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Strategic Outsourcing among Die and Mold Industry

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Abstract

Die and mold is tool, equipment or machine which is indispensable for manufacturing parts. Japan has the largest output in the world which has been declining with the breakdown of the bubble economy as a turning point though. Consequently the most of the firms in the industry have fallen in their income. However the growing firms are observed even in such circumstance. One is the type of flexible specialization by high value-added products and intends to execute “product integration”, the other narrows the business domain and intends to execute “process integration” by dispatching engineers to the clients. Though the resource of competence of both firms seems high grade equipment and high-end CAD system apparently, the capability of designing, engineering or the combination between engineering and marketing is quite important substantially. It is the key factor SMEs get opportunities in outsourcing from big firms strategically.

1. Introduction

In the area of press, forging, die-casting, injection molding and plastic forming such as blow molding, mold and die are basic tool, device or machine that are essential for part production and important base for any technical industrial manufacturing. Also, mold and die, which are combine effort of all the technology and technique related to metal processing and machine work, determines quality of manufacturing. Since mold and die are basically single part production, the amount of sales is relatively less compared to the number of employees and the amount of capital expenditure. There are many independent mold makers because irregular demand for mold and die lower the ratio of it being manufactured by finished product manufacturer. Many of mold makers are small and medium-sized enterprises and according to census of manufacturers (2000), 90% of these mold makers are small and medium-sized enterprises with less than 20 employees while 1% is enterprises with more than 100 employees. “Japan, lately developed country, has been becoming highly competitive in mass production industry since 1970. Molding, essential tool for these industries, has become highly competitive.” (Taguchi 1994 p.20). It is due to diffusion of numerical control machine tool and CAD/CAM. [1)] In recent years “mold makers were half-compelled to install CAD/CAM” (Saito 1994 p.20) by clients subject to receiving data in the course of promoting digitization, but their relation has been changed as 3D information technology has become upgraded and diffused and it has promoted front-loading. [2)]

Connecting digital technology with traditional mold making techniques add momentum to development of mold and die industry. It is because “diffusion of numerical control tool machine and CAD/CAM system enable to separate mold and die design from manufacturing” (Oda 1997

p.572) and it also enable designing companies to become independent. Using CAD system became an important factor for strategy of mold makers. [3)]

On the other hand, after burst of the bubble economy volume of manufacturing mold started going down, once was recovered and peaked at 1997 and again went down. As a recent trend, earning of mold makers reduced. [4)] As fig. 1 shows, fluctuations of the number and the sales amount of mold manufacturing, the number has leveled out and the sales amount has been reducing since 1997. (The sales amount of 2001 went down to 77 percent over 1997.) Especially the number and the sales amount of mold manufacturing of the outsourcings drops bitterly. The outsourcings account for about 90 percent in the number of mold manufacturing and about 75 to 80 percent in its sales amount. The number dropped to 93 percent and the sales amount dropped 70 percent over 1997. It indicates that mold manufacturing with lower additional value was outsourced or outsourcing mold went on dropping in price.

