The Sustainable Renovation of the Industrial Complex in Inner Tokyo: A Core of the Japanese Machinery Industry

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Abstract: The most important core that has sustained the innovations of the machinery industry of Japan is the technological complex composed of SMEs in Southern Tokyo, the core of which is Ota-ku. Entering the 1990s, the firms and their industrial complex have changed their respective methods of operations under the drastic change in economic conditions. That is, in addition to the founding (1st) generation the new generation participated as management and engineering staff. This resulted in the crystallization of craftsmanship and ME technologies to bring about the sophistication of plants and their complex. These innovations were led not by the TNCs but by the SMEs. Consequently the complex of SMEs that was in a vertical relationship with the TNCs has functionally grown into a horizontal one. At the same time, the new generation that has grown up together in the same area has promoted its network or interchanges with various types of residents to strengthen the overall industrial community. In recent years, the local government has promoted attractive regional industrial projects to strengthen and fortify both the technological complex and the innovative system. The measures taken for the vitalization of industry have in turn, brought about the improvement of the environment. In Inner Tokyo, the basis of sustainable renovation depends upon the renewal of the area based upon the symbiosis of industrial complex and the environment.

Key words: Southern Tokyo, technological complex, sustainable renovation, generation

Introduction

The sustainable development of industry should be investigated on the assumption of a symbiotic relationship with the preservation of the natural environment. Industry has been developed in the respective continents, countries and regions influenced by their natural and socio-cultural conditions. Therefore, the formation of regional industrial systems and their sustainable paths are different throughout each area respectively.

In Japan, after World War II, the manufacturing industry has developed at a high rate of growth under a nationwide production system that had its core in the metropolitan regions, most notably Tokyo. In the 1970s, problems related to pollution came to be predominant in Japan and the conditions in major cities became the target of harsh criticism. Industry was considered the culprit of destruction of the environment and it became the target of expulsion from urban areas. This manufacturing expulsion policy not only of national government but also of local governments was simply directed towards the industrial images of the heavy & chemical industries that were causing serious pollution. However, despite these industry expulsion policies, the nationwide industrial systems have not undergone any changes (Takeuchi 1996). On the other hand, steady fieldwork, supported by the method of interviewing over numerous plants was conducted by economic geographers who threw doubt on the industrial policies that continued to disregard the reality of circumstances (Tsujimoto et al. 1962; Itakura et al. 1968; Itakura et al. 1970; Takeuchi 1973a; Takeuchi 1978; Takeuchi and Mori 1981). Subsequently, economists, particularly the researchers of small & medium sized enterprises (SMEs), were considerably affected by the researches of economic geographers and many excellent empirical studies have accumulated (Sato 1981; Seki 1981; Ukai 1994; Watanabe 1997). The results of these field or empirical researches gradually began to be reflected in the regional industrial policy. Upon entering
the 1980s, the significance of concentration of industry in Inner Tokyo, the role of Tokyo in the nationwide system, the regional industrial system of the Tokyo area itself and the role of industry in the local economy became clear. As a result, the objectives of policies gradually became focused upon the promotion of industry in the urban area.

Entering the 1990s, with the steep appreciation of yen and the extended recession, industries have encountered the evolving of globalization with plants moving abroad, closing domestic plants down. Economists in turn have lead to predict the collapse of industry in Inner Tokyo. Without doubt, there has been a reduction in the number of plants in Inner Tokyo and there are many who thereby attempt to prove the hollowing out of industry in the inner city. However, this disregards the actual situation and is merely based upon statistics. In other words, industry in Inner Tokyo has been responding with severe discipline to the changes occurring in the prevalent international and nationwide industrial systems and continues to persevere and survive around a core of technologies to formulate a new type of knowledge-based industry complex based on hardware. Furthermore, new policies are being strongly promoted by the local government for sustaining a new industrial complex that places priority upon the preservation of environment.

The objective of this paper lies in the clarification of sustainable renovation of the industrial complex by SMEs in Southern Tokyo that is the technological core of Japanese machinery industry. For this purpose, the writers conducted detailed interviews of 120 plants and land use analyses of Ota-ku (city) in 1998 and 1999.

