INNOVATION AND REGIONAL DEVELOPMENT:
TRANSITION TOWARDS A KNOWLEDGE-BASED ECONOMY

Clusters Promoting Initiatives in Japan
Focusing on the case of TAMA (Technology Advanced Metropolitan Area)[1]

Florence, 25 and 26 November 2004

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The "cluster" notion has been highlighted in policy fields in recent years in Japan. The Ministry of Economy, Trade and Industry (hereinafter "METI") and the Ministry of Education, Culture, Sports, Science and Technology (hereinafter "MEXT") launched the "Industrial Cluster Project" in 2001 and the "Knowledge Cluster Initiative" in 2002 respectively in connection with each other. The TAMA Association initiative, formally started in 1998, is a preceding and typical example of the Industrial Cluster Project.

This paper firstly briefly introduces the Industrial Cluster Project and the Knowledge Cluster Initiative. Secondly, this paper introduces the TAMA Association initiative as its main focus, including the outcomes of the Association's activities. Thirdly, making use of the data of small and medium-sized enterprises (hereinafter "SMEs") in TAMA, this paper analyses the benefit of technology linkage between universities and firms, and among firms, and the benefit of geographical proximity, both of which are main targets of Japanese cluster promoting policies. Through these analyses, this paper highlights an innovation mechanism that is growing in TAMA, led by existing innovative firms, and the importance of an intermediary organization between universities and industry, and among firms.

1. Japanese cluster promoting policies

1.1 Industrial Cluster Project

Regional industrial policies of METI (the former MITI) from the 1960s until the early 1990s had been to promote regional development mainly through relocation of factories to non-urban regions from the large metropolitan areas. However, regional industrial policies have changed since the late 1990s to revitalizing the industry including the large metropolitan areas, in order to overcome the hollowing out of the manufacturing industry due to the shift of production overseas, particularly to China and other Asian economies. Regional agglomeration of industry has emerged as policy target to revitalize industrial competitiveness.

The earlier focus of the policy towards industrial agglomeration in the middle of the 1990s was to maintain a network of the different stages of the manufacturing processes of various SMEs located close to each other within a region, and to utilize the benefits of the division of labor among such SMEs. However, only trying to maintain such benefit of division of labor among different manufacturing processes was not enough to rectify the tendency of industry hollowing out.

As the new focus of the policy concerning industrial agglomeration, the linkage of different technologies or different knowledge among players in the industrial agglomeration including SMEs, large enterprises and universities and other research institutions, has started to attract greater attention of policy makers. Such linkage of different technologies or knowledge accumulated in the industrial agglomeration is expected to create new technologies, new products and new businesses and thereby new industries.

The Industrial Cluster Project was planned from the viewpoint of forming a network among players who have different technologies or knowledge in the industrial agglomeration. This notion was strongly encouraged by the preceding example of the TAMA Association to be explained in this paper and a few other examples such as clustering of IT software firms in Sapporo as well as successful overseas cases like Silicon Valley where numerous new businesses have been created based on the research results of universities and other research institutions. The trend of science and technology policy to encourage university-industry collaboration that will be mentioned in 1.2 below was also a factor to push the idea of the Industrial Cluster Project forward.

Taking into consideration the background outlined above, the Industrial Cluster Project started in 2001. METI says its objectives are to foster an environment for innovation through formation of a human network and thereby to realize self-sustaining regional vitalization. More specifically, it aims to form a human network among members including managers, engineers, researchers and financial supporters, and to create globally competitive industrial clusters in the respective regions through competition and cooperation among members in the human network (METI [2004])

In the 19 projects shown in Table 1, Regional Bureaus of Economy, Trade and Industry (hereinafter "Regional Bureaus of METI"), in cooperation with private cluster promoting organizations, have formed close working relationships with 5,800 SMEs taking up the new challenge and researchers from over 220 universities (METI [2004]). METI set up a budget, of which amount in FY2004 is 680 million yen, to support the private cluster promoting organizations in the respective regions to conduct network forming activities such as organizing workshops, exchange meetings and seminars, and coordinating cooperation between universities and firms, and among firms through specialized coordinators. In addition, related schemes including R&D support schemes and incubation facilities enhancing schemes under METI and its affiliated organizations in the amount of roughly 48 billion yen for FY2004, although they are not solely earmarked for the Industrial Cluster Project, are available for the firms and universities participating to the 19 projects (METI).

1.2 Knowledge Cluster Initiative

The long depression of the Japanese economy in the 1990s also gave new momentum to science and technology policy (hereinafter "S&T policy"). Utilization of scientific knowledge, including research results from universities, into the economy, industry and business has increasingly become an important policy target of S&T policy. The necessity of university-industry collaboration was legally codified in the Science and Technology Basic Law enacted in 1995. Based on this law, the government draws up the Science and Technology Basic Plan every five years.

The Second Science and Technology Basic Plan, established by a Cabinet Decision in March 2001, advocated the creation of Knowledge Clusters in regions. A "Knowledge Cluster" is a local system of technological innovations organized around universities and other public research institutions which have unique R&D themes and potentialities, and business firms both within and without the region are also expected to join. More specifically, it is a system which successively drives technological innovation and creates new industries through mutual stimulation between technological seeds in research institutions and practical needs in the real business world. Human networks and joint research entities are expected to promote this process (MEXT [2004]).

MEXT launched the "Knowledge Cluster Initiative" in 2002, with the aim of creating Knowledge Clusters and vitalizing regional economies. More specifically, MEXT says, its purpose is to create internationally competitive knowledge-concentrated systems for technological innovation, where the universities or other public research institutions play as the core of knowledge creation in collaboration with related research institutions and R&D firms in the region. Proper attention to the autonomy of local governments is assumed to be paid in the whole process (MEXT [2004]).

