

Chapter 1

Characteristics of Taiwanese and Korean Production Technology

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Introduction

In this chapter, based on materials obtained from the field survey which was conducted in Asian region during the June 2000 to December 2001 period, we attempt to highlight “the characteristics of production technology observed in the dies and molds industries of Korea and Taiwan.” In this trial, the characteristics common to the industries in both Korea and Taiwan are identified, and then each of these characteristics is described.

1. The Characteristics Common to Both Korea and Taiwan

First, an important point that should be mentioned is that in the two economies the die and mold industry has been developed to a phase which is worth to be regarded as a “process industry”. Secondly, the CAD software is likely to replace with that of SolidWorks, but as far as the CAD is concerned, it can be interpreted that “Auto CAD” and “Pro E” will continue to be *de facto* standards for a while. As a matter of course, it can be argued that these two points characterize the production technology adopted in the die and mold industry in Korea and Taiwan. In other words, the facts mentioned below are generally observed in these economies:

- (1) Enterprises of not only Korea and Taiwan, but other Asian countries as well, concede “constraints of resources in hardware technology”. In fact, the mold manufacturing companies can own and equip with the machines and equipment in terms of its investment capability, and they can manufacture dies and molds with an accuracy that can be achievable within these constraints. Therefore, as a matter of course, when a die or a mold with the same quality and the same accuracy is available in these countries, the offshore production base of dies and molds tend to automatically shift to

a country or an enterprise that offers the lowest production cost.

- (2) On the other hand, the die and mold industry in this region is little aware that dies and molds manufacture is a total system, in which “materials for dies and molds, heat treatment technology, machine tools, cutting tools, jigs and fixtures, and mold assembly including adjusting works” are amalgamated together. Hence, they inadequately understand “the importance of resources of long-standing know-how as corporate assets.” In short, they seem to consider that if they have a group of machine tools dedicated to machining dies and molds which are able to perform high speed, high precision machining, a 3-dimensional CAD/CAM system, 3-dimensional measuring instrument and auxiliary equipment, they will automatically be able to produce high precision dies and molds acceptable by customers in advanced countries. Certainly, they have installed these sophisticated machines and systems, and manufacture dies and molds in their own way, but there exist limits in terms of product quality, including the accuracy of the molds. Incidentally, among dies and molds manufacturers equipped with similar production facilities, those makers who are guided by Japanese engineers stationed there, who are run by managers and engineers having been gained skills while serving Japanese dies and molds manufacturers, or who have formed joint ventures with Japanese dies and molds manufacturers, have been manufacturing without exception “dies and molds in good quality.” For example, SDI Co. in Zhanghua City, Taiwan, which manufactures “dies and molds for lead frames” and can duly be evaluated as a world class, is equipped with a jig grinding machine of Hauser AG-make (purchased for ¥400 million in the early 1990s) and a 3-dimensional measuring instrument of Litz AG-make. In the SDI Co., the worker can embed the sintered carbide pieces with the accuracy of better than 1 second of out-of-square, which are produced in such high precision by the re-machining process for final adjustment, into a dies and molds base (material quality of punch: SKS3; material quality of dies, SKD11). In addition, the dies and molds base is subjected twice to sub-zero treatment. SDI’s manufacturing facility is certainly excellent, and through a tour around the factory, it was observed that the experience acquired by SDI’s president during his “apprenticeship” around 1964 at Yasugi factory of Hitachi Metals, Ltd., Japan, has contributed to a substantial extent to the excellent quality of SDI’s dies. In other words, manufacture of dies and molds with the kind of higher product quality cannot be realized only with the general use of NC-machine tools dedicated to machining of dies and molds, but with full use of combination of leading-edge technology and technical skills. Intuitively Japanese dies and molds

manufacturers may enable to survive in both domestic and international markets by producing the dies and molds with higher quality. By the way, this lack of the total system concept as has been discussed above is often observed in the Mainland of China as is exemplified in the following two cases:

- (a) CAD/CAM systems are more widely adopted in China than in Japan, but there the production and processing technologies learned by engineers are inadequate compared to the technological knowledge necessary for genuine design engineers.
- (b) In terms of processing technology, in the Chinese die and mold industry, there exists a two-pronged polarization of makers between those which “have adequate fund-raising capability and are thus equipped with the most advanced NC machine tools” and those which “do not have adequate fund-raising capability and are thus equipped with a lower technological level, and out-of-date obsolete machine tools”. Makers in the former group have the problem of “insufficient accumulation of processing know-how, while makers in the latter group have trouble in “improving processing accuracy”. Incidentally, these dies and molds manufacturing plants are not fully equipped with measuring instruments, so that the accuracy of the produced dies and molds is virtually determined by the machine tools used in machining. Regarding machine tools, they typically equip with machine tools for high precision processing from “European vendors,” the most advanced NC machines from Japanese makers and other less expensive ones from Taiwanese machine tool builders.
- (c) Dies and molds manufacturers in the region are provided with CAD data of drawings for products and their parts by their customers, and based on these data they design dies and molds. These design processes are carried out in most cases by their in-house resources. This in-house design of dies and molds becomes possible through the introduction of CAD systems, which are offered in the marketplace and thus readily available. On the other hand, such as process sequence design and work-preparation design, which require of accumulated know-how, generally involve a lot of problems. The fact that effective CAD/CAM integrated systems are not available from the market is further worsening these problems.

In the following account, we provide several examples, including those observed in other Asian countries, that support these characteristics of die and mold industry in the region.

- (1) In many cases, Korean dies and molds manufacturers are engaged in manufacture of dies and molds for the low-end applications by procuring high-performance MCs

(machining centers), cutting tools and materials for dies and molds from foreign vendors. As a result, coupled with inexpensive labor cost in the country, Korean dies and molds production cost stands at one third of Japanese production cost, so that the price competitiveness of Korean products is enormous. Further, due to faster improvements in performance of cutting tools, if a local mold manufacturer owns certain level of application technology, it can conduct machining with fairly high accuracy, even with use of Korean-made machining centers. For example, the work to embed mold blocks into a mold base frame no longer requires of skilled labor due to improvements in machining accuracy. Incidentally, “polishing the dies and molds” is a technique to smoothen “separation of the mold” from the work.

- (2) In Korea, in many instances, the machining of either press dies or molds for plastics injection is performed by Korean-made machining centers supplied by Hwacheon, Daewoo Heavy Industry, Tongil, etc. Korean mold makers very much hope to procure the Japanese-made machine tool, but they cannot afford to buy it because of its higher prices. However, when the required accuracy is at the order of 0.01 mm, as the case of Kwangsan that manufactures press dies shown, Korean-makes meet the requirement adequately, and in fact in Korea demand for dies and molds within this order of accuracy is substantial.

2. Characteristics Specific to Korea and Taiwan

2.1 Korea

It is explained that through strategic investment by big corporations in “Chaebol” groups, which are family-based industrial groups unique to Korea, the die and mold industry has been developed together with achieving the successful results. It can also be pointed out that as an emerging new current that is innovating the Korean industrial structure, engineers spun-off from big businesses have become managers of smaller companies manufacturing dies and molds. However, “cost squeeze” on subcontractors practiced by Hyundai Motors and other big corporations are as stringent as that practiced in Japan. With this background, some characteristics identified as unique to the Korean die and mold industry are as follows:

- (a) For example, because of the difference in living styles, dies and molds for microwave

ranges/ovens, which are manufactured in Korea, are double in size as compared with those manufactured in Japan, and these larger dies and molds are exported to the United States and Brazil. However, their work accuracy is in the order of 1/100 mm and prices of these molds are 10 to 20% less expensive than those manufactured and offered by Japanese makers. Then, it seems likely that demand for machine tools for machining dies and molds at high cutting speed that can process larger scale molds for shorter work hours is substantial.

- (b) The Korean die and mold industry has not yet achieved the horizontal division of labor attained by its Taiwanese counterpart, but in many instances Korean makers contract out heat treatment. Also, quality control over dies and molds is one of the troublesome problems to be solved sometime in the future.
- (c) In many cases, Korean makers adopt 3-dimensional CAD, while during the manufacturing process of dies and molds, there are frequent “on-the-spot dimension and tolerance fitting”, which suggests that there are underlying problems in process sequence design and work preparation design.

