Development of the Recycling Industry and Restructuring of the Old Industrial Complex: A Study on the Relationship between the New Environmental Industries and the Agglomeration of the Existing Heavy and Chemical Industries in Kitakyushu, Japan

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Abstract Kitakyushu is one of the oldest industrial districts in Japan. The stagnation of its regional economy has continued for a long time. However, in recent years, the recycling business has grown remarkably in Kitakyushu. The purpose of the present paper is to analyze the relationships between the existing heavy and chemical industry complex and the recycling industry in Kitakyushu. The environmental industry, especially the recycling industry, has a strong relationship with the heavy and chemical industries with respect to materials, technology, markets, etc. Information about wastes such as quantity, kind, and price of wastes is very exclusive and acquisition of such information is very costly. However, in the heavy and chemical industry complex, the exchange of wastes (by-products) has been actively performed up to now, and the cost of such transactions can be held down to a relatively small amount. The steel and cement industries are utilizing wastes as raw material and fuel. The materials production industry is now acting as a “recycling industry”.

The growth of the recycling industry shows the possibility that manufacturing, which is becoming hollowed-out, may rebound in Japan. The production conditions, as well as the waste management practices in the region influence the location of enterprises.

The successes of the recycling industry have brought changes to the inter-firm relationships common in old industrial districts. New linkages and networks are being constructed.

Key words: restructuring, industrial complex, recycling industries, Eco-Town project, transaction cost, industrial agglomeration

1 Introduction

A large body of literature in economic geography refers to industrial agglomerations. In contrast, there has not been much analysis of the heavy and chemical industrial districts and the industrial complexes that were previously important subjects of economic geography studies. The agglomeration of the heavy and chemical industries seems to have become a relic of the past. The stagnation of the old industrial districts has prompted observations encouraging changes to the industrial structure in a lot of advanced countries. In these old regions with rigid inter-firm relationships, local industries and enterprises have not created the flexible inter-firm networks that foster a connection with continuous innovations and new business opportunities. Ongoing development of the regional economy is obstructed (Grabher 1993; Hassink 2005; Keith 2005).

The current paper focuses on the agglomeration of the heavy and chemical industries, taking
up the Kitakyushu industrial complex, an old industrial district in Japan. Changing industrial complex in this district gives interesting topics in order to rethink the agglomeration of the heavy and chemical industries. The recycling industry, one of the environmental industries attracted attention recently, has rapidly expanded. The close industrial linkages between the recycling industry and the existing heavy and chemical industries enable the industry to grow.

The heavy and chemical industries have been considered to be ones that cause serious pollution problem. Air pollution or water pollution by harmful substances that these industries discharged have actually caused damage to many residents in the industrial district and it's surrounding. After the 1970s, however, these industries have reduced emission of harmful substances in some degree. As reduction of emission, the environmental pollution issue started slowly move toward solution. The emission of harmful substances has been reduced by some methods: law concerning the pollution control was established, industries that discharged emission developed their technology to remove harmful substances, and industrial structure in this district was converted.

However, removal of harmful substances from emission is less than perfect up to this time. For such occasions, a heavy and chemical industrial district will have one dilemma; if industry is regulated in order to keep environment, a decline of regional economy and reduction of employment will be caused, on the contrary, if industry grows, it will have a bad influence on environment. The dilemma is well-known problem that economic development, especially growth of the heavy and chemical industry, and the pollution control are in the relation of the trade-off. Such situation has operated as "institutional, political and cognitive lock in" for the economical change in old industrial regions (Chapman 2005; Hudson 2005). This viewpoint widely diffused belief in developed countries. Much the same is true of Japan. However, there are industrial districts that go their alternative ways in the industrial complex area of Japan. The districts have adopted the strategy in which economic development and environmental improvement are reconciled. It is recycling industries to play an important and center role for the strategy, which Japanese government also supports in order to improve the environment control.

Recycling is a business field in which growth will be expected in Japan, and the government began the Eco-Town project in 1997 to promote agglomeration of the recycling industry as part of the environment control. Under these circumstances, Kitakyushu Eco-Town has been the most successful venture aimed at attracting recycling plants in Japan.

Promotion of recycling is an important measure for the construction of a sustainable society, and has been analyzed from various approaches. Recently, much literature has focused on the recycling business (Ueta 1992; Porter 2002; Togawa 2002; Okamura 2004). The agglomeration of the recycling business in Japan has been explained in connection with the "Zero-Emission plan" for the industrial complex (Togawa 2001; Okamura 2004). However, the agglomeration process and its effect on the recycling industry have not been analyzed sufficiently. On the other hand, studies on the old industrial complex have focused on showing the reasons why the heavy and chemical industrial district has stagnated. However, they do not explain the growth of the new recycling industry in an old industrial district, especially Kitakyushu.