MEXT provides the budget of 500 million yen per year, over five years, for each nominated region to conduct such activities as setting up a "Knowledge Cluster Headquarter" in each region, staffing with specialist science and technology coordinators, carrying out university-industry-government joint research, patenting and developing research results, and holding forums or other type of meetings on research results. The total annual budget is 9 billion yen in FY2004 for the 18 regions shown in Table 2, which are nominated under the Knowledge Cluster Initiative (MEXT [2004]).

1.3 Relationship among Cluster Related Policies

1.3.1 Division of roles and relationship between the two cluster promoting policies)

The areas covered by most of the projects under the Industrial Cluster Project (hereinafter "the industrial cluster projects") are very broad. Meanwhile the projects under the Knowledge Cluster Initiative (hereinafter "the knowledge cluster projects") identify specific universities or other public research institutions as cores of knowledge creation; consequently their activities are focused on specific cities. And although the two cluster promoting policies have a common goal regarding university-industry collaboration, the initial target of specific activities of the industrial cluster projects is industry, while that of the knowledge cluster projects is universities and other public research institutions.

From the viewpoint of the industrial cluster projects, the knowledge cluster projects within the areas of respective industrial cluster projects are tangible and important tools of the cluster formation. From the viewpoint of the knowledge cluster projects, the industrial cluster projects are promising tools of catching the needs of regional industry to the universities as well as practical application of the R&D results to industry.

In order to achieve such synergy effects, the two Ministries of METI and MEXT are making various efforts to link the Industrial Cluster Project and the Knowledge Cluster Initiative. As an example, each region has established a Regional Cluster Promotion Association" consisting of representatives of both the industrial cluster projects and the knowledge cluster projects. The Regional Cluster Promotion Associations organize joint seminars for presentation of the outcomes of the industrial cluster projects and the knowledge cluster projects.

1.3.2 Policy cooperation in the financial aspect

The financial aspect of the cluster promoting policies is also important. The Financial Services Agency (hereinafter "FSA") recognizes that the Industrial Cluster Project contributes to the financial revival of SMEs through supporting business start-ups and new businesses. The Industrial Cluster Project is part of the "Action Program concerning Enhancement of Relationship Banking Functions" released in March 2003 of FSA.

In accordance with the Action Program, the Conference on Financing to Support Industrial Clusters was established in each of 11 regions nationwide according to the jurisdictional areas of the Regional Bureaus of the Ministry of Finance. As results of the Conference, regional financial institutions have started such initiatives as bridging loans for the Industrial Cluster Project related subsidies[2], an industrial cluster support fund and business plan contests (METI [2004]).

1.4 Characteristics of the Japanese Cluster Promoting Policies

We can find at least two major characteristics of the above-mentioned cluster promoting policies in Japan as compared with past regional economic and industrial policies as well as their characteristics as compared with prominent cases in the world, which I hopefully would like to learn further through this international conference in Florence.

[2] These bridging loans are provided to the SMEs adopted by the government subsidy schemes related to the Industrial Cluster Project to cover the time-lags between the start of their projects and the receipt of money from the national treasury.

1.4.1 Emphasis on linkage aspect

The first characteristic is the emphasis on the linkage aspect of the cluster notion. The recent regional cluster promoting policies, particularly the Industrial Cluster Project, have been planned based on criticism of past regional economic and industrial policies. The traditional form of regional development through the attraction of firms, especially large enterprises, from outside the region and massive investment in the physical infrastructure like industrial or scientific parks and buildings became to show their limitations. Instead, the recent cluster promoting policies give a focus on the formation of network or linkage among the players in the regions including business firms and research organizations such as universities.

Originally, the cluster notion has two core elements that were 1) "geographical concentration" or "agglomeration" of the location of players such as firms, research institutions and individual human resources, and 2) "network" or "linkage", or at least "interaction" by any meaning, among the players located in the agglomeration.

The recent Japanese cluster promoting policies no longer insist on creating new industrial agglomeration, but seek the creation of the linkage among the players and resources existing in the agglomeration, including the cases of the creation of start-up businesses as results of the combination of technological and managerial resources.

1.4.2 Emphasis on technological linkage

The second characteristic of the recent Japanese cluster promoting policies is the emphasis on technological linkage.

In the literature on clusters, the linkage aspect is not confined to technological linkage. As a typical, and the most influential, example of the literature on clusters, Porter [1998] describes the linkage aspect of clusters as meaning not only the linkage of technologies or knowledge but also the linkage through the commodity transaction or supply chain among the related firms.

Although the documents of METI and MEXT quote Porter's expression to explain the concept of the cluster, the emphasis of the cluster concept of both of the Industrial Cluster Project and the Knowledge Cluster Initiative in their substantial meaning is placed on the technological linkage or knowledge linkage of different players in the region, which can generate innovation.

As a matter of fact, there have been cluster-like policies in the field of SME policy from the past. The SME Agency of METI has been conducting policies to promote local concentration of SMEs in particular industries or composition of industries. Most of the industries covered by these policies have been traditional industries like textiles, clothing, ceramic wares and other commodities for daily use

These policies also recognized the role of linkage or interaction among SMEs in related industries. However, these policies did not focus on technological innovation, but economies of scale to obtain market information, attract customers, purchase parts and materials, use common facilities and employ workers with common skills etc. The policy target was only SMEs and the coverage area was relatively small.

To the contrary, recent cluster promoting policies emphasize technological linkage to generate innovation. Universities and other public research institutions have emerged as important policy targets.

However, we should be aware that actual policy measures also assist aspects other than the formation of technological linkage itself including connecting with trade firms and other sales promotion activities and securing financial resources, since these are necessary activities to bring the products produced as a

result of technological linkage to commercialization. These commercialization-related activities are increasingly recognized as important from the experience of cluster promoting policies.

2 TAMA Association

2.1 Typological Positioning of the TAMA Association initiative in the Industrial Cluster Project

This section explains the TAMA Association initiative as a leading example of the industrial cluster projects.

Industrial cluster projects can be provisionally divided into two broad categories according to their expected major mechanism to generate innovation. One is start-up firms based mechanism and the other one is existing innovative firms based mechanism.

