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Decentralization of Production and the Formation of Technology Regions: A Case Study of the Koriyama Technopolis

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Abstract: There are two steps in Technopolis development: attraction of high-tech industries to the designated areas, and construction of technology linkages between these incoming high-tech plants, existing plants, local universities and government R & Ds. The latter step of Technopolis development is examined in this paper using the example of Koriyama technopolis. Data used in this study are derived from questionnaire surveys and personal interviews with the high-tech plant managers in the Koriyama technopolis area. It turns out that industry-university-government technology linkage formation is not well developed due to the absence of proper information channels and lack of interest from the high-tech plants in the results of technological cooperation. These problems seem to stem from the nature of branch plants and the historical technological development of Japan. Therefore, a long time period is necessary for the formation of technology linkages in provincial areas.

Key words: decentralization, high-tech plant, technology linkage, Technopolis, Koriyama

Introduction

With the development of high-tech industries, many regions put their economic priorities on innovation techniques in order to obtain high-tech oriented industrial development. Regional planners have viewed decentralization of production, facilitated by information technology, as a key to regional industrial development (Amirahmadi and Wallace 1995). Attempts have been made to consolidate these activities following decentralization from large urban areas, and to form innovative regions for long-term economic development. The Japanese "Technopolis Plan" was one of these attempts to attract high-tech industries (decentralized from the large urban areas) to designated regions and to form industrial development areas.

There have been many studies on the Technopolis Plan by both Japanese (Yamazaki 1992; Itoh 1998; Tanaka 1996; Fujita 1988) and Western economic geographers (Glasmeier 1988; Stöhr and Pönighaus 1992; Sternberg 1995; Masser 1990) since the plan was established in 1983. Each Technopolis has its 5-year targets in manufacturing production value, workers, productivity, and population. Most of the Technopolis studies emphasized two points: the weakness of the Technopolis Plan itself (Yamazaki 1992; Glasmeier 1988; Takeuchi 1996), and the goal achievement of Technopolis areas (Yamazaki 1992; Ito 1998; Tanaka 1996; JILC 1997; Stöhr and Pönighaus 1992; Sternberg 1995). Through these studies, the failure of the Technopolis Plan became clear. Some of the main reasons for this failure include: designation of many Technopolis areas with insufficient central government support, mismatch of expected economic impact and decentralized production facilities, and production shift to Southeast Asia following the appreciation of the Japanese yen.

In fact, Technopolis development involves two steps. The first step is to attract decentralized high-tech plants from the large urban areas. The second step is to construct the complex technology linkages between these centralized plants and existing plants, local universities, and government R & D facilities. With the construction of these technology linkages, the development of self-motivated industrial regions was expected. In addition, most Technopolis areas changed their strategy from the attraction of high-tech plants (*gaihatsugata*) to

technology development of the existing plants (*naihatsugata*) after the first five-year plan ended in 1990.[1] Accordingly, the construction of technology linkages between industry, university, and government became more important. However, little is known about the reality of technology linkage development. Therefore, this paper tries to analyze the situation of technology linkage construction using the example of Koriyama technopolis. This study will concentrate only on high-tech plants since they are the main players, both in technology linkage construction and regional economic development.

There were three macro-scale regional development projects in Japan: the New Industrial Cities Plan, the Technopolis Plan, and the Brain Location Plan. The Koriyama technopolis region is one of the few areas that are designated by these three regional development projects. In addition, since the Koriyama technopolis is located at the southern entrance of the Tohoku region, and at the crossroads of the Tohoku and Joban expressways, it has excellent transport links. The plan itself anticipated that the Technopolis area would become a principal innovation point between the Tokyo area and the Tohoku region. Moreover, some previous studies indicate that the Technopolis areas located near Tokyo have better high-tech plant formation rates than those in the remote areas (Stöhr and Pönighaus 1992; Sternberg 1995; Yamazaki 1992). This is another reason for choosing Koriyama technopolis as the study area since it is located at the edge of the Kanto area and at the entrance of the Tohoku region.

To understand the responses of high-tech plants to the Technopolis functions, the following points were examined. What location factors are considered important by the high-tech plants when moving to the area? How are backward (subcontracting) and forward (marketing) linkages formed? And how is technology transferred along these linkages? How do high-tech plants respond to the presence of industry-university-government research co-operation?

There are 133 high-tech plants that are designated by the Koriyama Technopolis Promotion Organization (KTPO) as the technology seeds for Technopolis development. To find the answers to the above questions, the managers of these 133 plants were surveyed with a questionnaire, and 53 replies were finally received, a total of 40% of the questionnaires sent out during the period August to September 1998. In October 1998, I also conducted an interview survey with the plant managers and directors of nine high-tech plants that seemed to be a representative sample in the area in terms of their technology innovation. The outlines of these plants are shown in Table 3.

The trend of Japanese regional industrial development policy will be described in the next section. Then, the contribution of high-tech plants to the development of Technopolis will be discussed using the results of the questionnaire survey.