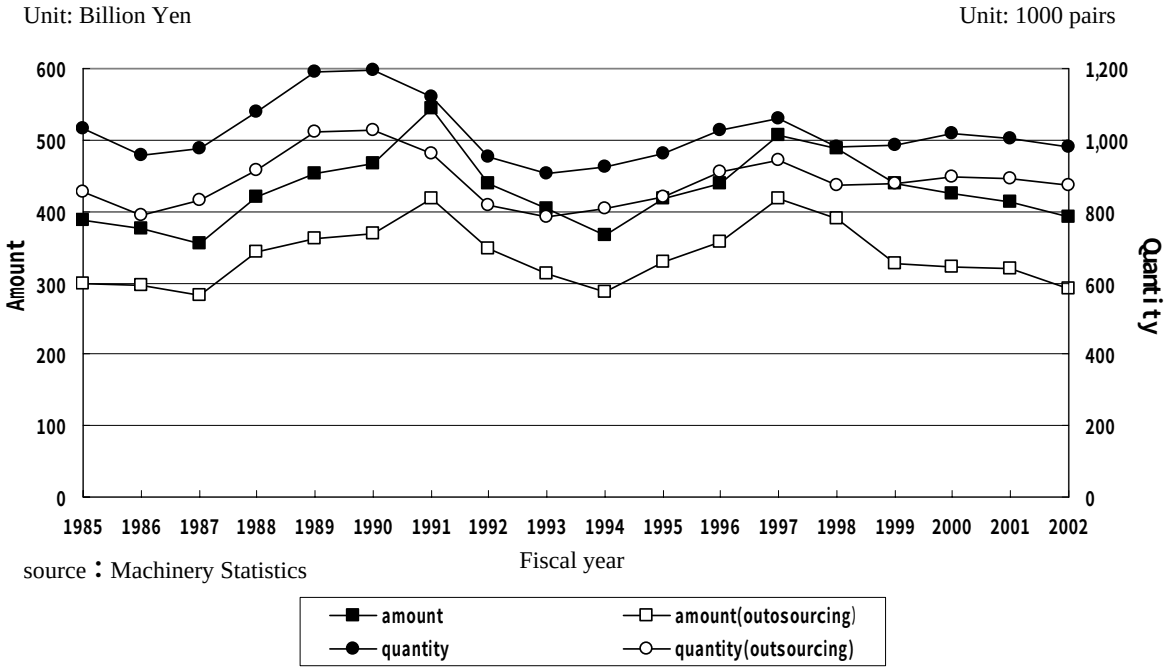

Fig 1. Fluctuation of molding market

They have discussed the innovation of the molding industry as the relation between the capital goods and processing equipment such as microelectronics innovation and CAD in the view of skill acquirement. Takeda (2001) stated that the adaptation of 3D information technology with processor functionality and media functionality influenced characteristics of organization, and changed division of labor. Nobeoka (1997) pointed out that adaptation of 3D information technology tends to significantly increase the role of designing along with the requirement of multi-skills. Murakoso (1999) examined “integration” and “specialization” of product items by analyzing the process of internationalization of small and medium-sized capital goods industry as a case of molding company. Asai (1995) took up mold and die in the view of skill acquirement and analyzed the characteristic of acquiring skills in mold makers. Considering those mentioned above about mold industry, this thesis takes the cases of medium-sized enterprises dealing with molds, and examines their orientation of innovation.

2. Case Examples

Despite flagging mold and die market, some mold makers ranked up profits. This paragraph describes of one of the growing enterprises dealing in molding in Tokai Region, which has its own strategy in marketing and technology, while situation has changed as progress of IT., internationalization and shortening delivery period.

(1) Enterprise “A” and mold design / production skill.

<Initiated based on high technology>

A founder of enterprises “A” “started business with high technology” (Taguchi 2001 pp.162-163), he, a present executive, with high technology spanned out and initiated company “A” (established in 1979) and has developed it charismatically. This enterprise is situated in the

southern part of Nagoya where many other suppliers of basic technological industries concerning machine processing are located.

This company has 120 employees and categorized as relatively major company amongst the mold makers who design and manufactures them. As fig. 2 indicates, this enterprise has been ranking up profits even though its performance dropped in early 1990's and around 2000. [5)] With 2000's slump as a turning point, this enterprise has restructured, reviewed operation structure, utilized information technology and promoted front loading to improve design section.