Start-up firms based one means that new technological seeds or scientific knowledge are assumed to be applied to industry and connected to business outcomes through the creation of start-up firms which possess the technological seeds or scientific knowledge. This category of innovation mechanism is seen in the field of IT software industry and bio-industry. Particularly in the bio-industry, university generated start-up firms are highly expected to work.

On the contrary, existing innovative firms based innovation mechanism means that the technological innovation or application of new scientific knowledge is realized through the technology transfer from universities to the innovative firms or the linkage among the innovative firms. This innovation mechanism is assumed to function in most of the high-tech manufacturing industries other than the bio and chemical industries.

Since the main industries in the TAMA region are manufacturing of electric and electronic machinery, transportation equipment and precision instruments, the expected major innovation mechanism in TAMA is the existing innovative firms based one. This section introduces the TAMA Association as a model case to realize existing innovative firms based innovation mechanism in Japan.

2.2 TAMA

2.2.1 What is TAMA

TAMA refers to a region along National Road Route 16 extending from the southwest area of Saitama Prefecture to Tokyo's Tama region and the central part of Kanagawa Prefecture (See Figure 1).

TAMA stands for "Technology Advanced Metropolitan Area".

The area of TAMA is 3,058□□, which is comparable to the Silicon Valley which is 3,900k□. The value of manufactured products shipped was approximately $US 200 billion in the year 2000, which was roughly two times that of Silicon Valley.

2.2.2 Components of industrial agglomeration

The region is concentrated with 1) R&D organizations of electric and electronic machinery makers and other large enterprises, 2) research institutions such as universities with faculties of science and technology, 3) product-developing SMEs (definition to be provided later) capable of planning and

developing products backed by capturing market needs, and 4) product-processing SMEs (definition to be provided later) capable of high-precision processing and quick delivery. They form an industrial agglomeration of economic entities capable of producing new technologies and products or sources of new industry creation.

2.2.3 Historical development of the region as an industrial agglomeration

With regard to the history of the formation of the industrial agglomeration of this region, what was once a major textile-producing district before World War II has gradually changed to and formed a dominant agglomeration of machinery industries composed of electric and electronic machinery, transportation equipment and precision instruments over many years. This was due to events such as the evacuation of major factories from central Tokyo and the Keihin Bay Area in the pre-war period, conversion of these factories from military production to non-military uses during the post-war reconstruction period, the establishment of new factories through the attraction of large enterprises from central Tokyo and the Keihin Bay Area around the high growth period and new start-up firms spun off from the large enterprises that had located in the region (Kanto Regional Bureau of International Trade and Industry [1997]).

2.2.4 Survey of Kanto Regional Bureau of MITI

The Kanto Regional Bureau of International Trade and Industry (hereinafter “Kanto Regional Bureau of MITI) (currently Kanto Regional Bureau of Economy, Trade and Industry) paid attention to the characteristics of the development-type industrial agglomeration in this region and conducted a survey in cooperation with the Tokyo Metropolitan government, Saitama and Kanagawa prefectural governments, as well as relevant Chambers of Commerce and Industry and Societies of Commerce and Industry. The survey revealed that product-developing SMEs in the region have formed a network with product-processing SMEs located surrounding them and are playing key roles for new regional economic development. It also revealed that various technologies, such as micro fabrication, measurement and control, information technology, and optical technology necessary for the development of state-of-the-art products are concentrated in TAMA (Kanto Regional Bureau of MITI [1997]).

2.3 TAMA Association

2.3.1 Process of its establishment

Based on the survey results, the Kanto Regional Bureau of MITI proposed establishment of an organization to strengthen regional university-industry and inter-firm collaboration in order to create new technologies and products by utilizing the potential of the industrial and technological agglomeration in the region.

Key persons of firms and universities in the region responded favorably. In September 1997, the "Preparatory Committee of Greater Tama Region Industrial Activation Council (tentative name)" (hereinafter "Preparatory Committee") was inaugurated with 55 representatives from 54 organizations, including private firms, mainly product-developing SMEs, universities and other research institutions, commerce and industry associations, and local governments, attending. In April 1998, the "TAMA Industrial Vitalization Council" was formally established by 328 members including 190 members of firms.

In April 2001, the Council, which was a voluntary organization, was reorganized and became an incorporate body: "TAMA Industrial Vitalization Association Inc. (formal name: Metropolitan Industrial Vitalization Association Inc., Chairman: Yuji Furukawa)" (hereinafter the "TAMA Association" including the Council age). As of June 1, 2004, the number of members stood at 610 including 301 members of firms.

TAMA is the name used by the Association to designate the area. The map in Figure 1 shows the geographical area that constitutes TAMA and determines eligibility for a manufacturing firm to be a regular member of the TAMA Association.

2.3.2 Description of activities

According to the prospectus for the establishment of the TAMA Industrial Vitalization Council, it was established to "develop the greater Tama region as a foundation for one of the world's leading new industrial areas and thereby lead the growth of the Japanese economy, by promoting active industry-university-government collaboration and exchanges in the area, especially by enhancing the product development capabilities of middle-sized and small and medium-sized enterprises and by establishing environments for new business creation, while paying due attention to harmony with the environment." In short, its basic philosophy is to promote industry-university-government collaboration and exchanges, with particular emphasis placed on strengthening the product development capabilities of middle-sized and small and medium-sized enterprises.

In order to achieve the objectives, the Association is actively operating in such fields as information networking, university-industry collaboration and R&D promotion, events promotion, start-up business support, sales promotion, and international exchanges. The Association's activities include not only those that directly contribute to collaboration promotion, but also those that contribute to individual business support, including start-up business support.