Regional Industrial Development Policy in Japan

Japanese regional industrial policy dates back to the end of World War II. After World War II, the Japanese government tried to revise industry by adopting a production system that emphasized the production of coal, iron and steel, and provided funds and materials on a priority basis to enterprise having high production efficiency. Efforts were also made to repair and strengthen the foundation of existing industrial areas, particularly the four big industrial regions. In the late 1950s, new industries such as the synthetic, chemistry, and electronic industries were developed, exploiting the advances in technological innovation in industrial facilities. By the end of the 1950s, Japanese industry was concentrated only in the three metropolitan areas. The northern Kyushu area of iron and steel had dropped out of the league of big industrial regions (Takeuchi 1996).

In 1960, the "National Income Doubling Plan" was established. This aimed to develop industrial production in the main industrial regions by concentrating investment of social capital and increasing the national income in a short time. This plan succeeded on the macro base and became the starting point of economic growth. But the plan created a large development gap between the metropolitan and provin-

cial areas (Takeuchi 1996). In order to overcome such regional disparities, the "Comprehensive National Development Plan" was established in 1962. The main actions of this plan were the establishment of "New Industrial Cities" and "Special Areas for Industrial Consolidation." Remote coastal areas suitable for heavy and chemical industries were designated as New Industrial Cities in order to promote industrial dispersal and reduce regional imbalance. The Special Areas for Industrial Consolidation were designated along the Pacific coastal belt to sustain economic growth and industrial development (Murata 1980). As a result of severe competition for the designation of these areas, 16 New Industrial Cities and 5 Special Areas for Industrial Consolidation were finally designated. However, only a few districts were able to increase the population as expected (Takeuchi 1996).

In 1969, the "New Comprehensive National Development Plan" was established under the high economic development of Japan. It aimed to form large-scale industrial districts in many areas that would be connected by highways and new trunk railways. Although traffic networks were completed, the plan was not continued because of the depression caused by oil shocks in the 1970s (Takeuchi 1996).

The Ministry of International Trade and Industry (MITI) enacted the "Industrial Relocation Law" in 1972. Based on this law the "Industrial Relocation Plan" was established in 1977. This plan aimed to attract industries from excessively congested areas (departure promotion areas) and to relocate them to less concentrated areas (relocation reception areas) and to change industrial location. Departure promotion areas were the Tokyo region and Kinki region, and the built up area of Nagoya City. Relocation reception areas covered 86.5% of the national land (Murata 1980).

With the "Third Comprehensive National Development Plan" (1977), new plant construction in the big cities was strictly limited and industrial decentralization was attempted in ten districts. This plan aimed to settle a certain population in each districts, to establish their life zone on a laminated scale, and to enrich social investment in national land planning (Takeuchi 1996).

After the oil crisis of the 1970s, Japanese industrial policy also changed from promoting heavy and chemical industries to promoting high-tech industries[2] (Yamazaki 1997). Then, high-tech related industrial development policies were realized by the "Technopolis Plan" in 1983. The aims of the Technopolis Plan were to promote manufacturing oriented R & D of existing industries, to establish knowledge-oriented R & D, and to create new industries. To realize this plan, a new organizational structure of technical linkage between industries, universities, and government was considered. As with the case of New Industrial Cities, pressure from local governments caused the national Technopolis project to become a local project with the designation of 26 areas during 1984 and 1989 (Itoh 1998; Yamazaki 1992).

In 1986, the "Private Participation Law" was enacted. Through this law, the Research Core, Telecom Research Park, New Media Center, Telecom Plaza, and Multimedia Tower projects were established. Of these, the Research Core Program was closely associated with MITI's industrial location policy (Yamazaki 1997). The Research Core Program consists of four facilities: an open-type test and research facility, a human resources development facility, a facility for promoting technology exchange, and an incubator for new business. Eleven centers including Tsukuba, Kanagawa and Senri (Osaka) were designated by MITI (Takeuchi 1996).

In 1986, the Techno-mart program was started with the aim of providing necessary information for firms at the inter-firm, inter-industry, and inter-region level through the network. Reduction of the technological gap between large urban areas and provincial areas was expected through this program. MITI assumed this program to be important for the success of Technopolis and this network was constructed within most Technopolis areas. In addition, Research Cooperation Centers were established in national universities and have promoted university-industry technology relationships since 1987. These centers are not only sources of human resources, production technology development, and technology transfer, but are also bases of information supply.

Through this program more than 47 Research Cooperation Centers were established in 40 prefectures (Itoh 1998).

The "Fourth Comprehensive National Development Plan" was established in 1987. This plan aimed to avoid an excessive concentration of economic activities in the Tokyo region by creating a more balanced national development based in Osaka, Nagoya, and high-order regional central cities. It was designed to develop the R & D capacity of Technopolis and core cities, to enable them to compete with Tokyo, and to use them as bases for promoting the dispersal and relocation of industry. The main theme of the Fourth Comprehensive National Development Plan was "Multipolar Patterns National Land Formation." In response to economic progress, and much emphasis on the software and service sectors, MITI enacted the "Brain Location Law." It promoted the concentration of knowledge functions of industrial firms in provincial areas by supporting the dispersal of 16 business categories, including research institutes, the engineering industry, and the software industry. These projects involved combining government, business, universities, and research institutes to create incubation centers with environments conductive to the emergence of new high-technology enterprises. The intention was that growth stimuli from these centers would percolate into surrounding areas (Takeuchi 1996). In accordance with the Brain Location Law, 26 areas were designated.

