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Industry-Academic and Inter-corporate Collaboration in TAMA (Technology Advanced Metropolitan Area)

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Abstract

Japan must create and develop new industries in order to get out of the prolonged recession and hollowing out of the domestic industry. In this respect, it is hoped that new technologies and products that will form the basis of new industries will be produced through industry-academic or inter-corporate collaboration. There are also active movements to promote industry-academic collaboration on a regional basis as part of the "Industrial Cluster Plan" and "Intellectual Cluster Formation Project".

TAMA Industrial Activation Association Inc. (initially "TAMA Industrial Activation Council," hereinafter referred to as the "TAMA Association" including the Council period), was established by private companies, mainly product developing small and medium-sized enterprises (hereinafter referred to as "product developing SMEs), universities and other education and research organizations, commerce and industry associations, and local governments, in the region along the national road Route 16 extending from the southwest portion of Saitama Prefecture to Tokyo's Tama district and the central part of Kanagawa Prefecture. It is an example organization pioneering intermediation of industry-academic and inter-corporate collaboration on a wide regional basis.

Analyses of the cases of industry-academic and inter-corporate collaboration formed with the purpose of developing new technologies or products that are collected from the Association or in the region show that the TAMA Association is fulfilling its function as an intermediary organization. For instance, there used to be few cases of development-oriented collaboration in the TAMA region despite of the fact that there are product developing SMEs and science and technology universities there, but now new collaboration has come to be formed between enterprises and universities that came into contact with each other through activities of the TAMA Association.

We have also confirmed that the TAMA Association's collaboration promotion

initiative induced positive reactions from core municipalities in the region, large enterprises and local financial institutions, and that collaboration between them and the TAMA Association and Association member companies has expanded in their mutual interest.

In order for collaboration to be successfully formed like that formed by the TAMA Association, it is essential that there exist product developing SMEs capable of accurately capturing market needs and having R&D-oriented characteristics and promoters of collaboration initiatives. Therefore, the TAMA Association method cannot be employed in all regions. But, it suggests that to find promoters of collaboration initiatives, product developing SMEs should be targeted, that the labor mobilization at large enterprises may provide a reserve army of product developing SMEs, and that administrative support should be focused on intermediary functions.

TAMA, where many product developing SMEs are located, also has strong innovation potential in terms of modularization. In fact, there are examples in which industry-academic collaboration under the auspices of the TAMA Association has raised the technological level of modules produced by product developing SMEs, and has made it possible for such enterprises to join modules in the fields of new products.

Keywords: Industry-academic collaboration; Cluster; Intermediary organization; Modularization; Product developing SMEs; TAMA; Greater Tama Region

JEL classification: O31, O32, O38, R10, M13

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1. Introduction

Japan must create and develop new industries in order to get out of the prolonged recession and hollowing out of the domestic industry. In this respect, it is hoped that new technologies and products that will form the basis of new industries will be produced by utilizing research results of universities and other research institutes through industry-academic collaboration or by combining different technologies and know-how through inter-corporate collaboration.

(Hopes on industry-academic collaboration, and regional clusters)

Establishment of the system to promote industry-academic collaboration has been under way, reflecting great hopes that have been placed on such collaboration in recent years. Among such efforts are the enactment of the "Law for Promoting University-Industry Technology Transfer (TLO Law)" in 1998, the introduction of the "Japanese version of the Bayh-Dole clause" in connection with the enactment of the "Law on Special Measures for Industrial Revitalization" in 1999, and the enactment of the "Law for Enhancing Industrial Technological Capabilities" in 2000 that has eased the regulation of dual employment of national university professors as directors at private companies, and that has made it easy for public universities to receive funds from the private sector. The "First Industry-Academic-Government Partnership Summit" was held in November 2001 and later "Regional Industry-Academic-Government Partnership Summits" were held in nine regions across the country. In addition, policy measures have been implemented to promote regional industry-academic collaboration and thereby creating new businesses and enhancing technological development, such as the "Industrial Cluster Plan" by the Ministry of Economy, Trade and Industry (METI) from FY2001 and the "Intellectual Cluster Formation Project" by the Ministry of Education, Culture, Sports, Science and Technology (MEXT) from FY2002.

(Intermediary function that is necessary for collaboration)

How is industry-academic collaboration actually being practiced in response to the gathering momentum and the institutional improvements? It is by no means easy for companies and universities to join hands for the purpose of R&D or product development, as they have different purposes and motives and in most cases they

don't even know about the existence of each other. Therefore, in order to put collaboration into practice, it is necessary to have an intermediary organization that provides universities and companies chances to meet each other and puts them together.

(TAMA as a practical example of a collaboration intermediary organization)

TAMA Industrial Activation Association Inc. (formal name: Metropolitan Industrial Activation Association Inc. It was initially "TAMA Industrial Activation Council," and will be referred to as the "TAMA Association," including its Council period, throughout this paper unless otherwise noted), can be viewed as a practical example organization pioneering the intermediation of industry-academic and inter-corporate collaboration on a wide regional basis. Namely, the TAMA Association was established in April 1998 for the purpose of promoting industry-academic and inter-corporate collaboration and thereby promoting the creation of new industries, in the western metropolitan area, where many product developing small and medium-sized enterprises (hereinafter referred to as "product developing SMEs") and science and technology universities are located.

There are other organizations that intermediate collaboration. With regard to industry-academic collaboration, for example, there are "Technology Licensing Organizations (TLOs)" that intermediate the transfer of research results of universities to private companies by supporting acquiring patents and licensing them, and incubation institutions that may support putting research results of universities to practical use by proving business space and other services to venture companies. With regard to collaboration among small and medium-sized enterprises (SMEs), there are various exchange meetings sponsored by chambers and societies of commerce and industry and other SME organizations, in addition to conventional cross-industrial cooperatives and cross-industrial exchange groups.

Unlike these organizations, the TAMA Association is a new type of collaboration intermediary organization in that 1) it covers a cross-prefectural area extending from the southwest portion of Saitama Prefecture to Tokyo's Tama region and the central part of Kanagawa Prefecture, 2) it consists of diversified entities, such as many vigorous SMEs and universities, and some large enterprises as well as local governments and commerce and industry associations that are all necessary for the promotion of industry-academic and inter-corporate collaboration, 3) these entities themselves take the initiative, and 4) the Association is engaged in various activities under the main purpose of promoting collaboration, including establishment of a TLO

and cooperation with incubation institutions.

(Purpose and main discussion of this paper)

This paper pays attention to the TAMA Association as it is a pioneering practical example of an autonomous collaboration intermediary organization composed of diversified entities in a cross-prefectural area. Specifically, the purposes of this paper are to understand the accomplishments of the TAMA Association as a collaboration intermediary organization, by collecting and investigating collaboration cases in and around the TAMA Association, and to get some ideas with regard to how collaboration intermediary functions and organizations should be in order to promote industry-academic and inter-corporate collaborations, especially on a regional basis, by studying the necessary conditions for a collaboration intermediary organization.

The main discussion of this paper is to verify that the TAMA Association has been demonstrating its function as a collaboration intermediary organization, based on the survey of collaboration cases. In doing so, we break down the patterns of the intermediary organization's involvement in collaboration into those in which the organization leads formation of collaboration as a coordinator, those in which it supports projects of existing collaboration teams, those in which it provides meeting opportunities, and those in which it partially provides support. In conjunction with this, this paper will study important requirements for the TAMA Association to be effective. This paper focuses on three points: existence of product developing SMEs, existence of leaders of the initiative, and form of administrative support. In addition, this paper will try to put TAMA, where many product developing SMEs are located, and collaboration there in order in relation to the "modularization" theory that has come into the limelight recently in economics and business administration studies.

2. Definition of terms

Before getting into the main discussionsbased on the survey of collaboration cases, we would like to introduce the definition of terms and concepts that are premised in the main discussions. In this Section, we would like to introduce the definition of industry-academy collaboration, inter-corporate collaboration, coordination, and intermediary function that are used in this report. In Section 3, we would like to introduce the concepts of TAMA, the TAMA Association, and product developing enterprises on the basis of the results of surveys conducted in the past.

(1) Industry-academic collaboration and inter-corporate collaboration

The "industry-academic collaboration" and "inter-corporate collaboration" that are analyzed in this report mean combining different technological seeds between companies and research institutes, such as universities, or among companies in order to develop a new technology or product (including services, hereinafter, the same). Typical examples of technological seeds are university researchers' R&D results and advanced technological knowledge in the field of their specialization, and companies' core technology to develop and manufacture their main line of products. But they also include know-how and other information held by companies such as customer information and knowledge about market characteristics.

Industry-academic cooperation takes various forms. Some of them have been institutionalized by MEXT as systems for research cooperation between national universities and private companies, such as "joint research," "funded research," "funded research workers," and "scholarship." Other public universities and private universities also take similar forms of collaboration. There are other forms of cooperation, such as "internship (dispatching students to companies for training purposes)," "providing research facilities," "transfer of research results, such as patent licensing," and "general guidance and advice." The kinds of "industry-academic collaboration" subject to analysis in this paper are those that lead to development of a new technology or product. Among the various forms of collaboration mentioned above, "joint research," "funded research," "funded research workers," and "transfer of research results, such as patent licensing" fall under this category. Of "general guidance and advice," those that lead to development of a new technology and product also fall under this category.

Inter-corporate collaboration also takes various forms. For example, a manufacturer's contracting out part of production process or consigning marketing to a distributor is a kind of inter-corporate collaboration. But the kinds of inter-corporate collaboration that are subject to analysis in this paper are, unless otherwise noted, those that put different technological seeds (including know-how) together in order to develop a new technology or product.

When several research institutions, such as universities, and several companies jointly form a consortium, it is a typical form of industry-academic collaboration covered by this paper.

When a national or public research institute is involved in collaboration, or when the government provides support or cooperation to industry-academic collaboration, it

is often called "industry-academic-government collaboration." However, since this paper focuses on collaboration for the development of a new technology or product in order to make our argument clear, even if the government provides general support or cooperation to industry-academic collaboration, we do not call it "industry-academic-government collaboration." And even when a national or public research institution is involved in collaboration, considering that the supply source of technological seeds is based on R&D results, such an institution is considered to be the same as a university, and we call it "industry-academic collaboration," not "industry-academic-government collaboration".

(Coordination and intermediary function)

As we have described in Section 1, the analysis in this paper focuses on intermediary functions and intermediary organizations for industry-academic and inter-corporate collaboration. The most typical intermediary function is coordination. Coordination in this report refers to realizing collaboration between a company and a research institute, such as a university, or between different companies having necessary technological seeds to develop products or services or to develop technology to produce such products or services that meet market needs and to commercialize such products or services. In other words, coordination means promoting collaboration between economic entities having technological seeds, while striving to match market needs. The person who carries out this function is called the coordinator.

Providing meeting opportunities and supporting collaborative development projects to facilitate coordination, and in some cases, doing coordination are called intermediary functions in this paper. The organization that performs intermediary functions is called the intermediary organization.

3. TAMA Association and product developing enterprises

In this section, we would like to explain TAMA and the TAMA Association as well as types of companies, such as "product developing enterprises," which is one of the keywords of this paper.

(1) TAMA

TAMA refers to a region along national road Route 16 extending from the southwest portion 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".

(Components of industrial agglomeration of the region)

The region is concentrated with 1) development bases of electric and electronic machinery makers and other large enterprises, 2) education and research institutes, such as universities having faculties of science and technology, 3) product developing SMEs capable of planning and developing products backed by capturing market needs, and 4) product processing small and medium-sized enterprises (hereinafter refered to as "product processing SMEs") capable of meeting orders for high-precision processing and quick delivery. They form an industrial agglomeration of excellent economic entities capable of producing new technologies and products or the sources of new industry creation.

(History of formation of the industrial agglomeration)

With regard to the history of 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 for many years, by such events as evacuation of major factories from central Tokyo and the Keihin Bay Area in the prewar period, conversion of these factories from military production to non-military uses during the postwar reconstruction period, establishment of new factories by the attraction of major corporations from central Tokyo and the Keihin Bay Area around the high growth period and new start-up firms by spin off from major corporations that had located in the region (Kanto Bureau of International Trade and Industry, 1997, p. 5).

(Survey by Kanto Bureau of International Trade and Industry)

The Kanto Bureau of International 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 in surrounding areas 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, that are necessary for the development of state-of-the-art products are concentrated in TAMA (Kanto Bureau of International Trade and Industry, 1997. To be described in (3)).