2.3.3 Establishment of TAMA-TLO

As part of its activities, the TAMA Association established a technology-licensing organization (TLO). A TLO is an organization promoting technology transfer from universities to industry by such means as acquiring patents on research results of university researchers and licensing the patents to private firms. At present, there are 42 TLOs, either approved or certified under the TLO Law, across the country. As part of its university-industry collaboration and R&D promotion activities, the TAMA Association began preparations for the establishment of a TLO in May 1999 and established the TAMA-TLO in July 2000 with nine universities and university researchers in the region as its members. Since members of firms in the TAMA Association are also members of the TAMA-TLO, the TAMA-TLO performs its activities in conjunction with the TAMA Association, and meets the needs of regional industry to put research results of the universities to practical use. At present, the TAMA-TLO can seek patents for the invention of researchers at 20 universities. Hereinafter, the "TAMA Association" will include the "TAMA-TLO," unless otherwise noted.

2.3.4 Establishment of TAMA Fund

The TAMA Association’s activities have been raising initiatives from the regional partners.

A regional financial institution, Seibu Shinkin Bank, which is a member of the TAMA Association, has been promoting business tie-ups with the TAMA Association. The Shinkin Bank commissions the technological assessment of its loan projects to TAMA-TLO in order to enhance its function of relationship banking.

And the Shinkin Bank has launched a venture capital fund, referred to as the "TAMA Fund", in cooperation with the TAMA Association, to invest in the firms which are in the early stage of the business to commercialize the outcomes of R&D. This Fund is for member firms of the TAMA Association and the TAMA Association (with TAMA-TLO) takes part in the investment committee to examine the projects and organize business support.

2.3.5 Cooperation with incubation institutions

Fuji Electric Co., Ltd., Sayama City and the Seibu Shinkin Bank, all of which are members of the TAMA Association, established and operate their incubation facilities forming business tie-ups with the TAMA Association. The TAMA Association provides the tenants with services such as support for making business plans, support for sales promotion, introductions to university professors and firms, advice for applications to public funds.

2.4 Outcomes of the TAMA Association

2.4.1 Raising regional and private initiatives

The outcomes of the TAMA Association can be described qualitatively and quantitatively.

The qualitative aspect of the outcomes is that the Kanto Regional Bureau of METI and the TAMA Association could successfully raise the autonomous initiatives of the private and the regional players. Although the TAMA Association was established in response to an approach from the Kanto Regional Bureau of METI, and its support is still a vital element for the Association, the Association is a membership organization consisting of, and managed by private firms, university professors, local governments, industrial associations and other individuals.

Members have increased from 328 including 190 members of firms at its establishment in April 1998 to 610 including 301 members of firms as of June 2004. This is particularly important, because members pay an annual membership fee. For example, an SME member with capital below 100 million yen will pay 70 thousand yen annually.

Financially, among the annual expenditure of approximately 80 million yen, one third is revenue from the government subsidy under the METI scheme to support private cluster promoting organizations, and the other two thirds is revenue from membership fees and consigned tasks from various public or private organizations. Moreover, the municipal governments of Hachioji city, Sagamihara city and Sayama city and a regional financial institution provide the Association with strong support such as dispatching staff to the secretariat office and furnishing the office space. In this respect, through the contribution of private and regional players, the Association achieves a high-level of financial independence, as these kinds of quasi-public activities.

More remarkably, a part of the Association's activities are lead by the initiatives of several members. As mentioned above, a regional financial institution, Seibu Shinkin Bank, established the TAMA Fund,

and three member organizations established incubation facilities with business tie-ups to the TAMA Association. These are typical examples of the initiatives by private and regional players that show the self-support and autonomous aspects of the TAMA Association.

2.4.2 Outcomes reflected in the number of support cases

We can see the quantitative aspects of the outcomes of the TAMA Association in the number of collaboration between firms and universities or among firms realized or promoted through the Association's support as well as the number of product development and other types of activities of the individual members supported by the Association.

Table 3 tabulates the number of cases of support by the TAMA Association and its affiliated organizations, in which member firms obtained substantial results such as the formation of collaboration, adoption by government R&D funding scheme, the conclusion of technology transfer contracts with TAMA-TLO, participation in business plan contests, dispatch of TAMA coordinators, acquisition of business orders, decisions of investment by the TAMA Fund, and becoming tenants of TAMA affiliated incubation facilities. The cases in which the TAMA Association gave one-off advice to member firms are omitted. The cases concerning product or business development including collaboration support cases are counted with the number of themes of the product or business development and usually plural numbers of support are provided for one case.

The total number of cases in this respect since its establishment on April 23, 1998 until September 30, 2004 is 148. Among these cases, 50 are concerned with supporting products or businesses that have been commercialized.

3 Innovation mechanism growing in TAMA

3.1 Innovation mechanism lead by the product-developing SMEs

This section tries to describe the innovation mechanism growing in TAMA, using data from the questionnaire survey on SMEs in the TAMA region. This analysis also shows the effect of clustering that can be expressed by technological linkage and geographical proximity. The innovation mechanism that the TAMA Association is aiming for is one which is lead by "product-developing SMEs". Therefore this section starts with a definition of the "product-developing SMEs"

3.1.1 Product-developing SMEs

"Product-developing SMEs" is defined as the SMEs in manufacturing industries that have their own design functions and have their original products in their sales portfolio. Their "original products" here means products based on their original designs. Their "original products" can include not only final products but also parts and semi-products, and not only the products sold under their brand but also under the brand of other firms. The designs may be made according to orders or specifications by customer firms. Most of these products are certain core components of final products produced by large firms and production or testing equipment used in the manufacturing lines of large firms.

Anyhow, the important point of the "product-developing SMEs" is that they develop and produce their products based on their designing and planning capacity. In this respect, they are quite different from

the subcontracting SMEs who manufacture or process products based on the designs given by customer firms.

The characteristics of product-developing SMEs in the TAMA region as defined above have been confirmed by surveys particularly by the Kanto Regional Bureau of MITI [1997][3] and Kodama, Toshihiro [2003a]. 1) They have better business performance. 2) They have many customer firms (approximately 250 on average), which can be thought to reflect their capability to catch the customers' needs. 3) They are research oriented as seen in indicators such as R&D expenditure ratio to sales amount and the number of patents held and patent applications and a tendency for collaboration with universities. 4) They are core firms of the region in the sense that they use many "product-processing SMEs" (approximately 110 on average) mainly in the region to supply parts or process materials or parts for them (see 3.1.2 below as for the process-processing SMEs).

