645	16,505	150	54	1.7	411,534	6.84	38.8	366,677
JAPAN	372,313	11,190	4,127,200	407,192	818	303	16.35	370,272	6.00	40.6	589,644
HOKKAIDO	85,516	557	34,715	1,740	19	5	—	1,730	(6.00)	(46.0)	25,496

other northern region nations such as Denmark, Finland, Norway, Sweden and Canada with Switzerland as a reference ("Annual World Statistic Survey", United Nations and Japanese Annual Statistical Survey). These nations, with the exception of Canada, are comparable in total population. In terms of land area, Denmark and Switzerland are smaller than Hokkaido.

In terms of total manufacture production and value-added production, Hokkaido, is lower than Denmark which is known as European "Dairy Country" Furthermore, comparing engineers and researchers working with manufacturing industries, Hokkaido has a mere 20% of that of Finland, 40% of Norway, and only 10% of Switzerland. R&D expenditure and number of patents filed are also in a similar situation are a mere 3-20% of that of the other northern regions.

The energy supply of Hokkaido is at the same level as Denmark, 30% of Sweden, and 52% of Switzerland. Also, Hokkaido has virtually no natural resources in comparison to the other northern region states.

Judging from the factors listed above, Hokkaido should pursue the road toward the knowledge intensive industry, where effort and knowledge are the major resources required.

6. Prospects of Machinery Industry in Hokkaido

The current conditions of the machinery industry in Hokkaido are unfavorable. The

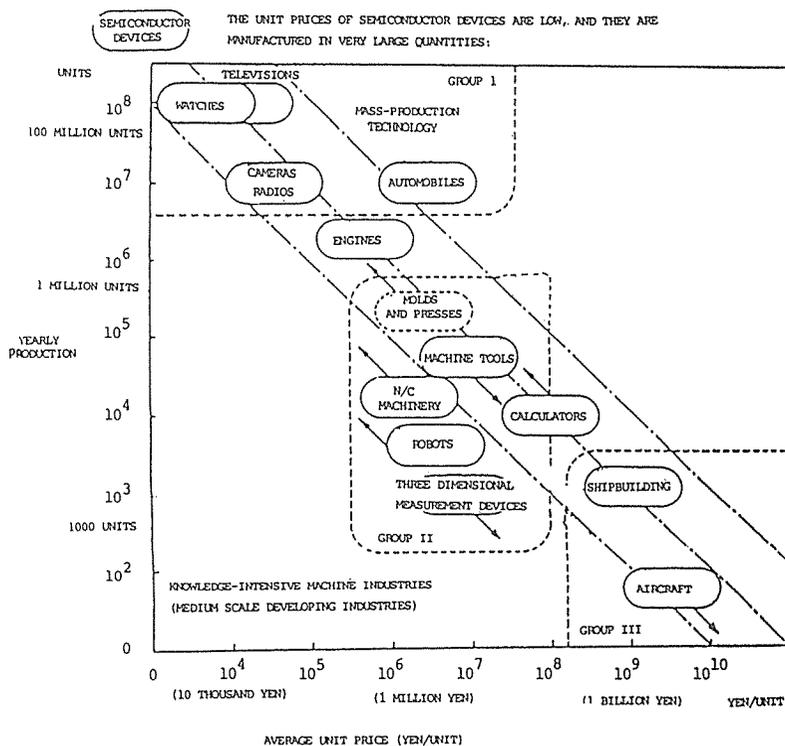


Fig. 4 Scale and Market Position of Industrial Products

following section will discuss the position of Hokkaido in an increasingly technology oriented Japan. A later section will provide a long term prospect of the machinery industry in Hokkaido.

A. Prospects of the Industrial Structure of the Next Generation.

Figure 4 illustrates the relationship between total unit production and the price of each unit (FY '81 Annual Machinery Statistics). The vertical axis represents annual deliveries, while the horizontal axis represents average unit price.

The industries represented in figure 4 can be classified into three groups. Group I includes the industries such as automobile, watch, camera, television, radio, etc., whose annual deliveries exceed 10^7 units. These are considered to be the major industries. Group II represents the knowledge intensive industries which are still in an early stage of development and are expected to become of major strategic significance. Group III includes aviation and shipbuilding industries which take on large projects which require vast amounts of scientific and technological backgrounds.

Group I includes the present mainline industries in Japan founded on superior product development and mass production technology. Comparing the size of each unit of output, this industry produces small-scale units with Group II producing medium-scale, and Group III, largescale.