In 1989 the industrial relocation plan was revised and the "New Industrial Relocation Plan" was established. In this new plan, high-tech industries, service industries, and R & D were attracted to the designated areas. In addition, human resources development, construction, and enforcement of test and research facilities, and networking among these R & D were implemented. The main characteristic of the industrial policies of the 1990s was construction of networks among the designated industrial bases through Technopolis and the Brain Location Laws (Yamazaki 1997).

In sum, from the 1980s the regional industrial development policy of Japan changed from resource-based industries to high-tech industries and technology development. Accordingly, the emphasis was gradually shifted from pure production function to production, R & D, management and service functions through the construction and utilization of information networks. Effective financial assistance also shifted from central to local government. However, the following two points have not changed: many industrial development plans have many designated areas, and the majority of the industrial policies are related to the decentralization of production and decision functions from densely concentrated large urban areas to less concentrated regions.

Industrial Development of the Koriyama Area

Experiencing industrial development after the designation of the Joban-Koriyama New Industrial City area, the main reasons for the Koriyama area being designated as a Technopolis in Fukushima Prefecture were: its bullet train station, agglomeration of some high-tech industries, consolidated commuting and social zones, Fukushima airports, and its location at the crossroad of the Tohoku and Joban expressways. Although most Technopolis areas include the prefectural capital as the mother city, Fukushima city, the capital of Fukushima Prefecture, is not included in the Koriyama technopolis. The Koriyama technopolis area provided 19.4% of manufacturing product value of Fukushima Prefecture in 1995 (Fukushima Prefecture 1998).

Until the 1950s, the industries of the Koriyama area were based on farm products and natural resources. However, after the designation of the Joban-Koriyama New Industrial City area, heavy and chemicals industries became the principal economic activities here. In the 1970s, electrical machinery and other machine-part assembly plants came to occupy an increasing share of industrial output. In 1986, the interior districts covered by the New Industrial City Plan were designated as the Koriyama technopolis area. This technopolis area includes Koriyama City as "Mother City" and also Sukagawa City, Kagamiishi Town, Ishikawa Town, Miharu Town and Tamagawa Village. In 1991, according to the "Brain Location Plan,"

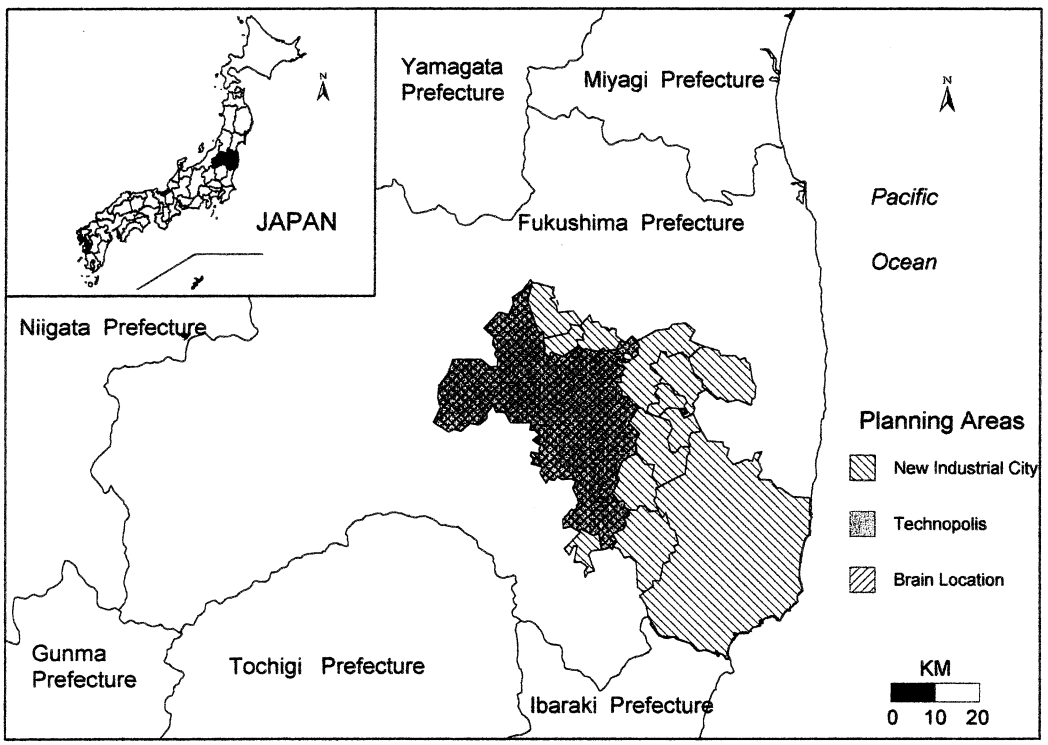
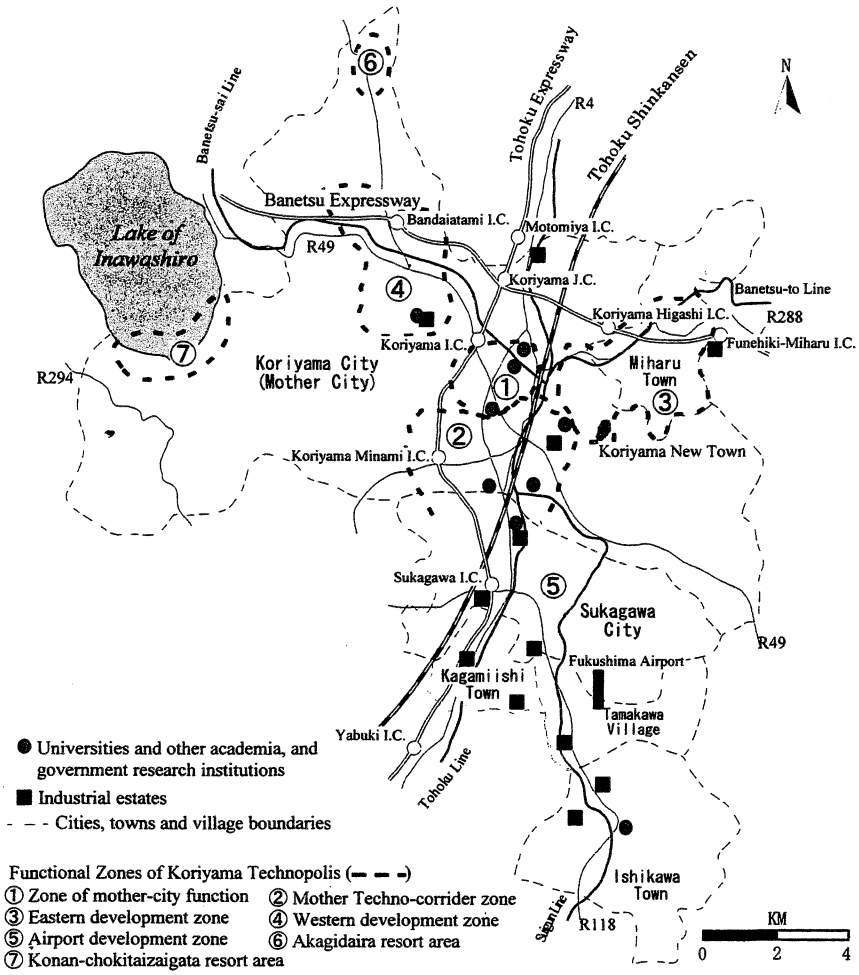