The concern of present paper is to determine the reason for the rapid development of the new industry in Kitakyushu, which is an old-type industrial district. Why has the recycling business developed in Kitakyushu, while the creation of new industries in many other old industrial dis-
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2 Declining the Kitakyushu Industrial District and Developing the Recycling Industry

Features and Problems of the Kitakyushu Industrial District

The Kitakyushu industrial complex, located on the northern part of Kyushu, is one of the oldest industrial districts in Japan. This industrial complex was established with the construction of the government-ownedYawata Steel Works (presently, Nippon Steel Corporation, Yawata Works) in the Yawata village, now in the Kitakyushu City. It was the initiation of industrialization of Japan.

The main industry in this district was coal and steel. The iron ore imported from China and good quality coal mined in the surrounding area (Chikuho coalfield), encouraged the rapid development of the steel industry in Kitakyushu. Moreover, chemical plants and ceramic factories began locating in the district during the 1910s. The three industries had created a large industrial complex that accounted for 10% of the industrial production of the whole country in the 1930s. Thus, the Kitakyushu industrial district established its position as one of four big industrial districts in Japan, which included the Keihin (the Tokyo-Yokohama metropolitan area), Chukyo (the Nagoya metropolitan area), and Hanshin (the Osaka-Kobe metropolitan area). The productive capacity of Kitakyushu depressed once by World War II.

After the World War II, the Kitakyushu industrial complex again and rapidly recovered with the revival of the Japanese economy. Since then, this industrial district has been the engine of the high growth of Japanese economy, which has been based on the heavy and chemical industries. Its position in the Japanese economy, however, has dropped gradually since the latter half of 1950s. The first reason for this decline was a change in the import orientation of iron ore. As the import of iron ore from Pacific Ocean coastal nations (Australia and United States) increased, the import center moved to other metropolitan and maritime ports from the Moji port in Kitakyushu.

Although steel production in Kitakyushu continued increasing, other new industrial districts grew at a faster rate than Kitakyushu. The locational advantage of Kitakyushu was lost due to the change in the import routes for raw materials.

The second reason for the decline is the energy revolution. The main energy source in Japan was coal until the 1950s, replaced by petroleum since that time. The nearby Chikuho coalfield received a great economic damage. As the main chemical industries in Japan changed materials from coal to naphtha derived from imported crude oil in the latter half of 1950s. The Kitakyushu industrial district lagged behind in the conversion from coal to naphtha. The new petrochemical industry had not developed enough in Kitakyushu. As the result, the district was defeated by competition from new industrial districts that had sophisticated and new plants.

The rapid development of Japanese economy ended due to the oil crisis in 1973. The Kitakyushu industrial district, however, had faced its growth limits before that. Steel manufacturing in Kitakyushu had become increasingly less competitive with the later industrial complexes using new equipment. Therefore, the steel industries in Kitakyushu had already begun to scrap and rebuild since the latter half of 1960s.

The conversion of the industrial structure in Japan beginning in the latter half of 1970s further accelerated the economic slump in Kitakyushu. In
manufacturing, the center of growth shifted to electronics, motor vehicle and semiconductors from heavy and chemical industries. The growing industries have come to Kitakyushu industrial district: motor vehicle, and semiconductors. However, the existing heavy and chemical industries lagged behind the quick response to these changes, which had a negative impact on the Kitakyushu economy. Many enterprises attempted to restructure to respond the changes, also consolidated existing facilities, and embarked eagerly in new fields. But the restructuring policies have not always succeeded. The depression in the steel industry caused redundant labor, unutilized land and a stagnation of the regional economy. The population of the Kitakyushu City has decreases continuously since 1979 (Fig.1). The vulnerability of the regional economy, which had depended on a single industry and a small number of large enterprises, was clearly evident.

The local government has dealt with the adjustment of the industrial structure, promoting the electronics industry, new materials, IT and IC industries, etc. However, the economy of Kitakyushu has not recovered despite these efforts. In declining the Kitakyushu economy, the growth of the recycling industry in this area has gathered attention in recent years.

**Recycling Industry and the Eco-Town Project in Japan**

The recycling industry is expected to grow rapidly in Japan. The amount of the market and employment in the environmental industries of Japan are shown in Table 1. It is forecasted that the market scale of businesses related to the environmental industry will expand from about 21,500 billion yen in 1998 to about 34,100 billion yen in 2010. The number of employee is expected to expand from about 780,000 to about 1,180,000 in the same period. The environmental industry is regarded as one of the high growth sectors in the midst of stagnation and a hollowing-out of the Japanese manufacturing industry.
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Table 1 Prospect on Environmental Business in Japan