The Changes Occurring in the Industrial Complex of Southern Tokyo

Reduction of the plants in Inner Tokyo

The Tokyo metropolitan area has been not only the largest industrial region in Japan but also the biggest core of the national industrial
system for a long time (Takeuchi 1994). While this area covers the Kanto Plains, extending over a 100 km radius from the center of Tokyo, manufacturing plants tend to be located within a 50 km radius (Tokyo=Keihin region). The inner area consisting mainly of the 23 ku of Tokyo (city area) and heavily concentrated areas of the plants are in this area. Within the inner area, the southern part (Southern Tokyo) features a particular concentration of the machinery industry and metal processing which distinctly differs when compared to Eastern Tokyo where production of daily consumer goods is concentrated (Mori and Takeuchi 1996). The center of Southern Tokyo is Ota-ku near Tokyo (Haneda) airport. In recent years there has been a marked reduction in the number of plants compared to the first half of the 1980s. Although such a reduction is distinct in comparison with the peak years of the 1980s, the actual difference is only slightly lower when comparison is made with the period before the bubble economy. The difference is actually only slightly lower. Even now, Ota-ku still remains the area with the largest number of plants in the inner area of Tokyo.

**The concentration of industry and the utilization of land**

Although the overall number of plants in Southern Tokyo has declined, with respect to Ota-ku, the distribution pattern of plants have not changed (Figure 1). Most of the sites of large-scale plants has been converted to apartment housing and there has been a distinctive decline in the number of plants in the area surrounding railway terminals. The area where there is a large concentration of small-scale plants in Inner Tokyo is at the same time an area where there is a large concentration of population, and its land use is characterized by the mixture of working and living (Takeuchi 1974). Since the 1970s, the mixture of plants and houses was unfavorably evaluated as “confusion” by the city planners, economists and governments from the view point of land use. The manufacturing plants were considered to be evicted from the inner area. However, in the long run, did this persistent encouragement of plants to withdraw actually lead to change in

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Figure 2. Change of the land use in Shinomaruko district, Ota-ku, 1968–1997.

[Image of land use comparison between 1968 and 1997]
the system governing land use? Let us compare the land use of a typical block with a high density of the plants in Ota-ku, with that of 30 years ago. During this intervening period, the share of manufacturing plants within the total land use has increased and exceeded 50% (Figure 2). This also coincides with the results of our previous research in another block of Ota-ku (Takeuchi 1995). During the period of “bubble economy” in the 1980s, the plants could be sold for high prices. For the managers who had acquired a high level of technical know-how, it was feasible for them to become employees of Trance National Companies (TNCs) with high salary. Despite such circumstances, why was such a land use system sustained? Furthermore, why did many of the younger generation participate as manager or engineer of SMEs in this area? How could this phenomenon be explained by the fore-going, mainly neo-classical economic theories? It is no doubt, by any rationale, that such a land use system be conceived to be so strongly sustained.

**Composition of the manufacturing industry**

Looking at the content of manufacturing in Ota-ku with reference to the standardized industrial classification, an overwhelming majority of the manufacturing production in this area features the machinery and metal processing industries. This seems to imply a heavy concentration of large-scale plants of automobiles, computers, machine tools, etc. in Ota-ku. However, today there are no longer many large-scale plants of finished products there, with a few exceptions such as Canon, Ricoh, etc. In other words, a true picture of industry in Ota-ku cannot be understood only through looking at the standard categories of industry. Consequently it is also impossible to formulate any direction for the sustainable renovation of Southern Tokyo on the basis of such a limited scope. Only through a detailed classifications break-down of the actual work processes, can we really appreciate how highly diversified are

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**Table 1. Composition of manufacturing in Ota-ku**

<table>
<thead>
<tr>
<th>a. Composition of firms, 1998</th>
</tr>
</thead>
<tbody>
<tr>
<td>Casting, Forming</td>
</tr>
<tr>
<td>Pressing</td>
</tr>
<tr>
<td>Cutting</td>
</tr>
<tr>
<td>Grinding</td>
</tr>
<tr>
<td>Polishing</td>
</tr>
<tr>
<td>Canning</td>
</tr>
<tr>
<td>Surface finishing</td>
</tr>
<tr>
<td>Assembling</td>
</tr>
<tr>
<td>Heat treatment</td>
</tr>
<tr>
<td><strong>Total</strong></td>
</tr>
</tbody>
</table>

Source: Database of industry of Ota-ku.