The industries of Group I are expected to maintain their current competitive positions without yielding to their foreign competitors for many years to come. The output of these industries is tremendous in volume and must be marketed on a global scale. Thus, even if some plants were opened in Hokkaido, these plants would be involved in the manufacture of a small part of a large process, hardly contributing to the technology of Hokkaido.

Group III on the other hand, is composed of industries which require huge supplies of capital and manpower for design and R&D. Especially with the aviation industry, continued increases in R&D expenditures are expected and it is becoming impossible for a single company to bear the expenses. It is expected that research and production would cross national boundaries. Here again, the role of Hokkaido would remain marginal.

Group II with its medium-scale characteristic, has something different to offer. The products of this category are to be utilized in a wide variety of industries, ranging from electric to machinery and information processing. In other words, each of the component parts by themselves are high precision, high density, and high value-added with wide applications, typical of the knowledge intensive field.

Comparing Group I and Group II, the former industries have a "tree structure" while the latter have a "matrix structure". The automobile industry for example, consists of a central trunk with small limbs branching out. It is highly efficient and centralized, but also inflexible. The knowledge intensive industries, on the other hand, consist of numerous small firms in coexistence, making it very flexible. In these highly specialized satellite-type firms, product development can be handled by a small number of engineers.

The industries which would suit the demands of Hokkaido best would be the knowledge intensive industries. In order to install these industries, Hokkaido should do its best to nurture the matrix-type industrial structure, rather than each individual industry, for these industries come as a set. It is from this viewpoint that regional technology, machine industry promotion, technopolis, and cooperation of the manufacturers with the

government and academia should be discussed.

B. Long Term Prospects of the Machinery Industry in Hokkaido

Recently, due to the deteriorations of the metropolitan living environment, overcrowding, and limited access to nature, engineers and workers have been returning to the countryside. Another factor which has come to serve as a catalyst to this trend is that distance, both in terms of space and information, has been decreasing rapidly through use of on-line communication channels and increased airflight routes. Furthermore, the disparities between facilities of the cities and that of the rural cities have been decreasing. Moreover, when we consider that industries exist for the betterment of man and not for the sake of industry itself, we can see that, in the long run, this trend is likely to increase in magnitude. Following this "ruralization" trend and the fact that Japan is moving into the knowledge intensive fields whose structures are decentralized, it becomes obvious that in the future, many satellite cities will be formed around a nucleic academic research city.

As mentioned earlier, the knowledge intensive industries are spread across a wide range of industries from electric to information processing.

Thus, it would be insufficient to have engineers working in only one field. Interaction of engineers over a variety of fields would be desirable, meaning it would be necessary to develop materials, electronics, software, and other industries along with the machinery industry in a balanced manner. In addition, a sophisticated metropolis with the presence of the government, universities and laboratories to act as center for coordination and exchange of information would be necessary.

In brief the requirements of knowledge intensive industries is as follows.

- a) Integration of personel, capital, and technology.
- b) A metropolis with government, university, and laboratory present.
- c) An advanced academic research city.
- d) Comfortable living environment.

In Hokkaido, the last three (b, c, d,) requirements have already been fulfilled. Sapporo serves as a metropolis around which many satellite cities exist. It can be said that this is one of the few remaining areas in Japan in which such an arrangement still exists. Thus, the most feasible approach to increasing the economic independence of Hokkaido is to attract knowledge intensive industries to the satellite cities in the Sapporo area. The following fundamental procedures come to mind.

I. Select and promote manufacturing industries which require large accumulations of capital, personel, and basic technologies. The existence of such a base would make later transformations into the knowledge intensive industries easier.

II. Study the products of the knowledge intensive industries, analyze the technologies involved, and perform market studies through a collective effort on the part of industry, government, and universities to pick out and nurture those industries with a high growth potential.

III. Encourage active involvement of local innovators in the selected industries with priority placed on software industries whose most important resource is manpower.

IV. Establish organnizations to provide and collect comprehensive and up-to-date information and to provide managerial support, both of which are of vital importance to the knowledge intensive industries.

7. Epilogue

The above presentation on the status of the machinery industry in Hokkaido is based on personal convictions. From a political and economic viewpoint, Sapporo is a major city, however, from the industrial viewpoint, it is still very small. As a native and also as a researcher, I am regretful of this situation, and at the same time, I have limitless hopes for the advancement of Hokkaido in this area. Finally, I am under the sincere conviction that the promotion of knowledge intensive machinery industries are in line with the overall industrial policy of Japan.

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