

Chapter 4 Integration of Hardware, Software and Services in the Machine and Information Industry

4.1 Background of the Investigation: Seeking Ways to Revitalize Japan's Machine and Information Industry

Trapped in a protracted recession, many companies in the Japanese machine and information industry are faced with numerous difficulties such as intensifying global-scale competition and sagging demand. For these companies, finding ways of maintaining and strengthening their competitiveness and profitability is the most serious concern. Although the Japanese machine and information industry enjoyed global-level competitiveness for a long time, the industry is now impacted by such changes in the global environment as rollbacks by the U.S. and European companies and catch-up by Asian companies, particularly China with its overwhelming price competitiveness and spectacular progress in product quality. Technological innovation and competition have constantly spurred sophistication of machine levels, and exports and globalization of machines have led to technological equalization. As a result, it has become increasingly difficult for Japan to maintain its competitiveness and profitability with its supremacy in manufacturing of machines (hardware) alone. From this perspective, one way to strengthen and reconstruct the Japanese machine and information industry is through full utilization of intellectual property³ and integration of the

³ This includes intellectual properties (patents,

machine (hardware) business with software⁴ and services.⁵

Integration of software and services with the machine (hardware) business can be roughly divided into two approaches. The first is to enhance the machine functions by building software and services into the machine. The second is to enhance machine use by supplying software and services separately. Needless to say, a narrowly defined software business for computers and a broadly defined software business for other machines and service-related business have been conducted within the machine and information industry in the past. So far, the strong competitiveness of Japanese machinery (hardware) has helped to raise its profitability, so the Japanese machine and information industry has not had to think of augmenting the profitability of its software and service products. Instead, these have often been bundled with the machine (almost free of charge) and supplied as a part of the hardware, often for merchandising purposes.

copyright, trademarks, confidential information), databases, documents, drawings, designs, and programs, as described in "Essence of Intellectual Management" by Patrick H. Sullivan, May 2002, Toyo Keizai Zei Shinposha. It also includes experience, know-how and skills.

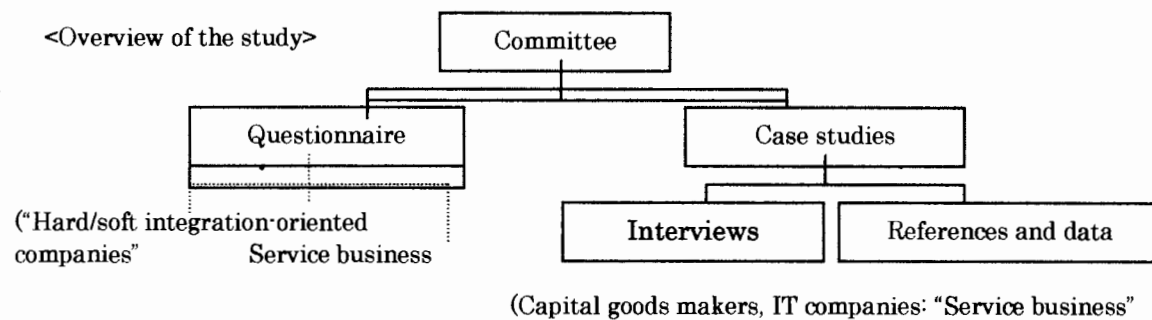
⁴ In this report, computer software is classified into "software in the narrow sense" and "software for machines other than computers; and know-how, consulting, engineering and solutions are classified into "software in the broader sense" or simply "software."

⁵ "Service" in this report refers to the provision of various types of services and their contents, such as manufacturing support or related information, usually intended for general business purposes. These services should be treated differently from the so-called "free-of-charge services."

At present, companies in the machine and information industry are just beginning to integrate their software and service businesses for the purpose of improving competitiveness and profitability. In fact, there are few successful cases, if any. The machine and information industry's current efforts to integrate its software and service business with its hardware business differs greatly from those of the past in that their main purpose is to improve profitability and to increase job opportunities.

Regrettably, little investigation was

conducted in this field in the past and the actual conditions are not well known. We have decided, therefore, to carry out a fact-finding survey based on the perspective that full utilization of intellectual assets and integration of software and services with machinery (hardware) will be key factors for revitalizing the Japanese machine and information industry. A questionnaire was distributed to companies in the machine and information industry, and interviews were conducted with capital goods makers and leading IT companies.