**b. Size-Structure of the Plants (%)**

<table>
<thead>
<tr>
<th>Number of workers</th>
<th>1960</th>
<th>1995</th>
</tr>
</thead>
<tbody>
<tr>
<td>1~3</td>
<td>43.8</td>
<td>48.7</td>
</tr>
<tr>
<td>4~9</td>
<td>36.5</td>
<td>32.5</td>
</tr>
<tr>
<td>10~19</td>
<td>10.0</td>
<td>10.5</td>
</tr>
<tr>
<td>20~29</td>
<td>4.7</td>
<td>4.4</td>
</tr>
<tr>
<td>30~49</td>
<td>2.4</td>
<td>1.8</td>
</tr>
<tr>
<td>50~99</td>
<td>1.6</td>
<td>1.1</td>
</tr>
<tr>
<td>100~</td>
<td>1.0</td>
<td>1.0</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>100.0</td>
<td>100.0</td>
</tr>
</tbody>
</table>

Source: Manufacturing in Ota-ku.
the plants in this area. In practical terms, most of the plants consist of such processors as metal pressing, welding, metal plating, sheet metal forming and molding, etc. (Table 1a). The content of processing located here is said to cover such a wide range of capability that they can cover almost the whole range of minute processing at this site. These processors form a common base of the machinery industry and can be labeled as the “basic industries” (Takeuchi 1972). On the other hand, due to the small size of each plant and the fact that a lot of their products or processing itself are also small, there also exists a considerably wide range of special machines and parts manufacturers producing dies, jigs and tools. These plants are larger than the processors. As will be related later on, it is the groups of these plants that are taking the lead in the industrial complex in recent years, and it is their trend on which we will focus.

In looking at their composition broken down by respective scale, most of the firms consist of SMEs with less than 300 employees in statistical figures. Furthermore, the majority of SMEs in Ota-ku has less than 30 employees and therefore, their functional capabilities are very strong within the manufacturing system (Takeuchi 1975). Still, over half of the small firms are extremely small-scale (micro) plants comprised of less than four employees each (Table 1b). Inversely the number of plants with 300 or more employees declined from 33 in 1975 to 13 in 1995. Consequently, it can be said that the SMEs that sustain the industry of Ota-ku are those in the strata of micro-processors, and the machine manufacturers based on them.

Not a few foreign researchers consider that the industrial manufacturing system of Japan is governed by the TNCs while the SMEs subsisting outside of the KEIRETSU groups are an extremely weak element and their complexes have been considered as only the bottom structure in the industrial systems. Although the overall direction of industrial activity in Japan may be led by the TNCs, the role of the SMEs is rather under-estimated. This is because their analyses of the major cities only apply the case of Osaka or Nagoya (Edgington 1999) and have not taken notice of the Tokyo area. In other words, this is considered to be the consequences of paying less attention to the researches of economic geographers on the Tokyo area based on detailed field study. Ignoring the Tokyo region and confining studies to the Osaka and Nagoya regions, the TNCs as the leaders of specific industrial groups can be said to dominate the subcontracting groups of SMEs of the respective areas and appear to be dominant and governing throughout the whole range of Japanese industrial activities. However, putting the entire machinery industry not only of the Tokyo region but of the whole of Japan into perspective, we cannot ignore the presence of the core that serves to support the overall industrial innovation. Historically speaking, the most important technological core of the nationwide system of the machinery industries has been the industrial complex of Southern Tokyo centering on Ota-ku. It is important in the analysis of the regional industrial system, not to confound the idea of “core firms” with that of “core area.” However, a recently conducted study which reflects the effect of economic geographers, and a research of SMEs undertaken for many years based on extensive field work of Ota-ku (Wittaker 1996) has surprised many Japanese economic geographers, who have previously been quite prone to follow the trends established by foreign, often Anglo-Saxon economic geographers.

The Industrial Complex, its Formulation and Leveling up

Formation of the industrial complex

Accumulation of the machinery industry

The center of machinery industries prior to World War II in Southern Tokyo was closer to the CBD (Takemi 1930; Sumiya 1964). The concentration of the machinery industry in Ota-ku as the current center started from the latter half of the 1950s (Itakura et al. 1968). Many large-scale plants of electrical equipment, precision instruments, machine tools and automobile such as Toshiba, NEC, Oki Electric, Canon, Nikon, Ricoh, Isuzu, etc. are located in this area together with their many subcontractors (Matsuda 1960). In the 1960s, the industry
gradually moved out into Kawasaki, Yokohama and the southwestern outskirt of Tokyo, and the industrial area was expanded. But this movement did not cause any decline or weakening of industry in Southern Tokyo (Takeuchi 1973b).

