Chapter 6 Machine Elements Sector

6-1 Molds and Dies

6-1-1 Supply and demand trends

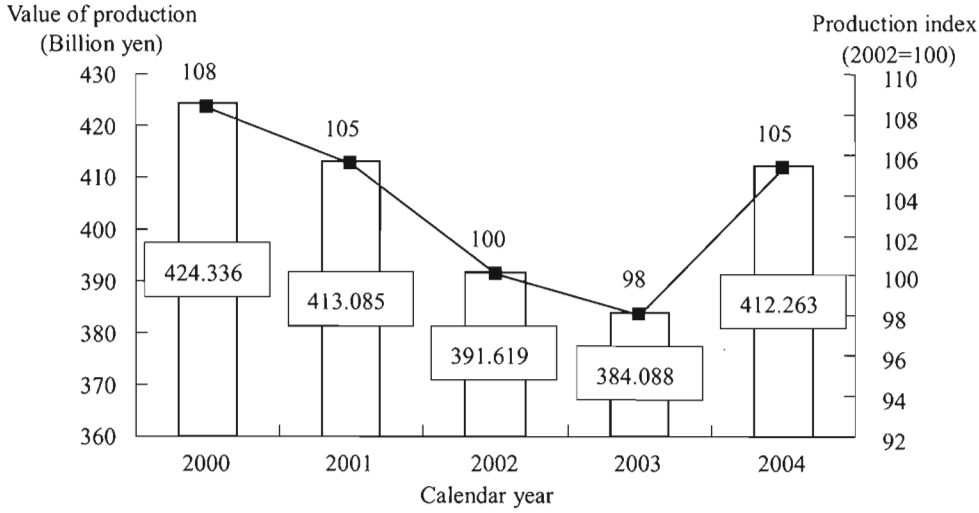
(1) Overview

The production of molds/dies in Japan in 2004 was ¥412.3 billion, a favorable increase of 7.1% from the previous year. There are increases in the production of stamping dies and plastics molds against this backdrop. In contrast, the production of casting molds and glass molds decreased in comparison with the previous year. As notable characteristics of the trend in the production of molds/dies in 2004, we can mention a "reduction in production volume," "growth in size," and "price increases."

Mold/die exports were at ¥371.9 billion, an increase of 15% from the previous year. Against this backdrop, we can mention the increase of mold/die exports to China and Thailand. The import amount of molds/dies was at ¥60.8 billion, an increase of 30% from the previous year. There is an expansion of exports to Japan from Korea and China against this backdrop.

(2) Production

The production of molds/dies manufacturers (with 20 or more employees) in 2004 was at ¥412.3 billion, ¥28.2 billion higher than the previous year. It can be stated that Japan's mold/die production has demonstrated a rapid recovery (Diagram 6-1-1) as its production in 2003 was the lowest recorded in five years. Diagram 6-1-3 shows that the production of all types of molds/dies became favorable compared with the previous year.



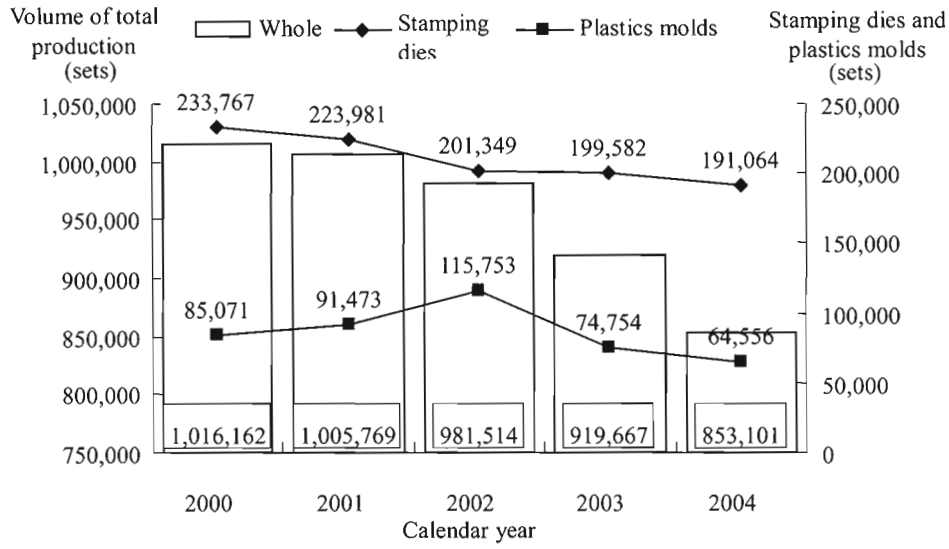
Source: Prepared from the "Yearbook of Machinery Statistics" by the Ministry of Economy, Trade, and Industry

Diagram 6-1-1 Production value of molds and dies manufacturers (with 20 or more employees)

However, only the production of casting molds (9% reduction from the previous year) and glass molds (7.2% reduction from the previous year) fell compared with the previous year. Also, the production of stamping dies fell sharply in 2003 but recovered drastically in 2004.