The detailed results of the investigation are reported separately.⁴ An overview is presented below.

4.2 Present Situation of the Software and Services Businesses in the Machine and Information Industry: Based on Questionnaire Results

If the intellectual properties of a company are utilized to their fullest extent to help the company reinforce its strengths or to help it improve its competitiveness and profitability, such properties, regardless of whether they are

built into hardware products as part of the company's hardware-related business or software and services are independent business segments of the company, will contribute to revitalizing the company and restoring the vitality of the industry. Due to space restraints and for the purpose of limiting the number of subjects to a manageable size, the latter half of the questionnaires were given to companies that deal with sales of software and services as both independent accounting items.⁵ This clarifies the degree of profitability achieved by independent appropriation and illuminates the

⁴ "Integration of Hardware, Software and Services in the Machine and Information Industry." Machine Industry Economy Report, H-14-5.

⁵ In the questionnaire, the question actually asked was "Are sales of software and services treated independently in your accounting?"

extent of its contribution to the company's business performance.

○Overview of the Questionnaire Investigation

- The questionnaire was distributed on October 4, 2002, and collected on October 25, 2002 (via post).
- All 576 subjects investigated were from listed companies, classified into machinery and machine parts suppliers (for huge companies, the questionnaire was sent to multiple departments; in total, 703 companies and departments), and 297 randomly selected non-listed companies.
- One hundred fifty-six effective responses were received. The effective recovery rate was 15.6%.

The actual situation was first analyzed by classifying the respondents into two groups: companies treating services as an independent business segment, or "service-software independent companies," and companies integrating software and services into their hardware business, or "service-software integration companies." While the former are companies for which services and software sales are independent accounting items (39 companies, or 27.9%), the latter are companies that integrate services and software with their machine (hardware) business (117 companies, or 75%)⁶. The key portions of the results are described below.

Emphasis on Software and Services:

⁶ From Question 14, respondents are divided into two: (1) those treat sales of software and services as that independent accounting items, and (2) those that do not. Therefore, there is a possibility that the respondents in the second group include some that are engaged in software or service-related businesses but that do not separate them out as independent segments and other cases.

Respondents as a whole seem to utilize software and services to enhance the competitiveness and profitability of their company. This tendency is seen in such response as "(we) consider software and services as constituting an important part of the machine (hardware) business to boost competitiveness and to improve profitability, so we combine them with machines (hardware). It is not our goal to simply increase the sales of software or services." Thus, the tendency to regard the "software and services business as part of the core i.e. hardware business" is commonly found among the responses of the service-software integration companies.

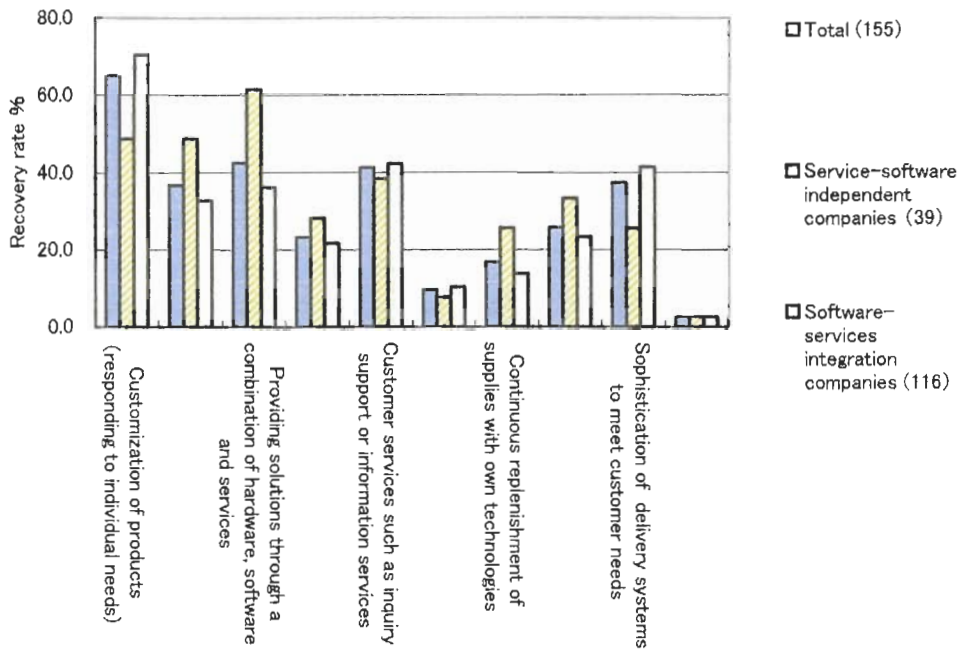
Management Resources Regarded as Important:

When companies consider it necessary to combine software and services with their core business operations, they seem to regard the "core technology of software and services" as the most important management resource. This response is followed by "human resources" and "competitiveness of hardware." "Information

assets and intellectual properties” scored high marks among “service-software independent companies,” while “price competitiveness” scored high among “software-service integration companies.”

Actions to Strengthen Competitiveness and Profitability: The two groups differ strikingly in terms of their actions conducted to strengthen competitiveness and profitability (see chart 4-1).

Chart 4-1 Actions Conducted to Strengthen Competitiveness and Profitability of the Core Business



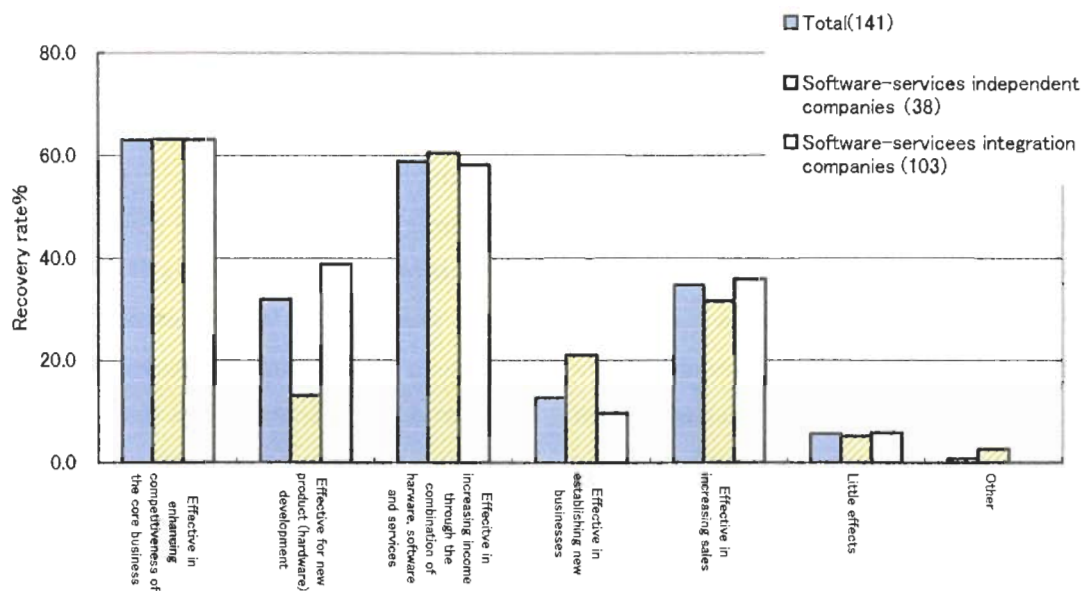
The uniqueness of the actions taken by “hardware-software integration companies” were shown in such responses as “customization of products” and “sophistication of delivery systems to meet customer needs.” On the other hand, “software-services independent companies” seem to consider providing “solutions through combination of hardware, software and services” and “systems and packages of core equipment” as important management resources. “Customer services such

as inquiry support or information services” scored comparatively high in both groups.

Main Contents of Software or Services: Nearly 60% of the companies responded that “strengthened competitiveness of the core business” and “improved profitability through a combination of hardware, software and services” produce synergetic effects. They perceive combining software or services with the core business as generating sizable effects. There is a wide gap between these two responses and the

next, “contributing to increased sales” (See Chart 4-2).