From the latter half of the 1960s, national and local governments looked upon manufacturing as the culprit of pollution and forcibly moved manufacturing plants out of Inner Tokyo. On the other hand, manufacturing has been supported by economic growth, and the tendency of out moving of large-scale plants has been continued. In parallel with the move to vacate Tokyo by large-scale plants, SMEs also began to leave Inner Tokyo. However, in reality, a large number of the plants relocating to the extended area of Tokyo resulted in an expansion of the metropolitan industrial region, and on a nationwide basis, this came to imply the further concentration of the machinery industry in the Tokyo metropolitan region as the consequence. Since the inner area suffered from the out moving of many plants, its position in the whole Tokyo area declined (Takeuchi 1972). A majority of the economists, geographers, and urban planners forecast that the manufacturing sector would vanish from Inner Tokyo, and governments expected and supported their idea. However, a majority of the SMEs remained in Southern Tokyo, contrary to their expectation. The manufacturers, although small in size are responding to market demands with their own efforts. In other words, they have been raising their technological level as manufacturers or processors with originality, responding to the strict demands of various machine manufacturers. Within the area, various plants strengthened their cooperative relationship to each other through their own original technology, and formulated technological complexes (Takeuchi 1983). The large plants of automobiles, electrical machinery, machine tools, etc. were becoming located in the surrounding areas of the metropolitan region, and they contribute to form industrial systems of the Tokyo metropolitan industrial region. On the other hands, the industrial complex of Southern Tokyo shouldered an important role as the common technological base of the machinery industry of the metropolitan industrial region (Takeuchi, 1980). It was the industrial complex developed in the inner area that was prepared to respond to demands that enabled the machinery industries to expand (Takeuchi 1983). It was quite natural that the result failed to come up the expectation of governments, and many researchers did not observe or were unaware of the actual situation. This actually comprised the first step in the sustainable path of Inner Tokyo. Furthermore, during this time, there was growing participation of micro firms. Again, it is very hard to apply the ready made theories formulated in the western world to the interpretation of the presence, characteristics, and functions of industrial groups within the inner areas of large cities. The writers have been emphasizing the indispensability of fieldwork whenever conducting any analysis of industrial activities and its regional systems. It is particularly important for the investigation of SMEs, which reflect their respective regional conditions.

**Transformation towards a new hardware center** Entering the 1980s, technological innovation enabled progress, with the transformation to Micro-Electronics (ME) serving as a core. However, in the latter half of this decade, the appreciation of yen, the further heightening of international competition, etc. caused a deterioration of operating conditions governing manufacturing. The SMEs were facing severe demands of customers to reduce costs and improve their level of precision. At the same time, the shortage of labor became rather acute and labor costs increased sharply through the rapid rise in the wages. This caused a serious shock, especially to the micro firms that had developed with high reliance upon the craftsmanship skills. Such firms respectively acquired ME technology through their own efforts, and they transformed their production systems based on scientific technology. In this way, the technological complex, through “learning by practice” brought about the renewal of the “new hardware center” of the whole Tokyo region. This was to fortify a learning system for the innovation of firms in Inner Tokyo. Firms that refused to expend efforts towards acquiring this level
of sophistication or which failed in such attempts naturally were eliminated from the ongoing severe competition. This fact was one of the major causes of the decline in the number of plants.

Southern Tokyo has been featured as a "seed-bed" or "incubator" by numerous economists and economic geographers. However, this is a misunderstanding caused by the absence of appropriate fieldwork. In other words, manufacturing in Inner Tokyo having been at times forced by governments to move out, they have survived as firm as wild grass in situ. They have never been a subject of protection by the governments or any public or private organizations. The managers and engineers in Southern Tokyo who always overcame technological innovation by their own efforts, are all imbued with their sympathy as the "working community," forming an area which has its own unique cultural features. This is the second stage of the sustainable path in Southern Tokyo. However, despite the very high technological level attained through their own efforts, with respect to the large enterprises, they were still mostly positioned at the end of the vertical and subcontractual relationship.

New stage of the technological complex In the early 1990s, the Japanese economy plunged itself into a long term recession as a result of the sudden increase in the value of yen and the intensity of international competition. Under such circumstances, many of the plants were moved out to Southeast Asia, China, etc. and the stagnation of industry in Japan became a reality. The stagnation in the inner area of major cities was far more severe than the outskirts or provincial areas. The number of plants in the inner cities experienced a sudden drastic decline and many economists forecast a hollowing out of the industries. Nevertheless, in such circumstances, the manufacturers in Southern Tokyo are proceeding to achieve a renewal of themselves and their complex through their own efforts. This transition appears to be similar to the situation caused by the rise in the value of yen in 1985. However, the actual correspondence of the manufacturers and industrial complex is different from that of the 1980s. What were the major features of the renewal of the manufacturers and their complex in the 1990s?