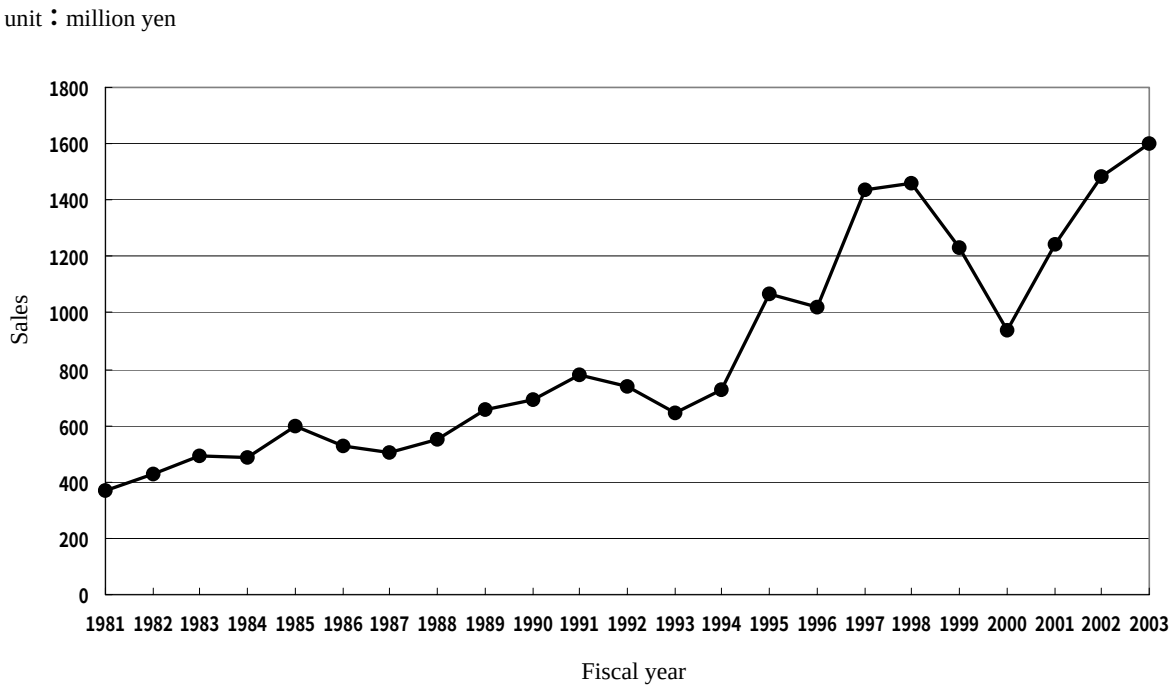

Fig .2. Performance Fluctuation of Enterprise"A"

<Dealing with multiple industries>

Enterprise "A" deals with major companies in several business fields such as electric, automobiles, gas appliance, water treatment and so on and has many suppliers. 98% of mold

production of enterprise “A” is metal stamping, most of which are for home electric appliances and automobiles. This enterprise manufactures outer parts of air conditioners, gas appliance, kitchen appliance of makers and stoves. Since auto makers produces outer part by themselves, this enterprise, being a supplier, makes the parts that don’t influence their appearance; For example, inner parts which are reinforced from inside, back side cover, frame parts and under body. This enterprise gradually shifted to relatively large press molding that weighs highly on field techniques, which improved technology, in result; the enterprise has been developing its reputation and new market.

This enterprise tries to receive orders for new exclusive parts of mold manufacturing because it is more profitable than carry-over design which faces request of severe discount of about 30%. This enterprise deals in new design with high additional value, of which gross profit rate is 80%. Recently this enterprise has been trying to expand its field to receive order keenly for process related work which utilizes molding technology for a trial of water treatment filter. In order to promote receipt of order for new difficult parts of mold production, this enterprise stationed 10 freelance sales persons who meets clients or collect information.

<Investment of capital goods as a strategy to gain advantage in competition>

Enterprise “A” has been doing capital investment actively since the early stage and to shift to large molds which are less competitive and, to make a difference, this enterprise has installed numerical control machine tools, machining center (pentahedron processor) and wire discharge processor. Likewise in connection with information technology this enterprise installed CAD/CAM during the earliest stage; however, it didn’t lead their work to be more efficient. Then this enterprise started to do full-scaled capital investment from 1997 and installed 3D solid CAD. CAM made 80% of their machine process equipment unmanned; for example, they even linked

design sector with production sector by LAN and made high precise process by computer numerical control machine tool. It characterizes enterprise 'A" that they can now receive whole package order for press molding. They analyze and compute production extent of the order by CAE during developing stage and manufactured various parts to finish, setting up all at a time.

Also, they develop their own technology that leads to better productivity. The method that they developed during their progress of work like thermal forming that composite different materials to form one body is utilized for new product making.

<Collecting knowledge information to design sector>

Design and production of mold and die require knowledge information such as technology and skills. Enterprise "A" acknowledges that skill is engineering and software in the course of making product such as planning, design, production of mold as a whole, not process ability of manual work as an individual.[6)] About 60% of employees in this enterprise are engaged in design utilizing CAD/CAM/CAE etc. Their target is to train engineers to be ones who can understand the whole process of making product or business; therefore, they divided work to improve expertise of each sector and rotated engineers to each sector to get trained.