Examples of the products of the product-developing SMEs are nano-tech precision processing equipment such as electron beam lithography systems, various use of measuring and testing equipment such as electron beam surface roughness analyzers, probe cards for testing silicon wafer and magnetic material measurement systems, transmission components and equipment for radio frequency, microwave and optical signals. Further descriptions of the examples of the product-developing SMEs can be seen in Kodama [2003b].

3.1.2 Relationship with product-processing SMEs

The "product-processing SMEs" refers to the SMEs that are engaged in parts processing, such as cutting/grinding/sanding, casting/forging, pressing, coating/surface treatment, component assembly, and metal molding. They function as processing subcontractors of large firms and product-developing SMEs.

There are many product-processing SMEs capable of meeting orders for high-precision and quick delivery in the TAMA region. It forms one of the conditions for the product-developing SMEs to develop and produce their products.

There are such product-processing SMEs in most of the machinery manufacturing related industrial agglomerations throughout the country. However, one of the most important characteristics of the TAMA region is that there are numerous product-developing SMEs.

3.1.3 Innovation mechanism lead by the product-developing SMEs

Figure 2-1 shows the simplified structure of the production network developed among the firms in the TAMA region. When the product-developing firms succeed in developing the products to be purchased by the large firms, the economic effect spreads over the region through orders to the product-processing SMEs.

However, the linkage to combine different core technologies among the different product-developing SMEs and between the large firms and the product-developing SMEs to develop new products was not popular and collaboration between universities and the product-developing SMEs was minimal when the Kanto Regional Bureau of MITI conducted a survey published as the Kanto Regional Bureau of MITI [1997].

[3] Points are introduced in English in Kodama [2002], pp.14-16.

The TAMA Association was established to develop the technological linkage for developing new technologies and new products by combination of the different technologies among the product-developing SMEs and between the product-developing SMEs and large firms and collaboration between the universities and the product-developing SMEs as shown by figure 2-2.

That is to say an innovation mechanism has been developed around the product-developing SMEs in the TAMA region and the TAMA Association is enhancing this innovation mechanism by building the technological linkage among the players.

3.2 Data analysis to examine the innovation mechanism

Here, this paper conducts an econometric analysis to examine the existence of the innovation mechanism around the product-developing SMEs in the TAMA region as described above. This analysis also examines the benefit of clustering quantitatively, while most of the existing literature concerning regional clusters has examined the benefits using theoretical or qualitative descriptions or by case studies of individual firms.

3.2.1 Data set

The data set used here is constructed from a questionnaire survey conducted in 2003 to the firms in TAMA including both the TAMA member firms and non-member firms. Kodama [2003] reports the overall and descriptive results of the questionnaire survey with the methodological explanation of the questionnaire survey.

Total respondents of the questionnaire survey was 214, among which SMEs accounted for 200. The 214 respondents consisted of 120 respondents from 262 member firms of the TAMA Association excluding financial institutions and specialized services firms like business consultants (respondent ratio: 45.8%) and 94 respondents from 1364 non-member firms (1200 random samples and 164 firms that we could identify as product-developing firms in advance) (respondent ratio: 6.9%).

Although the respondent ratio of the non-member firms was low, we can assume the results concerning the product-developing SMEs are reliable according to the high respondent ratio of the member firms (45.8%) and the relatively high respondent ratio (17.1%) of the non-member firms that we could specify as product-developing firms in advance.

The low respondent ratio of the non-member and non product-developing firms may be problematic. However, the results of the analysis on the effects of technological linkage to the operational profit ratio comparing the product-developing SMEs with the non product-developing SMEs to be conducted here can be regarded as useful, since the non-member and non product-developing respondent SMEs have better business performance than usually observable in SMEs in Japan at that time.

From the 200 SME samples, the analysis here uses 158 samples in machinery related manufacturing industries, since these industries comprise the majority of the industrial concentration of the TAMA region and in which the distinction between product-developing SMEs and non product-developing SMEs seems to be significant. Among the 158 samples, 103 are product-developing SMEs and 55 are non product-developing SMEs. The non product-developing SMEs basically correspond to the product-processing SMEs.

3.2.2 Analytical framework

We analyzed the effects of clustering on the business performance of the firms. In this paper, we summarize the notion of the cluster as the linkage among players and geographical proximity. With regard to the linkage aspect, we specify it to the technological linkage among players according to the characteristics of the Japanese cluster promoting policies as reviewed in 1.4.2 above and the concept of the TAMA Association described in 2.3 and 3.1above.

The operational profit ratio to sales is used as a dependent variable to indicate business performance.

Firstly, we examine the effect of technological linkage on the operational profit ratio. Technological linkage is divided into three types i.e. linkage with one or more universities or other public research institutions (hereinafter just linkage with universities), linkage with one or more large firms and linkage with one or more SMEs. Any of the three types of linkage here means the collaboration of any of the three combinations of players for the purpose of developing new technologies or new products.

One of the dummy variables whether the firm has linkage with universities, whether the firm has linkage with large firms, or whether the firm has linkage with other SMEs is used as explanatory variable. The dummy variable representing linkage with universities will be 1 when the sample firm has linkage with universities, and will be 0, when the sample firm has no linkage with universities. The dummy variables representing linkage with large firms and representing the linkage with other SMEs are devised correspondingly.

The age of the firm since establishment and that raised to the second power are used as control explanatory variables in each equation.

Regression for each equation is made separately for each of the sample groups i.e. the product-developing SMEs and the non product-developing SMEs.

Further, another sample categorization is made according to the customer type of the main products of the firms. The customer types are “large firms”, “SMEs”, “universities and other public research institutions”, “consumers”, “public organizations” and “others”.