In 2004, the shares of stamping dies and plastics molds exceeded 80% of the whole (stamping dies—41.5%, plastics molds—38.7%). As such, we will examine the trend in the production volume of molds/dies centering on stamping dies and plastics molds.

Next, we shall examine the trend in the production volume of molds and dies. From Diagram 6-1-2, it is evident that the production volume of entire molds and dies (unit: set) has fallen drastically over the last five years. Additionally, stamping dies and plastics molds show a similar trend. In concrete terms, the production volume of entire molds and dies of 919,667 sets in 2003 was reduced to 853,101 sets in 2004. The production volume of plastics molds went down from 199,582 sets in 2003 to 191,064 sets in 2004. Neither has shown any increase in production since 2000. Additionally, the production volume of plastics molds was reduced from 74,754 sets in 2003 to 64,556 sets in 2004. The production volume of plastics molds increased once from 2001 to 2002, but shifted to a decrease later.



Source: Same as for Diagram 6-1-1

Diagram 6-1-2 Trend in production volume of molds and dies

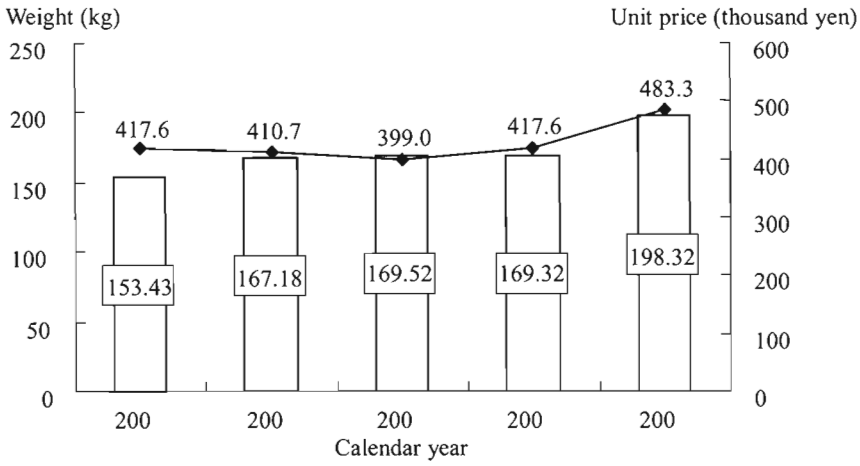
Diagram 6-1-3 Value of production of (genre-specific) molds and dies

(Calendar year, unit: million yen)

Classification	2000	2001	2002	2003	2004	Growth rate (y/y, 2004)	% of total (2004)
Stamping dies	165,962	174,418	163,864	153,414	171,052	11.5%	41.5%
Plastic molds	176,164	158,136	149,446	15,046	159,472	6.0%	38.7%
Die casting dies	26,419	27,431	2,753	2,807	29,718	5.9%	7.2%
Forging dies	16,185	13,879	14,204	1,518	15,777	3.9%	3.8%
Rubber molds	12,923	11,127	10,386	10,935	11,307	3.4%	2.7%
Casting molds	9,754	1,157	11,814	11,979	10,861	▲9.3%	2.6%
Powdered metal molds	8,865	7,562	6,35	6,842	7,383	7.9%	1.8%
Glass molds	8,063	8,964	7,996	7,207	6,691	▲7.2%	1.6%