The advantage of this enterprise is finishing techniques of skilled engineers and equipment backed up by high technology. This enterprise used to rely on skilled engineer's experience or occupational hunch; however, because of new system they adopted, they collected knowledge information to design sector and request skilled engineer to learn CAD, too. Tacit knowledge of organization like they predict that weight of field workers in a company will be 5% remain as a strategy. Considering needs of new design engineers who have field work experience, this enterprise annually hires 10 graduates who are able to understand computer and gives them site training.

<Engineers dispatch>

The specialties of enterprise “A” are finishing technique and maintenance technology, which require integration, but they dispatch engineers (about 50) upon request of clients in the field of only mold design and production. This enterprise dispatch engineers for two types of works: one is production technology corresponds to outsourcing and another is molding design and maintenance. The former type is where clients don’t design and manufacture the parts in the course of producing mold by their own employees, but outsource it all to mold maker. This enterprise dispatch CAD engineers to the client for the former type of work. In the case of later type, the enterprise dispatches the most skilled maintenance engineers who even maintain the mold and die manufactured by other companies.

(2)Enterprise “B” and digital engineering

<Initiation of the company specialized in digital engineering>

Enterprise “B” is composed of enterprise “B1”, a small and medium-sized mold maker and “B2”, a digital engineering enterprise. “B1” manufactures only rubber molds for weather strips; seal parts for water protection, installed around car windows. Manufacturing molds of these parts is niche area and profitable. Executive who initiated enterprise “B” in 1984 had a unique career of being a banker and mold broker. He established ‘B2” in the center of Aichi prefecture in 1995 on the base of “B1”. “B1” has 26 employees and “B2” has 115 employees. (As of April, 2003).

As mold market has been shrinking because of burst of the bubble economy, “B1” also experienced extreme deterioration of business like their sales dropped by 30% in 1991. They acknowledge from this experience that utilization of CAD is essential, so they established enterprise “B2”. [7)] At the same time, they move the major factory “B1” to the vicinity of clients.

As fig. 3 indicates, “B2” has been improving performance smoothly, and recently “B1” has improved performance, so both companies generate a synergistic effect.