<table>
<thead>
<tr>
<th>Field</th>
<th>1998</th>
<th>2010</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Turnover</td>
<td>Employee</td>
</tr>
<tr>
<td>1 Pollution control &amp; Circulation use for water</td>
<td>7,434</td>
<td>227,126</td>
</tr>
<tr>
<td>Air pollution control</td>
<td>464</td>
<td>6,078</td>
</tr>
<tr>
<td>Water pollution control</td>
<td>5,149</td>
<td>128,202</td>
</tr>
<tr>
<td>Circulation use for water</td>
<td>1,668</td>
<td>91,304</td>
</tr>
<tr>
<td>Others</td>
<td>154</td>
<td>1,542</td>
</tr>
<tr>
<td>2 Waste management &amp; Recycling</td>
<td>11,483</td>
<td>496,786</td>
</tr>
<tr>
<td>Waste management</td>
<td>5,669</td>
<td>346,970</td>
</tr>
<tr>
<td>Recycling</td>
<td>5,814</td>
<td>149,816</td>
</tr>
<tr>
<td>3 Restoration of natural environment</td>
<td>2,466</td>
<td>31,709</td>
</tr>
<tr>
<td>4 Analysis and assessment on environment</td>
<td>140</td>
<td>23,333</td>
</tr>
<tr>
<td>5 Environmental energy</td>
<td>33</td>
<td>218</td>
</tr>
<tr>
<td>Total</td>
<td>21,566</td>
<td>779,172</td>
</tr>
</tbody>
</table>


Figure 2 Eco-Town Areas in Japan

Waste management and recycling is the largest of five divisions in the environmental industries, accounting for about 11,400 billion yen and 53.3% of the whole in 1998. That division employs the largest number of employee, which represents 63.8% of the environmental industries.

Waste problems have become aggravated in Japan. The shortage of landfill sites for waste disposal is a serious concern. The wastes generated in metropolitan areas is often carried and dumped illegally to the countryside, which has led to regional conflicts and calls for the construction of new landfill sites. Hence, this has led to a promotion of the recycling business to increase the reclamation of waste.

Laws of environmental controls, recently im-
implemented in Japan, have played an important role in promoting the growth of recycling industry. In particular, the law concerning recycling has made a lot of progress in this decade, obligating firms, municipalities, and residents to promote recycling. The new environmental controls have provided the groundwork upon which many environmental businesses were formed.

As part of its environmental initiatives, the Japanese government started the *Eco-Town* project in 1997. The project, which aims to promote environmental industries, has been developed in 24 districts throughout Japan (Fig. 2). The *Eco-Town* project has two purposes: to develop the regional economy through environmental industries; and to construct a sustainable society.

Under the program, environmental industries are promoted through the “screening of regions” and government “subsidies”, which are a conventional way of industrial promotion in Japan. To be approved as an *Eco-Town*, the local government has to generate an environmental promotion plan (*Eco-Town* plan). This plan is judged by the Ministry of Economy, Trade and Industry and the Ministry of the Environment. If approval is obtained, the region will be authorized as *Eco-Town*. To obtain the subsidy, the recycling business plan of each applicant is examined. The criteria of selection are originality, pioneering and the possibility of serving as a model business in another region, etc. Therefore, it is very important for the local government and the enterprise to cooperate and to complete a business plan earlier than other regions because of the difficulties in obtaining approval for a business plan that is presented late. This approach aims to avoid setting redundantly up identical plans by many different regions, and to promote original environmental businesses through regional competition 1).

The Success of *Eco-Town* Project in Kitakyushu

The Kitakyushu *Eco-Town* has been the most successful project in the promotion of the recycling industry. The Kitakyushu *Eco-Town* plan consists of three spheres, which are carried through in three zones. The first is the advancement of function in basic research and education on environment at Kitakyushu Science and Research Park. In this zone, basic environmental research and waste management is carried out, and talented students are trained in environmental business and policy. Secondly, the empirical research zone has been set up in the coastal part of Wakamatsu Ward, and research facilities of these enterprises have agglomerated. These facilities focus on researching practical technology for waste management and recycling. Thirdly, the promotion of recycling businesses to attract enterprises is centralized in the business zone of the coastal part. The Kitakyushu local government tries to maintain close relationships among the basic research, the empirical research and the environment business facilities (Matsunaga 2003, 2004b).

In the first stage of the Kitakyushu *Eco-Town* plan (1997–2002), the industrial complex zone (business zone) was built for the growing recycling industry. The plan aimed to develop the large unutilized site of the steel plant in the coastal part and to form an agglomeration of recycling firms in this site. Eight enterprises have already located their factories there, and recycled seven types of waste (PET bottles, office automation equipments, automobiles, consumer electronic equipments, fluorescent fixtures, medical devices, and construction debris) (Table 2). Most of these enterprises have reduced processing costs because of collecting a large amount of waste in the large site and processing operation on large-scale. In addition, a waste-to-power generating enterprise is also located here.