2.2 Taiwan

The general tendencies of dies and molds manufacturing technology in Taiwan are as follows.

- (a) Compared to the Korean industry, the Taiwanese die and mold industry shows a production pattern that makes much use of a horizontal division of labor of venture enterprises, which rely on the “human wave tactics” consisted of a few people as venture capitalists (each of these individuals brings funds or technology to form a network of related businesses). Also, this production pattern features “two-tier peer contractors” rather than subcontractors, and as such the prevailing dies and molds production regime in Taiwan consists of clusters of small local factories, each operating with a single machining center, a press machine or only two ordinary lathes. These clusters of smaller factories exist in Shulin, Sanchong and Xinzhuang, and in these areas if an enterprise designs dies and molds by using drawings of a product as input, the firm is able to build these dies and molds by “contracting out all manufacturing processes.” Arrk Shangent positively capitalizes on these features unique to the Taiwanese production regime of dies and molds.

- (b) Regardless of the size of operation, all dies and molds makers have been exporting their products. For example, Shyuan Shin, which employs only five workers and produces injection molds that produce plastic cases of cosmetics and caps of perfume bottles, exports 30% of its molds produced. By the way, this maker runs its operation with two EDMs, a conventional lathe and a conventional milling machine, and jobs to be done by a machining center are all outsourced.
- (c) The requirements for machine tools dedicated to the manufacture of dies and molds are summarized by three items: “price”, “achievable accuracy” and “durability”. Regarding required specifications, the point to be noted is that the importance once attached to “heavy cutting performance” is shifting to “high machining speed and accuracy” while the demand for ATCs (automatic tool changers) is less significant. Incidentally, general requirements sought for the basic specifications of MCs are as follows: revolution speed of the main spindle: 10,000 r.p.m., cutting feed speed: 10 mm/min, and provision of the NURBS-based high accuracy and curved surface machining function. In short, in the late 1990s, a transition of production method for dies and molds from “heavy cutting performance” to “high machining speed and accuracy” has been commenced. Accordingly, Taiwanese dies and molds makers are very much hoping to purchase Japanese-make machining centers, but their prices are 2 to 2.5 times higher than those of Taiwanese-make MCs, and they are forced to equip with the Taiwanese machines due to financial constraints.

3. Concluding Remarks

From the observations of the situation stated earlier, the author could suggest the following research task to be tackled in the future: “the development of appropriate countermeasures addressing the hollowing out of the domestic die and mold industry”, based on the premise that the die and mold industry is a process industry. At present, comparative studies of this particular industry are excessively attentive to the disparity of labor cost from country to country, and prone to lack cool-headed analyses from a technological point of view. By analyzing the earlier discussed characteristics of dies and molds production technology prevailing in Asian economies, based on the premise that the die and mold industry is a process industry, potential ways for the Japanese die and mold industry to survive will naturally emerge. Japanese dies and molds manufacturers must seek “the way of survival”, which capitalizes on (a) accumulated know-how that

enable them to make effective use of machine tools devoted to the high-speed and high-accuracy machining of dies and molds, and (b) the abundant pool of skilled technicians specializing in the manufacture of dies and molds as well as technologies and expertise that cannot be acquired by simply purchasing machines and equipment. In short, they must seek how they are able to manufacture dies and molds differentiated from Korean and Taiwanese makes, under the premise that “their rivals in Asian region hold the same, most advanced design and manufacturing machines and equipment” as Japanese manufacturers. If we can allow ourselves to present a personal view for readers’ reference, in order to survive in the domestic and international markets, Japanese smaller manufacturers of dies and molds should equip themselves with the following capability for technological innovation:

(a) Manufacture of dies and molds to be used for high value-added parts and products, specifically those dies and molds to be used for the manufacture of health & medical equipment and instruments, components for information technology devices, and LSI-related parts.

(b) Manufacture of dies and molds that require special processing capabilities, such as dies and molds for plastic seals of ICs.

(c) Enhancement of dies and molds products and capabilities of technological innovation through partnerships with varying industries (interdisciplinary partnership of different industries).