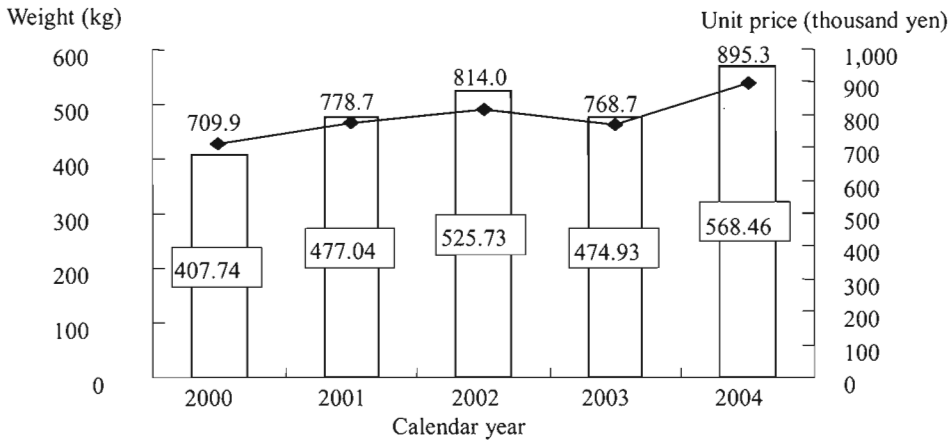
Source: Same as for Diagram 6-1-1

Next, we shall demonstrate the mold/die unit price (thousand yen) and average weight (kilogram) per unit. Diagrams 6-1-4, 6-1-5, and 6-1-6 demonstrate that increases in weight and prices are in progress for the molds and dies total, stamping dies, and plastics molds. For the overall molds and dies, the unit price increased from ¥417,600 in 2003 to ¥483,300 in 2004 (Diagram 6-1-4). Additionally, the average weight of a single mold/die increased from 169.32 kg in 2003 to 198.32 kg in 2004. The unit price of a stamping die increased from ¥768,700 in 2003 to ¥895,300 in 2004 (Diagram 6-1-5). Also, the weight of a stamping die increased from 474.93 kg in 2003 to 568.46 kg in 2004. Furthermore, the unit price of plastics molds increased from ¥2,012,700 in 2003 to ¥2,470,300 in 2004 (Diagram 6-1-6). The weight of a plastics mold increased from 455.47 kg in 2003 to 523.33 kg in 2004. Additionally, we see that unit prices and single weight of molds/dies overall, and prices for stamping dies and plastics molds in 2004 were both record high over the past five years. Generally, the production of large molds and dies calls for highly advanced technology. For example, among stamping dies, the progressive type is larger than the single type, calling for more sophisticated technology in the production—it is thus priced higher.



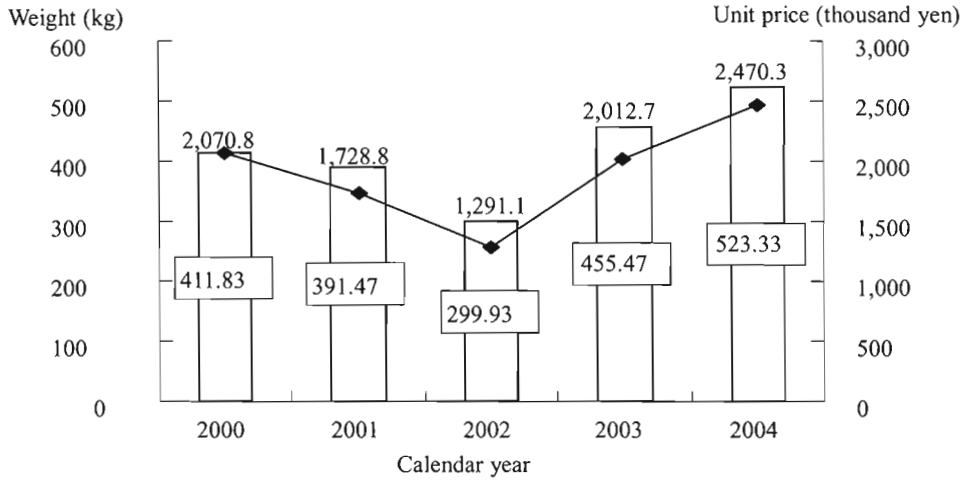
Source: Same as for Diagram 6-1-1

Diagram 6-1-4 Weight and unit price of a die for overall molds and dies



Source: Same as for Diagram 6-1-1

Diagram 6-1-5 Unit price and weight of a stamping die



Source: Same as for Diagram 6-1-1

Diagram 6-1-6 Unit price and weight of a plastic mold

Consequently, we can assume that decreases in the production volume and increases in unit prices and unit weights of molds and dies indicate that the Japanese mold/die industry is specializing in the production of molds/dies calling for more sophisticated technology.

From the above, we can mention a "substantial recovery in the production value" and a "reduction in the production volume" as a trend in the production of overall molds/dies as well as stamping dies and plastics molds in 2004. Additionally, it can be assumed that there is radical progress in the "growth in size" and "price increases" of molds/dies in Japan against the background of such production trends.

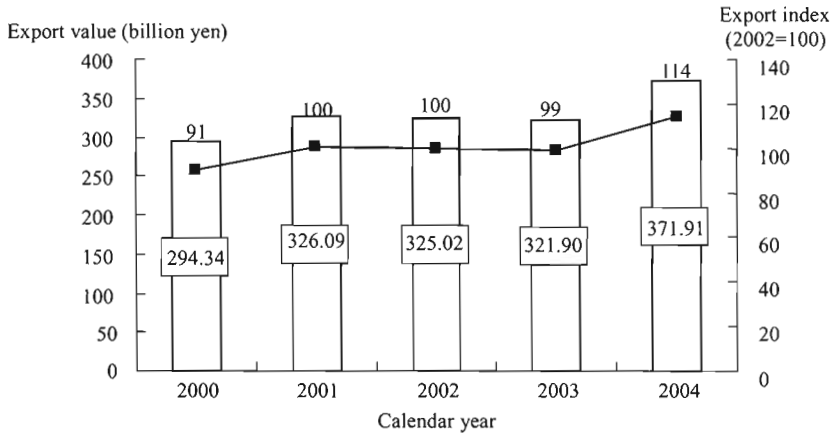
Mr. Yokota states the following in "Conference of Mold/Die Engineers" (Etsujiro Yokota, General Outline: On the Trends in China and Asia. 2005). The mold/die manufacturers in China lack design technology and production capabilities for large, precision, intricate, and long-life molds/dies. Furthermore, Chinese mold/die manufacturers tend to avoid attempts to produce such high-quality molds/dies. Such trends can also be seen in other newcomer countries in mold/die production such as Thailand. Consequently, Japanese manufacturers who develop production in Thailand and elsewhere in Southeast Asia place orders for the production of high-quality molds/dies at Japanese enterprises and low-quality molds/dies at local enterprises. Nation-specific specialization is being suggested relative to the production of molds/dies as demonstrated by Mr. Yokota [2005] against the background of size and price increases of molds/dies in Japan as discussed so far.