Secondly, we examine the effect of geographical proximity. For that purpose, we divide the dummy variable of the linkage with universities according to the location of the partner universities i.e. TAMA, central Tokyo, other area in Japan and foreign countries. Similarly, we divide the dummy variable of the linkage with large firms and the dummy variable of the linkage with other SMEs according to the location of the partner large firms or SMEs.

The age of the firm since establishment and that raised to the second power are used as control explanatory variables in the same way as the examination of the effect of the technological linkage.

Categorization of the samples used for the regression is made in the same way as the examination of technological linkage, according to whether it is a product-developing SME or non product-developing SME and according to the customer type of the main products of the firm.

Table 4 shows the number of samples in each type of technological linkage with the sample categorization as to whether the sample SME is product-developing or not. As for the sample categorization according to customer type, only major categories used for the regression are shown in Table 4.

3.2.3 Results of the analysis on technological linkage

Table 5 shows the OLS estimates of the coefficients of the dummy variable representing the linkage with universities for each of the case categorizations. The case categorization in the first column is made according to whether the samples are product-developing SMEs or non product-developing SMEs. The case categorization in the second column is made according to the customer type of the main product of the sample SME.

Similarly, the table shows the OLS estimates of the coefficients of the dummy variable of linkage with large firms and the dummy variable of the linkage with other SMEs.

Firstly, we look at the estimation results concerning the linkage with universities. The effect of linkage with universities is not clearly confirmed generally. However, the coefficient of the dummy variable representing the linkage with universities is positive and significant at 10% level, when the sample SMEs are product-developing SMEs and they produce their main products to be used by large firms. .

It is possible that linkage with universities is effective for the SMEs whose main customers are large firms, which usually give large markets for suppliers and may have strict requirements for suppliers to show high technology performance.

It is important that, among the SMEs whose main customers are large firms, the coefficient of the dummy variable representing linkage with universities is positive and significant only for the product-developing SMEs. The coefficient is negative and insignificant for the non product-developing SMEs.

This result suggests that linkage with universities is effective only for the firms that have enough absorption capacity such as the product-developing SMEs.

Secondly, we look at the estimation results concerning linkage with large firms. The effect of linkage with large firms is slightly clearer than linkage with universities. The coefficient of the dummy variable representing linkage with large firms is positive and significant at 10% level even without specifying the customer type, when the samples are product-developing SMEs. And it is positive and significant at 5% level, when the sample SMEs produce their main products to be exclusively used by large firms and they are product-developing SMEs. The coefficient is negative and insignificant for the non product-developing SMEs.

Thirdly, when we look at the estimation results concerning linkage with other SMEs, the effect of linkage is much clearer than the linkage with large firms. The coefficient of the dummy variable representing linkage with other SMEs is positive and significant at 5% level without specifying the customer type. But if we divide the sample group between the product-developing SMEs and the non product-developing SMEs, the coefficient is positive and significant only for the product-developing SMEs.

The same coefficient is positive and significant at 10% level with a larger value, when the sample SMEs are product-developing SMEs and produce their main products to be used by large firms. The coefficient is positive and significant at 5% level, when the sample SMEs are product-developing SMEs and produce their main products to be exclusively used by large firms.

These findings of Table 5 suggest, firstly, that technological linkage with other players is effective, but effective only for the firms that have enough absorption capacity such as the product-developing SMEs. They suggest, secondly, that technological linkage is more effective, and particularly that linkage with universities is only effective for the firms that produce products containing high-spec technology requested

by their customers such as the large firms in the consumer electronics, telecommunication, automobile and other high-tech industries deploying in the global market and engaging in global competition.

3.2.4 Results of the analysis on geographical proximity

Table 6 shows the OLS estimates of the coefficients of the dummy variables representing each type of technological linkage with the specification of the location of the linkage partners, for each of the major case categorization, in order to examine the effect of the geographical proximity.

If the coefficient of the dummy variable representing technological linkage with partners located in TAMA is positive and significant, we can infer that geographical proximity has a positive effect. If the coefficient of the dummy variable representing technological linkage with partners located in the central Tokyo is positive and significant, we can also infer that geographical proximity has a positive effect, since for the firms in TAMA, it is as convenient to commute with firms in the central Tokyo as commuting between firms in TAMA.

Firstly, we looked at the estimation results concerning linkage with universities. The coefficient of the dummy variable representing linkage with universities in TAMA is positive and significant at 5% level, when the sample SMEs are product-developing SMEs and produce their main products to be exclusively used by large firms.

The coefficient of the dummy variable representing linkage with universities in central Tokyo shows a much clearer effect. It is positive and significant at 5% level, without specifying the customer type, for the samples including both of the product-developing SMEs and the non product-developing SMEs, and the sample of product-developing SMEs. The same coefficient is positive and significant at 1% level with the larger value, when the sample SMEs are product-developing SMEs and produce their main products to be used for large firms.

On the contrary, the coefficient of the dummy variable representing linkage with universities in other areas shows no significant value for any case categorization.

These facts suggest the positive effect of geographical proximity for linkage with universities for product-developing SMEs, although it is also possible that the coefficient for central Tokyo may suggest the effect of the wide variety of the technological seeds in the universities in central Tokyo.

Secondly, we look at the estimation results concerning linkage with large firms. The coefficient of the dummy variable representing linkage with large firms in TAMA is positive and significant at 1% level, when the sample SMEs are product-developing SMEs and produce their main products to be exclusively used by large firms. The coefficients of the dummy variables representing linkage with large firms in central Tokyo and linkage with large firms in other areas do not show significant value for any case categorization.

These facts may suggest the positive effect of geographical proximity for product-developing SMEs to have linkage with large firms with respect to a certain case of producing products exclusively for large firms.

Thirdly, we look at the estimation results concerning linkage with other SMEs. The coefficient of the dummy variable representing the linkage with other SMEs in TAMA is positive and significant at 5% level, when the sample SMEs are the product-developing SMEs and produce their main products to be exclusively used by large firms.