Many existing larger manufacturing enterprises
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Table 2 Environmental Businesses in Kitakyushu Eco-Town

<table>
<thead>
<tr>
<th>Area</th>
<th>Business</th>
</tr>
</thead>
</table>
| Industrial Complex Zone | PET bottle recycling  
Office automation equipment recycling  
Car recycling  
Consumer electronic equipment recycling  
Fluorescent recycling  
Medical device recycling  
Construction debris recycling 1  
Construction debris recycling 2  
Waste-power generation |
| Empirical Research Area | Food waste recycling  
Styrene foam recycling |
| Industrial Complex Zone for Small and Medium-Sized Enterprise | Used cooking oil recycling  
Can and bottle recycling  
Waste fluid recycling  
Waste paper recycling  
Car recycling |
| Second Industrial Park and Others | Amusement machine recycling  
Printer toner cartridge recycling  
Wood waste recycling  
Wind power plant  
Beverage container recycling |

Source: The data from The Kitakyushu City

within the Kitakyushu industrial district have invested in the recycling sectors. Through investment, larger enterprises maintained a close relationship with the recycling factories. In addition, technology and skilled labor is exchanged between recycling factories and existing larger enterprises. For example, the technology of the steel factory is used to material recycling process of the PET bottles. Similarly, many recycling factories utilized the equipment, technology and knowledge of related manufacturing enterprises.

A relationship with the large established manufacturers has encouraged the small and medium-sized enterprises and venture startups. In order to advance their businesses, the industrial estate was constructed. The firms that recycle cooking oil, cans and bottles, waste fluids, end-of-life vehicles and waste paper located their factories here, and constructions of factories were faster than predicted by the plan. Other enterprises are examining the business scheme. Numerous studies in economic geography have addressed that the promotion plan and the relationships with larger enterprises has important roles on attracting many venture startups. The first stage plan of Kitakyushu Eco-Town (1997-2002) succeeded beyond the original forecasts.

The second stage plan was approved on August 2002, and the industrial estate for environment business was expanded. Recycling factories for printer toner cartridge, wood waste, and beverage container and amusement machine, and wind power plant have already been completed in this second industrial estate 2).

The location of such a range of recycling enterprises is often pointed out as an admirable feature of Kitakyushu Eco-Town (Hosokawa 2000). Such an evaluation is appropriate when considering that the Eco-Town business aimed at the development of the recycling industries. However, the advantage of Kitakyushu is not only the agglomeration of recycling firms. More important is in the agglomeration of the empirical research facilities. A total of 24 empirical research facilities of universities and enterprises have been located in the coastal part of Wakamatsu Ward (Table 3). There are few loca-


Table 3 Research facilities in Kitakyushu Eco-Town

<table>
<thead>
<tr>
<th>Location enterprise</th>
<th>Operation</th>
</tr>
</thead>
<tbody>
<tr>
<td>1  Yokogawa Bridge Corporation etc.</td>
<td></td>
</tr>
<tr>
<td>2  Kyushu Institute of Technology etc.</td>
<td></td>
</tr>
<tr>
<td>3  Takenaka Corporation etc.</td>
<td></td>
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<tr>
<td>4  Kurita Water Industries LTD etc.</td>
<td></td>
</tr>
<tr>
<td>5  Fujita Corporation etc.</td>
<td></td>
</tr>
<tr>
<td>6  Taisei Corporation etc.</td>
<td></td>
</tr>
<tr>
<td>7  Obayashi Corporation etc.</td>
<td></td>
</tr>
<tr>
<td>8  Kumagegumi Corporation etc.</td>
<td></td>
</tr>
<tr>
<td>9  Kumagegumi Corporation etc.</td>
<td></td>
</tr>
<tr>
<td>10 Kumagegumi Corporation etc.</td>
<td></td>
</tr>
<tr>
<td>11 Kumagegumi Corporation etc.</td>
<td></td>
</tr>
<tr>
<td>12 Environment Technos Corporation etc.</td>
<td></td>
</tr>
<tr>
<td>13 Ijima Corporation</td>
<td></td>
</tr>
<tr>
<td>14 Hossy family Japan Corporation</td>
<td></td>
</tr>
<tr>
<td>15 Workshop of WOW-System</td>
<td></td>
</tr>
<tr>
<td>16 Nippon Steel Corporation etc.</td>
<td></td>
</tr>
<tr>
<td>17 Hazama Corporation</td>
<td></td>
</tr>
<tr>
<td>18 Hitachi LTD etc.</td>
<td></td>
</tr>
<tr>
<td>19 Fukuoka University</td>
<td></td>
</tr>
<tr>
<td>20 r-nissei corporation etc.</td>
<td></td>
</tr>
<tr>
<td>21 Ebara corporation etc.</td>
<td></td>
</tr>
<tr>
<td>22 Nippon Steel Corporation</td>
<td></td>
</tr>
<tr>
<td>23 Institute of The Kitakyushu City</td>
<td></td>
</tr>
<tr>
<td>24 Institute of prefecture</td>
<td></td>
</tr>
</tbody>
</table>

Source: The Internal data from The Kitakyushu City

3 Significance and Restriction of Agglomeration of Heavy and Chemical Industry

Agglomeration of Heavy and Chemical Industry and the Development of Recycling Industry

Why has the recycling industry grown up in the Kitakyushu industrial district?

In recent years, while globalization progressed with accelerating speed, the localization of production in the narrower regions has changed. In relation to the latter phenomenon, much literature concerning economic geography has pointed out the importance of industrial agglomeration. The strength and the competitive ability of regional
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economies such as Silicon Valley, Third Italy, and Ota Ward in Tokyo has developed from the advantages of industrial agglomeration generated by many enterprises located within a specific spatial range.