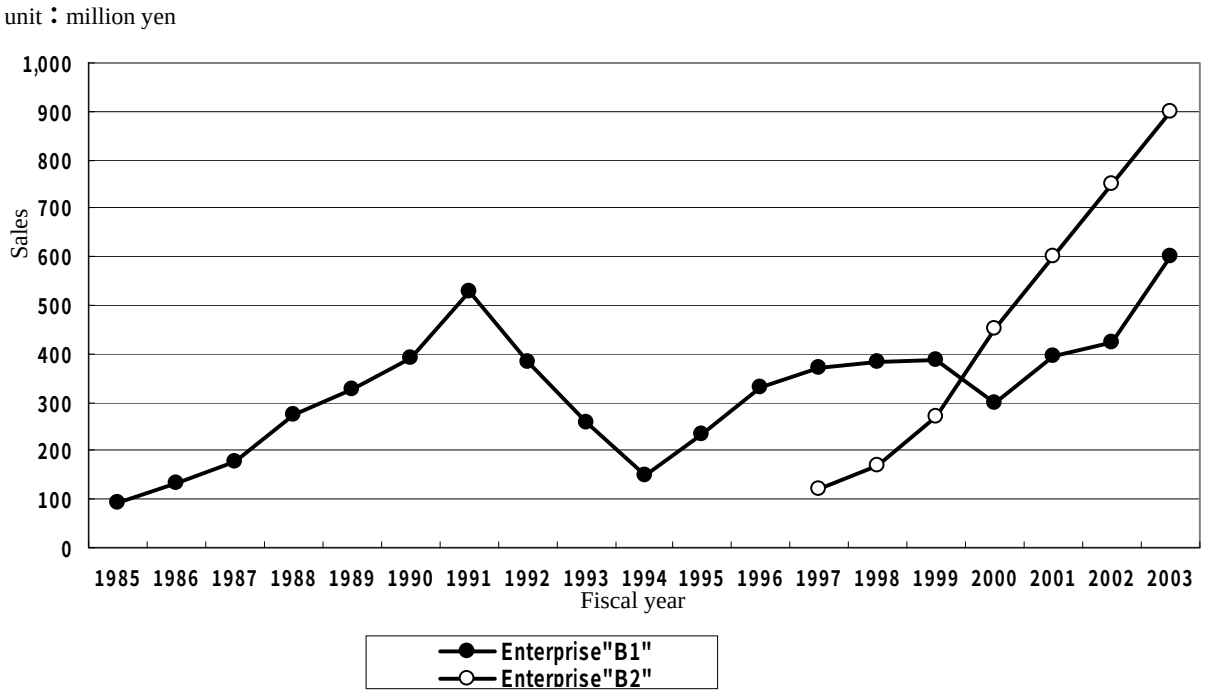

Fig. 3. Performance Fluctuation of Enterprise“B”

<Strategic use of CAD system>

“B1” has been installing CAD since 1990 upon the request of client and has been installing CATIA since 1992 basically for receiving the customer’s data. “B1” started full-scale installation of CAD after “B2” was established, and utilization of CAD increases opportunity of “design-in” which means outsourcing engineers who takes part in product development at client’s site.[8)] This enables enterprise” to obtain information speedy and expanded their business. Enterprises “B” used to outsource CAD designing until they realize that they need designing by digital technology to expand their business. Starting with transferring digital data to and from auto makers, enterprises “B” has been taking in 3D solid designs; rapid proto-typing (PR) made from

ABS resin; CAE, the front of CAD system as their own technology. The reason behind all these changes is, in spite of the amount of the money received from the clients has decreased, expenditure of outsourcing CAD design stayed still.

"B2" makes 3D solid modeling in the stage of product design of auto parts which is one of the earlier step of molding design, and analysis of digital mock-up which utilizes all the data from 3D solid modeling, function, strength and stress, is considered as a pillar of their business. [9)]

Since 90% of the "B2" is carry-over design of former or present products, it requires efficiency. Because of that, enterprise "B2" made a full-scale investment on CAD system and is centering on high-end 3D solid CAD (CATIA V5 etc).[10)] Participation and planning of "B2" brings information in early stage to "B1" as a division of molding design and production. Since "B1" and "B2" are located far from each other, they made an annex of "B2" in "B1" and deliver the design data.

<Design-in and engineers Dispatch>

Product development of auto parts, as a major area of enterprise "B2", is repetition of designing and prototype production. "B2" acknowledged front loading which means thorough digitization and putting work load in the early stage improve the efficiency of product development, and the objective of the enterprise "B2" as the outsourcing is to integrate all engineering techniques. This enterprise deal in rubber and resin of auto parts only in order to advance through specialization. Auto parts are made more and more in modules, but it requires working face to face because of frequent design changes called "unpredicted design".

Since designing work requires concealment of information, enterprise "B2" sends engineers at client's site to fulfill the requirement. Earlier this enterprise mostly sent CAD operators; however

the request for skilled engineers who are able to use CAD is increasing as CAD software has upgraded.

The contract of the work is consignment, but in reality it is dispatch. [11] In that case, enterprise ‘B2” dispatches skilled engineers along with younger engineers, which contributes in training young engineers. 90 out of 115 employees in the “B2” are dispatched. Dispatch eases responsibility of meeting due dates and quality of product while trustees have to have responsibility for them. Also dispatch makes it possible to accesses development information of client and receives related order. Consequently a part of the forefront development information is reviled to the outsourcing through dispatched engineers.

Dispatched engineers of enterprise “B2” send some useful development information to “B1” immediately to make effective schedule for mold manufacturing.

<Developing CAD-used knowledge-base-system by business academia collaboration>

“B1” has tried to have more proposals to step into new field. This enterprise created innovative environment such as strengthened its solidarity with software research and development companies, universities and public organization to promote joint project as a coordinator. The government and the local government have entrusted this enterprise for developing product design related to dentistry and design system for seat-holding device (wheelchair) for the seriously disabled and so on. This enterprise has been accumulating knowledge while working on these projects. This enterprise collaborated with a university and developed the technology that converts knowledge codes into natural language description by automatic generation to utilize knowledge-base CAD effectively on the real design job, and plans its commercialization. This enterprise is aiming that its development quickens fostering engineers and make carry-over design more efficient.