(2) TAMA Association

(How it came into being)

Based on the survey results, the Kanto Bureau of International Trade and Industry proposed establishment of an organization to strengthen regional industry-academic and inter-corporate 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 companies and universities in the region responded favorably. In September 1997, the "Preparatory Committee of Greater Tama Region Industrial Activation Council (tentative name)" (hereinafter to be called the "Preparatory Committee") was inaugurated with 55 representatives from 54 organizations, including private companies, mainly product developing SMEs, universities and other research institutes, commerce and industry associations, and local governments, attending. In April 1998, the "TAMA Industrial Activation Council" was formally established by 328 members (including 190 corporate members).

In April 2001, the Council, which was a voluntary organization, was reorganized and became an incorporate body: "TAMA Industrial Activation Association Inc. (formal name: Metropolitan Industrial Activation Association Inc., Chairman: Yuji Furukawa)" (Hereinafter to be called the "TAMA Association"). As of October 1, 2002, the number of members stood at 495 (including 271 company members).

TAMA is the name used by the Association to designate the area. The map in Figure 1 shows the area that constitutes TAMA and is the eligible locating area for

becoming regular members of the TAMA Association.[Note 1].

(Description of activities)

According to the prospectus for the establishment of the TAMA Industrial Activation Council, the TAMA Association 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-academic-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-academic-(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, industry-academy collaboration and R&D promotion, events promotion, new start-up business support, and international exchanges. The Association's operations include not only those that directly contribute to collaboration promotion, but also those that contribute to individual business support, like new start-up business support operations. The type of operations to support individual companies, such as solving problems by visiting companies in a group, including experts, has increased in recent years. However, this paper mainly focuses on the collaboration intermediary function of the TAMA Association.

The TAMA Association's main objective is to promote collaboration, but it is also engaged in various activities that will contribute to the objective. As part of such activities, the Association established a technology-licensing organization (TLO) that

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(Note 1) Companies outside the area can be admitted to the TAMA Association as supporting members (such members are not given the right to vote at general meetings and cannot become executive members, but can take part in the Association's operations in the same capacity as regular members). Universities, public-service corporations, and individuals can be admitted as regular members, if they have a cooperative relationship with a company eligible to become a regular member (manufacturer or other company engaged in product development-related activities).

is seen as one form of industry-academic intermediary organization, and formed business tie-ups with incubation institutions.

(Establishment of the TAMA-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 companies. At present, there are 28 TLOs, either approved or certified under the TLO Law, across the country. As part of its industry-academy 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 the company members of 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 the 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 of 16 universities. Hereinafter, the "TAMA Association" will include the "TAMA-TLO," unless otherwise noted.

(Cooperation with incubation institutions)

The TAMA Association signed a business tie-up agreement with the "Fuji Incubation Office (called FIO for short)," which was established by Fuji Electric Co. (hereinafter referred to as "Company FD"), a TAMA Association member, at a site adjacent to the company's Tokyo Systems Factory in Hino City in November 2001. Under the agreement, FD provides the tenant enterprises in FIO with hardware and services for manufacturing, such as trial production, evaluation, and test instruments, while the TAMA Association provides software services concerning support for industry-academic collaboration and utilization of public funds.

"Sagamihara Incubation Center" an incubation institution established by the Sagamihara municipal government in April 1999, is a member of the TAMA Association. Although Sagamihara Incubation Center and the TAMA Association have no formal partnership, member tenant companies often utilize the collaboration intermediary functions of the two organizations on a complementary basis.

(Characteristics of the Association's organization)

The TAMA Association has several characteristics that can be attributed to the

background that led to its establishment.

First, the biggest reason why the Association was established is that product developing enterprises, most of them being small and medium-sized but having their own designed products, which will be described in (3) below, are concentrated in the area and that they were recognized as having the capabilities to promote industry-academic and inter-corporate collaboration and to make great contributions to the creation of new industries and the enhancement of regional economies. Therefore, what forms the core of the "industry" in the TAMA Association's industry-academic collaboration activities are product developing SMEs and leading product processing SMEs that can become key local players. Namely, the main target is these leading SMEs. The TAMA Association does not aim at raising the level of SMEs as a whole. Rather, the Association intends to enhance the capability of product developing SMEs and have their spillover effects spread to other SMEs through production outsourcing.

Second, companies' collaboration activities have spread to wider areas and such activities do not necessarily have to be contained within a single prefecture. Meanwhile, industrial agglomeration composed of homogeneous elements that are expected to promote industry-academy and inter-corporate collaboration, such as science and technology universities, R&D facilities of large enterprises, and product developing SMEs, have spread to the southwest portion of Saitama Prefecture, Tokyo's Tama region and the central part of Kanagawa Prefecture. Therefore, the TAMA Association was established to cover a cross-prefectural area encompassing +Tokyo, Saitama and Kanagawa.

Third, the TAMA Association consists of diversified bodies that are necessary for flexible promotion of industry-academic and inter-corporate collaboration, such as leading SMEs, education and research institutes like science and technology universities, several core large enterprises, commerce and industry associations, and local governments.

Fourth, though the TAMA Association was established at the approach of the Kanto Bureau of International Trade and Industry, a state organ, it is a membership organization with membership fee and an autonomous body operated by its members.

In other words, the TAMA Association 1) mainly targets product developing SMEs and other leading SMEs, 2) operates in a wide regional area extending beyond one prefecture, 3) is composed of diversified bodies that are necessary for the promotion of industry-academic and inter-corporate collaboration, 4) is an autonomous private membership organization operated by its members, and 5) performs various activities

that will contribute to its main objective of promoting collaboration.

(3) Product developing enterprises

In order to facilitate the understanding of the TAMA Association, it is necessary to define product developing enterprises and product processing SMEs. These corporate types are concepts mainly for manufacturing industries, in particular, the machine manufacturing industry.

(Product developing enterprises)

First of all, "product developing enterprises" means those enterprises that have designing capabilities and have their own products. "Have their own products" means that the enterprises sell their own designed products(Note 2). This definition attaches importance to enterprises' planning and designing capabilities. We also attach importance to sales of one's own products, because it is important that enterprises are producing vendible products. In other words, the definition of product developing enterprises pays attention to enterprises' product development capabilities backed by their grip on market needs.

With regard to "one's own products," what is important is whether the enterprises planned and designed the products by themselves or not. Whether they are end products or not, and whether they are one's own brand products or not are not important. "Own products" means finished products, half-finished products, or components/accessories used in finished products (including those shipped to other companies on an OEM basis) that are produced based on that company's plans and designs. On the contrary, "subcontract products" means half-finished products, components/accessories used in finished products, or raw materials that are produced based on other companies' plans and designs, or on the specifications, quality, and shape designated by others.

Most of the large manufacturing companies inevitably fall into the category of

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(Note 2) In the case study of this paper and the two surveys conducted by the Kanto Bureau of International Trade and Industry (Kanto Bureau of International Trade and Industry 1997 and 1998), the ratios of own-designedproducts to total sales were obtained in units of 10%. Therefore, strictly speaking, enterprises whose own-designed product to sales ratio is 5% or larger are treated as “product developing SMEs” and those whose ratio is less than 5% are excluded.

product developing enterprises defined above. In this paper, however, we focus on small and medium-sized product developing enterprises, and if distinction is necessary, we call them "product developing SMEs."

(Product processing SMEs)

On the other hand, "product processing SMEs" means small and medium-sized enterprises that are engaged in parts processing, such as cutting/grinding/sanding, casting/forging, pressing, coating/surface treatment, component assembly, and metal molding. There are enterprises that are both of the product processing type and product developing type. When we say "product processing SMEs," it means that we pay attention to such enterprises' function as processing subcontractors of "product developing enterprises." The existence of product processing SMEs capable of meeting orders for high-precision processing and quick delivery is an important factor to support the product development capabilities of product developing enterprises. But, many of the product processing SMEs do not have their own products and they have been performing as subcontractors of large enterprises.

Enhancing technical capabilities and self-reliance of product processing SMEs is another important policy issue. But, it alone is not enough to avoid industrial hollowing out. The existence of companies capable of creating products is important. Therefore, this paper focuses on product developing enterprises, especially on product developing SMEs that can partly replace large enterprises as the new promoters of product development.

(Performance of product developing SMEs)

The two surveys conducted by the Kanto Bureau of International Trade and Industry - Kanto Bureau of International Trade and Industry (1997) and Kanto Bureau of International Trade and Industry (1998)[(Note 3)] are on product developing

(Note 3) Since this author was involved in the two surveys as a Bureau staff member and since their explanations of the concepts and significant of TAMA and product developing SMEs have continuity with this paper, this paper introduces the outline of the two surveys.

enterprises in the Greater Tama Region (which corresponds to TAMA)[Note 4] and product developing enterprises in the Greater Kanto Region[Note 5], respectively. The findings of the surveys show that product developing SMEs[Note 6] with a firm grip on market needs and with strong technology development orientation have been performing well by utilizing excellent product processing SMEs as subcontractors and leading regional economic development.

First, the outline of the Kanto Bureau of International Trade and Industry (1997) survey on product developing enterprises in the Greater Tama Region is as follows:

1) Strong performance: Shipments by product developing middle-sized and small/medium-sized enterprises during FY1993~1996 grew at an annual rate of 6~7%, while shipments by manufacturing industries as a whole remained sluggish during the same period.

2) Grip on market needs: Product developing middle-sized and small/medium-sized enterprises are sensitive to the trend of market needs, with even small/medium-sized enterprises having more than 200 corporate customers.

3) Technology development orientation: Product developing enterprises, including small and medium-sized ones, have strong technology development orientation, as can be seen from the high ratio of R&D expenses to sales and the high ratio of enterprises having industrial property.

4) Focus on domestic production: Many of the product developing enterprises focus on domestic production. More than 80% of product developing SMEs do not have a production base abroad and many of them say they do not plan to establish one within the next five years.

(Note 4) The appellative "TAMA" was not in existence in those days and the region was called the "Greater Tama Region." Hereinafter, with regard to description of activities before the inauguration of the TAMA Industrial Activation Council, the region will sometimes be referred to as the "Greater Tama Region."

(Note 5) Tokyo and 10 prefectures: Ibaraki, Tochigi, Gunma, Saitama, Chiba, Kanagawa, Niigata, Yamanashi, Nagano, and Shizuoka.

(Note 6) The distinction of the size of enterprises in the Kanto Bureau of International Trade and Industry (1997) and (1998): "Small and medium-sized enterprise: Capital of less than 100 million yen or workforce of less than 300," "Middle-ranked enterprise: Capital of 100 million or more but less than 10 billion yen," and "Large enterprise: Capital of 10 billion yen or more."

5) Existence of number-one firms: There are many so-called "number-one firms" among product developing middle-sized and small/medium-sized enterprises whose own products enjoy an extremely high market share in specific product fields.

6) Division of labor with product processing SMEs in the manufacturing process: Product developing enterprises use many product processing SMEs as subcontractors. There are many excellent product processing SMEs capable of meeting orders for high-precision processing and quick delivery in the Greater Tama Region.

7) Spin off from existing companies: Many of the product developing SMEs were established by young engineers in their late 30s after spinning off from existing companies.

(Product developing enterprises in the whole Greater Kanto Region)

The Kanto Bureau of International Trade and Industry (1998) survey covered product developing enterprises in the Greater Kanto Region, more extensive than the Greater Tama Region. The findings of the survey revealed that product developing SMEs also exist in other regions and that they show a similar trend as that of their counterparts in the Greater Tama Region in that they have made steady progress backed by their firm grip on market needs and strong technology development orientation, that they form the core of regional economy by establishing a network with many firms having excellent processing technology, and that many of them were established by founders who spun off from existing companies to make use of their technological expertise and ideas.

Since the survey was not conducted in a random sampling method, it is difficult to obtain a statistically accurate geographical distribution of the enterprises. However, as far as this survey is concerned, it shows that the Greater Tama Region has more product developing SMEs than the other areas in the Greater Kanto Region.

Product developing enterprises, especially SMEs, are important as promoters of new product development that will provide a base to correct industrial hollowing out and act as key players to promote regional economic development. Accordingly, they are the main targets of the TAMA Association's activities, and this paper focuses on them as promoters of industry-academic and inter-corporate collaboration.

(Networking status within the Greater Tama Region before the TAMA Association)

The findings of the Kanto Bureau of International Trade and Industry (1997) survey that covered the Greater Tama Region show that what characterizes the network structure in the region is that product developing SMEs have developed a

network relationship with product processing SMEs through outsourcing. However, the network relationship is that of division of labor in manufacturing process and collaboration aimed at product development is not common. As for industry-academic collaboration, although the university side has become positive toward collaboration, it has only a short track record of industry-academic collaboration in the region, especially with SMEs. The findings also revealed that the lack of information about potential collaboration partners and lack of chance, in addition to lack of manpower and funds, are problems in promoting industry-academic and inter-corporate collaboration.