(3) Exports and imports

The total export of overall molds/dies in 2004 was ¥371.9 billion (Diagram 6-1-7). The export of overall molds/dies fluctuated at an almost constant level after 2001 and in 2004 it increased by 15% from the previous year. Stamping dies had stagnated since 2001, but showed a 21.8% growth in 2004 from the previous year (Diagram 6-1-8). Similarly, plastics molds had stagnated since 2000 but achieved a 16.5% increase in 2004 from the previous year (Diagram 6-1-9). Given such a background, we can mention a substantial increase of mold/die

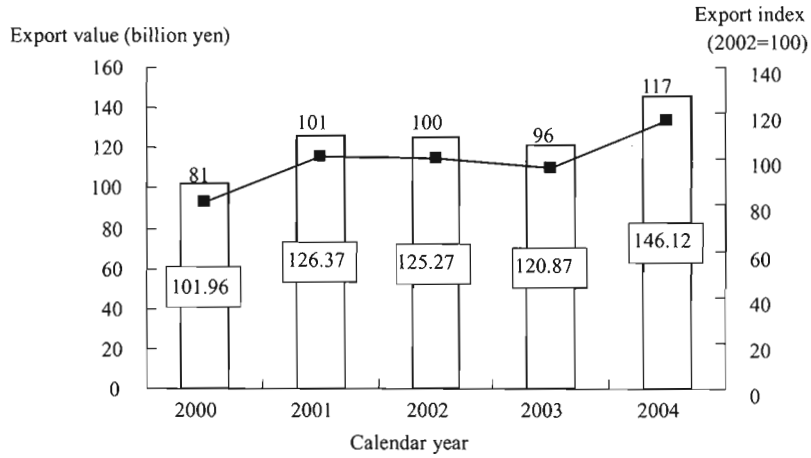
exports to China. Diagram 6-1-10 shows the shift of shares by the top three countries as partners of Japan's mold/die exports in 2004. According to Diagram 6-1-10, the share of mold/die exports to China among the total mold/die exports in 2000 was a mere 11.9% while the mold/die exports to China in 2004 expanded to 18.5% of the whole. Also, the total of exports to China and Thailand in 2004 exceeded the exports to the US.

In contrast, the import of molds/dies in 2004 was at ¥60.8 billion, an increase of 30% from the previous year (Diagram 6-1-11). The import of molds/dies has been on the increase continuously since 2000. In particular, imports of molds/dies from Korea have been expanding. Diagram 6-1-12 shows the shift of shares among the top three partner nations of molds/dies for Japan. In 2004, 56.0% of the total imports were imported from Korea. Additionally, mold/die imports from China also grew. In 2004, 16.3% of total mold/die imports were from China (6.4% in 2000). For Japan, China casts an ever-larger shadow.



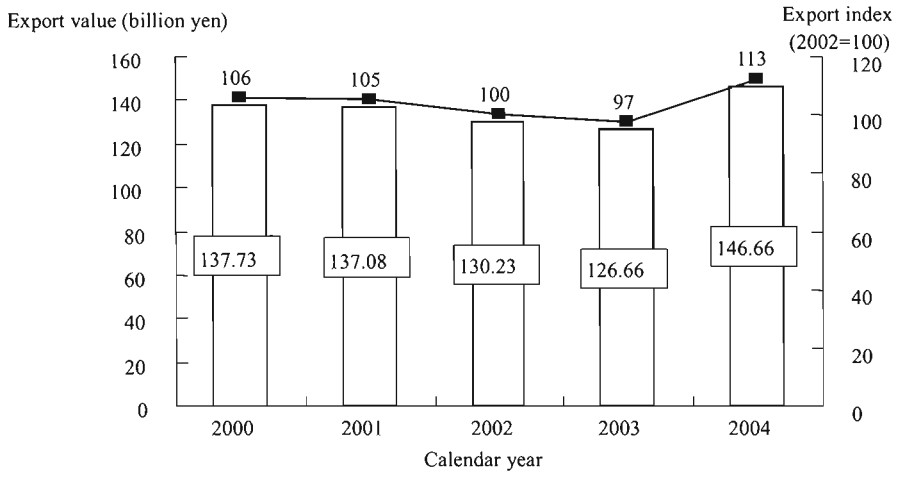
Source: Prepared from "Trade Statistics" by the Ministry of Finance