"Flexible specialization" and "transaction costs" are used as key concepts in the analyses of economic geography (Scott 1988; Yanai 1997; Matsubara 1999; Fujikawa 1999; Mizuno 1999; Tomozawa 2000). The system of standardized mass-production broke down during the latter half of 1970s, and uncertainty in the market has increased. To correspond with the changing market trend, the enterprises divided their production processes horizontally and vertically. Therefore, many specialized firms were formed, and flexible relations develop between those enterprises. As a result, the transportation and the transaction costs increased.

The transaction costs are necessary to enable firms to trade in the marketplace: costs to find business opportunities; the costs of negotiation and contract; the costs to fulfill contract and so on. These transaction costs are considered to be information costs on the goods and the contract. Transaction costs increases when the production process is divided horizontally and vertically because the acquisition of information to connect different enterprises becomes difficult. In order to overcome the increasing costs, many enterprises located their factories in proximity.

The spatial agglomeration enables the enterprises or factories located there to access easily and quickly to information, and to respond quickly to various and fluid markets. Spatial proximity becomes especially important for obtaining implicit knowledge, as well as explicit information. It is important for enterprises to obtain not only the formalized information like a mail order catalog through business but also obscure information that is not processed for a specific purpose. It is, however, difficult for an enterprise located outside the industrial district to acquire such information enough, especially information on tacit knowledge, which circulates chiefly by face-to-face contact and hearsay in agglomeration area. The advantage of industrial agglomeration in this case is evident. Especially, this advantage works strongly in a field that demands are diversified and shifting quickly. The IT, prototype machine and fashionable clothing industries are such examples.

How does such analysis apply to the recycling industry?

The requirements of recycle business follow: 1) a large amount of waste; 2) useful substances contained in the waste; 3) homogeneity of waste; 4) a system for gathering a large amount of waste; 5) recycling technology; and, 6) demand for recycled goods (Ueta 1992; Akimoto 1994). These show that raw material (waste), recycling technology, and markets for products (recycled goods) are important and necessary conditions for the recycling business.

In the collection of waste, existing industrial districts have larger advantage. Industrial waste discharged by the factories is more homogeneous and higher in quality than domestic waste, therefore, the recycling of industrial waste is comparatively easy and inexpensive. Needless to say, a large volume of industrial waste is generated in industrial districts. Therefore, it is easy for the recycling firms to collect high-quality waste in industrial districts. Kitakyushu industrial complex has the role as the supplier of raw materials for recycling.

In Kitakyushu, existing manufacturers has developed much technology for recycling: PET bottle recycling and the used car recycling. The power generation utilizing wastes as fuels in Kitakyushu Eco-Town have used the technology developed by the steel manufacturer. These recycling companies have strong relationships with the steel
company that capitalizes these firms and provides the machines, devices, and engineers.

For instance, almost all the scrap iron and nonferrous metals that are collected by the recycling factories from consumer electronics and office automation equipment are sold in the Kitakyushu city. Moreover, the residue generated from the recycling of medical devices is accepted as raw materials and fuel for the cement plant in Kitakyushu and its surroundings. The agglomeration of existing manufactures has become markets for recycling products.

The background of the recycling business is not only raw material, but the technology and market in the industrial district as well. However, it is very difficult to gather through markets information about the three factors (raw material, technology, and market) of wastes, because the distribution of waste is different from one of normal goods. It is important for the waste recycling industry to gather and to tie the information about the three factors for new business.

In general, a database of information on waste is not easily constructed. Manufacturers do not want to indicate either the kinds or amount of waste produced. In some cases, the waste discharged by an enterprise shows its technological level and production achievements of the enterprise. The manufacturer puts out wastes, therefore, selected carefully business contacts for its wastes and recycling.

The treatment of waste in Japan has been taken on by numerous small businesses, each with very intricate processes. Therefore, it is arduous to obtain information about the reliability of an enterprise and the cost of waste management. It is a feature of the waste management industry that the transaction costs are higher than ones in other industries. Under such circumstances, the Japanese enterprises have treated their wastes through not markets but habitual practices and personal connections.

The Japanese government has tried to create waste management businesses and recycling industries through market mechanisms. The Eco-Town project is one of the attempts. As discussed previously, the raw material (waste), the technology, and the market are interrelated in the recycling business, by which the recycling industry is force to bear high transaction costs. Industrial agglomeration works effectively to reduce the transaction cost. Otherwise confidential information on waste is frequently exchanged through face-to-face contact within the industrial district, and such information enables the agglomeration of the recycling business.

Recently, some information on waste has become open to the public on the Internet. The attempt which starts tying efficiently information on the waste, the recycling technology, and the agents of waste managements and so on has been activated. However, such an attempt does not seem to succeed easily, because information recorded in the list is only very limited. The recycling industry grows up in specific regions that have agglomeration of the heavy and chemical industry. The case of Kitakyushu industrial district explains it.