Figure 1. New Industrial City, Technopolis and Brain Location Plans in Fukushima Prefecture.

Koriyama City and Sukagawa City became "Industrial Agglomeration areas" and other towns and village of the Koriyama technopolis became "Surrounding Areas" of industrial development (Figure 1).

The main industrial activities of the Koriyama technopolis area include production and assembly of musical instruments, production of electronic communication and transportation machinery (such as automobile parts), chemical industries such as those for industrial and medical chemical production, and food and soft drink processing. Particularly prominent are production and assembly of musical instruments, and information and communication machinery. For the sustainable development of new technology, industries using micro-electronic technology, and biotechnology, were especially encouraged, and improvements were made in the development of new material production technology (Fukushima Prefecture 1995).

In the Koriyama Technopolis Plan, Koriyama City serves as the "Mother City" in which a high-class living environment is found. Also, other industrial development functions such as telecommunication and financial centers are located here. In the Mother City's "Technology Corridor Zone," technology centers, research and development centers, and high-technology industries were expected to be located together. Other development zones such as the "Eastern Development Zone," "Western Development Zone," and "Airport Development Zone" were designated as production development zones. The distribution of industrial estates, R & D parks, and new towns of the area, is shown in Figure 2. It is intended that the Koriyama area will develop new social systems with the construction of a high class living environment, and a high technology level based on technological collaboration between industry, universities, and government within the existing infrastructure of "Joban-Koriyama New Industrial City." With the development of the Koriyama area, the final intention is to lead the Tohoku region in technological innovation, and to fulfill the objective of the "All Japan Techno



Sources: Fukushima Prefecture (1998), KTKSK (1997).

Figure 2. Industrial estates, academia and government research institutions in the Koriyma technopolis area.

Area" in the 21st century (KTKSK 1991, 1997).

In 1986, KTPO was founded in accordance with the "Technopolis Law" to realize the Technopolis Plan. The principal functions of this organization include granting loans for industrial innovation activities, the promotion of technology development and regional technology diffusion, and the promotion of local entrepreneurship. After the designation of the Koriyama Brain Location area in 1991, KTPO also served as the main body for realizing the plan, and promoted industrial producer service and technology exchange functions (Fukushima Prefecture 1995). In other words, KTPO has two main functions regarding the industrial development of the Koriyama area: the incubation and promotion of high-technology plants, the promotion of industry-university-government research co-operation and the development of new technology both inside and outside the Technopolis area.