In other words, although there are potential agglomeration of enterprises and universities having excellent capabilities to develop products and technology in the region, collaboration between them is not sufficient in terms of development of products and technology, and the development potential is yet to be fully taken advantage of. Therefore, in order to take advantage of the potential of the excellent industrial agglomeration and technological agglomeration in the region, it is important for enterprises and universities in the region to recognize each other and deepen exchange and collaboration. It was for this reason that the Kanto Bureau of International Trade and Industry and the Preparatory Committee proposed the establishment of a collaboration promotion organization.

4. Outline of the survey of collaboration cases

Now, I would like to relate the findings of our survey of collaboration cases. This section will explain the survey method and give an outline of the survey results and Section 5 will analyze the contents of collaboration intermediary functions of the TAMA Association and their achievements.

(Survey method)

We carried out a survey to collect cases of the kinds of industry-academic collaboration (including industry-academic-government collaboration) and inter-corporate collaboration that have been explained in Section 2 (1) above, including those formed through activities of the TAMA Association, in the TAMA region.

RIETI commissioned collection of collaboration cases to the TAMA Association. Specifically, we identified collaboration cases to be studied, and the central players based on the information provided by the secretariat of the TAMA Association, on the

information obtained through questionnaires sent to executive company members and e-mail inquiries sent to all company members, and TAMA Coordinators(Note 7), who have been registered with the TAMA Association, interviewed the central players concerning identified collaboration cases. As to collaboration cases of nonmembers and those in which the TAMA Association is not involved, we identified study cases by taking information provided by TAMA Coordinators into account. The questionnaire was prepared beforehand. It consists of 1. Profile of the company studied (or university researchers, etc.), 2. Contents of collaboration (outline of the product or service targeted, collaboration partner), 3. Process of collaboration formation (process of the creation of the product or service targeted, process of the formation of collaboration team), and 4. Factors that led to the formation of collaboration.

The interviews were held during the period from December 2001 to March 2002.

We also collected cases that show achievements of the TAMA Association's activities other than the promotion of collaboration, such as establishment of information systems and other solutions of management issues through dispatch of TAMA Coordinators or other specialists, and acquisition of personnel realized as a result of meeting through TAMA Association activities.

(2) Profiles of companies surveyed

(Identification of objects of field interview)

Since the results of the identification of cases to be surveyed showed that the central players of collaboration are companies except in one case, the field interviews were conducted mainly on companies. That is to say, mostly companies lead collaboration projects both in the case of inter-corporate collaboration and industry-academic collaboration. In only one case was the central player a university researcher. However, it can be said that the company played a major role in this case as well, as the researcher concurrently serves as a director of the company. Including this case, the number of companies interviewed was 40, and as will be described in

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(Note 7) The TAMA Association has scores of registered "TAMA Coordinators" that offer specialized services such as management consultation to member companies. They are certified small and medium-sized enterprise management consultants, consulting engineers, or patent attorneys or have eqivalent ability. They are different from the coordinators that we defined in Section 2. (2), but are TAMA Coordinators in the specific meaning as described here. Ten of them cooperated with this survey.

(3) below, the number of collaboration cases and other cases combined was 56.

(Most of the companies in collaboration cases are product developing enterprises)

Table 1 shows profiles of the companies studied and Table 2 shows their performance in terms of sales. Most of the companies studied are product developing enterprises. One of the 40 companies visited for interviews belongs to an industry that cannot be defined as product developing type (transportation in the industrial classification of "Miscellaneous"). Of the remaining 39 companies, the number of those falling under the category of product developing enterprises having design capabilities and their own products (with the ratio of own products to total sales standing at 5% or higher) came to 34. Of the 25 collaboration case enterprises in the manufacturing industry, 23 companies are product developing enterprises. In terms of the size of enterprises as measured by capital and the number of employees, they are all SMEs, except for two companies(Note 8).

(Characteristics of the companies studied)

Since most of the companies covered are product developing SMEs, their profiles have characteristics similar to those of product developing SMEs we have seen in 3 (3) above.

1) They enjoy relatively strong performance as measured by sales growth rate since FY1998. If provisional figures for FY2001 are included, the average annual growth rate declines due to the effect of economic recession in FY2001. However, the average annual growth rate of shipments by the manufacturing companies studied are higher than those of the index of shipments in the Indices of Industrial Production by METI.

2) Given the fact that they have 380 corporate customers on average, the product

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(Note 8) Article 2 of the Small and Medium Enterprise Basic Law defines small and medium-sized enterprises as follows. Manufacturing industry: Comapanies with capital of 300 million yen (100 million yen before the revision of the Law in 1999) or less or workforce of 300 or less. Service industry: Companies with capital of 50 million yen (10 million yen before the revision of the Law in 1999) or less or workforce of 100 (50 before the revision of the Law in 1999) or less. Of the 40 companies covered, one in the manufacturing industry and one in the service industry (software industry) exceeded these figures.

developing SMEs have a strong grip of market needs.

3) The companies covered by the survey placed orders with 95 firms on average and the collaboration case manufacturing enterprises belonging to the Association placed orders with 125 firms on average, indicating that they have formed division-of-labor relationships with many product processing SMEs through outsourcing.

4) Despite the fact that most of them are SMEs, their R&D researcher ratio is very high, suggesting they are strongly R&D oriented. According to the "Basic Survey of Japanese Business Structure and Activities" (METI), "the ratio of employees assigned to R&D sections to the total number of regular employees" at relatively large manufacturing corporations with workforce of 50 or more and capital of 30 million yen or more was 6.7% in FY1999. By contrast, the ratio of R&D researchers to full-time employees (wider in concept than regular employees) at the companies covered by the survey was 25.2% on average and the comparable figure at collaboration case companies was 26.6% on average.

(3) Outline of survey results

The number of collaboration cases collected was 52 (including 7 cases that were not made public) in terms of the number of products and services targeted. We also collected 4 cases of "other activity accomplishment cases" in order to understand activity accomplishments of the TAMA Association. They are listed in Table 3.

(Number of cases by development stage)

These cases include "commercialized cases," that were put to practical use, "development-in-progress cases,"[(Note 9)] "development-yet-to-be-initiated cases," and "development suspended cases." Table 4 is classification of the 52 collaboration cases by development stage and by the type of TAMA Association involvement as well as by type of business.

By type of development stage, the collected collaboration cases are mainly "commercialized cases" or "development-in-progress cases" (hereinafter, these two types of cases are to be called "'active' collaboration cases"). There are 45 cases of

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(Note 9) The "development-in-progress cases" of the "(TAMA Association's) non-involvement cases" (to be described later) include one case where development has been completed and they are waiting for the timing for commercialization.

such "active" collaboration. On the contrary, there are 2 "development-yet-to-be-initiated cases" and 5 "development suspended cases."

"Development suspended cases" include cases whose commercialization has been abandoned, cases whose prospect for commercialization is uncertain, and cases whose development has been temporarily suspended.

"Development-yet-to-be-initiated cases" are cases whose development themes have been fixed and collaboration partners are identified, but whose development has yet to be initiated due to lack of funds or manpower.

With regard to "development suspended cases" and "development-yet-to-be-initiated cases," we will withhold publication of their detailed information that could lead to the identification of case names, company names and other proper names. In the following, we will focus on the analysis of "active" collaboration cases(Note 10).

Among the "(TAMA Association's) non-involvement cases," there are commercialized cases where testing machine makers based their development on requests and orders from researchers of universities or other research institutes that are customers of the testing machine makers. Since each of these development acts itself is carried out by a single company, we differentiate them from other cases and call them "commercialization (similar to single)." We have included such cases in our study because we assumed such testing machine makers got development hints and ideas from the knowledge of the researchers through contact with them.

(Number of cases by type of TAMA Association involvement)

Of the 45 "active" collaboration cases in the region, 40 cases are by TAMA Association member companies and five cases are by non-member companies. Of the 40 cases by TAMA Association member companies, 23 cases are "TAMA Association support cases," to which TAMA Association's activities contributed in one way or another, and 17 cases are "non-involvement cases," in which the TAMA Association was not involved.

Support contents of the TAMA Association support cases, that is to say, the breakdown of the TAMA Association's collaboration intermediary functions by type,

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(Note 10) Each "development suspended case" has its own reason for having being suspended and it is meaningful to analyze the reason. However, since it is difficult to show a general trend based on only 5 samples, this paper analyzes mainly "active" collaboration cases.

will be described later.

Besides these cases, we have confirmed 2 cases of "development-yet-to-be-initiated cases," for which collaboration may be initiated in the future. There is no "development suspended case" among the "TAMA Association support cases."

We have also confirmed 4 cases of "other activity's achievement cases" that show achievements of the TAMA Association's activities other than promotion of collaboration.

(Industry-academy collaboration and inter-corporate collaboration)

Most of the "member cases" collaboration cases are industry-academic collaboration, including consortium-type collaboration in which two or more companies take part. Of the "active" collaboration cases, only 2 cases of "TAMA Association support cases" are inter-corporate collaboration and 3 cases of "non-involvement cases" are inter-corporate collaboration cases.

On the other hand, of the five "non-member cases," one case is industry-academic collaboration and the remaining 4 cases are inter-corporate collaboration.

Since 36 of the 45 "active" collaboration cases are industry-academic collaboration, our analysis focuses on industry-academic collaboration.

(Significance of the number of cases)

These cases are limited to those that were made available through the TAMA Association and thanks to cooperation of the parties concerned. When one company has several collaboration cases, we studied only two or three representative cases. We believe that TAMA Association member companies as well as non-member companies have many collaboration cases other than those we collected this time. We believe we have studied a relatively high percentage of "TAMA Association support cases." But even the cases that are supported by the Association, there are more cases, such as those that we could not study because of confidentiality involved and those that were in the process of formation and not in time for our study.

Therefore, the significance of the number of cases that we collected and tallied is, firstly, that we were able to analyze the mechanism of collaboration formation and TAMA Association's function as an intermediary organization and understand a certain trend, by collecting 52 cases of collaboration and 29 cases of the TAMA Association's activities ("collaboration cases" and "other activity achievement cases" combined). Secondly, the significance of the number of cases is, with regard to "TAMA Association support cases" among the "collaboration cases," that "we can

confirm at least that number of cases."

5. TAMA Association's collaboration intermediary functions

From the results of the study of collaboration cases, we would like to analyze the contents of the TAMA Association's collaboration intermediary functions and investigate the achievements of the Association's collaboration intermediation.

(1) Types of collaboration intermediary functions of the TAMA Association

From the contents of the TAMA Association's support in collaboration cases, we can roughly classify the Association's collaboration intermediary functions as follows. Table 5 is a list showing the detailed contents of each type of function.

(Function to lead collaboration formation: Coordination function)

The first type of function is to lead collaboration formation. Namely, the TAMA Association coordinates collaboration. In this type of case, so far, the TAMA Association often formed a consortium by utilizing the "Regional Consortium Research and Development Scheme"(Note 11) by the government (METI takes charge), and Dr. Makoto Ibuka, president and representative director of TAMA-TLO, or Dr. Yuji Furukawa, chairman of the TAMA Association, plans and manages projects as a project leader or a sub-leader, or the TAMA-TLO or the TAMA Association serves as a managing organization. There is also the case of coordination by Mr. Hideto Okazaki, director general of the TAMA Association that led to the development of a new product ("Sagami mulberry tea") through collaboration between an agricultural venture firm and universities. Mr. Okazaki had been engaged in the project since he was a staff member of the Industrial Promotion and Development Foundation of Sagamihara (also functioning as the Kanagawa chapter of the TAMA Association).

(Note 11) The "Regional Consortium Research and Development Scheme" is a scheme by which local private comapnies and research institutions such as universities and national research institutions form a consortium (collaborative research body) to carry out research and development aimed at putting technological seeds of the universities or national research institutions to practical use through private companies under the auspices of the New Energy and Industrial Technology Development Organization (NEDO). Budgetary ceiling per case is 300 million yen (100 (million yen per year) x 3 (years) = 300 (million yen)).

(Support for projects of existing collaboration)

The second type of function is to support member companies' projects to develop new products, for which collaboration has been formed by the companies themselves. In these cases, the TAMA Association supported application for the regional consortium scheme or R&D subsidies with regard to an industry-academy collaboration project proposed by a member company ("Sodium hypochlorite activator"), and provided start-up support ranging from company establishment procedures to building a business model, patent acquisition, brush-up of business plans and matching up with venture capital with regard to a business plan drawn up by a member in collaboration with a non-member company ("Sales promotion system using electronic advertisement").