<International expansion>

Internationalization of enterprise B started with establishing a branch in INDIA by hiring engineers from outcast (depressed class). Those Indians were dispatched to auto part makers after they go through certain training in Japan. Along with the upgrade and the popularization of CAD systems, the request of companies doing mass production has shifted from dispatched CAD operators to engineers who mastered 3D CAD and understand whole product development process, product form and its function, purpose and molding cost. So enterprise “B2” reconsidered plan of hiring Indians and concentrated on Japanese centered adoption.

On the other hand, Indian engineers who speak English played an important role in international expansion in English speaking countries. This enterprise opened offices in USA and UK and stationed them in both countries. Before opening an office in the U.S., this enterprise investigated molding field and its requirement in USA, and found that the level of mold engineers was lower and there were less precise mold makers as compared to Japan. On the other hand, low-priced products of Japanese makers couldn’t be competed with the Chinese products. [14)] As a result enterprise an US office of “B2” managed to bring good results, and in conjunction with that, overseas production of enterprise “B1” also increased significantly and the success of “B2” in the U.S. contributes in the performance of “B1”.

3. Discussion

As mentioned so far, while the market of mold and die has been losing grounds, both the enterprises “A” and “B” deal in outsourcing and are on a growth path; however, their directions of business development are different.

Enterprise “A” has aimed to work for all the fields of press molding in several areas of industries. Working for several industrial areas reduces the chance of being effected by the demand fluctuation in molding industries. Enterprise “A” avoids designing of similar products (carry-over parts) which are being requested for discount, and preferred mold manufacturing of profitable new product or in new field, to receive orders of whole project. Thus is “integration of manufacturing items.”(Murakoso 1999 p.126) They limits to press molding only of which this enterprise has know-how, and differentiates from others. It premises the feasibility of company’s economy considering working ratio of capital goods. [15)] Enterprise “B” narrowed manufacturing items down to auto parts of plastic and rubber to improve its specialization, and on the base of it this enterprise expanded market and directed “integration of the work process.” It is predicated on collecting information of market and clients. Both the enterprises “A” and “B” have already installed CAD around year 1990, but it didn’t bring result in this phase. Installation of CAD from 1997 made both the enterprises CAD makeup. CAD makeup means that most of the design work is done by CAD; for example, molding by 3D solid CAD considered as design work such as drafting. CAD designing accumulates know-how fed back from the course of mold making. In enterprise “B” which considers digital engineering as business, CAD system enables this enterprise to participate in product design that is the earlier stage if molding design and it brought development information of client earlier and increased mold orders.

“Single part production and high ratio of machine equipment in molding reduce economic efficiency and it reflects that less users of molds manufactures mold by themselves.” (Taguchi 2001 p.17) Mass production machine industry such as automobile industry and major processing and assembly makers tend to be short of not only molding engineers but also product design engineers. They concluded that it cost down accepting dispatched engineers according to demand,

whose salaries were relatively lower, compared to hiring permanent employees. That is the background behind mold makers are independent industry and develop the system of dispatching engineers. On the other hand, frequent design changes makes doing concurrent engineering difficult, which also favored mold makers. Dispatching engineers of enterprise “A” is done upon the request of clients, but in the case of enterprise “B”, engineers are dispatched for product design as business and it is more strategic. Also it generates additional values such as feeding back to clients’ information, reduction of risks for date of delivery and of responsibility for quality of products, fostering engineers in its course and so on.

4. Conclusion

This thesis picked up 2 different types of molding enterprises in Tokai Region, which have been growing despite the phase of shrinking its market and made preliminary consideration for the ways of innovation by observing operations of both the enterprises. The result of those implies below:

(1) The source of competitiveness in case samples are phenomenally installation of capital goods: advanced equipment such as numerical control machine tool in the case of enterprise “A” and high-end CAD system represented by 3D solid CAD in the case of enterprise “B”, but they depend on the ability of mastering and capability of meeting clients needs. Those kinds of ability or capability are not individual skills but are group skills of design using CAD and engineering.

(2) Methods of product supply in molding enterprises are basically specialization, but their directions differ depending on the content and characteristic of products manufactured by molds. The enterprises which have technology such as enterprise “A” have wide range of specialization and if they promote outsourcing from major companies, “the integration of manufacturing items”

would bring competitive advantage. In this case, the working ration of capital goods infusion is important measurement and the strategy of feasibility of ‘economy of scope’ is required. In other words, technology and marketing are linked mutually and it is important that the enterprises enhance sales and ability of information gathering.