Participation of the new generation and renewal of the firms and the complex

In the 1990s, the outstanding feature in this area is the participation of the new generation as management or engineering staff in the business, added to the first (founding) generation. Although two generations are usually grasped only as the confrontation, is not so simple, indeed. Most of the first or founding generation started their business around the 1950s and belongs to the senior (65 years or more) generation. In other words, members of the first generation who are usually lacking in higher educational backgrounds, have used craftsman skills to boost their technology and have usually accommodated the demands for ME by customers. In comparison, the new generation is well-educated and also rich in academic background. It is natural, therefore, that many of them have studied ME and other so called high-tech fields. They have many friends in various fields through their life, and they are surviving through a wide network of information. The two generations have tended to oppose each other in both business philosophy and the way of thinking regarding engineering and management. However, highly developed craftsman's skills of the first generation and ME technology or modern sense of new generation are mutually understood and lead to crystallization through mutual discussion and practical development of a new products (Figure 3). For instance, the vacuum pump is the indispensable life-component for the manufacturing of the bill-counting machine. The critical process of the vacuum pump production is a drilled-hole measured infraction of a micron. Know-how of the hole was developed and practiced by a lone craftsman of the first generation. It is he who founded the pump manufacturing firm, which is why this company enjoys 90% of world share. However, the technology to have the computer memorize them and make continuous production feasible depends on the ME engineering of the new generation.

One of the conditions that makes this crystallization possible is the fact that the new genera-
tion has, since childhood, looked at the way of life of their father's, and been brought up with a feeling of pride in the behavior of the first (founding) generation. That is to say the new generation has matured as members of the community with a strong affinity to manufacturing. Compared to the first generation, the new generation has, through their school life with a wide range of human relationships, nurtured a very open mind. Furthermore the range of interchange among corporate enterprises is often on a nationwide basis and sometimes even international basis. Therefore, it is natural that the new generation becomes the motivating and pulling power for the formation of inter-firm networks. Many of the firms of which the owner is the first generation have not been able to implant an interest in manufacturing in the mind of the succeeding generation, and without the participation of the new generation they have to be leftbehind. The firms that have failed to survive are conspicuous among micro firms of less than three employees. However, there are rather many firms in this strata as well, that have succeeded in their renewal. Basically, the decline of the number of plants in Southern Tokyo is due to the firms that have failed to survive because of their inability to cope with the technological revolution. This is rather a natural result as for the process of sophistication of the industry. In other words, it is incorrect to lay the blame for the decline in the number of plants and the number of employees to the drop in the functional capability of the designated area. This particular concept regarding "generation" is one of the important concepts in grasping the dynamic shift and change of industrial trends.

Table 2. Categories of renewed enterprises by the orientation

<table>
<thead>
<tr>
<th>Category</th>
<th>Example</th>
</tr>
</thead>
<tbody>
<tr>
<td>(A) Ultra high level of processing</td>
<td>Unique processing</td>
</tr>
<tr>
<td></td>
<td>Grinding of non-spherical lens</td>
</tr>
<tr>
<td>(B) Particular products</td>
<td>Specialized mechanics or parts</td>
</tr>
<tr>
<td></td>
<td>Precision molds</td>
</tr>
<tr>
<td>(C) Development and trial manufactur-</td>
<td>Trial or pilot type Production for large companies</td>
</tr>
<tr>
<td>ing</td>
<td>Proposal of know how for other firms</td>
</tr>
</tbody>
</table>

The classification of renewal of manufacturing plants

Although there are many different kinds of plants which have coped with the environmental changes and accomplished a high level of achievement, it is possible to classify them into the following three categories (Table 2). The first refers to the majority of firms that have achieved their objective through acquiring high precision processing technology for fractions of a micron. However, the ratio of adopting ME machines is low among them and the majority has employed various standard machine tools. For the processing in small units, the use of standard machine tools are indispensable, and they likewise make the use of highly skilled craftsmanship also indispensable.

The second refers to the manufacturers of single models of finished products, parts, and molds. To enumerate examples of such items, it will be rather useful to refer to the development of the can opening tab by a small firm. At first, a research institute of the University of Tokyo received the request from the largest can manufacturer in the US on the development of a precision mold for manufacturing of a safe can opening tab. However, it failed despite a large amount of fund invested. It is rather surprising that the system was developed independently by a small firm with only seven employees. There are many examples like this in Ota-ku.

The third classification covers requests from TNCs for the development, testing, trial manu-
manufacturing and production of prototypes, and the prescribing of production methods to be employed. There are firms that receive such orders from more than 50 different customers in four days. And they have been able to complete development of one product. The technological level of such a firm is extremely high. Most of them depend on standard machines or equipment rather than MC nor NC machines. It is predictable that this type of firm will increase in numbers in the future.