Responses of High-tech Plants to the Technopolis

Importance of the location factor

The situation of new plant formation in Fukushima Prefecture and the Koriyama technopolis area is shown in Table 1. It is clear that

Table 1. New firm formation in Fukushima Prefecture and the Koriyama technopolis (1981–1995)

	Fukushima Prefecture (a)			Koriyama Technopolis (b)			b/a (%)		
	1981–1985	1986–1990	1991–1995	1981–1985	1986–1990	1991–1995	1981–1985	1986–1990	1991–1995
Life related industries	181	325	186	21	35	22	11.6	10.8	11.8
Basic material	203	322	227	39	59	44	19.2	18.3	19.4
Processing/assembling	367	388	230	70	67	33	19.1	17.3	14.3
All industries	751	1,035	643	130	161	99	17.3	15.6	15.4

Life related industries: food, beverage, textile products, clothing, lumber and wood products, furniture, pulp, paper and paper products, publishing and printing, rubber products, leather products and others.
Basic material industries: chemicals, petroleum, plastics, ceramics, iron and steel, and metal products.
Processing and manufacturing industries: machinery, electronic machinery, transport equipment, precision instruments and machinery.
Sources: KTCPA (1991, p. 76; 1997, p. 76).

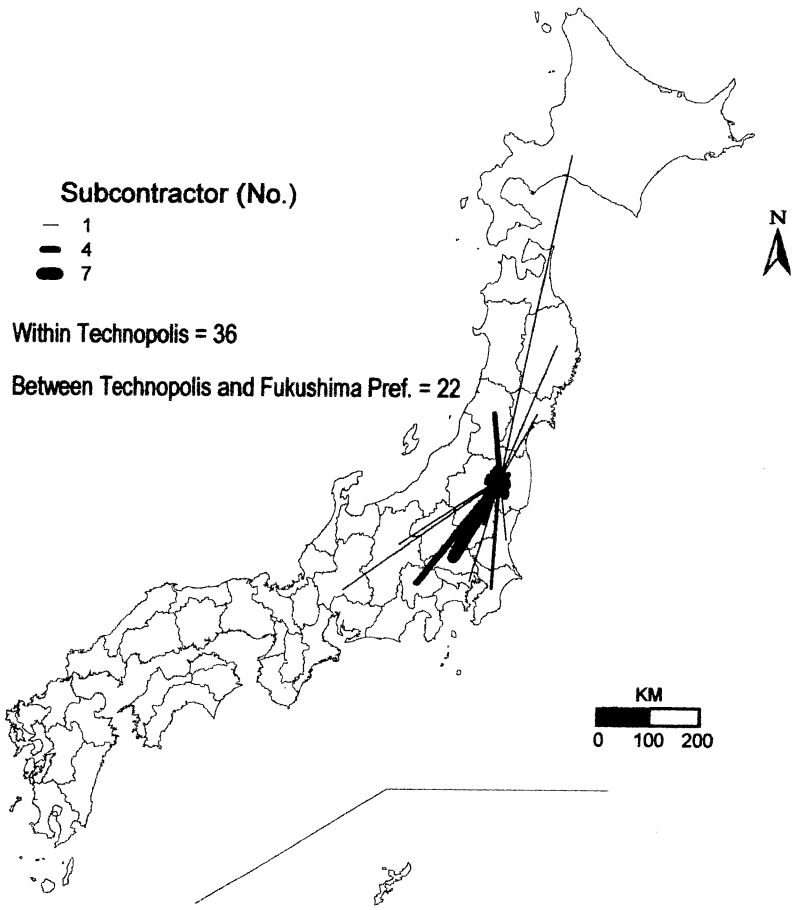
Table 2. The three most important location factors of high-tech industries in the Koriyama technopolis area

	Location factors	Before 1971	1972–1978	1979–1985	1986–1992
G1	Adequacy and cost of water supply	1 (8)	0 (0)	1 (3)	3 (9)
	Reliable electric power supply	0 (0)	0 (0)	0 (0)	1 (3)
	Attraction of local government	1 (8)	4 (11)	1 (3)	5 (14)
	Good transport links	1 (8)	7 (20)	8 (22)	5 (14)
	Proximity to market	1 (8)	1 (3)	2 (5)	0 (0)
G2	Availability of skilled labour	0 (0)	5 (14)	10 (27)	4 (11)
	Proximity to subsidiary companies	1 (8)	0 (0)	1 (3)	0 (0)
	Available Tecnology in the area	0 (0)	0 (0)	0 (0)	1 (3)
	Availability of public traning and research facilities	0 (0)	0 (0)	0 (0)	0 (0)
G3	Lower labor costs	3 (23)	6 (17)	4 (11)	5 (14)
	Cheaper land prices	3 (23)	8 (22)	7 (19)	10 (29)
	Town of origin of the plant owner	2 (15)	4 (11)	2 (5)	1 (3)
	Others	0 (0)	1 (3)	1 (3)	0 (0)
		13 (100) n=6	36 (100) n=13	37 (100) n=13	35 (100) n=12

Numbers within the parenthesis are percentages.
Source: Questionnaire survey.

the rate of new plant formation in Fukushima Prefecture as a whole has decreased since the end of the 'bubble economy' in 1990. The share of new plant formation in the Koriyama technopolis area has continuously decreased since 1985 (before the bubble economy). Assembly and processing plants that are assumed to be important for local economic development are also decreasing in their shares. From these figures, it is reasonable to conclude that the designation of Technopolis has had no particular effect on the location of new plants. In addition, since the Koriyama technopolis is the most industrialized area within Fukushima Prefecture, the new plants seem to avoid the high labor costs and land prices of this relatively industrialized area.