Diagram 6-1-7 Status of mold/die exports



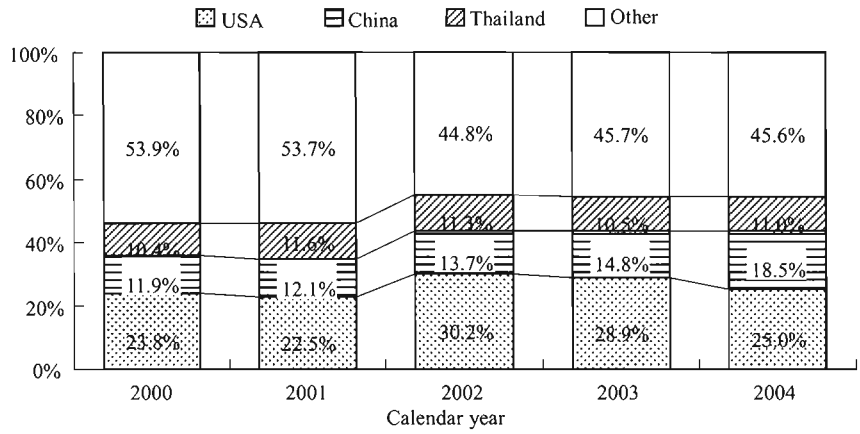
Source: Same as in Diagram 6-1-7

Diagram 6-1-8 Status of export of stamping dies



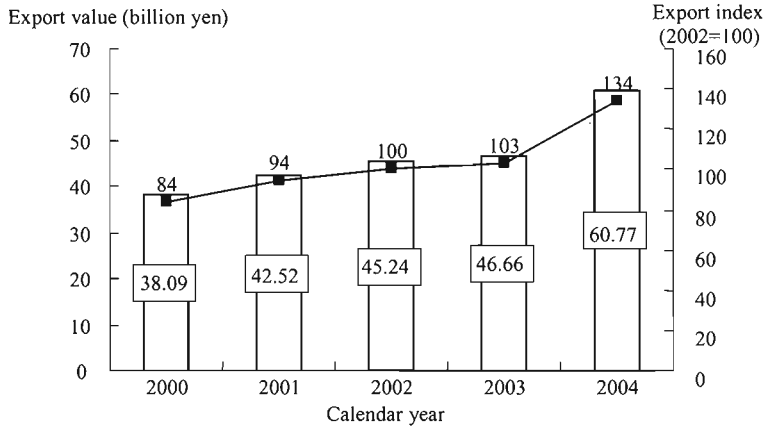
Source: Same as in Diagram 6-1-7

Diagram 6-1-9 Status of export of plastics molds



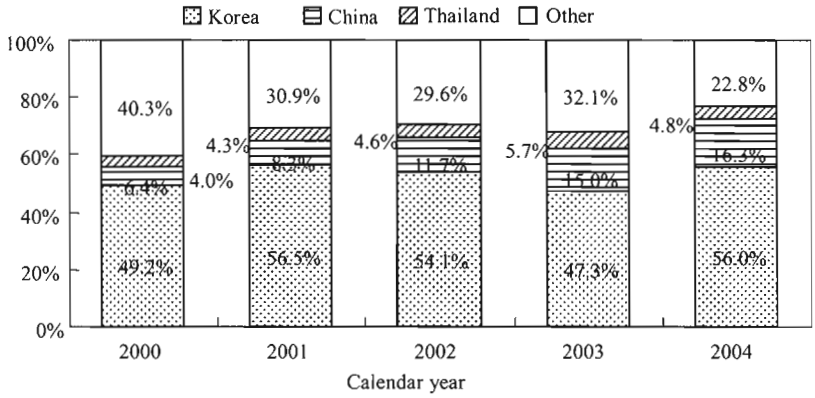
Source: Same as in Diagram 6-1-7

Diagram 6-1-10 Country-specific status of export of molds/dies for major countries



Source: Same as in Diagram 6-1-7

Diagram 6-1-11 Status of molds/dies import



Source: Same as in Diagram 6-1-7

Diagram 6-1-12 Country-specific status of import of molds/dies for major countries

6-1-2 Business conditions and industry trends

(1) Business trends

Business trends of the seven most-prominent companies in the mold/die industry from 2003 to 2004 are shown in Diagram 6-1-13 below. There is no information depicting in detail the market share of individual companies in the mold/die industry. Therefore, the present report conducts analyses on mold/die-related companies mentioned in Annual Corporation Reports (Volume 1) by Nihon Keizai Shimbun [2005] and companies permitting the perusal of their brief announcement of the most recent financial statement following the end of the fiscal year as well as the annual security reports, at the same time as being members of Japan Die & Mold Industry Association.

As a result of the recovery in the production volume in the mold/die industry, seven out of eight companies are expanding their sales in the business segment relative to mold/die production. Nichidai Corporation appears to have decreased in terms of the sales in the segment. This is due to a decrease in the sales of "system sales" included in the mold/die business of the company. Consequently, sales in the mold/die business, excluding the "system sales" of Nichidai Corp., grew 7.8% from the previous year.