In this manner, the overall concentration of the plants in Ota-ku features the acquisition of high level technological expertise and inclusive of craftsmanship skills, imbued with a high level of processing skills and labeled as a "specialized technology district" (Storper 1992). Furthermore both products and processing are, as already mentioned, featured by the fact that they have been independently developed upon the basis of pre-existing technology. Of the enterprises investigated, 75% are in the stage of a worldwide top-level classification and they have acquired technology that is identified as the only one of its kind. In the case of Southern Tokyo, the "key firms" that lead in innovation are not TNCs but SMEs. Furthermore their main strength lies not in the "Chuken firms" of among the New-medium strata that have recently been the focus of attention (Nakamura 1990; Hayter 1997), but the micro firms of even smaller scale.

**Strengthening of the Localized Industrial Complexes**

**Improving the autonomy of industrial complex**

In the case of the manufacturing of Southern Tokyo, there is the necessity of issuing procurement orders to a wide variety of numerous processors. For instance, manufacturing plants in Ota-ku are almost all smaller than 50 sq. meters in area. Therefore, there is a limit to the extent of in-house processing. On the other hand, it is risky for them to go into a new field outside of their own specialty. This automatically necessitates to share possession of procurement processors with high level of technology and skills, which are well known to them and located in the same area. The reasons of purchase from the plants in Southern Tokyo are: first, acceptable technology and quality, second, precise delivery, third, capability of development, and fourth, reliability, as conditions uniformly applicable. At present, there are many plants in Southern Tokyo that are moving to the outskirts of Tokyo. However, they invariably leave their planning, development, and trial or pilot production operations in Southern Tokyo. This is also conditioned by the fact that they are able to have a number of other associate processing plants with high technological level and able to share their work. Another source of attraction of Southern Tokyo is the presence of vendors and traders capable of accommodating urgent demands of any kind of material regardless of quantities required. This capability cannot be found anywhere else. What is important in Southern Tokyo is not the scale of the enterprises but the scope of operating groups.

Southern Tokyo in entering the 1990s has experienced the changes as already mentioned through the crystallization of a merging of two generations. They independently boasted their high level technological capabilities to the world and succeeded in bringing their manufacturing groups commensurate to the shares of top quality production. This has caused not only the Tokyo region but also of the machinery industries on a nationwide basis, to rely upon these technological complexes. In other words, these relationships that are based upon high level of processing, feature strong intra-regional network. Based on that, in the case of parts and finished products, inter-regional networks become predominant. However, because manufacturing in such complexes is on extremely high technological level even in the case of excessively small firms, such firms receive orders from throughout the country. We may conclude that the relationship between the scale of the plants and the extent of the network is not always clearly defined. This strong engineering or technological complex and the regional innovative system of Southern Tokyo is being led by the "key plants" that is capable in both development and processing. Most of
the key plants are small in scale including micro firms.

In recent years, the SMEs have been improving their autonomy as not only individual enterprises but also as industrial complexes. In the machinery industrial systems composed of the SMEs outside Tokyo, they are considered as rallying under the TNCs in a vertical linkage. On the other hand, industrial complexes of SMEs in Southern Tokyo are clearly shifting into a horizontal one (Figure 4). The strong support of such a trend is definitely a requisite in the sustainable renovation of industrial complexes in Inner Tokyo. This is also the way for industrial complexes based upon skills, being developed into new types of knowledge industrial complexes that are accompanied with relevant hardware. It is not appropriate to confine the "knowledge industries" to be led only by the software. In this process, however, it is quite natural for the firms not to be able to keep up with the technological learning system and to be left behind and henceforth. There shall be a considerable decline in the number of surviving enterprises. It is impossible to move such autonomous and high level of localized technological complex to provincial areas of Japan or overseas. It is extremely difficult to formulate such an innovative systems and its milieu in a short time. Under such circumstances, one of the most important problems faced by Japanese industrial policy makers is determining how to sustain and develop the technological complexes of SMEs in Southern Tokyo centering Ota-ku. The sustaining and rising of technological complexes of Southern Tokyo are also of the most significant importance for the machinery industry of Asia which is developing on the basis of strong technological ties with Japan.