In the questionnaires, the location factors are divided into three groups. The first group includes factors that can be classified as "local government attraction factors" such as adequacy and cost of water supply, reliable electric power supply, etc. The second group includes "long-term regional development factors[3]" such as proximity to suppliers and marketing linkages, etc. Finally, there are "short-term regional development factors[4]" including cheap labor supply and land prices. In fact, the comparative



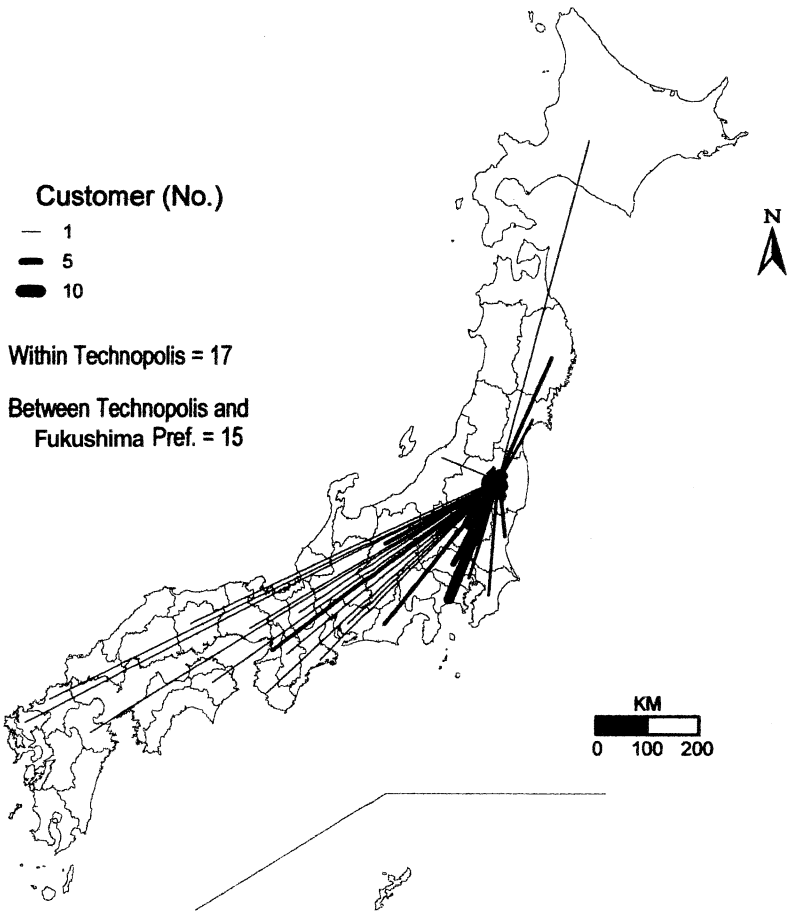
Source: Questionnaire survey.

Figure 3. Distribution of the three most important subcontractors in high-tech plants of the Koriyama technopolis.

advantages of the first and third groups are difficult to maintain over a long period in the present global economy. The three most important location factors for high-tech plants in the Koriyama technopolis area are shown in Table 2. Although the location factors are slightly different at various periods, it can be assumed that most of the high-tech plants were established to exploit the short-term comparative advantages. As a result, their contribution to the innovation of the area may be low.

Situation of forward and backward linkages and technology transfer

The locations of the forward and backward linkages of high-tech plants are divided into the Koriyama technopolis, Fukushima Prefecture (excluding the Koriyama technopolis area), Tokyo and its surrounding area (including Tokyo Metropolis, Kanagawa, Chiba and Saitama Prefectures), and other areas of Japan. According to available data from questionnaires, 14 plants have no backward linkage. The distribution of all backward linkages of the other plants (35) shows that 23.1% are in the technopolis area, 15.1% in Fukushima Prefecture, 30.9% in Tokyo and its surrounding area, and the rest (30.9%) in other areas of Japan. In addition, the distribution of the three financially most important backward linkages by prefecture is shown in Figure 3. It is clear that the majority of backward linkages come from inside the technopolis and Fukushima Prefecture, and to a certain extent from Yamanashi, Saitama, and



Source: Questionnaire survey.

Figure 4. Distribution of the three most important customers in high-tech plants of the Koriyama technopolis.

Yamagata Prefectures.

According to the answers to the questionnaires, the locational distribution of forward linkage (49 plants) shows that 8.5% are in the Technopolis area, 8.6% in Fukushima Prefecture, 33.0% in Tokyo and its surrounding area, and the rest (49.9%) in other regions of Japan. The distribution of the three financially most important forward linkages by prefecture is shown in Figure 4. It is clear that the majority of the products manufactured in the Koriyama Technopolis area were transacted within Technopolis and Fukushima Prefecture. The rest of the products were mainly shipped to Kanagawa Prefecture and throughout the country. From the nature of forward linkage one can track the production process of the Koriyama technopolis area. In the above mentioned three financially most important forward linkages, 67.9% were finished product makers, 18.8% the subsidiaries of finished product makers, 8.9% from independent processing plants, and 4.5% from sales companies.