(Providing meeting opportunities)

The third type of function is to provide member companies and university researchers, etc. with opportunities to meet with prospective collaboration partners, or to contribute to confidence building with collaboration partners. In these cases, there were cases where collaborators met at various events sponsored by the TAMA Association ("Ultrasonic local positioning system") or in small group activities of the TAMA Association ("Administrative supporting business of housing complex with NPO"). There were also cases where a member company has developed and commercialized a product based on the hint the company had obtained by participating in an IMI consortium ("Inductively coupled plasma (ICP) etching equipment") and where collaboration added momentum as a result of a collaboration partner becoming a TAMA Association member ("Motion vector digital video processor").

(Partial cooperation)

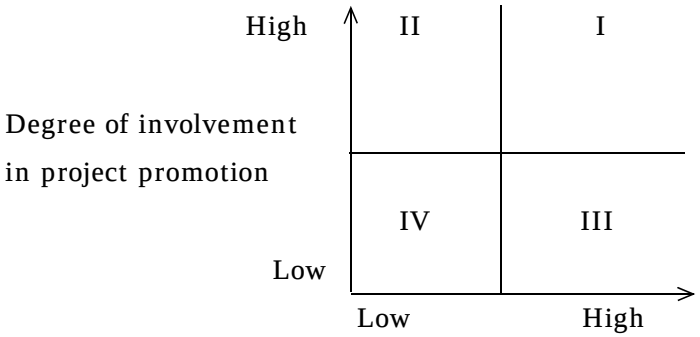
The fourth type of function is to support part of product development projects for which collaboration formation and project promotion are basically being undertaken by member companies themselves. There can be various cases in this type. In these cases, there are cases where the TAMA-TLO supported patent applications ("Sound reverberation adjunction machine (Advanced echo machine)") and provided opportunities to participate in exhibitions sponsored by the TAMA Association ("Lightweight material curving technique and automatic forming system").

(Number of achievements)

The above four function types can be put in order by the degree of involvement in collaboration formation and the degree of involvement in project promotion. Cases in which the degree of the TAMA Association's involvement in collaboration formation was high are Type I and Type III, and cases in which the degree of the TAMA Association's involvement in project promotion was high are Type I and Type II. In other words, Type I and Type III are cases of new collaboration formation through the TAMA Association's activities, and Type II, though not collaboration formation, are cases for which the TAMA Association's support activities were essential or contributed much to the promotion of projects. In this sense, it can be said that cases in Type I through Type III are those in which the existence of the TAMA Association had much to do with the formation of collaborative projects (or those that would not have been formed, but for the TAMA Association).

Now, let's take a fresh look at Table 4. Of the "active" collaboration cases, the number of "TAMA Association support cases," to which the TAMA Association's activities contributed in one way or another, was 23. The breakdown of the 23 cases by the four types of the TAMA Association's collaboration intermediary function shows that there were 8 cases in which the Association led collaboration formation (Type I), 5 cases in which the Association supported projects of existing collaboration (Type II), 7 cases in which the Association provided meeting opportunities (Type III), and 3 cases in which the Association cooperated partially (Type IV).

(Figure 2)



In other words, we have confirmed that 20 cases in terms of products and services targeted were those of Type I through Type III, namely collaboration cases in which collaboration projects have been formed through the TAMA Association's activities as

a collaboration intermediary organization.

(3) Formation of new collaboration

Next, we would like to compare the 20 cases of collaboration intermediation results with other collaboration cases and then study their characteristics.

First, judging from the fact that new collaborations were formed through the TAMA Association's activities in Type I and Type III, it can be said that 1) new collaboration has been formed within the TAMA region, the area that the TAMA Association targets in, and that 2) most of the newly formed collaborations are industry-academic collaboration aimed at introduction of new technical seeds.

(Formation of collaboration within the TAMA region)

Table 6 is a list of the locations of the collaboration partners of the companies we interviewed (mostly, companies in charge of commercializing products). A look at the cases of collaborations formed by companies by themselves (Type II "project supported existing collaboration cases" and Type IV "partial cooperation cases" in the "TAMA Association support cases," "noninvolvement cases," and "non-member cases." Hereinafter, they may be referred to as "spontaneously formed collaboration cases.") show that they were formed either within the same prefecture or with partners located far away from the regional concept of TAMA.

On the other hand, a look at the cases of new collaboration formed through the TAMA Association's activities (Type I "Association-led collaboration formation cases" and Type III "meeting opportunity provided cases" in "TAMA Association support cases") show that many of them were formed among cross-prefecturally located entities within the TAMA region.

In other words, since the inauguration of the TAMA Association, regional collaboration has come to be formed as expected in the TAMA region, an area where, in the past, despite the existence of companies and universities capable of forming industry-academic collaboration, few examples of collaboration aimed at developing products or technology had been seen.

(Formation of new technology introduction-type industry-academic collaboration)

Table 7 shows combinations of core technologies of companies in charge of product commercialization and technological seeds of research institutions, such as universities, or technological seeds of cooperating companies, in the "active" collaboration cases. It shows that in the spontaneously formed collaboration cases,

about half of them are industry-academic collaborations and about the other half are inter-corporate collaborations and that the role of universities in some of the cases of industry-academic collaborations is to brush up the core technologies of the company sides, such as conducting evaluations of experiments and giving advice.

On the other hand, in cases of new collaborations formed through the TAMA Association's activities, there are many cases where companies, while utilizing their own core technologies, introduce new technological seeds from universities or other research institutions and make use of them in developing new products. This is partly due to the fact they include cases whose development risks are covered considerably by R&D support systems run by the government, such as the Regional Consortium Research and Development Scheme. But it also shows that forming new technology introduction-type industry-academic collaborations has become easy after the inauguration of the TAMA Association.

(4) Coordination function

A close look at Type I "Association-led collaboration formation cases" show that the TAMA Association has demonstrated its coordination function in individual collaboration cases, and that its coordination through several consortiums reveals a common orientation.

(Coordination in individual collaboration cases)

First, IMI consortium project[Note 12] (Design and prototype making of Intellectual Micro Instruments), from which the product development themes of Nos. 1 to 3 were derived, were formed by key members of the TAMA Association in accord with the progress of preparation for establishment of the Association.

After the inauguration of the TAMA Association, the R&D Promotion Committee formed under the Association screens R&D themes of member companies, gives advice, supports applications for the Regional Consortium Research and Development Scheme in the case of promising themes, and in the process promotes collaboration formation and project formation.

(Note 12) The formal name of the IMI consortium is "Development of measurement control technology that supports energy saving in the electronic device development process." (Subtitle: "Design and prototype making of IMI (Intelligent Micro Instruments)")

As a result of the support provided by the R&D Promotion Committee of the TAMA Association, three themes were adopted as regional consortium R&D projects by March this year: "Decentralized power conditioner for photovoltaic power generation system," "BioMEMS dioxin gauge system" and "Hydrograph gauge and constituent gauge based on hetero-core optical fiber sensor".

In these Association-led collaboration formation cases, reliability and strong designing and management capabilities of the coordinators (project leaders or sub leaders) were pointed out as the factor behind confidence building.

(Consistent technological orientation)

The "IMI Consortium" and the three cases that were promoted by the R&D Promotion Committee of the TAMA Association, and adopted by the Regional Consortium Research and Development Scheme, have a common characteristic in that they all aim at micrifying device parts by using micromachining technology. That is to say, the "IMI Consortium" aims at micrifying probes and sensors, "Decentralized power conditioner for photovoltaic power generation system" electronic circuits, "BioMEMS dioxin gauge system" biochips, and "Hydrograph gauge and constituent gauge based on hetero-core optical fiber sensor" optical fiber sensors. "Ultramicroscopic hole processing technology on silicon wafers" In Type III "meeting opportunity-provided cases" is also aimed at establishing a micro-fabrication technology for silicone.

These consortium-formed projects are being coordinated by the TAMA Association and the TAMA-TLO under the common objective of developing a new micro-device industry in the TAMA region on the basis of clusters of industries and technologies, such as measurement control, digital control, biotechnology, and optical technologies in the region.

(5) Spillover effects on meeting formation

The example of the "IMI consortium" shows that it has a spillover effect in that the meeting of members participating in the consortium leads to the formation of new collaboration projects.

For example, the meeting between Company TE, a high-precision processor using laser/electronic beams, and Company TC, a semiconductor measuring instrument maker, and researchers of the Machine System Unit of the National Institute of Advanced Industrial Science and Technology (AIST) led to the formation of "ultramicroscopic hole processing technology on silicon wafers."

Another example is that Company EX, a manufacturer of electronic beam-applying precision process analysis equipment, independently developed "Inductively coupled plasma etching equipment" based on advice from AIST researchers and data provided by Company TC, another participant in the consortium. Company EX posted sales of about 100 million yen in FY2001 and expects annual sales of 300~400 million yen in the years to come.

In addition, exchanges among consortium participants, companies and researchers, are continuing and some companies that had participated in the consortium have established business relations.

(6) Effects of supporting existing collaboration projects

In Type II "project supported existing collaboration cases," the collaboration formation was carried out by member companies themselves, but the TAMA Association was actively involved in the promotion of the projects and, in this sense, they are cases whose projects were formed or accelerated through TAMA Association activities.

In the case of "Sodium hypochlorite activator," for example, it was first commercialized in April 2001, and it posted 18 million yen in sales in FY2001. Sales for FY2002 are projected to be 70 million yen. Around FY2000, when the project was at the preliminary development stage, the project was in danger of being suspended due to problems with R&D expenses. However, the project was adopted by the "Regional Consortium R&D Scheme for Venture Firms" and was carried on thanks to the support of the TAMA Association and Sayama Chamber of Commerce and Industry, a board member of the Association.

As for the "Sales promotion system using e-ads ”、the TAMA Association provided support in company establishment procedures, business model building, and patent acquisition by introducing experts to an entrepreneur promoting the project. It also provided support in brushing up the business plan and matching up with venture capital by having him take part in business contests and matching events. The project was first commercialized in August 2001 and posted annual sales of 70 million yen. Without support of the TAMA Association, commercialization of this project would not have been possible.

(7) Comparison of formation opportunities with existing collaborations

Table 8 shows collaboration formation opportunities provided by those other than the TAMA Association. It shows that in cases in which the TAMA Association was not

the main factor for meeting formation ("project supported existing collaboration cases," "partial cooperation cases," "noninvolvement cases," and "non-member cases"), the sources that provided opportunities for meeting formation can be classified broadly into companies' own networks and intermediary organizations other than the TAMA Association.

(Companies' own networks)

Many of the cases of collaboration formation through companies' own networks are those that utilized personal connections, such as "members of an association of cooperating companies of a bigger customer company" (Case 9), "acquaintances through human networks at academic meetings" (Case 11), "business acquaintances of the president in his previous company" (Case 24), "president's personal connections" (Case 27), "network of presidents and those who have transferred from large enterprises" (Case 29), "former president was a board member of the educational institution of the collaboration partner" (Case 30), "friend of R&D department director in his college days" (Case 32), "boss-subordinate relationship in president's previous company" (Case 48), and "personal connections of the person in charge of development in his previous company" (Case 49)." In addition, there are cases where a company consciously formed a team for development collaboration, such as Company TE in "Water jacket for semiconductor manufacturing installation" (Case 26), and cases where the president has enrolled in the graduate school of the researcher who was the collaboration partner, such as Company YP in "Supercritical state plating system" (Case 11) and Company TS in "Local positioning system using supersonic waves" (Case 18).

(Intermediary organizations other than the TAMA Association)

There are also cases where meeting opportunities were provided by cross-industrial groups, a society of commerce and industry, academic societies, an incubation institution (Sagamihara Incubation Center), or as an M&A item by a securities company, suggesting that these organizations also perform collaboration intermediary functions.

(Three-layer structure of collaboration formation)

To sum up, there are three layers of providers of meeting opportunities for collaboration in the TAMA region and its surrounding area: 1) companies' own networks, 2) existing intermediary organizations, such as cross-industrial groups,

and 3) the TAMA Association. Of the three, we have found that the TAMA Association is contributing to the formation of new types of collaboration that are not provided by the existing intermediary organizations, in terms of regional expanse and contents of industry-academic collaboration, and is also playing its role in promoting existing collaboration projects as we have described in (3) above.