Renovation of industrial complexes, the community, government, and environment

Generation and the community The new generation not only brought about a rise in the level of the technological complexes but also changed the characteristics of the community that supported them (Figure 5). For instance, up to the first half of the 1980s, there was a concentration of more plants than today in
Southern Tokyo. However, in those day, there represented an arena wherein the craftsmen were merely engaged in competition among themselves. They were strongly bound by a common feeling that conducted their processing together under the TNCs vertical governance. Although they formed a "productionist culture" that assumed a "lord of the castle mentality" (Wittaker 1996), they were immature as an "industrial community" (Takeuchi 1973b). During the latter half of the 1990s, the number of plants declined in Southern Tokyo, and new houses were built on the former manufacturing sites that were vacated and looked converted to residential area by appearance. However, the regional feature as the socio-industrial complex integration of plants with the homes of their management and work force has not changed (Takeuchi 1985a; Mori and Takeuchi 1996; Takeuchi 1996; Ota-ku 1995). On this particular aspect, an investigation of 2,000 plants in Eastern Tokyo has revealed the same trend (Takeuchi et al. 1997).

The younger generation that commenced their participation in the 1990s was all brought up in the same area as opposed to their parents originated from many different provincial areas in Japan. And the younger generation has possessed a close-knit social networks since their childhood. Therefore, they are not only working together in this area but are continuing their association in recreation, social and cultural activities of a daily life. As the natural consequence, they become fully acquainted with and understand each businesses. The members of the new generation are sharing their industrial life. And they are not only members of the same generation groups in their business but are becoming deeply engaged with their parents' generation, through their friendships and the mothers engaged in PTA activities, and also interchanges even with the other residents who are not related in any way to the manufacturing. Compared to the times when there were more plants, the density of daily association has become closer and tighter.

In Inner Tokyo, there is very little distinction or awareness of the difference in terms of social class among residents, as compared to Europe or the US and this has no significance whatever in intermingling of the populace. Particularly in the case of neighborhood in Inner Tokyo, the addition of the new generation or the succession and retirement of generations does not bring about any social segregation, which is apparent in the western society (Scott 1988). Of course, there is an increase in the ratio of office workers in this area. And the majority of the new generation graduated from universities or colleges. Whether they are the children of managers or not, they have a common industrial mind to challenge with the higher technology. Consequently many different social groups are fused and joined together, forming the warm-hearted community. This does not relate in any way to forcible exclusion of the plants from the area with the exception of a few bigoted people who are still under the mind control of an erroneous concept similar to "witch hunting" of the 1970s.

The addition of this new generation has become one of the more important aspects in favor of the sustainable renovation of not only the industrial space but also the social space. As a result, the "industrial community" has become more consolidated. The consolidation of the community were amalgamated by a heart to heart relationship, serves to fortify or strengthen the technological complex, and is an important condition and/or for the embeddedness for its sustainable development.

The role of governments Until the 1970s, the manufacturing industries in Inner Tokyo were considered as injurious and harmful, resulting in the execution of a policy favoring forcible extrusion of plants from Inner Tokyo. Both the central and local governments applied this formula. However, despite such severe pressures, the plants of Inner Tokyo have retained their robustness for survival. The result of detailed fieldwork succeedingly conducted by Japanese economic geographers reveals the actual situation, and was instrumental in changing government awareness such that policies drastic revision after the beginning of the 1980s. Particularly in the early 1990s, MITI for the first time correctly became aware of the significance of the accumulation of the plants. With the enactment of "The Law of Temporary Measures Concerning the Activation of Specific
Industrial Accumulation" based on the idea of geographers, the unjustified severe restrictions upon the locating of the plants were alleviated (1999). In the “Revitalization Project of the Tokyo Bay Area” by the central government, emphasis was placed upon the role fulfilled by the accumulation of plants in Ota-ku (Takeuchi 1999).

In the case of Ota-ku, manufacturing is deemed to be supporting not only the economy, but also the cultural and social aspects of their life. The pillar of the fundamental policy of Ota-ku is to establish an “industrial city,” promoting the further expansion of industry through comprehensive action with the private sector (Wittaker 1996). In practical terms, a database is being prepared on the products and technologies concerning all enterprises based on related software, supporting the information exchange system through investment from both the public and private sectors. Action is also being taken to back up a study and learning system for both management and technology and also a system for corporate interchanges. Through such actions, the breakdown of industrial division is progressing. At present, there are five actively cooperating groups by firms of dissimilar industries, with the government as catalyst. These groups were originally spontaneously formed. They became established by the support of governments and are now rather secure and preplanned, and being given support for “embededness” of technology-oriented industry. Assistance of the government is being extended to participation in trade fairs held overseas places like Chicago, Hanover, Singapore, etc.