(3) It is effective strategy for small and medium-sized enterprises to take opportunity of outsourcing required and created by major companies and to make dispatch engineers as a strategy. By contriving ways of dispatching system, dispatched engineers are expected to be communicators who increase orders and bring product development information and dispatch, fostering system for younger engineers.

Note

1. Japanese machine tool makers supplied numerical control machine tool with lower price. (Taguchi 2001, p.108).
2. Front loading is the strategy for shortening developing period and cutting cost. Thomke and Fujimoto (2000) discuss solving problem on product development in details.
3. CAD/CAM/CAE is called CAD system here. Mold makers promoted to install CAD system for base technological industries that support mass-production industry like tool machine parts, casting and the like. According to Investigation of Chubu Industrial Advancement Center (March, 2000),” questionnaire survey for three industry sectors of mold and die, casting and tool machine parts indicated that mold and die companies have most advanced in installing CAD.

4. Questionnaire survey of member companies of Japan Die and Mold Industry Association Center Division shows that more than 80 percent of sales reduced in 2002 over previous year. (Japan Die and Mold Industry Association Central Division, Management and Labor Committee, Dec. 2002.)
5. Fig. 1 shows that there weren't any big changes as a whole country. According to current survey of industrial production of Ministry of Economy, Trade and Industry), the number of sales stayed still, but the sales amount was getting dropped.
6. Generally "engineering" is translated as "kougaku." Engineering here means broadly technical actions related to whole process to become products.
7. Separating design from production (Oda 1997 p.572) led establishing company "B" if interpreted roughly. Auto industry has been utilizing CAD/CAM/CAE since the earlier stage.
8. "Design-in" usually means that parts makers (finished parts makes and assembly makers) participate in the course of new model design. (Saito 1994 p.18).
9. "Digital mockup" enables to apply 3D, large-scaled display technique in real time, to define parts on a computer without making its prototype, and to assemble them.
10. Enterprise "B2" have installed 8 CATIA [V4] seats, 5 CATIA [V5] seats, 4 TOGO seats, 2 Caelum seats, a Unigrahic seat, an I-DEAS seat and a PRO-E seat as of July,2003. According to hearing from major venders, the national sales of CAD in 2001 was 253.7 billion yen: out of that CAD for machinery is 156.1 billion yen (the number is 209 thousand seats.), and out of that 3D CAD is 75.5 billion yen (58 thousand seats).
11. Dispatching service lessen the risk because outsourcer have responsibility for quality of finishing goods and meeting due date. In the case of dispatching engineers, they work with employees of the outsourcer face to face and are able to receive overtime pay. On the other

hand, under consignment contract if engineers take work home, even the same employees of the outsourcer would negotiate the price of their work.

12. Enterprise “B” was entrusted with these: “CAD/CAM/CAE tool development for denture design”, information venture supporting program of Information- technology Promotion Agency, Japan (INP); “knowledge data base development for know-how of mold design by knowledge-base CAD of next generation”, Information Communication Industry Promotion Project for Immediate Future Society (2000) of Aichi prefecture; “CAD/CAM System Development of Seat-Holding Device for the Seriously Disabled” (2001), General Development Institute of New Energy and Industrial Technology R&B Business of Regional New Life Consortium with An Immediate Effect of New Energy and Industrial Technology Development Organization (NEDO).
13. Enterprise “B” opened offices in India, the U.S. and the U.K. Indian engineers are assessed lower dispatching rate because of language barrier, even though their capability is equal to Japanese engineers. Since Indian engineers haven’t become skilled engineers, they are dispatched to English-speaking countries.
14. Takizawa (1995) pointed out that American auto makers tend to request Japanese mold makers to complete production trial, and in the U.S. there aren’t mold makers which finish product with high quality and there is shortage of engineers of auto makers.
15. Integration of product items is to work on various products to expand product items and integrate them. Necessary condition for solving clients’ issues is construction of technical platform combined by development of capital goods and skills.
16. After burst of the bubble economy, auto makers promoted rationalization and reduced engineers who work on product development. Increment of new types of vehicles such as

recreational vehicle resulted in creating additional works of development. So they need the outsourcing to complete the work.

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