6. Expanding collaboration in TAMA

In the previous section, we have seen the role the TAMA Association has played as an intermediary organization in industry-academic and inter-corporate collaborations; this can be seen directly from the results of our study of collaboration cases. In this section, we will see that various organizations that indirectly support collaborations between SMEs and research institutions like universities are responding positively to the TAMA Association's activities and enhancing the collaboration intermediary functions of the TAMA Association as a whole.

(1) Municipalities and chambers of commerce and industry

Since the inauguration of the TAMA Association, some municipal governments have been important promoters of the Association's activities. For example, Hachioji city provides office space for the Association's secretariat, and Sagamihara, Hachioji, and Sayama cities provide manpower to the secretariat. In addition the Industrial Promotion and Development Foundation of Sagamihara is engaged in activities as a branch office and information network center of the TAMA Association[(Note 13)].

While carrying out industry promotion measures for their own regions by themselves, these cities want to make use of the TAMA Association's activities when their industry promotion measures require linkage with companies or universities outside of their city regions. They, thus, contribute positively to the activities of the TAMA Association. Becoming a member of the TAMA Association is advantageous for a municipality because it facilitates understanding industry promotion efforts of other municipalities and provides stimulation.

In concert with municipal governments' activities, local chambers of commerce and industry are also engaged in such activities as coordination of regional consortium projects (Tachikawa Chamber of Commerce and Industry, Sayama Chamber of

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(Note 13) In FY2001, the Tokyo Metropolitan Government also provided manpower.

Commerce and Industry) and management support for the "Mini-TAMA Meetings" (Kawagoe and Sayama chambers of commerce and industry for "Seibu Mini-TAMA Meeting," and Sagamihara, Machida, and Hachioji chambers of commerce and industry for "Route 16 Mini-TAMA Meeting").

(Large enterprises)

The TAMA Association has more than 10 leading large enterprises included among its members. Of them, the group of Yokogawa Electric Corp., a leading manufacturer of controllers and measuring instruments and whose head office is located in the TAMA Region, has been providing strong support to the TAMA Association. An employee from Yokogawa Research Institute Corp. (hereinafter to be referred to as Company YS) has been playing an important role since the preparatory stage before the inauguration of the TAMA Association. Now, other large enterprises have also begun to strengthen collaborations with the TAMA Association(Note 14).

For example, as we have described in 3. (2), major electric maker Company FD established an incubation office to support entrepreneurs under the business tie-up agreement signed with the TAMA Association in November 2001. In addition, in April 2002 the company launched a new service to give silicon fine processing and manufacturing and mounting board manufacturing to other companies including taking small-lot orders (foundry service).

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This foundry service has a direct bearing on the collaboration projects described in this paper. In the four consortium cases in the "Association-led collaboration formation cases," such as the "IMI consortium," the middle-sized and small/medium-sized enterprises in charge of product commercialization have acquired new technological seeds, such as micro-machining technology, and are establishing the technological feasibility of products employing such technological seeds. However, in order to commercialize the products full scale, they need expensive equipment necessary for micro processing (typically, such as those used in semiconductor manufacturing processes). For this reason, foundry services that take small-lot orders for semiconductor manufactures or make semiconductor-manufacturing equipment available have been called for. For large semiconductor manufacturing plants,

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(Note 14) A total of 17 large enterprises attended an order taking/placing meeting held in August 2001 to place orders.

however, orders for micro processing from middle-sized and small/medium-sized enterprises are normally too small to make business sense. Middle-sized and small/medium-sized enterprises, for their part, believe that placing orders to major semiconductor manufacturers results in high costs. Against these backgrounds, Company FD announced that it would start foundry services to accept small-lot orders, opening the way for middle-sized and small/medium-sized enterprises that have adopted micro-machining technology to put their R&D results to practical use.

(Financial institutions)

The TAMA Association has three shinkin banks (Ome Shinkin Bank, Seibu Shinkin Bank, and Tama Chuo Shinkin Bank) as its members from among private financial institutions(Note 15), and the banks are striving to deepen cooperative relations with member companies. In particular, Seibu Shinkin Bank, in addition to providing manpower to the secretariat of the TAMA Association, has been promoting concrete projects, including support for the Association's business plan contests, sponsoring exhibitions and business fairs for taking/placing orders in cooperation with the TAMA Association, and business tie-ups with the TAMA-TLO (commissioning to the TAMA-TLO the technology transfer, technology assessment and other operations that are necessary for company support business planned by the bank).

(4) Manpower matching

Many of SMEs belonging to the TAMA Association seek top-notch manpower. The TAMA Association had been engaged in matching manpower of member large enterprises with manpower needs of SMEs. Starting in FY2002, the Association began a manpower matching service in a tie-up with Recruit Ablic Inc. (the company is also a TAMA member and hereinafter will be referred to as Company RA), the

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(Note 15) Among government-affiliated financial institutions, the Japan Finance Corporation for Small Business and the Shoko Chukin Bank are TAMA Association members. The Japan Finance Corporation for Small Business has detailed knowledge of many of the SMEs belonging to the Association, as it has served as the provider of equipment funds to them since the early stage of their foundation. Moreover, "Tama Ryokuei-kai," a group of the Corporation's credit-worthy borrowers, was one of the parent populations when the TAMA Association raised members at the inception of its operation.

largest private placement firm in Japan.

Under the tie-up, Company RA introduces and dispatches middle-aged employees (aged 45 to 59) of large and middle-sized enterprises that are customers of RA's outplacement service to TAMA-member SMEs that are seeking manpower in the form of temporary transfers, change in employment after a certain period of temporary transfer, or immediate transfer. The TAMA-member SMEs enjoy services ranging from consultation to personnel dispatch at no cost. RA, for its parts, obtains job placement information of many SMEs in bulk by joining hands with the TAMA Association with a membership of 270 companies. This is advantageous to RA, because collecting job placement information from SMEs, which usually come in small lots, is costly.

7. Necessary conditions that have formed the TAMA Association system

We have so far seen that the TAMA Association has been performing its function as a collaboration intermediary organization and how the intermediary function works. It is interesting to study if such a collaboration intermediary organization can be formed in other regions. In order to help such study, I would like to put in order the conditions that have made the formation of the TAMA Association and industry-academy and inter-corporate collaborations under the Association possible.

(1) Necessary conditions that have formed the TAMA Association system

(Existence of product developing SMEs)

First, there are many product developing enterprises among SMEs in the region. We have seen in 3. (3) that product developing SMEs have the capability to accurately assess market needs and that they are strongly R&D orientated. In 4. (2), we have seen that most of the companies, whose collaboration cases we studied, are product developing SMEs and that they have the capability to assess market needs and are strongly R&D orientated. Therefore, it is inferred that in order to absorb advanced technological seeds and put them to practical use through industry-academic or other form of collaborations, R&D and market needs assessing capabilities of the product developing SMEs are necessary.

We might add that the TAMA Association was established with the existence of such product developing SMEs in mind, and that the main target of its organization and operations has been to support product developing enterprises and other active companies, not to support SMEs as a whole. It is believed that this is another

important factor that has produced good results in the Association's activities.

(Existence of leaders)

Second, there are people who support the activities of the TAMA Association as members and leaders.

The TAMA Association is a membership organization with membership fee operated by its members including companies and university researchers. Private companies, mainly product developing SMEs, educational and research institutions like universities, and several core municipal governments and commerce and industry associations such as chambers of commerce and industry have played key roles and promoted the activities of the TAMA Association since its early stages of operations.

There are many people who take the leadership at various levels, such as TAMA Association representatives, leaders and coordinators of specific collaboration projects, and personnel in charge of secretariat operations.

Needless to say, the Association members' spontaneous participation and the existence of leadership personnel are essential for successful operation of regional initiatives like the TAMA Association.

(Form of government support)

The existence of product developing SMEs and the existence of leaders are prerequisites for TAMA Association's collaboration intermediary activities. Then, assuming that such prerequisites are in place, how should government support be provided?

The TAMA Association was established at the approach of the Kanto Bureau of International Trade and Industry, and the three metropolises and prefectures that constitute the region played an important role in its establishment.

Although the TAMA Association has been striving to be autonomous, even after its inauguration, it is still essential, at least under the current situation, to effectively utilize public funds in implementing specific projects. For example, it is necessary for the TAMA Association to design and propose by itself or support member companies in order to positively utilize various subsidies provided by the central and local governments. Even after its financial base has been secured in the future, it would be useful to utilize public schemes in order to effectively promote industry-academic collaborations and R&D activities.

The support provided by the Kanto Bureau of International Trade and Industry (now, Kanto Bureau of Economy, Trade and Industry) after the establishment of the

TAMA Association is also extremely important for the Association. But, it is mainly "soft" support, such as provisions of various policy information, joint visits to individual companies with the TAMA Association secretariat staff or TAMA coordinators, and advice on organizational operation including guidance on institutionalization as an incorporated association. In other words, it can be said that the government has been performing a kind of intermediary function from a broader perspective and in a more indirect way than the TAMA Association. Such support posture of the government has been contributing the promotion of autonomous, spontaneous activities of the TAMA Association and its member companies.

(2) Manpower that supports product developing SMEs

As was described in (1) above, the existence of product developing SMEs having both market needs-assessing capability and R&D orientation and the existence of leaders who support collaboration promotion initiatives like those of the TAMA Association are important as prerequisites for collaboration intermediary activities. Therefore, it does not necessarily mean that an organization like the TAMA Association can be established in all regions. In particular, the existence of product developing SMEs is essential both as the promoters of such initiatives and as the core companies to promote individual collaboration projects.

From the findings of the collaboration cases, let's examine where the personnel who support product developing SMEs have come from. Table 9 shows the backgrounds of the managers in cases where they themselves play the central role in the promotion of collaborative projects. It shows that most of the managers started businesses after spinning off from existing large or middle-sized enterprises. Table 10 shows how personnel other than the managers were recruited. Here again, it is shown that with regard to core engineers, many of them have been recruited from other companies including large enterprises. The fact that many of the product developing SMEs were established by engineers, who spun off from existing companies, was also revealed in the two surveys conducted by the Kanto Bureau of International Trade and Industry (Kanto Bureau of International Trade and Industry, 1997 and 1998) that were described in 3. (3).

That TAMA is located in the metropolitan area where there are supposed to be many personnel, who have gained experience in working for large or middle-sized enterprises, may have worked in favor of the formation of product developing enterprises in the region. However, this would give a hint to other regions in promoting the establishment of product developing SMEs.

On the other hand, it was often pointed out that the lack of personnel is a problem in promoting product developing SMEs' collaboration with academics. Table 10 reveals enterprises' efforts to overcome the problem.

8. TAMA in relation to modularization

This paper has so far focused on an empirical analysis of TAMA based on the collected collaboration cases. In this section, I would like to try to explain TAMA in relation to the concept of "modularization" that has come into the limelight in economics and business administration studies in recent years, as one of the preliminary studies to explore ways to put in order the theoretical concept of TAMA. Especially the existence of many product developing SMEs would be important in relation to the modularization.

(1) Product developing SMEs as module firms

(Concept and significance of modularization)

Modularization means "disassembling a complicated system or process based on a certain interface rule to semi-autonomous subsystems that can be designed independently" (Aoki [2002] p. 6) or "building a complicated product or operation process by smaller subsystems that can be designed independently and function uniformly as a whole." Baldwin and Clark [2002] pp. 35-36).

Division of labor in production process is also modularization in that it disassembles a complicated system or process to parts. But what modularization scholars have focused on in recent years is modularization of design. Modularizing design will permit improvement and development of the module independent of other modules, and will thus result in accelerating innovation speed. Moreover, modularization of organizations that modularize design is also drawing attention. Citing IBM's System/360, the first modular computer that was announced in 1964, as an example, Baldwin and Clark say, "As different firms (and different units of IBM) handled their respective modules independently, the innovation speed increased remarkably. By concentrating on a single module, each division and firm was able to engage in research and development in depth." (Baldwin and Clark [2002] p. 39)

(Standardization of interface rule)

According to a modular theory, in order to ensure independence of each module, it is desirable that interface rules among modules are formulated beforehand or

standardized. A typical case of modularization is assumed to be the situation where development of each module is carried out autonomously under a standardized module-interface rule, or under standardized product architecture, like the one seen in the computer industry. However, Aoki [2002], while citing the "approved drawing system" of Asanuma [1997][(Note 16)], argues that cases where there is no standardized module interface rule and where the rule is formed through exchanges of information between high-end system designers and individual module designers in the process of drawing are also modularization (Aoki [2002] p.p. 14-15).