Chart 4-2 Synergistic Effects Generated by Integrating Software and Services with the Core Business (Multiple responses allowed)



Responses differed between the groups. While 40% of “hard-soft integration companies” replied that it is “effective for new product (hardware) development, the “software-service independent companies” said that it is effective in “establishing new businesses.”

Comparison with a Benchmark Company (Questions given to “service-software independent companies only): Eleven items related to business strategy were compared with those of a benchmark company. The subject companies replied that they are superior in only three items, i.e. “product (hardware) competitiveness,” “customization capabilities,” and “technological levels of software and services.” On the other hand, they replied that the benchmark company was superior in “price competitiveness,” “the number of human resources,” “tactics to attract customers,” “unique business models,” and “profitability.”

There are some problems that “product (hardware) competitiveness” and “customization capabilities,” which companies think that they are superior, do not sufficiently display synergetic effect of software or service combination, and the customization process involve too many difficulties. The results suggest that these drawbacks are the likely cause of their not being able to realize potential of high profitability.

Profitability - 1/4 in “software-hardware independent business companies”: Over 45% “software-service independent companies” replied that the rate of software or service business to the company’s total sales or to the business division account for only “less than 5% of the total sales.” Those replied “less than 10%” account for nearly 60%. The percentage of companies replied “over 30%” was about 23%. These suggest that the sales percentage of

software or service is not necessarily large. On the other hand, when we compare the ratio of profits in software and service to the entire company, the results are divided into two groups: companies with high profits-to-sales ratio and those not. To the question concerning the profitability of software or services related business, 25.6% of "software-service independent companies" replied that "software and service business is a successful profit-generating business in the company." The ratio of the R&D outlay to the total sales is low, suggesting insufficient capital allocation.

○Questionnaire results suggesting:

It has been revealed from the questionnaire results that, in the machine and information industry, there is a high expectation of integrating software or services, and "software-service independent companies" utilize intellectual assets. Although companies support the idea of improving competitiveness through the strengthening of the company's main business, or through integrating software-service with hardware, to generate a synergistic effect, in reality, the integration of software or service-related business do not always automatically lead to a strong competitiveness or to a high profitability. The results suggest that there are still issues to be solved in technologies, business models and human resources. Whether or not a company can achieve expected success depends on how the company deals with software and hardware business integration or conditions allowing it.

4.3 Three Background Factors behind the Growing Attention to Integration of Software

and Services Business

Unlike the machine (hardware) business, the software and service-related business in the machine and information industry can cover quantitatively limited fields. Most individual needs are covered by individual solutions. Since services, in particular, are human resources-dependent business operations, there are limitations to the amounts of cost slashing. It is, therefore, not easy to expect large sales increase, even though the business generates sizable sales. The situation is the same for the category of narrow sense software. Excluding such narrow sense software products as operating systems for computers or software systems mounted in mass-produced machines, the cost burden for a developer is huge. The costs include not just development costs but operation and maintenance costs and upgrading costs in the categories of custom software and application software tailored for individual users. Recently, the degree of complication and sophistication of software products has increased rapidly, making it difficult for developers to maintain quality assurance. Even though they develop high-end applications by employing expert engineers, it is difficult to convert these software products for other applications. As a result, the developers cannot maintain high level of profitability from these products. This is said to be the limitation of the order-based application software business.

Nevertheless, software and services are the segment that is attracting the keenest attention in the machine and information industry at present. The following three factors seem to be present behind the high expectations:

Competition for Sophistication in Software and Services: The first factor is the sophistication of existing software and services. Sophistication has been raised repeatedly in the industry. Recently, this competition is increasingly intense in the area of IT. The software and services business of the machine and information industry has the basic aim of marketing hardware products, and companies implement this business strategy for the purpose of promoting sales of hardware and improving the level of customer satisfaction with respect to the competition. Software or service products designed for these purposes certainly enhance the value of a machine's (hardware) utility, but they are not regarded as value-generating products per se. On the contrary, they tend to become a cost-driving factor rather than generating profits. Nevertheless, companies should remain committed to this strategy to avoid being left behind by the competition.