This fact may suggest the positive effect of geographical proximity for product-developing SMEs to have linkage with other SMEs with respect to a certain case of producing products exclusively for large firms.

However, the coefficient of the dummy variable representing the linkage with other SMEs in other areas is also positive and significant at 5% level without specifying the customer type, when the samples are product-developing SMEs. And the same coefficient is not significant even for product-developing SMEs, when the sample SMEs produce their products to be used by large firms. There are very few samples having linkage with other SMEs in other areas among the sample SMEs that produce their products exclusively for large firms and that are the product-developing SMEs.

A possible interpretation is that, technological linkage with a firm located in another area is necessary and possibly effective if the firm is specialized in a specific technology that is not found in the TAMA region. The TAMA region has a huge concentration of industrial goods manufacturers that benefit finding a linkage partner to develop new products in the field of industrial goods to be used by large firms. But it may be necessary to find a linkage partner outside of the region to develop new products for broader purposes.

3.3 Implications

From the analysis in this section, we can deduce several implications, which are important from a policy viewpoint.

1. The technological linkage with other players including universities and other public research institutions, large firms, and SMEs is effective for firms that have enough absorption capacity, such as product-developing SMEs.

2. Geographical proximity helps the potential players to create technological linkage among them. However, there are cases that technological linkage between the players located in different areas is formed and effective.

3. In this respect, promoting technological linkage among the potential players is beneficial to the economy, and the cluster formation is an effective way to promote technological linkage in the sense of utilizing the advantage of geographical proximity for potential players to come together.

4. Product-developing SMEs are a promising category of the firms as promoters of technological linkage as well as promoters of the cluster formation. At the same time, we should note that product-developing SMEs are developing and producing their products on the basis of a production network with numerous product-processing SMEs, and that some of them are trying to transform themselves into product-developing SMEs.

5. Intermediary organizations would play a crucial role in promoting technological linkage and the cluster formation, because, even though the economical benefits of technological linkage for a certain category of firms like the product-developing SMEs is confirmed by the analysis here, we can observe empirically that technological linkage among potential players is not easily established in the business field or between the academic and business fields due to a lack of information sharing and the lack of mutual reliance.

6. he analysis of this section also confirmed that an innovation mechanism lead by the product-developing SMEs, where the profitable technological linkage is created between the product-developing SMEs and universities as well as large firms, and among the product-developing

SMEs, is really working in TAMA. We can imagine that the TAMA Association is functioning as an intermediary organization to enhance this innovation mechanism, although the data analysis here does not precisely specify how far the technological linkage was created through the activities of the TAMA Association.

4 Conclusions

Japan has recently launched cluster promoting policies. Emphasis of these policies is placed on creation of technological linkage to generate new products and new businesses, including both types of technological linkage through the promotion of start-up firms and through the promotion of collaboration with and among the existing innovative firms.

The TAMA Association's initiative is performing to build up an innovation mechanism based on existing innovative firms together with some activities to promote start-up firms. The data analysis confirmed that product-developing SMEs are vital to lead the cluster formation as existing innovative firms. The TAMA Association is assumed to play a key role as intermediary organization.

This paper concludes with provisional findings on the characteristics of the experience in TAMA, which may be relevant to the argument on clusters in the world. They are firstly that the experience in TAMA gives an example of a cluster formation initiative to build upon existing innovative firms-based innovation mechanism, and secondly that it suggests a vital role of intermediary organizations to help the potential players to create the technological linkage.

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Table 1. Table 1. Industrial Cluster Projects

Regions and Projects	Main industrial fields
Hokkaido	
Hokkaido Super Cluster Promotion Project	
1) Hokkaido Information Industry Cluster Forum	IT industries
2) Hokkaido Bio-industry Cluster Forum	Bio-related industries
Tohoku Region	
IT, Bio and Future Manufacturing Industry Project	IT, bio and manufacturing
Industry Promotion Project for Circulating Society	Recycling business and environment protection-related industries
Kanto Region	
Regional Industry Vitalization Project	
1. TAMA (Western metropolitan region)	Opt-mechatronics industries (industrial, electronics, telecommunication, transportation and precision machinery manufacturing and software industries)
2. Region along Chuo Freeway	General and precision machinery manufacturing
3. Tokatsu and Kawaguchi region	Mechatronics, bio and IT industries
4. San-en-nanshin region	Transportation equipment and opt-electronics industries
5. Northern metropolitan region	Transportation and electric machinery and other manufacturing
Metropolitan Biotechnology-Related Startups Network	Bio-related industries
IT Venture Forum	IT-related industries
Chubu Region	
Tokai Business Creating Manufacturing Project	Manufacturing (incl. IT related industries)
Tokai Business Creating Bio and Manufacturing Project	Bio-related industries
Hokuriku Business Creating Manufacturing Project	Manufacturing
Kinki Region	
Kinki Bio-industry Project	Bio-related industries
Active Manufacturing Firms Support Project	Manufacturing
IT Cluster Promotion Project	IT industries
Kinki Energy and Environment Cluster Promotion Project	Energy and environment protection-related industries
Chugoku Region	
Chugoku Machinery Industry Innovating Project	Automobile, shipbuilding, industrial machinery and other machinery manufacturing
Circulating Industry Formation Project	Recycling business industries
Shikoku Region	
Shikoku Techno-bridge Project	Manufacturing focusing on health and environment protection
Kyushu Region	
Kyushu Recycle and Environmental Industry Plaza	Recycling and environment protection-related industries
Kyushu Silicon Cluster Project	Semi-conductor related industries
Okinawa Prefecture	
Okinawa-type Industry Promotion Project	Health-related, IT-related, environment-related, processing and trading industries

(Note) Each of the nine regions corresponds to jurisdictions of each of the eight Regional Bureaus of METI and the Okinawa Integral Bureau of the Government.