(Product developing SMEs as module firms)

In that sense, product developing SMEs in TAMA are module firms in charge of individual modules. In TAMA, there are many companies that supply parts and equipment systems for use in large enterprises' production equipment and products as their own products, such as manufacturers of equipment to be incorporated in semiconductor manufacturing process, including testing process, like probe cards to test semiconductor wafers and wire bonding checkers for semiconductors, and manufacturers of parts of electronic devices, like parts, equipment, and systems for use in high frequency, optical signal transmission equipment. In other words, these product developing SMEs design and plan module parts on their own, and then they supply them to enterprises as parts of large enterprises' final products or manufacturing process.

In the regions where mass-production industries are concentrated, large enterprises that are finished product makers or primary parts manufacturers directly subcontract work to surrounding product processing SMEs. However, the fact that such a type of outsourcing has been decreasing is pointed out as a problem of a mass production concentrated region. On the other hand, there are many product developing SMEs in TAMA, and they are semi-autonomously engaged in research and development of modules for large final product systems and production processes of

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(Note 16) Asanuma Banri [1997] says that when a finished carmaker designs parts and loans the design drawings to suppliers, the drawings are called "loaned drawings," and when a finished carmaker presents rough specifications to suppliers, has the suppliers develop parts in accordance with the specifications and submit the drawings to the finished carmakers for approval, the drawings are called "approved drawings." (id. p. 187).

large enterprises. Product processing SMEs are not only outside vendors for large enterprises but also suppliers to product developing SMEs in the smaller parts modules.

The interface rules that connect modules designed by product developing SMEs and large enterprises' final product systems or manufacturing processes are not necessarily standardized in TAMA, and in many cases individual specifications are adjusted in consultations with many customers. However, in the sense that product developing SMEs are in charge of designing of the products in question, it can be said that modularization has made progress.

Moreover, these product developing SMEs have many customers, not just one particular large enterprise. Therefore, the modules produced by these product developing SMEs are used not just in product systems or manufacturing processes of one particular large enterprise, but are used as common modules in product or manufacturing systems of several large enterprises. In addition, some product developing SMEs produce modules for different fields of products by using the same core technologies(Note 17) .

(2) Modularization and collaboration

As just described, there are many modules that improve and develop semi-autonomously in TAMA thanks to the existence of product developing SMEs and the promising innovation potential of the region can also be explained in the context of the modular theory that has come under the spotlight in recent years.

The significance of the fact that industry-academic and inter-corporate collaborations make progress in TAMA, where there are many modules designed by product developing SMEs, is as follows. First, product developing SMEs can enhance the level of their module products (parts) by introducing advanced technologies of universities, etc. Second, both in cases of industry-academic collaboration and inter-corporate collaboration, product developing SMEs can advance into the fields of new products, that is to say, new module products (parts), by fusing different technologies.

Table 7 shows both cases. For example, "High-density LSI wafer probe card" (Case

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(Note 17) For example, a manufacturer of probe cards for use in testing semiconductor wafers also produces probe cards to test liquid crystal panels and plasma displays.

1), one of the products produced by the IMI consortium, is a case where the function of a probe card that is a module product, has been enhanced drastically by fusing micro-machining technology and Company TC's conventional probe-card production technology. "Decentralized power conditioner for photovoltaic power generation system" (Case 4) is a case where Company YD and Company ND have advanced into a new product module for use in photovoltaic generation system by introducing photovoltaic generation algorithm and micro-inverter circuit design technology, respectively.

9. Conclusion

In conclusion, I would like to put in order the results of the analysis and studies made in this paper and suggestions derived from them.

First, this paper collected and analyzed industry-academic and inter-corporate collaboration cases formed with the purpose of developing new technologies or new products in TAMA Association and surrounding areas. The results of the analysis confirmed that the TAMA Association has begun to produce achievements as a collaboration intermediary organization, as can be seen from the formation of new collaborations between product developing SMEs and universities as a result of their meeting through the TAMA Association's activities, and that the TAMA Association's collaboration promotion initiative has spread to local governments, large enterprises, local financial institutions, and placement service companies.

Second, calls for tangible results of economic structural reforms have increased recently. Structural reforms, such as disposal of non-performing loans, corporate restructuring, and administrative and fiscal reforms, are accompanied with pain. The other side of economic structural reforms is creation of new industries. The fact that industry-academic collaborations and regional cluster initiatives that are expected as measures to create new industries do exist and have produced results in TAMA is meaningful in that they show signs of a change in the Japanese economic structure.

Third, while in order to promote industry-academic collaborations and inter-corporate collaborations an intermediary organization is needed, the TAMA Association presents one practical example as a collaboration intermediary organization on a wide regional basis. Important characteristics of the TAMA Association as a collaboration intermediary organization are 1) its main targets are product developing SMEs and other active SMEs, 2) it is supported by spontaneous activities of TAMA Association members, such as product developing SMEs and

science and technology universities, and 3) the TAMA Association's activities are combined with the government administration's intermediary support functions that encourages TAMA Association members' autonomous, spontaneous activities.

Fourth, as the prerequisite for the formation of the TAMA Association method, it is necessary that there exist many product developing SMEs and leaders, who promote collaboration intermediary activities. Therefore, it does not necessarily mean that an organization like the TAMA Association can be established in all regions. However, it suggests the importance of focusing on product developing SMEs to look for promoters of industry-academic collaborations and regional cluster movements.

Fifth, in light of the fact that many of the product developing SMEs were started by engineers, who had spun off from large or middle-sized enterprises, the current movement to review the practice of life-time employment and the aged-based remuneration system by large enterprises and the resulting labor mobility offer a good chance for many regions to encourage the creation of product developing SMEs. In this sense as well the establishment of environments to promote business start-ups is called for.

Sixth, we studied TAMA, where many product developing SMEs are located, and industry-academic and inter-corporate collaborations there in the context of the modularization theory that has come into the limelight recently in economics and business administration studies, and confirmed that TAMA has high innovation potential in this context as well. In this regard, however, further studies are needed, including a comparison with the Silicon Valley phenomenon.

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(Figure 1)　Geographical Location of TAMA

Source; Created by using Nijix Cartographic Design Institute & Design EXchange Co.,Ltd. ***MAPIO JAPAN****, and data from* ***Kantou Bureau of METI*** *and* ***TAMA Industrial Activtation Council*** *.*

(Table 1) Profiles of companies covered by the survey

	All companies covered	Collaboration case companies						Other activity achievement case companies (all member companies, manufacturing industries)
			Member companies				Non-member companies (all in manufacturing industry)	
				Manufacturing	Software	Others		
Number of collected cases	40	37	32	25	4	3	5	4
Year founded								
Oldest	1941	1941	1941	1941	1976	1976	1947	1951
Average	1973	1973	1972	1968	1986	1989	1980	1970
Latest	2000	2000	2000	1992	1993	2000	1999	1985
Year established in the TAMA region								
Oldest	1945	1945	1945	1945	1984	1976	1981	1951
Average	1976	1976	1974	1970	1991	1984	1988	1971
Latest	1999	1999	1996	1992	1996	1991	1999	1985
Capital (in \1 million)								
Largest	2623	2623	2623	2623	665	40	34	85
Average	207	222	254	292	194	20	16	34
Smallest	3	3	10	10	10	10	3	13
Number of employees								
Largest	539	539	539	539	140	38	51	272
Average	83	81	89	99	79	17	27	99
Smallest	5	5	5	5	16	5	12	18
Sales (in \1 million) (FY2000)								
Largest	14500	14500	14500	14500	2200	511	2500	6297
Average	2080	2058	2253	2702	984	207	812	2125
Smallest	10	10	10	87	120	10	118	255
Design capability								
Share of companies having capability (%)	95	97	97	100	100	67	100	75
Share of companies not having capability (%)	3	0	0	0	0	0	0	25
(Number of responding companies)	39	36	31	25	4	2	5	4
%)	63	66	66	70	21	100	67	45
Share of companies with 5% or more (%)	85	89	88	92	75	67	100	50
Share of companies with less than 5% (%)	13	8	9	8	25	0	0	50
(Number of responding companies)	39	36	31	25	4	2	5	4
Number of order-placing companies								
Largest	3000	3000	3000	3000	150	50	500	1000
Average	380	355	393	495	51	33	119	613
Smallest	5	5	5	10	5	20	5	400
Number of order-receiving companies								
Largest	847	847	847	847	50	15	100	400
Average	95	91	99	124	15	8	43	181
Smallest	0	0	0	4	0	3	3	3
R&D staff ratio (%)								
Largest	75	75	75	75	44	43	36	39
Average	25	26	27	27	22	41	21	15
Smallest	2	5	5	5	11	40	12	2
(Number of responding companies)	38	35	30	24	4	2	5	4
R&D planning period (Year)								
Longest	11	11	11	11	3	2	3	3
Average	2	2	2	2	2	2	3	2
Shortest	1	1	1	1	1	1	2	1
(Number of responding companies)	34	31	28	22	4	2	3	4
Overseas production base								
Share of companies having an overseas	18	16	16	16	25	0	20	25
Share of companies with no overseas production base (%)	83	84	84	84	75	100	80	75
Future domestic-overseas weight (Ratio of companies choosing the following options)								
a. Will increase overseas weight	20.0	18.9	21.9	24.0	25.0	0.0	0.0	25.0
b. Will maintain present level	45.0	45.9	43.8	40.0	50.0	66.7	60.0	25.0
c. Will increase domestic weight	7.5	8.1	9.4	12.0	0.0	0.0	0.0	25.0
d. Not certain	17.5	16.2	15.6	16.0	25.0	0.0	20.0	25.0
(Number of responding companies)	36	33	29	23	4	2	4	4
Number of establishments within the TAMA region								
Largest	4	4	4	4	2	1	1	4
Average	1.2	1.1	1.2	1.2	1.0	0.7	1.0	1.8
Smallest	0	0	0	0	0	1	1	1

(Table 2) Changes in sales of companies covered by the survey
(Annual rate, %)

	Number of companies	FY1998 - FY2000	FY1998 - FY2001 (Provisional)
Surveyed cases	40	7.9	2.3
<By case type>			
Collaboration case companies	37	7.9	2.3
TAMA member companies	32	8.0	2.6
Manufacturing	25	8.7	2.6
Software	4	-1.2	2.8
Others	3	0.1	1.8
Non-member companies	5	6.4	-2.6
Other activity achievement case companies	4	6.9	2.7
<By business type>			
Manufacturing	33	8.5	2.2
Self-designed product ratio of 5% or mo	29	8.6	2.3
Self-designed product ratio of less than 5%	4	8.0	1.2
Software	4	-1.2	2.8
Others	3	0.1	1.8
<By membership status>			
TAMA member companies	35	8.0	2.5
Manufacturing	28	8.7	2.5
Self-designed product ratio of 5% or more	24	8.7	2.6
Self-designed product ratio of less than 5%	4	8.0	1.2
Software	4	-1.2	2.8
Others	3	0.1	1.8
Non-member companies	5	6.4	-2.6
<Reference>			
Industrial shipment index		3.9	-0.9
5 machinery industries		6.2	-0.7

Note:
Industrial shipment index was calculated from each fiscal year's shipment index (actual results for FY2001) after adjustment of annual figure for FY2001 based on "Indices of Industrial Production" (Ministry of Economy, Trade and Industry).