Also, Diagram 6-1-13 shows that six companies, excluding Futaba Corporation and Fuji Technica Inc., have been expanding their business profits. Futaba Corporation has suffered a 5.3% decrease compared with the previous year in their business profit. Futaba Corporation explains its profit deterioration as due to "rising costs of steel material."

In contrast, Fuji Technica Inc. has experienced a substantial 61.5% loss in business profit compared with the previous year. Fuji Technica Inc. developed a large-scale project for North America based on a package contract of automotive body development. However, the company consigned an outside company for the body development in the project. This limited the profitability for Fuji Technica Inc. Additionally, unexpected adjustment costs were incurred relative to the project. These two factors contributed to the major loss in business profit for the Automotive Stamping Die Department at Fuji Technica Inc. in 2004.

ARRK Corporation substantially boosted both its sales and business profits from the previous year. In the background there is a management policy of the company dubbed "mountain chain management" (see the *Nihon Keizai Shimbun* of March 18, 2005, morning edition). Diagram 6-1-13 is a list of companies with which ARRK Corp. concluded partnership in

some form. As we see in Diagram 6-1-13, ARRK Corp. bought finance-related companies to turn them into their subsidiaries in different parts of the world, not just in Japan. However, ARRK Corp. does not involve itself in the management of the companies it has bought up. Those companies bought up by ARRK Corp. can expand their reliability by becoming subsidiaries of ARRK Corp. Additionally, they can share customer information on molds/dies with ARRK Corp. and among its subsidiaries, expand the number of corporate customers. The "mountain chain management" of ARRK Corp. is a system where the corporate performances of the companies involved are improved by becoming subsidiaries of ARRK Corp. A typical example is Sekisui Machinery Co., Ltd. shown in Diagram 6-1-13. Sekisui Machinery recorded a business loss of ¥34.48 million in 2003. However, it recorded a business profit of ¥281.9 million in 2004. It can be estimated that an increase in business partners resulted from becoming a subsidiary of ARRK Corp., in addition to a growth in demands for molds/dies.

In 2004, companies other than ARRK Corp. attempted expansion into China and other business expansions. Fuji Technica Inc. established a subsidiary Yantai Fuji Wilson Engineering Co., Ltd. in Shandong province in China. Similarly, Guangzhou Marujun Co., Ltd., a subsidiary of Marujun Co., Ltd. in China, established its second plant in Guangzhou in October 2004.

Diagram 6-1-13 Consolidated statement of major mold/die manufacturers (at the time of announcement of previous settlement)

(Unit: ten thousand yen)

Company name	FY 2003		FY 2004		Growth ratio (y/y)	
	Sales	Business profits	Sales	Business profits	Sales	Business profits
ARRK Corp.	8,166,000	770,800	16,073,200	1,144,800	96.8%	48.5%
Plastics molds						
Sekisui Machinery Co., Ltd.; molds	527,377	▲3,448	614,105	28,139	16.4%	Moved into the black
Stamping dies						
Futaba Corporation Production machinery business	3,117,900	333,800	3,413,400	316,200	9.5%	▲5.3%
Fuji Technica Inc. Automotive stamping dies business	1,866,938	144,332	1,964,871	55,576	5.2%	▲61.5%
Kuroda Precision Industries Ltd. Precision instruments	1,039,506	129,969	1,255,385	165,388	20.8%	27.3%
Hoden Seimitsu Kako Kenkyusho Co., Ltd. Dies	415,054	85,305	442,649	99,645	6.6%	16.8%
Marujun Co., Ltd. Mold/die business	331,500	31,900	408,700	32,300	23.3%	1.3%
Forging dies						
Nichidai Corporation Dies	625,425	62,150	605,055	65,675	▲3.3%	5.7%

Note 1: Names of business segments to which company mold/die businesses belong are given under the company names.

Note 2: The figures of sales include intersegment sales.

Note 3: ARRK Corp. gives sales and business profits of the whole company. (Incidentally, Sekisui Machinery Co., Ltd. is a subsidiary of ARRK Corp.)

Source: Prepared based on financial statements and brief announcements of the most recent financial statements following the end of the fiscal year of each company.

Diagram 6-1-14 Business partner companies of ARRK Corp. (2004–2005)