Limit of Network Based on Agglomeration of the Heavy and Chemical Industry
The agglomeration of the recycling industry has been built on an inheritance from the heavy and chemical industries. However, at the same time, features of the existing manufacturing facilities restrict the development of the recycling industry: for instance, restrictions on formation of new partnership and inter-firm relations, and tapping new markets.

A feature of the industrial structure in Kitakyushu is the strength of the basic material industries, especially the steel and chemical. The industries are characterized by rigid and vertical inter-firm
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relationships that the larger enterprises dominate at the top. The transactions of industries are very exclusive. These inter-firm relationships forced subsidiary companies to hold back the narrow scope of the product and the process technology. Many small- and medium-sized subcontract factories rely on orders from a few larger companies. The mode of such inter-firm relation has a long history, and has formed the milieu of regional economy on Kitakyushu up to now.

As a result, the marketing and R&D functions of those enterprises are insufficiently developed. New industries and businesses cannot easily enter the market of the basic material industries because of the exclusiveness of business field in such an industrial district. For example, some recycling enterprises in Kitakyushu have purchased mechanical equipment not from local manufacturers but from foreign manufacturers or ones of another region, although there are firms in Kitakyushu that have the ability to make the equipment. Some enterprises with such advanced technology have lost new business opportunities because they lack a marketing and R&D function, and, especially, they lack the entrepreneurship.

In economic geography, such rigidity in old industrial complex is considered as obstacles to the transformation of the industrial structure and to regional economic growth. Hassink (2005) explains why the restructuring of an old industrial region has not advanced by using the concept called the “three lock-ins”: functional, cognitive and political. The functional lock-in refers to hierarchical inter-firm relationships, and the cognitive lock-in shows a lack of the entrepreneurship (Grabher 1993). The political lock-in defends the profits of an existing sector (larger enterprise and especially, labor unions), and creates an atmosphere in which many actors do not like competition or changes in the regional economy (Edquist 1997). These lock-ins, which are closely related, have brought a continuous decline in the economic viability of the old industrial district.

The new recycling cluster arises from the Kitakyushu industrial district, which is a typical, old industrial complex. It resulted from the efficient use of the heavy and chemical characteristics. However, the rigidity pointed out in literature has not disappeared, and there is a possibility that it will further obstruct the development of recycling industries. Sustainable development requires a separation from such stiffness. The success of Kitakyushu Eco-Town may trigger the creation of a flexible new network between firms in this old industrial district.

4 Creation of New Networks

Recycling Business Network in Kitakyushu Eco-Town

As already described, the agglomeration of the recycling industry in Kitakyushu is based on the heavy and chemical industry and a close relation has not existed between the recycling enterprises. Each recycling factory has an area for gathering waste and for sales of post-process goods, which are not clustered to take immediate advantage of agglomeration (Matsunaga 2004a). However, relationships between the recycling enterprises have recently become strong.

The deals for waste and the recycled materials circulating between the enterprises located in Kitakyushu Eco-Town are expanding. The location of power plant within Kitakyushu Eco-Town has created opportunity for strengthening inter-firm linkages. The power plant which was built in 2005 utilizes the waste generated by recycling factories as fuel. The electricity made here is supplied to the firms in Eco-Town. The power plant has built up a circulating system of wastes and recycled materials, and close inter-firm linkages centered on
itself in *Eco-Town*. The recycling plants firstly recycle the waste appropriate to its process, and then exchange the wastes material that cannot be recycled till then. Thirdly, the final wastes generated by recycling factories are used in the generating station. This inter-firm cooperation reduces both costs (cost of electricity, transportation, disposal of wastes) and waste in the industrial estate. If these efforts advance further, a market of recycled materials may develop, stabilizing the procurement of the wastes, and affecting an expansion of the recycling industry agglomeration.

**Kitakyushu Eco-industrial Complex Plan**

The inter-firm cooperation in relation to the environmental industry has begun to occur outside *Eco-Town*, as well. The “Committee of the Eco-industrial Complex Plan” is composed of 15 major enterprises with factories in the Kitakyushu city. This committee, which started in 2003, aims to use surplus energy, to recycle wastes, and to foster inter-firm relationships. The reports submitted in 2003 and 2004 have shown three strategies: a cascade use of surplus energy; development and use of hydrogen energy; and the recycling of material resources. To date, the utilization of resources and energy has been optimized in each factory.

The Kitakyushu eco-industrial complex plan aims to overcome limitations of the factory, enterprise, and *keiretsu* frame, and to achieve the best use of resources and energy at an industrial district-wide. The purpose of this plan is not only to reduce environmental disaster, but also to improve the competitiveness of the heavy and chemical industries and to revive the old industrial complex in Kitakyushu by sharing electricity, exhaust heat, and waste.