Reviewing the Software and Services Business as an Income Source: Secondly, the software and services business is gaining increased recognition as a new source of income. Software and services businesses are dependent upon human resources, and the exacting requirements incurred for the development of tailored applications and pressure to customize have suppressed the rapid expansion of the business. For these reasons, this business long failed to attract attention vis-à-vis the growing hardware business. Given the intensifying competitiveness of the hardware business environment, however, the software and services segment is gaining renewed attention as a new

income source. In addition, recent developments in IT have made it easier to provide more efficient support for machines, enhancing the segment's potential for growing into a profitable solution business.

In many cases, however, whether these independent software and services can really become sufficiently beneficial for users to pay extra for them willingly is the greatest question. Japan's machine and information industry and its users have placed higher expectation on "unbreakable machines" or "maintenance-free machines." Since software and services developed for these purposes have been regarded as "free-of-charge service" products, it is difficult to unbundle or charge for them. Also, in the field of narrow sense software products, processes that require manual work are increasingly outsourced to overseas vendors, or to oversea software companies that come to Japan to obtain orders under development contracts. For these reasons, it would not be easy to make software and services into a stable income source

Successful Precedents – Realization of High Profits Third, expectations are being pinned on companies which succeeded in generating high profits by embarking upon software-services integration business in areas that have hitherto not been regarded as high growth segments. The questionnaire results suggest, on the other hand, that software-services integration businesses are not very successful.⁷ Utilization of intellectual properties such as patents or

⁷ Interviewed by Mr. Hisashi Ono, Nomura Research Institute, January 14, 2003.

unparallel technologies, the method implemented in the software-services integration business model, is basically the same as the business model implemented in the photocopier and printer segments. Replenishment of supplies or regular maintenance service conducted in the photocopier and printer segments is an example of a business model that attempts to realize high profitability and stable income, even after the machine (hardware) is sold. There are some cases that deserve our keen attention. These are the companies that have succeeded in inventing a business structure making use of IT infrastructures, which have matured fully since the second half of the 1990s, for the purpose of generating profits in the business segments in

which high demand growth was no longer expected. This suggests that utilization of the huge intellectual assets that Japan's machine and information industry has accumulated over a long period, could be one way of increasing the possibilities of revitalizing the industry.

4.4 What Precedents Suggest

What assets must software and services businesses use to enhance their competitiveness and profitability? The following findings were obtained from the results of interviews of capital goods makers and successful IT companies^{8,6}. Such successful companies as GE and IBM of the United States were also surveyed for the purpose of comparison. The successful cases are summarized in chart 4-3.

⁸ The list also includes companies which have not yet established high income business operations.

Chart 4-3 Cases of Software or Service Integration Business

Company	Segment	Notable points	Operation start-up
GE (U.S.)	<ul style="list-style-type: none"> ·Aerospace engines ·Radiation apparatuses (ME) ·Large gas turbines ·Railroads 	<ul style="list-style-type: none"> ·Expanded market by changing the way of thinking→growth potential→larger income ·Developed business model that provides users with clear advantages ·Bought a company to strengthen technological capabilities and to establish an implementation system ·Full use of IT and IT infrastructure→developed new products ·Established a system of continuous upgrading 	<ul style="list-style-type: none"> ·Full-scale operation in 2nd half of 1990s
IBM (U.S.)	<ul style="list-style-type: none"> ·Middleware (software) ·Global service 	<ul style="list-style-type: none"> ·Emphasized servers in the hardware segment and middleware in the software segment (withdrew from application business) ·Stabilized income with services, aimed at high-risk, high-return in software and hardware businesses→larger income ·Outsourcing→joint venture with info. systems division of a client company→lock-in ·Allocated required talents aggressively 	<ul style="list-style-type: none"> ·2ndhalf of the 1990s
Company A*	<ul style="list-style-type: none"> ·Large gas turbines 	<ul style="list-style-type: none"> ·Responded to changes in the market and demand →secured market and added value ·Led the way with world-class technology in the hardware field ·Constructed proving plants, aimed at dominating by investing in IT earlier than others 	<ul style="list-style-type: none"> ·2nd half of the 1990s