Finally, from the distribution patterns of forward and backward linkages and production processes, the high-tech plants of the Koriyama technopolis area can be divided into three types. The first type of plant is that which out-sources within the technopolis area and ships the semi-finished product to the large urban areas for further processing. The second type is that which out-sources to Saitama and Yamanashi Prefectures and ships its product again to the large urban areas. The third type

Table 3. Outlines of the personal interview conducted in high-tech plants

Plant	Product	Location of headquarter	Date of establishment	Capital (100K)	Number of workers
A	Electrical equipment parts	Kanagawa Pref.	1982	96	56
B	Automatic machine	Hokkaido	1969	10	120
C	Food stuff chemical	Tokyo	1992	597	66
D	Electrical equipment	Tokyo	1991	10,172	35
E	Communication equipment	Tokyo	1983	25	96
F	Electrical measurement machines	Tokyo	1991	75	36
G	Electrical equipment	Fukushima Pref.	1972	10	80
H	Computer and peripherals	Fukushima Pref.	1983	1,125	172
I	Industrial chemical	Tokyo	1915	20,270	234

Source: Questionnaire survey.

of plant has no backward linkage and ships its products to other high-tech plants in the Koriyama technopolis or Tokyo and its surrounding area. In other words, the Koriyama technopolis shows both local industrial linkage formation (the first and third types) and also the behavior of a branch-plant economy (the second and third types) in accordance with its proximity to the Tokyo region.

Two methods of technology transfer can be expected in the area. The first method is the acquisition of technology from somewhere else (including intra-firm training) and the second method is technology transfer from the high-tech plants to other local plants. In fact, most of the plants practiced intra-firm training methods (79.24%). In addition, technology acquisition from the forward linkages and public training centers were found here to some extent (30.19% and 24.52%, respectively). These figures indicate that some technology diffusion has occurred through forward industrial linkages and public training centers. On the other hand, a majority of high-tech plants (59.4%) have no technology transfer through their backward linkages.

Industry-university-government research co-operation

In the Koriyama technopolis, KTPO has played the main role as a coordinator in various kinds of technology exchange, training, symposiums, and as a dispenser or contributor of many kinds of subsidies. In this section the responses of high-tech plants to the various measures of KTPO are examined.

Inter-plant technology exchange According to the respondents, 10 out of 53 plants conduct inter-plant technology exchange. Of these, 5 plants participate in a group form of technology exchange while the others utilize public research facilities for this exchange. Of these, two of the high-tech plants interviewed participate in technology exchange (Table 3). The first plant (B) has been participating in group type research co-operation. According to the plant manager, group members have to observe the production process of each member's plant with the aim of developing new production methods and products through the combination of different production fields. However, this co-operation is merely the starting point and there is no development of new production technology as a result. Another plant (F) is conducting research co-operation with a sales company for new product design. It is also at the first stage and there is no new design development yet.

In the questionnaires, each plant is asked for their opinions on inter-plant research co-operation. The result is surprising: 23 out of 53 plants answered that this inter-plant research co-operation was not necessary for them. Most of the plants that answered that technology co-operation was necessary emphasized that they wanted to promote the technology level of their plants through this co-operation, and that in the future this co-operation would be essential. However, only a few plants that assumed research co-operation was necessary were actually doing it. On the other hand, the plants which answered that inter-plant research co-

operation was not necessary emphasized that the production technology obtained through their parent companies was good enough, and with their type of production it was not necessary to conduct research. In fact, a majority of these plants are incoming plants,[5] and other single-location plants[6] which also feature monopolization of their own technology as a principal means of competing in this time of severe competition.

Finally, the factors hindering inter-plant technology exchange are examined. A majority of plants have cited the lack of inter-plant connection as a primary factor (52.2%). Again, answers favoring intra-firm links (within the firm itself or between mother firms and subsidiary firms) suggest they regard their technology development as good enough for the foreseeable future, and the tendency of monopolization of technology with the attitude "we don't want to transfer our technology to other plants" accounted for nearly 50% (27.1% and 22.7%, respectively) of responses. As regards other minor problems, some plants, especially incoming plants, said they had to get prior permission from the mother firm or headquarters to address them. The previously mentioned 10 high-tech plants conducting inter-plant technology exchange said a primary problem was that 'inter-firm relations are inadequate, and information regarding the other plants in the area is not clear.'