The Japanese heavy and chemical industry complex is restructuring due to a price-dumping war with the other Asian manufacturers (Sugiura 2001). It is a process of hollowing-out the manufacturing sector and the regional economy, and resulted in vacant land, excess facilities, and redundant labor. To sustain enterprises in the region given such circumstances and to attract new factories, it is necessary to improve local conditions to enhance competitiveness with the foreign companies. In order to maintain competitiveness, strengthening the inter-firm and inter-factory linkages becomes important because of reduced production costs.

The strategy of the eco-industrial complex is an attempt at the reconstruction of the industrial complex through environmental concerns. This plan has resulted in the setting of a new paper mill in Kitakyushu in 2004. The factory was constructed on the site of the steel manufacture factory. The paper mill uses the site and the building of the unutilized facilities. Therefore, the construction cost of factory was reduced and the construction period was shortened. The paper mill uses cheap surplus electricity from the steelworks, and the steelworks recycle sludge and waste generated by the paper mill as a raw material. Both companies share the advantages of reduced transportation costs due their proximity and inter-firm linkage.

**Formation of the New Inter-firm Linkage**

1) Reorganization of the Nippon Steel Corporation Group: Integrate Yawata

A new inter-firm linkage occurred in the Nippon Steel Corporation Group, which has played significant role with Kitakyushu *Eco-Town*. This network, named Integrate Yawata, is composed of 25 enterprises. Many of the enterprises that participate in this network were derived from Nippon Steel Corporation entities.

The Nippon Steel Corporation has restructured its business over tens of years, corresponding to the decline of the steel industry. As a result, some sections have become independent corporations.
Although the enterprises belong to the Nippon Steel Corporation group, there are no close mutual relationships among the different types of businesses. They have operated individually, and do not share information on technology, equipment, professionals and ideas. Significance to form the group has been almost lost. To improve coordination, the Integrate Yawata group was established.

This organization has two purposes. The first aim is to strengthen the inter-firm linkages. Recently, many enterprises have increased the use of subcontractors to reduce costs. Instead of approaching outside enterprises for subcontracts, orders are placed within the group. Previously, tasks that could have been accomplished by group members were purchased from outside firms because information within the group had not been shared. The Integrate Yawata has created an efficient network where sharing information has made possible the best use of each enterprise's strengths.

The second purpose is to increase joint contracts. The firms have restructured and specialized, as a result they work within a very narrow field. To share information, they strengthen the inter-firm linkages and relationships, through which they increased joint contracts within the group. The Integrate Yawata has six teams: the environment, engineering, logistic distribution, information technology, medical care, and education. An organizer introduces members to customer based on consultations, which may result in "flexible specialization".

2) Kitakyushu Interdependent Business Consortium for Sustainable Development: KICS

Cooperation between the firms outside the keiretsu system is becoming more prominent. In Kitakyushu, the enterprises that are interested in environmental business organized an industrial group called the Kitakyushu Interdependent Business Consortium for Sustainable Development (KICS), established in 1998 by 45 middle-size local firms. KICS is composed of various types of enterprises such as transportation, service, manufacturing, consulting, and recycling, etc. One of the purposes of KICS is to create new business opportunities in Kitakyushu through mutual cooperation. Another one is to promote environmental businesses in foreign countries. KICS holds a conference monthly. Their activities can be classified into five fields: collection of information on technology and market concerning environmental businesses; project development; collaboration among them and university, government and other business personnel; and public relations of KICS.

5 Conclusions

The industrial agglomeration of existing heavy and chemical industries has played an important role of creating a new recycling industry in Kitakyushu. The agglomeration has contributed to reduce transaction costs concerning buying and selling wastes and the demand for recycled materials, and to develop the recycling industry successfully.

The growth of the recycling industry shows the possibility that manufacturing, which is becoming hollowing-out, may rebound in Japan. Local enterprises have the responsibility of appropriate waste management; therefore, the agglomeration of the recycling industry provides an advantage to the whole regional economy. The principle of "extended producer responsibility" strengthens such a tendency. New production conditions, as well as waste management practices in the industrial district, have influenced the new location of the enterprise.

What plays such a role is not only new recycling factories. Steel works in Japan have expanded to accept waste plastics as an alternative raw material to coke in the blast furnace to decrease the
manufacturing costs and reduced the environmental burden. Cement manufacturers have also embraced the application of wastes as raw materials and fuels. These materials production industries have played an important role as "recycling industries", providing old industrial districts with key roles again.

The success in the recycling industry is bringing the changes in inter-firm linkage. It has not been demonstrated whether the new network succeeds. However, the situation "lock-ins," which are obstacles to the reform of the old industrial district, have been changed. The agglomeration of the heavy and chemical industries provides benefits to the recycling industries, and the agglomeration of the recycling industries strengthens the old heavy and chemical industrial district.

However, the recycling industry and Eco-Town project of Japan share some problems. The first is the increasing international competition in the recycling business. The other Asian countries also recognize the recycling industry as growing sector, making efforts to promote the development of industry. The Environment Science and Technology Parks just like Eco-Town of Japan are built in Taiwan, and The Eco-Industrial Parks are setting up in South Korea and China. Recycling industries have many field of labor-intensive processing. Therefore there is no guarantee that Japan survives in competition with these countries that have the many and cheap labor forces. A large amount of waste is already exported to China from Japan. As a result, the shortage of materials has actually arisen on a part of recycling business of Japan. It is predicted that such a trend causes hollowing out of the Japanese recycling industry.