		<ul style="list-style-type: none"> • Use of IT infrastructure, emphasized monitoring • Paid attention to the global market (domestic users have established a dedicated organizational structure) 	
Company B *	<ul style="list-style-type: none"> • Construction machinery 	<ul style="list-style-type: none"> • Competed with the two top hardware companies in the world • Use of IT infrastructure, emphasized monitoring • Advanced control (against burglary, ATM robberies) • Invested in a satellite communications company (obtained information gathering media) • Manages a direct servicing company → advantage of grasping user needs 	<ul style="list-style-type: none"> • 2000s
Company C*	<ul style="list-style-type: none"> • Social infrastructure system • Information systems and services 	<ul style="list-style-type: none"> • Change in demand (sale of systems → sale of services) • Currently enforcing selection and concentration (makes social infrastructure system, IT consumer electronics element of differentiation) • Aimed at global status in hardware (storage products) 	<ul style="list-style-type: none"> • On-going
Company D*	<ul style="list-style-type: none"> • Solution provision 	<ul style="list-style-type: none"> • Opened standards → (opened source code, standardized interface) → concentrated in middleware → responded to upgrading • High R&D outlay (15% of sales) • Obtained technologies to respond to customization and standardization • Set up a global business from the beginning 	<ul style="list-style-type: none"> • Since the 2nd half of the 1990s

Company E**	<ul style="list-style-type: none"> • Air conditioner 	<ul style="list-style-type: none"> • Mature demand → started maintenance and energy saving services • Packaged remote services → reduced customer costs → increased income • Based on the existing nation-wide service network • Accumulated customer data → proposed additional services → utilized them for product development 	<ul style="list-style-type: none"> • Since end of 1990s
Company F**	<ul style="list-style-type: none"> • Boilers and water-processing apparatuses 	<ul style="list-style-type: none"> • Sales of apparatuses → exploited onerous maintenance contract business • Established a system of “remote surveillance service for existing apparatuses + a nation-wide service network” • Provided “boiler + peripheral equipment” package service • On-line information sharing by maintenance staff • Nation-wide and the on-line center of the main office, development division 	<ul style="list-style-type: none"> • 1990s

*Through the survey. **Through interviews and corporate profile data.

1) Core Business – a Premise

In order to raise competitiveness and profitability not only by enhancing the functions of machines (hardware) but by integrating software or services into a company's business, it is necessary to secure the company's core business and utilization of intellectual properties. Successful companies have carried out business integration on the premise of their differentiable, supreme core business (hardware). This tendency has also been observed in the IT field, in which the core software and services are considered prerequisite.

(2) Establishing an Organizational Structure to Endorse Income through the Integration Business

Elements required for the integration business are different from those for manufacturing. The following points are observed in successful cases:

- Grasping user needs User needs are dynamically changing in line with a quantum leap in IT infrastructure and enlarged technological possibilities. It is the early adopters, such as IBM and SAP, that have succeeded in grasping needs at an early stage and connected them to expansion of their markets. For them, communication with users, joint development, and extraction and embodiment of the needs through the information-gathering and information-sharing efforts of outsourcing companies or of their own company are indispensable. Needs differ from user to user, however, and they are not easy to grasp. The precedents suggest that collection of

data and information on a long-term basis is essential. The example of GE's aircraft engine integration business suggests, moreover, that if companies change their mindset and recognize that there could be multiple times the demand in the integration business as compared with machines (hardware) alone, it is possible for them to increase sales and profits, even though there is no high growth potential in the machine (hardware) market. Global monitoring for this purpose is also important as a means of grasping user needs.

- Technological development essential In order to realize merits commensurate with the price paid by users and to make the business profitable for vendors, development of sophisticated application technologies and a rationale for offering them at reasonable prices are necessary. For this purpose, development of software or service products based on needs and data is essential. In order for a company to involve itself closely with customers in the areas of information and data, investment in IT that performs data collection, accumulation and analysis through monitoring is also important. Companies setting a precedent have conducted technological innovation on a continuing basis aimed at leveling maintenance costs by developing merchandize under long-term service agreements (LTSA); sophistication of services by operating measuring systems; and cost reduction by developing packaged products, which will eventually develop into advanced services. To this end, they have engaged in sophistication of application technologies and establishment of IT infrastructure, through construction of proving plants with capital on a

scale of a few tens of billion yen or through equity participation in satellite communication companies, for example. In other words, integration of software and services business with the core business requires application technologies and sophistication of IT-derived technologies. Unremitting efforts to improve these (continuous evolution) are also essential.