Sponsoring of national and international trade fairs in Ota-ku is also assisting the growth of corporations in this area. This is promoting the development of relationships not only with the TNCs in Japan but also with foreign enterprises as well, since the physical aspects, industrial parks and industrial apartment complexes, are under construction. The improvement of small and unclean plants is being accomplished through the introduction of the “New Factory Project.” The construction of industrial centers (PIO) that become points of focus for the activation of industry is playing a dominant role in the software related policies for the promotion of various seminars, interchanges activities promotion of inter-firms cooperation, trade fairs, etc.

Co-existing with the environment Government policies upon first glance appear only for the activation of industrial activities. However, in fact, they are also contributing to the improvement of the physical environment. In other words, the construction of centers for the promotion of industries (PIO), the construction of industrial parks on the reclaimed land, and the construction of industrial apartment complexes represent a comprehensive vision of manufacturing and residence being fused together. And industrial building for high tech industry is also an example of realizing effective land use, where for instance, in an industrial apartment complex, the plants are located on the ground floor with the second floor and above being devoted to the residence of managers or workers. In the case of combination of manufacturing and living, the public pollution created by the generation of noise, vibration, etc. can be avoided, and it can also contribute to the improvement in external appearance. Among these “plant and housing combination facility,” there are no firms that have failed during the last ten years. These combination structures have provided great improvement to both the environment and the urban appearances. Industrial parks have provided a solution to serious pollution problems related to urban areas and have also contributed to produce actively operating environment for manufacturing.

Therefore, it is obvious that the promotion of manufacturing does not run counter to the interest of the maintenance of a pleasant environment and the realization of harmonious land use. These operations are expected to play an important role in the renewal project of the Tokyo Bay Area to produce a space for people to play, live, study and work together. Currently in Southern Tokyo, the basis for industrial policies has been constructed through the reflection of their past policy of driving out the plants from Inner Tokyo. Now the direction has changed drastically to an evaluation of industry as playing continuously an important
role not only in the regional economy but also on a more expanded to the overall scale. In other words, the promotion of the formation of "ideal" land use and the strengthening of the industrial community based on the symbiotic relation of industry, living, and environment should be the basic direction in which sustainable renovation in Southern Tokyo is to proceed.

Conclusion

The development of industry and its role in the economy as a whole, differ from one country to another. As for the respective enterprises, it is possible to analyze on the basis of global standards in the case of TNCs. However, it is more complicated for SMEs. The differences between countries and between specific regions are much greater because the activities of SMEs are affected substantially by local conditions. In the case of Japan, industrial systems since before the Meiji Restoration (1868), the people introduced western technology by their own efforts, acquired them on the basis of pre-existing technology, and formulated regional industrial systems. Accordingly, it is impossible to properly assess this development on the mere basis of western standards. Furthermore the same applies to domestic conditions in Japan, since rural and urban areas differed greatly, as is also the case between large cities such as Osaka and Tokyo. This is particularly important when considering the significance of SMEs and their complexes in Inner Tokyo and their sustainable development. Inner Tokyo has not been protected by the governments. In fact, the policy was directed for a long time toward forcible expulsion. They have comprised the technological core of national systems. Therefore, it is impossible to characterize industrial complexes such as Southern Tokyo only by the borrowed western concept of "industrial district." The industrial complexes of Southern Tokyo are independent and are endowed with an exceedingly high ability to conduct development. As a machinery production system, they have evolved to formulate an independent technological complex that has been promoted to reach a horizontal and equivalent relationship to TNCs. As a result, complexes based upon skills have grown to become a new type of knowledge-based industrial complexes. The sustaining and development of these industrial complexes of Southern Tokyo is an extremely important issue when considering the national system of the machinery industry. The renovation of the industrial complex in Southern Tokyo is realized by the promotion of a symbiotic relationship among the regional economy, the community, land use and the natural environment. This should be also the desirable realistic direction of the regional and industrial policy in Inner Tokyo.

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Notes

1. Southern Tokyo consists of Ota-ku, Shinagawa-ku, Meguro-ku and a part of Minato-ku in Inner Tokyo. The "ku" (ward) of Tokyo respectively comprise the same administrative functional units as other single cities.

2. The number of plants in Ota-ku declined from 8,897 in 1985 to 6,787 in 1995, and in the same period, the number of employees also declined from 95,602 to 62,864.

3. In the concentrated area of small plants in Inner Tokyo, most of the managers and their families live on the same site as the plants. Employees also live in the same ku of the plants or a neighboring ku or city with various service sectors such as shops, restaurants, beauty salons, barbers and schools which depend mainly on the people who are engaged in manufacturing. They form a unifying area of residence and manufacturing which is characterized as a 24 hours, warm hearted community (Takeuchi 1973b, 1974, 1985b, 1988, 1994).

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