The second issue is that the Eco-Town project is built on the Fordist system: the "mass-production, mass-consumption, and mass-abandonment". The recycling business required a large amount of waste. But we should decrease waste in order to build the sustainable society. It is a contradiction and a restriction of modern society system. It is necessary to shift from the mode of mass-production and mass-abandonment the new sustainable system. The Eco-Town project in Japan faces a turning point.

This paper was revised on Matsunaga (2004a).

Notes

1) However, a large-scale recycling business is actually advanced in most Eco-Town plans, and the uniformity is pointed out in the review process.
2) Six enterprises have been receiving the subsidy of the Ministry of Economy, Trade and Industry among these recycling factories: the PET bottles recycling; office automation equipments recycling; the automobiles recycling; the consumer electronic goods recycling; fluorescent lamps recycling; and, construction debris recycling.
3) Inter-firm cooperation has not necessarily expanded of its own accord. The role of local government as the mediator is also important.

References


Development of the recycling industry and restructuring of the old industrial complex (497)


リサイクル産業の発展と重化学工業地帯の再生
—環境産業と既存重化学工業の集積との連関を中心に—

松 永 裕 巳

要 旨

北九州は日本で最も古い工業地帯のひとつである。国内の他の重化学工業地帯と同様に、そこでもオイルショック以降の構造不況の影響を受けて、長期間にわたり地域経済の停滞が続けてきた。しかし1990年代後半以降、北九州においては、既存の重化学工業との強い親和関係から、リサイクルビジネスの活発な成長が観察されている。

本稿では、北九州におけるリサイクル産業の発展が、既存産業（重化学工業）の集積上のような連関とつながりを持ちながら進行しているのかについて考察する。1990年代以降に活発化する産業集積をめぐる議論では、機械関連産業における中小企業を中心とする産業集積に話題が集中している一方で、かつて集積をめぐる焦点のひとつであった重化学工業のそれについては等間視されている。本稿は、等間視されていた重化学工業の産業集積に改めて光を当て、北九州におけるリサイクル産業の活発な成長に対してその産業集積が有する産業連関上の意味を明解する。これによって、産業集積をめぐる議論に対して新たな視点を付加することを試みる。

リサイクルビジネスは、原料（廃棄物）・処理技術・再生品の市場などの点で、既存の重化学工業と生産連関のままならず、種々の側面で強い連関をつながりを有している。ここで特に重要となるのは、廃棄物に関する情報である。一般に、廃棄物の排出量、種類、価格などに関する情報を、廃棄物元企業の生産連関情報（原材料の構成、技術水準、生産量など）に密接に結びついていることから、示されている情報は個々の企業が一般商品市場に出回ることが少なく、したがってその取得には大きなコストが必要である。しかし、従来から廃棄物（副産物）のやりとりが活発に行われてきた重化学工業では、こうした情報が比較的得やすく、その取引コストは相対的に小さくなる。このことが、リサイクルビジネスの立ち上げはもちろん、その他の当業の成長・発展にも有利に作用している。つまり、北九州においては、既存の重化学工業を、リサイクル産業という新たな成長分野の創出、さらにその後の発展において、生産連関だけでなく、原料（廃棄物・副産物）供給および再生資源の需要という情報の連関においても、重要な意味を持っているのである。またリサイクル産業の発展に伴って、こうした連関を逆方向の連関も展開されている。製鉄業やセメント工業など既存の重化学工業の重要な側面においても、再生資源や廃棄物の積極的な利用が進んでおり、したがって、素材産業そのものが「リサイクル産業」の役割を担いつつあるのである。

こうしたリサイクル機能の集積は、既存の重化学工業の活性化に寄与することなく、空洞化しつつある製造業の国内回帰の可能性を高める上でも重要な意義を有している。環境意識の高まりの中で、メーカーは廃棄物を適切に処理することができることが求められているが、これは製造業の大きな課題であるとともに、ただでさえ高い国内コストを引き上げる要因ともなってきた。しかし、地域内における廃棄物の適切な処理およびリサイクルが比較的容易であるということになれば、廃棄物処理に課題を抱える企業・産業の誘致に対して大きな誘因になる。したがって、北九州におけるリサイクル産業の発展は、これまでのような単なる生産条件だけではなく、廃棄物を適切に処理し得るという条件からも、企業の立地、さらには産業の新たな集積にとって重要な意義を与えるものである。

さらに、リサイクル産業の成功は、古い工業地帯に特有な硬直的な企業間関係に変化をもたらしている。環境をキーに新たな企業間ネットワークが、従来の系列や企業グループ内に限定されていた取引関係の枠を超えて、構築されつつあるのである。

キーワード：リサイクル産業、エコタウン、取引コスト、産業集積、工業地帯の再生

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