Technological co-operation between industry and university According to the KTPO, the Engineering Department of Nihon University, the Dental Department of Ohu University, and the Food and Nutrient Department of Koriyama-joshi University are the main academic establishments in the area. In addition, Aizu University in Fukushima Prefecture was opened in 1993. This university was expected to become the base of human resources development related to information technology (KTKSK 1997). The questionnaire survey shows that eight high-tech plants have collaborated with universities in developing new products and production technology. Four of these are single-location plants, one is a mother plant,[7] and three are incoming plants. Three of the single-location plants have engaged in technological co-operation with the universities located within the Koriyama technopolis, while another single-location plant has cooperated with the universities in both the Technopolis area and the Tokyo region. The mother plant and two of the incoming plants are in research co-operation with universities located in the Tokyo region. The remaining incoming plant is conducting research co-operation with a university located in Miyagi Prefecture. The pattern of research co-operation reveals that the plants accessible to the Tokyo region have a tendency to engage in research co-operation with universities located in Tokyo. There are three possible reasons for this situation. Firstly, since the universities located in the technopolis area are small and narrow in their fields of study, they do not offer matching specialized technology. Secondly, the research level of these universities is not high enough for new product development. Thirdly, the industry-university connection is not developed enough for research co-operation. However, regarding the second reason, no plant said that it was the lower research level of the universities that led to the lack of research co-operation. Thus, the problem seems to be due to the lack of proper contact, and mismatches between the research fields of the local industries and the local universities.

Of the plants interviewed, three are participating in industry-university research co-operation. The first plant (B) conducted research co-operation with the local university and used this to develop new production methods. This development led to the commercial production stage, with financial help from KTPO. However, this plant is no longer conducting such research co-operation. The reason is that the level of demand for the product (developed by industry-university research) was not high enough to justify further development. The second plant (F) also developed new products from industry-university research co-operation. However, as with the first plant, there was no reason to continue such research. In fact, in terms of the cycle of industry-university co-operative research development, the capital investment is solely on the industry side, and the resulting new products from the above co-

operation have proceeded to the stage of commercial production in the same industry or production plant as in the other areas. Then, this product is shipped to other plants to make the finished product, or to the consumer. The profit gained by selling the products is probably used for further research and development of new products and production methods. In the cases of two plants mentioned above, the research development cycle is broken down in the consumption process. There are two possibilities here. One is that the product quality or production method (geared towards minimum production costs) is not of good enough quality to compete successfully in the local or global market. The other is concerned with the wealth or income of the consumer. In the second case, decreasing wealth or income has encouraged consumers to use both luxury and basic goods for as long as possible, delaying replacement, and as a result demand for new products is depressed. An important issue arising from this situation is whether or not the new products developed by local industry-university research co-operation can compete with the new products developed between the large companies and universities of the Tokyo area. Although the third plant (I) has been conducting research co-operation with the local university since 1997, there is no feedback from the university.

As regards the responses of high-tech industries to industry-university research co-operation, the majority of the plants (52.6%) answered that such co-operation was not necessary. The plants interested in conducting industry-university research development also pointed out that there was insufficient opportunity for it.

Conclusions

The results of the surveys conducted in the Koriyama technopolis area lead to the following conclusions.

1. In order to gain a competitive advantage, new plant formation seems to some extent to avoid already industrialized regions in their search for areas of low-production-cost. On the other hand, the local universities and public research facilities in the technopolis area are not sufficiently developed for technology-oriented plants to decentralize from large urban areas.

2. The university is a key center for basic research and human resources development in the provincial area. However, as is found in the Koriyama area, there is, for various reasons, no distinctive result from industry-university research co-operation. Although there are some cases of research co-operation, their results and prospects have not progressed well enough for long-term regional development.

3. One expectation of the Technopolis Plan is technology transfer from incoming plants to local plants. However, in the case of the Koriyama technopolis, although a certain amount of technology transfer did occur through forward and backward linkages, inter-plant research co-operation did not take place as expected, for various reasons. In practice, many plants are conducting technology transfer with their mother-company and headquarters, without involving the technopolis related organizations.

4. The main problems in the construction of a industry-university-government technology linkage stem from two related factors, namely the absence of proper information channels between the related plants, universities, and government facilities, which in turn means that high-tech plants are not interested in the results of technological cooperation. These problems seem to stem from the nature of branch plants and the historical technological development of Japan. Research co-operation with industries was not allowed in Japanese universities until 1983 (Bass 1998). Therefore, a period of time is necessary for the formation of technology linkages in provincial areas.

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Notes

1. The first 5-year plan for twenty Technopolis areas designated before 1986 ended in 1990 and that for the areas designated between 1987 and 1989 ended in 1995.
2. High-tech industries in this study include those concerned with pharmaceutical products, communication equipment, computer and peripherals, electrical equipment, electrical measurement machines, electrical equipment parts, medical equipment, and optical instruments (JILC 1997).
3. It is assumed that a plant that can construct its own technological development linkage within the Technopolis area can continuously improve its technology and productivity. As a consequence, it can survive for a long time against rising production costs.
4. It is assumed that although cheap labor and land prices are very effective in attracting branch plants, it is difficult to sustain this comparative advantage for long.
5. These are all the plants that have no decision-making function related to management and sales, and R & D.
6. They are the plants which contain their own management and sales, R & D, and production functions, and which have no other production plants.
7. They are the plants which contain their own management and sales, R & D, and production functions, and which also have other production plants in different places.

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(J): written in Japanese
(JE): written in Japanese with English abstract