Date	Name of company	Location	Form of partnership with ARRK Corp.
Year 2005			
July 4	Mobis Slovakia S.R.O.	Slovakia	Capital participation
July 4	ARRK Technical Services Limited	UK	Formation of sub-subsidiary
May 23	Accuris Co., Ltd.	Republic of Korea	Turning into sub-subsidiary
May 10	Advanced Tooling Systems	Netherlands	Turning into sub-subsidiary
April 27	Kyoden Products Co., Ltd.	Osaka prefecture	Turning into subsidiary
April 26	SERMO Group	France	Turning into sub-subsidiary
April 16	Cecchin Management Limited	Canada	Turning into subsidiary
April 4	Okayama Minolta Co., Ltd.	Okayama prefecture	Turning into subsidiary
Year 2004			
March 31	Sanyo Chemical Co., Ltd.	Yokohama city	Turning into subsidiary
March 16	Changzhou Huawei ARRK Mold Co., Ltd.	China	Formation of subsidiary
February 7	Showpla Hong Kong Limited	Hong Kong	Turning into subsidiary
January 26	Toho System Co., Ltd.	Osaka prefecture	Turning into subsidiary
January 25	Nihon Micron Co., Ltd.	Nagano prefecture	Turning into subsidiary
January 18	PCL Group GmbH	Germany	Turning into sub-subsidiary
January 13	Standard Co., Ltd.	Nagano prefecture	Turning into subsidiary
October 8	Clover Sozhou ARRK SEKISYO Design Co., Ltd.	Hokkaido	Turning into subsidiary
August 31	Electronics Co., Ltd.	China	Formation of subsidiary
August 5	PLAKOR Co., Ltd.	Republic of Korea	Turning into subsidiary
August 5	DAE YEE TECH Co., Ltd.	Republic of Korea	Turning into subsidiary
August 5	Innotec Co., Ltd	Republic of Korea	Turning into subsidiary
August 5	MET Engineering Co., Ltd.	Republic of Korea	Turning into subsidiary
August 5	Chil Sung Machinery and Mold Co., Ltd.	Republic of Korea	Turning into subsidiary

Source: Prepared from information disclosed by ARRK Corp.

(2) Technological innovations and management environments

We shall examine the technological innovations and research and developments in mold/die manufacturers (Diagram 6-2-15). As a keyword for R&D and technological innovation by the companies in the mold/die industry in 2004, we can mention "R&D and technological innovation for shorter lead time." Regarding the components of die equipment, for example, Futaba is working on the development of an automatic device that quickly processes products of the size required by the die user. Also, Fuji Technica is conducting research on the application of non-contact 3D measurement data for die correction work. Such R&D aims at the shortening of die correction work. Additionally, the company also endeavors to standardize the die structure, stabilize drawing quality, and shorten the design period. ARRK Corp. is also attempting the development of a "CAD/CAM/CAE system for promoting the integration of 3D CAD data related to die design through production" in order to achieve the shortening of die lead time.

Diagram 6-1-15 Major R&D at mold/die manufacturers

Name of company	Trend in R&D
Futaba	Development of an automatic device to swiftly process products of the size requested by the user
Fuji Technica	Application of noncontact 3D measurement data for die correction work; Standardization of die structure
ARRK	CAD/CAM/CAE system for promoting the integration of 3D CAD data related to die design through production

Source: Prepared from financial statements of the companies

Next, we shall take a look at the management environment. There are two keywords in the management environment in the mold/die industry for 2004. They are the "promotion of in-house production of molds/dies by large companies" and the "development of mold/die-related collaboration between industry and universities." A typical example of in-house die production by large companies is the trend by Canon Inc. and Matsushita Electric Industrial Co., Ltd. in their mold/die business. Canon emphasized the in-house production of molds/dies by starting its Mold/Die Technology Center in the company on January 1, 2004. The objective of Canon is to enable the shortening of product development and the accumulation of production technologies through the in-house production of molds/dies, etc. Matsushita Electric Industrial along with Toyota Caelum Incorporated is developing a knowledge-base CAD/CAM system for the production of plastics molds that permits beginners to carry out production like experienced technicians.

At the same time, the environment in the mold/die industry in 2004 is being set toward the development of collaboration between mold/die manufacturers and universities. In May 2003, Iwate University established the Mold/Die Center at the Faculty of Engineering while several other universities established organizations related to mold/die technology within their faculties. For example, Kyushu Institute of Technology established the Advanced Mold and Die Technology Center at its Faculty of Computer Science and Systems Engineering in March 2004. Furthermore, Fukuoka Institute of Technology established the Next-Generation Micro/Nano Mold and Die Development Center in September 2004. Also, there is a plan to establish a mold/die faculty, the first in Japan, at the Shibaura Institute of Technology centering around the Japan Die & Mold Industry Association.

Diagram 6-1-16 Major universities related to molds/dies

Name of university	Name of institution	Establishment
Iwate University	Die and Mold Technology Center attached to the Faculty of Engineering	May 2003
Kyushu Institute of Technology	Advanced Mold and Die Center	March 2004
Fukuoka Institute of Technology	Next-Generation Micro/Nano Mold and Die Development Center	September 2004
Shibaura Institute of Technology	Mold & Die Department at the Faculty of Engineering	to be determined