(Table 3) List of cases of collaboration covered by the survey (blank columns under "Theme" indicate nondisclosure cases)

		No.	Theme of product/technology	Core company	development	Commer-cialization
Cases of member companies	TAMA Association support cases		＜Ⅰ Cases of TAMA Association-led collaboration formation＞			
			IMI (Intelligent Micro Instruments) consortium project			
		1	High-density LSI wafer probe card	Tokyo Cathode Laboratory Co., Ltd.	1998	2002
		2	Microfabricated chlorine gas sensor	DKK-TOA Corporation	1998	2004
		3	Miniaturization of wireless probes for electronic measuring instruments	Stack Electronics Co., Ltd.	1998	
		4	Decentralized power conditioner for photovoltaic power generation system		2000	2004
			Controller module	YEM Inc. (Yamashita Engineering Manufacture Inc.)	2000	2003
			Inverter module	Niwa Electric Co., Ltd. (non-member)	2000	2004
		5	BioMEMS dioxin gauge system	DKK-TOA Corporation	2001	2006
		6	Simple XML-EDI system	Busyukogyo Co., Ltd.	2001	2003
		7	Hydrograph gauge and constituent gauge based on hetero-core optical fiber sensor	Inter Action Co.	2001	2004
		8	*Sagami mulberry tea* and its related products	Amco Co., Ltd.	1999	2000
			＜Ⅱ Cases of project promotion for existing collaboration＞			
		9	Sodium hypochlorite activator	Seiko Electronic Co.,	1996	2001
		10	Super critical plating system	YP System Co., Ltd.	2001	2004
		11	Highly-efficient magnetism measurement technology	Faber Co., Ltd.	1999	2000
		12	Highly-efficient measurement technology of magnetism in amorphous film, etc.	Faber Co., Ltd.	2000	2001
		13				
		14	Sales promotion system using e-Ads	Global Area Network Co., Ltd.	2000	2001
			＜Ⅲ Cases of providing meeting opportunities＞			
		15	Inductively Coupled Plasma (ICP) etching equipment	Elionix Inc.	2000	2000
		16	Microscopic hole processing technology for silicon wafers	Tosei Electrobeam Company Limited	1998	2005
		17	Motion vector digital video processor	YEM Inc. (Yamashita Engineering Manufacture Inc.)	2001	2005
		18	Supersonic Local Positioning System	Toyo System Co., Ltd.	1999	2004
		19	Digital archiving system using high definition photography	Open Future System, Inc.	2001	2003
		20	Administrative supporting business of housing complex with NPO	Media Plus Inc.	2000	
		21	Hand-drawn animation tool and on-line learning activities presentation tool	Media Plus Inc.	2001	
		22				
			＜Ⅳ Cases of partial cooperation＞			
		23	Automatic flushing toilet	Aoki Precision Instruments Manufacturing Co., Ltd.	1997	2002
		24	Sound reverberation adjunction machine (Advanced echo machine)	Japan Kyastem Co., Ltd.	1998	2003
		25	Lightweight material curving technique and automatic forming system	Yoneyama Manufacturing Co., Ltd.	1996	2007
	Non-involvement cases	26	Water jacket for semiconductor manufacturing equipment	Tosei Electrobeam Company Limited.	1992	1992
		27	Friction-electrification type coating device for insulation painting of micro motors, etc.	P, C, Rotors Co., Ltd.	1998	2001
		28	Automatic immunochemical analyzer	Sel Corporation Co., Ltd.	2000	2001
			Visual transmitter	Sel Corporation Co., Ltd.	2001	2002
		30	Crystal device products based on photolithography technology	Hertz Technology Inc.	1999	2003
		31	Surface Acoustic Wave (SAW) filter	Hertz Technology Inc.	2000	2002
		32	Hybrid plastic mask processing technology	Process Lab. Micron Co., Ltd.	1999	2004
		33	Low temperature carbonizer	Kyoritsu Kogyo Co., Ltd.	2001	2003
		34	Carbon modification apparatus	Kyoritsu Kogyo Co., Ltd.	1999	2003
		35	High pressure gas cylinders using carbon fiber (FRP)	Kyoritsu Kogyo Co., Ltd.	1999	2003
		36	Low-noise, waste heat recovery type high quality air charging system	Fuji Kogyo Co., Ltd.	1996	
		37～40				

			＜Cases of testing machine manufacturers＞			
		41	Super-fine film scratch tester	Rhesca Co., Ltd.	1987	1989
		42	Friction and abrasion tester	Rhesca Co., Ltd.	1994	1994
		43	Solder checker	Rhesca Co., Ltd.	1994	1995
		44	Laser manipulating system	Sigma Koki Co., Ltd.	1990	2000
		45	Sealed-type low power CO2 laser	Onizuka Glass Co., Ltd.	1992	1994
		46	Highly-efficient laser irradiation device using the fiber-stretching method	Onizuka Glass Co., Ltd.	2002	2003
		47				
Non-member cases		48	Rain sensor	Omega Technomodeling Co., Ltd.	1999	2000
		49	Outsourcing of parts feeder system and reforming business	Giken Kaihatsu Group Co., Ltd.	2000	2002
		50	Nursing care provision business	Giken Kaihatsu Group Co., Ltd.	2000	2002
		51	Uses of paint-type insulation based products and service	Japan Telenics Co., Ltd.	2001	2002
		52	Highly-efficient heat exchanger	Ucan Co., Ltd.	2001	2002

(Table 3-2) Cases of other TAMA activity achievements

	Description of activities	Company	Implementation period
53	LAN installation with support from ITSSP coordinator	Tsukumo Engineering, Inc.	2000
54	Support on improvement in processing		2001
55	Establishment of TMY producing information system	Tama Yakin Co., Ltd.	2002
56	Adoption of new university graduates	Gorin Packing Co., Ltd.	2001

(Table 4) Classification of the surveyed cases

	Commercialized	Commercialized (single resemblance)	Development-in-progress	Active (sub total)	Development-yet-to-be-initiated	Development suspended	Total
Collaboration cases							
<By type of TAMA involvement> Cases of TAMA member companies							
TAMA Association-supported cases							
I Leading collaboration formation	1	0	7	8	0	0	8
II Project promotion for existing collaboration	4	0	1	5	1	0	6
III Providing meeting opportunities	1	0	6	7	1	0	8
IV. Partial cooperation	0	0	3	3	0	0	3
Total	6	0	17	23	2	0	25
Noninvolvement cases							
General	3	0	8	11	0	4	15
Testing machine manufacturers	1	4	1	6	0	1	7
Total	4	4	9	17	0	5	22
Total of TAMA member cases	10	4	26	40	2	5	47
Non-member cases	1	0	4	5	0	0	5
Total of collaboration cases	11	4	30	45	2	5	52
<By field>							
Manufacturing technology development	10	4	25	39	2	2	43
System development	1	0	5	6	0	1	7
Others	0	0	0	0	0	2	2
Total of collaboration cases	11	4	30	45	2	5	52
Other activity achievement cases				4			4
Total				49			56
Total of TAMA Association-supported cases				27			29

(Table 5) Description of support of TAMA Association-supported cases (excluding nondisclosure cases)

Theme of product/technology and type of TAMA Association support			Core company	Partners of collaboration	Contents of support by TAMA Association		
＜ I Cases of Tama Association-led collaboration formation＞							
		IMI (Intelligent Micro Instruments) consortium project		Mechanical System Group of National Institute of Advanced Industrial Science and Technology, Tokyo Metropolitan University, University of Electro-Communications, Tokyo Denki University、Tokyo Institute of Technology, Tokyo Metropolitan Industrial Technology Research Institute, Kanagawa Industrial Technology Research Institute, Yokogawa Research Institute Corp., super precision trial manufacturing supporting companies, Manufacturing Science and Technology	Formation of the Consortium (FY1998)		
	1	High-density LSI wafer probe card	Tokyo Cathode Laboratory Co., Ltd.		Realization of IMI Consortium targeted		
	2	Microfabricated chlorine gas sensor	DKK-TOA Corporation		Realization of IMI Consortium targeted		
	3	Miniaturization of wireless probes for electronic measuring instruments	Stack Electronics Co., Ltd.		Application of the technology obtained through IMI to self-designed products		
	4	Decentralized power conditioner for photovoltaic power generation system		Professor of Tokyo University of Agriculture and Technology, Professor of Tokyo Metropolitan University, Fuji Electric Co., Ltd., Yokogawa Research Institute Corp., companies that support commercialization	Formation of the Consortium (FY2000)		
		Controller module	YEM Inc. (Yamashita Engineering Manufacture Inc.)				
		Inverter module	Niwa Electric Co., Ltd. (non-member)				

Examples of collaboration							
	5	BioMEMS dioxin gauge system	DKK-TOA Corporation	Mechanical System Group of National Institute of Advanced Industrial Science and Technology, Tokyo Metropolitan University, Tokyo University of Pharmacy and Life Science, Tokyo Institute of Technology, Kanagawa Industrial Technology Research Institute, company that provided high-efficient reagent chemicals, super precision trial manufacturing supporting	Formation of the Consortium (FY2001)	TAMA-TLO is the managing organization	
	6	Simple XML-EDI system	Busyukogyo Co., Ltd. (proposing company)	A professor of Hosei University, software developing companies, company that coacted in validations and tests	Formation of the Consortium (FY2001supplementary budget)	TAMA-TLO is the managing organization	Dispatch of ITSSP specialists
	7	Hydrograph gauge and constituent gauge based on hetero-core optical fiber sensor	Inter Action Co.	Professor of Soka University, Yokogawa Denshikiki Co. Ltd.	Formation of the Consortium (FY2001supplementary	TAMA-TLO is the managing organization	
	8	*Sagami mulberry tea* and its related products	Amco Co., Ltd.	Lecturer of Tamagawa University, professor of Kogakuin University, associate professor of Tokyo University of Agriculture, JA, farmers, tea manufacturers	Business coordination through "Study Group of New Agriculture" (Industrial Promotion and Development Foundation of Sagamihara and TAMA Association)		
	＜II Cases of project promotion for existing collaboration＞						
	9	Sodium hypochlorite activator	Seiko Electronic Co., Ltd.	Technician of Toranomon Hospital, manufacturers of precision testing/analyzing instruments, sales subsidiary of medical equipment	Assistance in application for the Consortium Scheme (FY1999 supplementary budget, venture type)	Business coordination by Sayama Chamber of Commerce and Industry (TAMA member)	Holding a seminar on the SME R&D support schemes by Sayama Chamber of Commerce and Industry and TAMA
	10	Super critical plating system	YP System Co., Ltd.	Professor and research associate of Tokyo University of Agriculture and Technology	Assistance in application for the Consortium Scheme (FY2001)		
	11	Highly-efficient magnetism measurement technology	Faber Co., Ltd.	Professor of Oita University	Assistance in application for an R&D subsidy scheme (FY1998)		

12	Highly-efficient measurement technology of magnetism in amorphous film, etc.	Faber Co., Ltd.	Professor of Oita University	Assistance in application for an R&D subsidy scheme (FY2000, applied independently based on the previous case)		
14	Sales promotion system using e-Ads	Global Area Network Co., Ltd.	Consulting company	Invitation to "Study Group for New Business Formation" of TAMA Association in FY2002	Participation in "Business Plan Contest" held by TAMA in FY 2001	
<III Cases of providing meeting opportunities>						
15	Inductively Coupled Plasma (ICP) etching equipment	Elionix Inc.	IMI members; especially Mechanical System Group of National Institute of Advanced Industrial Science and Technology	Independently developed a product that was derived from the IMI consortium	Suggestion and data offerings in processing from IMI members	Actual adoption of the equipment in the Consortium of BioMEMS dioxin gauge system
16	Microscopic hole processing technology for silicon wafers	Tosei Electrobeam Company Limited	Leader of Mechanical System Group of National Institute of Advanced Industrial Science and Technology, professor of the Research Center for Advanced Science and Technology at the University of Tokyo (RCAST), Tokyo Cathode Laboratory Co., Ltd.	Providing meeting opportunities at the IMI consortium and at a visiting seminar to TAMA universities	Tachikawa Chamber of Commerce is the management organization of the Consortium (supplementary budget of FY1998, smaller type)	
17	Motion vector digital video processor	YEM Inc. (Yamashita Engineering Manufacture Inc.)	Professor of Kanagawa Institute of Technology	Holding a seminar on TAMA-TLO + Enhancing mutual reliance through the fact that both are TAMA members		
18	Supersonic Local Positioning System	Toyo System Co., Ltd.	Professor of Soka University	Providing a meeting opportunity at the party after the TAMA General Assembly in FY1999		
19	Digital archiving system using high definition photography	Open Future System, Inc.	Professor Ozawa of Keio University	Introduced through a participant of TAMA-IT Study Group		
20	Administrative supporting business of housing complex with NPO	Media Plus Inc.	NPO-FUSION Nagaike	Providing meeting opportunities at the "Forum of Creating Information Industry" cosponsored by TAMA and at TAMA-IT Study Group		