An environment for protecting intellectual property rights for user data collected through monitoring has not, yet been well established, however and this remains as an issue to be solved.

•Customization and standardization Although it is important to respond adequately to user needs, it is costly to provide a solution for each user. Development of a business model will provide the key to maximizing both the degree of customer satisfaction and profits. Precedent-setting companies have implemented a method known as the "Dell model," in which they accommodate customization needs for customers and standardization of the integration business, depending on the characteristics of particular industry or company.

Furthermore, they utilize IT in the above process and accumulate experience, know-how and other information to construct a database, or to share and utilize it not only on a domestic but also on a global basis, and thereby succeed in enhancing efficiency. These companies utilize IT for their business development, and they take 5 to 10 years to implement it as a business model. Meanwhile, they must grasp a standardizable scope through experience with many users and their know-how accumulation

and enlarge the scope of their customization. Once an IT infrastructure has been well established, needless to say, these companies are in a more advantageous position than others for accumulating information and know-how.

•Securing human resources The quality of human resources required by software and services integration businesses is changing gradually. In the United States, companies quite often secure human resources and techniques related to software and services through M&A. Unwanted staff are relentlessly slashed and replaced by new, necessary staff. In Japan, the required quality of human resources is also gradually changing, in line with the sophistication of user needs and the age of global business deployment and competition. Although companies replenish skills through mid-career recruitment to some extent, the main method of enhancing the skill level of employees is through in-service training. Given that each precedent stresses securing human resources to this extent, it is questionable whether or not Japanese companies can cope with the changes occurring in the securing of human resources on a global front.

(3) Synergistic Effects

The above examples equally demonstrate that operating a machine (hardware) business of its own is a must for bringing about synergistic effects when a company sets up an integration business. This is because possession of a hardware business works as a factor for differentiating itself from vendors dedicated to software and services businesses, putting it in an advantageous position relative to software and services. This, in turn, contributes to

development and production of next-generation machinery based on increased experience through closer relations with users and through accumulation of know-how. These synergistic effects will then, generate new potential for Japan in that Japanese companies will be able to utilize their strengths not only in IT, but also in actual products and in the actual world.

If software and services business grows further in the future, on the other hand, there is a likelihood that the significance of a company having its own machine (hardware) business could fade away. This is because, in order to operate its business from the user's viewpoint, it will be necessary to respond to user demands with a holistic approach, incorporating other companies' products and peripherals. Such a trend is already visible in some companies. Companies can cope with these requirements by making available various combinations of hardware, software and service. They also have to think about the contents of their software and services. These for example, could be a combination to win the competition, a combination to secure a stable income or a combination to earn large profits. The combination patterns vary, depending on the company or on the industrial segment. Further consideration will be required in this connection.

In this investigation, although companies in the machine and information industry as a whole showed considerable interest in the integration of the software and services business, there are actually some companies that

successfully improved their competitiveness and profits through integration of the software and services business. In order to make use of these experiences for revitalizing the entire machine and information industry, it will be necessary for individual companies to achieve substantial results in software-services integration. To this end, utilization of intellectual assets accumulated through a long history will play an essential role. Developing ways of utilizing existing intellectual assets is of primary importance. In the past, Japan was good at obtaining "tacit knowledge" information. But Japan must absorb tangible information as well so that this new type of information can also be incorporated and systematized in an evolutionary chain – accumulation → sharing → utilization → development → proposal. In order to realize this evolutionary chain, it will be necessary to establish a system for identifying the value of the intellectual properties incorporated in actual products and present in real world knowledge and to maximize their use. Companies must be fully equipped with IT infrastructures, and they must become more aware of their intellectual assets. Further promotion and improvement of fundamental infrastructure as well as creation of a better environment for intellectual assets are essential. At the same time, there is an urgent need for them to recruit and nurture human resources, including knowledgeable engineers, both at home and abroad.