Source: Prepared from the websites of the universities

(3) Future prospects and challenges

We shall now consider the future prospects and challenges of the mold/die industry. In the future, the mold/die industry will develop further in such countries as Korea, China, and Taiwan. This will occur because these countries are attempting to establish a system of training mold/die engineers for their domestic mold/die industries. For example, as stated before, there is

an ongoing effort in Japan to establish a mold/die department, the first in Japan, at the Shibaura Institute of Technology supported by Japan Die & Mold Industry Association and Ogaki Co., Ltd. (Nikkei Business Daily, December 17, 2004, p.12, see "Comeback of domestic molds/dies 4"). Nonetheless, Korea, China, and Taiwan have a history of training mold/die engineers through the establishment of mold/die departments at their home universities. As Diagram 6-1-17 shows, Korea, China, and Taiwan have established mold/die-related departments and research facilities at universities since the first half of the 1980s in order to train mold/die engineers. In Korea, there are currently 19 universities and colleges nationwide with a mold/die department, including Seoul National Polytechnic University. Mold/die research institutions such as the Dalian Institute of Technology in China offer PhD courses related to mold/die technology and train students with sophisticated knowledge on mold/die technology. In Japan, however, many Japanese mold/die manufacturers believe that "they are faced with the graying of experienced engineers without any young recruits or trainees" (Nikkei Business Daily, December 10, 2004, morning edition. "Third questionnaire on the mold/die industry"). While there are mold/die-related centers and departments being instituted at such schools as Iwate University, Kyushu Institute of Technology, and Fukuoka Institute of Technology, as stated above, such efforts have just begun. Consequently, it is still unknown as to what extent contributions can be expected from Japanese universities toward the training of mold/die engineers in the future.

Given such facts, it is highly likely that Japan will be caught up with by such countries as Korea, China, and Taiwan, even if Japan possesses a technological edge regarding mold/die production at present. In fact, Mr. Yokota [2005] points out that mold/die engineers in such countries as Korea, Taiwan, and Singapore are rapidly growing to catch up with Japan (except China which will require some time to develop mold/die technology). The fact that mold/die imports from Korea and China are growing yearly, albeit in small absolute amounts, can be considered as numerical figures indicative of such signs.

It can be stated from the above that the issue that the Japanese mold/die industry is facing is how to train sophisticated mold/die engineers and under what system it should be done in the future. It can also be put forth that the establishment of mold/die departments at Japanese universities and the further promotion of human resources development regarding mold/die technologies is a solution to such issues.

Diagram 6-1-17 Major universities relative to molds/dies in Korea, China and Taiwan

Country	University	Name of institution	Year of establishment
China	Shanghai Jiao Tong University	Mold/Die CAD National Engineering Research Center	1983
Korea	Seoul National Polytechnic University	Department of Molds and Dies, Faculty of Engineering	1984
Taiwan	National Kaohsiung University of Applied Sciences	Department of Molds and Dies, Faculty of Engineering	1984

Source: Prepared from the websites of the universities

The Economic Research Institute (ERI) Japan Society for the Promotion of Machine Industry (JSPMI)

A general description of the Economic Research Institute

The Economic Research Institute (ERI) was set up as a section of Japan Society for the promotion of Machine Industry (JSPMI) in August of 1964. The activities of the Institute are (1) research of machine industry,* (2) Joint & Commission research to other organizations, and (3) Machine Industry Library. In April of 1971 the special membership of ERI was organized and through this system we have been offering useful materials and informations to the industries concerned, enterprises and public organizations in order to diffuse the research results.

* Machine industry includes such industry sectors as electrical and non-electrical machinery, transport equipment and precision machinery.

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Director (Masakuni Sekimoto)
Advisory Committee
- Planning and Administration Dept.
- Research Dept.
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Experienced researchers and distinguished guest researchers actively take part in many research projects regarding machine industry in Japan and other countries on the basis of the results of researches which have been accumulated for a long time. The Advisory Committee, which consists of Industrial-Academic-Governmental complex, plans an important role in decision of annual research subjects and their methods.

The trends of the Machinery and Information Industry

In this department, the reports are made every year on about ten subjects such as the recent management strategy of Japanese machine industry, the policy for adjustment to the age of internationalization, the trends of the Machinery and Information Industry and the change of its structure, the outlook of economy and industry in Euro-American and Asian countries.

Guidelines to new society, technology and economy

Urgent problems required by the industrial fields are primarily taken as the subjects of the research. More than 1800 themes have been taken up inclusive of joint researches with other organizations, and a lot of reports on important research themes have been published. The research reports amount yearly to more than 30 and they are essential materials to machine industry.

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We publish research reports and research summaries, and hold lecture meeting of the Machinery and Information Industry and monthly STEP research meeting. By means of these activities we offer useful informations.

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Machine Industry Library attached to ERI is open to persons who belong to and are interested in machine industry. This Library houses not only books and magazines regarding machine industry but also a lot of books specialized in the industrial economy and research reports of organizations related to machine industry. Statistics regarding industries in Japan and other countries (census, annual, monthly reports) are provided here. A plenty of financial data of enterprises in major countries are also collected.

Open: Monday-Friday, 9:00-16:30
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Special Membership of ERI

This System is organized to give the members priority to utilize the research results of the Economic Research Institute. Special members are granted the following privileges: (1) research reports (about 30 volumes a year), monthly journals "KSK SCANNER-Foreign Information on Industries", and "Promotion of Machine Industry" are available free, (2) the special members can participate in "STEP research meeting" (3) only the special members can use the lending service of the library and so on. Our researchers are ready to give advice on the problems which the special members face.

*STEP = Socio-Techno-Economics with a new Philosophy

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