(Sources) METI (2004), "Industrial Cluster Projects" and materials of Regional Economy and Industry Group of METI

Table 2 Projects under the Knowledge Cluster Initiative

Cities	Projects	Area of specialization of joint research
Sapporo	Sapporo IT Carrozzeria Cluster	IT (Software and system ware information technology)
Sendai	Sendai Cyber Forest Cluster	Intelligent electronics (e.g. photonics, wireless system, MEMS application)
Nagano-Ueda	Nagano-Ueda Smart Device Cluster	Smart devices using nano carbon composites and organic nano-materials
Hamamatsu	Hamamatsu Optronics Cluster	Super-visual imaging technology to support next-generation industry and medicine
Toyama-Takaoka	Toyama Medical and Bio Cluster	Medical systems based on biotechnology and microelectronics
Kanazawa	Ishikawa High-Tech Sensing Cluster	High-tech measurement and support technology for human intelligent activity
Gifu-Ogaki	Gifu/Ogaki Robotics Advanced Medical Cluster	Medical and health care systems using IT and robotic technology
Nagoya	Nagoya Nano-Technology Manufacturing Cluster	Nanotech/Materials
Kyoto	Kyoto Nanotech Cluster	Creation of nanotech business
Kansai Science City	Keihannna Human L-cube Cluster	Creating technologies to support fulfilling living through the sophisticated use of IT and genomics
Kansai Wide Area Cluster		
Saito (Northern part of Osaka)	Saito Bio Medical Cluster	Drug discovery and new medical strategy based on molecular medicine
Kobe	Kobe Translational Research Cluster	Translational research focused on advanced medical fields like regenerative medicine
Hiroshima	Hiroshima Biocluster	Gene technologies and cell utilization technologies for supporting medicine and drug development
Ube	Yamaguchi Ube Medical Innovation Cluster	Next-generation medical equipment based on optic technologies like LEDs
Tokushima	Tokushima Health and Medical Cluster	Technologies for searching the disease-linked proteome and genome, and promotion of activities in related industries
Takamatsu	Takamatsu Rare Sugar Biocluster	Basic technology for creating a sugar bioindustry using rare sugars as new materials for the life sciences
Kyushu Wide Area Cluster		
Fukuoka	Fukuoka System-LSI Design and Development Cluster	System LSI design and development technology
Kitakyushu	Kitakyushu Human Technology Cluster	System LSI technology, nano-size sensor technology, and emerging technologies

Source: MEXT [2004], "CLUSTER – Knowledge Cluster Initiative – 2004"

Table 3 Number of Cases of TAMA Association's Support since its Establishment on April 23, 1998 until September 30, 2004

1. Total cases of support TAMA Association affiliated organizations				148
	2. Support by TAMA Association (including TAMA-TLO)			126
		3. Formation of collaboration for developing products / businesses		61
			4. Matching coordination	19
			5. Project promotion of existing collaboration	26
			6. Providing meeting opportunities	10
			7. Partial support	6
		8. Support for product / business development of individual firms		58
		9. Support for individual firms unspecified with specific products		8
		10. (Support for start-up businesses (included in 2))		19
	11. Investment by TAMA Fund			24
		12. (Investment for start-up businesses (included in 11)		23
	13. (Commercialized cases (included in 1))			50

(Notes)

1. The number of cases of support by TAMA Association (including TAMA-TLO) (2 to 8) is indicated by the number of themes of products or business development, excepting "9. Support for individual firms unspecified with specific products" that indicates the number of issues to be solved. Plural measures of supports are very often provided for one case. The number of investments by the TAMA Fund (11 and 12) indicates the number of firms invested in.

2. Two of the 24 cases in "11. Investment by TAMA Fund" are also included in "2. Support by TAMA Association (including TAMA-TLO)). Similarly, two of the 23 cases in "12. Investment for start-up businesses" are included in "10 Support for start-up businesses by TAMA Association". "1. Total cases of support under TAMA activities" shows the number exclusive of the double counting.

3. The counted cases are those in which member firms obtained substantial results such as the formation of collaborations, adoption by a government R&D funding scheme, the conclusion of a technology transfer contract, participation in business plan contests, dispatch of TAMA coordinators, acquisition of business orders and decisions of investment by the TAMA Fund. The cases in which the TAMA Association just gave one-off advice to the member firms are omitted.

4. tart-up businesses here mean firms within five years of their establishment at the time of the support by the TAMA Association or investment by the TAMA Fund.

Sources: TAMA Association, Inc., Seibu Shinkin Capital Co., Ltd.

Figure 2.1. Network among Firms

BEFORE Etablishment of TAMA Association

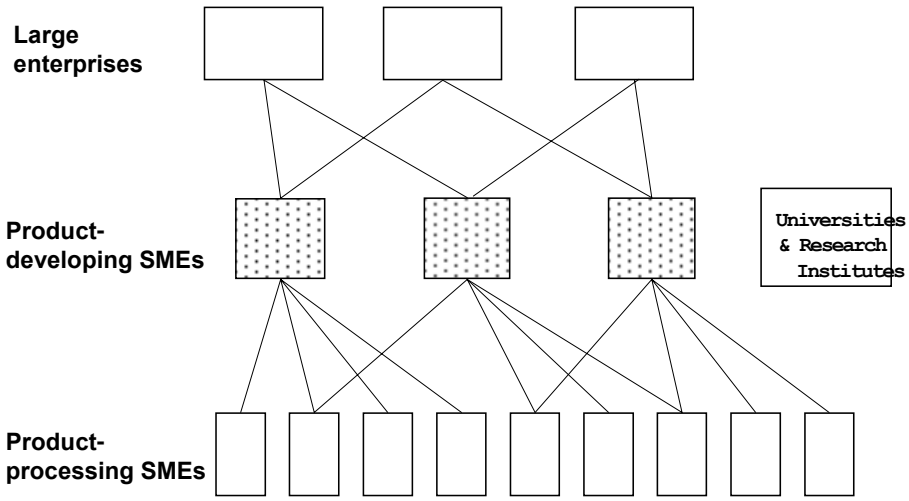

Figure 2.1. Network among Firms

BEFORE Establishment of TAMA Association