		21	Hand-drawn animation tool and on-line learning activities presentation tool	Media Plus Inc.	Professor of Tokyo University of Agriculture and Technology, foundation supporting validation and evaluation	Providing meeting opportunities through a visiting seminar to TAMA universities and a seminar on university technology		
	<IV Cases of partial cooperation>							
		23	Automatic flushing toilet	Aoki Precision Instruments Manufacturing Co., Ltd.	Professor Kiyosawa of Toyo University	Enhancing the mutual reliance by that both are TAMA members	Invitation to the "Business Plan Contest" held by TAMA Association in	
		24	Sound reverberation adjunction machine (Advanced echo machine)	Japan Kyastem Co., Ltd.	Professor of Kogakuin University	Application for patent through TAMA-TLO		
		25	Lightweight material curving technique and automatic forming system	Yoneyama Manufacturing Co., Ltd.	Professor of Tokyo Metropolitan Institute of Technology, Manufacturer of automation equipment	Providing a booth at an exhibition at Kogakuin University held by TAMA Association		
Other activity achievement cases	Cases of other TAMA activity achievements							
		53	LAN installation with support from ITSSP coordinator	Tsukumo Engineering, Inc.		Dispatch of ITSSP specialists by Kanto Bureau of METI and TAMA Association		
		54	Support on improvement in processing			Dispatch of ITSSP specialists by Kanto Bureau of METI and TAMA Association		
		55	Establishment of TMY producing information system	Tama Yakin Co., Ltd.		Dispatch of ITSSP specialists by the Office Kanto Bureau of METI and TAMA Association		
			Adoption of new college graduates	Gorin Packing Co., Ltd.	Professor Kiyosawa of Toyo University	Provided acquaintance through the TAMA activities since the Preparatory Committee for		

(Table 6) Combination of locations

	No.	Theme of product/technology	Core company	Location of the core company	Location of collaborating universities/other research institutes					Location of collaborating companies						Managing corporation	Participation ratio on a cross-prefectural basis in TAMA (%)
TAMA Association supported cases		＜I Cases of TAMA Association-led collaboration formation＞															47%
		IMI (Intelligent Micro-Instruments) consortium project															
	1	High-density LSI wafer probe card		Saitama Namekawa-machi	Tokyo Hachioji City	Tokyo Chofu City	Saitama Hiki-gun Hatoyama-cho	Kanagawa Yokohama City Midori Ward	Tokyo Kita Ward	Kanagawa Ebina City	Tokyo Musashino City	Tokyo Hachioji City	Tokyo Nishitama-gun Mizuho-machi	Niigata Nagaoka City			Tokyo Minato Ward	69%
	2	Microfabricated chlorine gas sensor	DKK-TOA Corporation	Tokyo Higashiyamato City														31%
	3	Miniaturization of wireless probes for electronic measuring instruments	Stack Electronics Co., Ltd.	Tokyo Akishima City														31%
	4	Decentralized power conditioner for photovoltaic power generation system																
		Controller module	YEM Inc. (Yamashita Engineering Manufacture Inc.)	Kanagawa Atsugi City	Tokyo Koganei City	Tokyo Hachioji City	Ibaragi Tsukuba City	Tokyo Musashino City			Tokyo Hino City	Tokyo Musashino City	Tokyo Minato Ward				Tokyo Hachioji City	78%
		Inverter module	Niwa Electric Co., Ltd. (non-member)	Saitama Tokorozawa City														78%
	5	BioMEMS dioxin gauge system	DKK-TOA Corporation	Tokyo Higashiyamato City	Ibaragi Tsukuba City	Tokyo Hachioji City	Kanagawa Yokohama City Midori Ward	Kanagawa Ebina City	Tokyo Hachioji City		Tokyo Musashino City	Tokyo Hachioji City	Tokyo Musashino City				Tokyo Hachioji City	22%
	6	Simple XML-EDI system	Busyukogyo Co., Ltd. (proposer company)	Tokyo Ome City	Tokyo Koganei City						Tokyo Shinjuku Ward	Tokyo Shibuya Ward	Tokyo Mizuho-machi				Tokyo Hachioji City	0%
	7	Hydrograph gauge and constituent gauge based on hetero-core optical fiber sensor	Inter Action Co.	Kanagawa Yokohama City Kanazawa Ward	Tokyo Hachioji City						Tokyo Shinjuku Ward						Tokyo Hachioji City	67%
	8	*Sagami mulberry tea* and its related products	Amco Co., Ltd.	Kanagawa Sagamihara City	Tokyo Machida City	Tokyo Hachioji City	Tokyo Setagaya Ward										Kanagawa Sagamihara City	50%
		＜II Cases of project promotion for existing collaboration＞																0%
	9	Sodium hypochlorite activator	Seiko Electronic Co., Ltd.	Saitama Sayama City	Tokyo Minato Ward						Saitama Kawagoe City	Kanagawa Kamakura City						0%
	10	Super critical plating system	YP System Co., Ltd.	Tokyo Higashimurayama City	Tokyo Koganei City													0%
	11	High-efficient magnetism measurement technology	Faber Co., Ltd.	Tokyo Hachioji City	Chiba Chiba City	Oita Oita City	Nagano Nagano City				Tokyo Suginami Ward							0%
	12	High-efficient measurement technology of magnetism in amorphous films etc.	Faber Co., Ltd.	Tokyo Hachioji City	Chiba Chiba City	Oita Oita City	Nagano Nagano City				Tokyo Suginami Ward							0%
	13																	
	14	Sales promotion system using e-Ads	Global Area Network Co., Ltd.	Tokyo Minato Ward	Tokyo Taito Ward						Tokyo Taito Ward							0%
		＜III Cases of providing meeting opportunities＞																40%
	15	Inductively Coupled Plasma (ICP) etching equipment	Elionix Inc.	Tokyo Hachioji City	Ibaragi Tsukuba City						Tokyo Mizuho-machi							0%
	16	Microscopic hole processing technology for silicon wafers	Tosei Electrobeam Company Limited	Tokyo Mizuho-machi	Tokyo Meguro Ward	Ibaragi Tsukuba City					Saitama Namekawa-machi						Tokyo Tachikawa City	33%
	17	Motion vector digital video processor	YEM Inc. (Yamashita Engineering Manufacture Inc.)	Kanagawa Atsugi City	Kanagawa Atsugi City													0%

Cases of TAMA member compan	18	Supersonic Local Positioning System	Toyo System Co., Ltd.	Tokyo Tachikawa City	Tokyo Hachioji City													0%
	19	Digital archiving system using high definition photography	Open Future System, Inc.	Tokyo Shinjuku Ward	Kanagawa Yokohama City Kohoku Ward													100%
	20	Administrative supporting business of housing complex with NPO	Media Plus Inc.	Kanagawa Sagamihara City							Tokyo Hachioji City	Tokyo Chuo Ward						50%
	21	Hand-drawn animation tool and on-line learning activities presentation tool	Media Plus Inc.	Kanagawa Sagamihara City	Tokyo Koganei City													100%
	22																	
		＜IV Cases of partial cooperation＞																33%
	23	Automatic flushing toilet	Aoki Precision Instruments Manufacturing Co., Ltd.	Tokyo Nerima Ward	Saitama Kawagoe City													100%
	24	Sound reverberation adjunction machine (Advanced echo machine)	Japan Kyastem Co., Ltd.	Tokyo Tachikawa City	Tokyo Hachioji City													0%
	25	Lightweight material curving technique and automatic forming system	Yoneyama Manufacturing Co., Ltd.	Tokyo Mizuho-machi	Tokyo Hino City						Tokyo Hamura City							0%
																		12%
Noninvolvement cases	26	Water jacket for semiconductor manufacturing equipment	Tosei Electrobeam Company Limited	Tokyo Mizuho-machi							Tokyo Hamura City	Tokyo Musashimurayama City	Tokyo Mizuho-machi					0%
	27	Friction-electrification type coating device for insulation painting of micro motors etc.	P, C, Rotors Co., Ltd.	Saitama Sayama City							Tokyo Shinjuku Ward	Toyama Takaoka City	Tokyo Shinagawa Ward	Kanagawa Hadano City	Tokyo Chiyoda Ward			20%
	28	Automatic immunochemical analyzer	Sel Corporation Co., Ltd.	Tokyo Hino City							Tokyo							
		Visual transmitter	Sel Corporation Co., Ltd.	Tokyo Hino City	Korea Pusan City													0%
	30	Crystal device products based on photolithography technology	Hertz Technology Inc.	Tokyo Hachioji City	Tokyo Hachioji City													0%
	31	Surface Acoustic Wave (SAW) filter	Hertz Technology Inc.	Tokyo Hachioji City							Tokyo Fuchu							0%
	32	Hybrid plastic mask processing technology	Process Lab. Micron Co., Ltd.	Saitama Kawagoe City	Saitama Kawagoe City													0%
	33	Low temperature carbonizer	Kyoritsu Kogyo Co., Ltd.	Kanagawa Sagamihara City	Tokyo Setagaya Ward													0%
	34	Carbon modification apparatus	Kyoritsu Kogyo Co., Ltd.	Kanagawa Sagamihara City	Yamanashi Kofu City													0%
	35	High pressure gas cylinders using carbon fiber (FRP)	Kyoritsu Kogyo Co., Ltd.	Kanagawa Sagamihara City							Tokyo Chiyoda Ward	Aichi Nagoya City	Tokyo Chiyoda Ward	Tokyo Bunkyo Ward	Tokyo Minato Ward	Tokyo Chiyoda Ward		0%
	36	Low-noise, waste heat recovery type high quality air charging system	Fuji Kogyo Co., Ltd.	Kanagawa Sagamihara City	Tokyo Hachioji City													100%
	37～40																	

	<Cases of testing machine manufacturers>																	0%
41	Super-fine film scratch tester	Rhesca Co., Ltd.	Tokyo Hino City	Tokyo Bunkyo Ward														0%
42	Friction and abrasion tester	Rhesca Co., Ltd.	Tokyo Hino City	Ibaragi Tsukuba City														0%
43	Solder checker	Rhesca Co., Ltd.	Tokyo Hino City	Osaka Ibaraki City														0%
44	Laser manipulating system	Sigma Koki Co., Ltd.	Saitama Hidaka City	Saitama Wako City	Others													
45	Sealed-type low power CO2 laser	Onizuka Glass Co., Ltd.	Tokyo Ome City	Unspecified														
46	Highly-efficient laser irradiation device using the fiber-stretching method	Onizuka Glass Co., Ltd.	Tokyo Ome City	Yamanashi Kofu City														0%
47																		
																		7%
48	Rain sensor	Omega Technomodeling Co., Ltd.	Kanagawa Sagamihara City							Tokyo Minato Ward								0%
49	Outsourcing of parts feeder system and reforming business	Giken Kaihatsu Group Co., Ltd.	Kanagawa Sagamihara City							Tokyo Chiyoda Ward	Tokyo Akiruno City	Italy Bologna City						33%
50	Nursing care provision business	Giken Kaihatsu Group Co., Ltd.	Kanagawa Sagamihara City							Kanagawa Yokohama City Kohoku Ward								0%
51	Uses of paint-type insulation based products and service	Japan Telenics Co., Ltd.	Kanagawa Sagamihara City							Tokyo Meguro Ward	Kyoto Kyoto City	Kanagawa Sagamihara City	Nagano Ueda City	Kanagawa Sagamihara City	Tokyo Setagaya Ward			0%
52	Highly-efficient heat exchanger	Ucan Co., Ltd.	Tokyo Hachioji City	Tokyo Koganei City														0%

Cases of non-member companies

Note: Participation ratio on a cross-prefectural basis in TAMA: Percentage of number of collaboration partners cross-prefecturally located within TAMA. The figure for each division is the simple average of the percentage figures in each division.

(Table 7) Combination of technological seeds

	No.	Theme of product/technology	Core company	Core technology of core company	Technological seeds of collaborating universities & other research institutes		Technological seeds of collaborating companies	
supported cases		＜ I Cases of TAMA Association-led collaboration formation＞						
		II (Intelligent Micro Instruments) consortium project						
	1	High-density LSI wafer probe card	Tokyo Cathode Laboratory Co., Ltd.	IC/LSI probe cards	Micro-machining	Electric contact formation	Super-precise prototype processing	
	2	Microfabricated chlorine gas sensor	DKK-TOA Corporation	Chemical substance sensor	Micro-machining	Advanced sensor processing	Super-precise prototype processing	
	3	Miniaturization of wireless probes for electronic measuring instruments	Stack Electronics Co., Ltd.	Probes for electronic measuring, high frequency wavetransmission unit	Micro-machining	Miniturizing of communication circuits	Super-precise prototype processing	
	4	Decentralized power conditioner for photovoltaic power generation system						
		Controller module	YEM Inc. (Yamashita Engineering Manufacture Inc.)	Digital control devices (especially image processing)	Photovoltaic power generation algorithm			
		Inverter module	Niwa Electric Co., Ltd. (non-member)	Power supplier	Micro-inverter advanced digital circuits designing	Micro-device designing		
	5	BioMEMS dioxin gauge system	DKK-TOA Corporation	Chemical substance sensor	Micro-machining	Dioxin analytical method	High-performance reagent	Super-precise prototype processing
	6	Simple XML-EDI system	Busyukogyo Co., Ltd.	Productivity management know-how in auto parts manufacturing	PSLX interface		Production information system	Communication modules
	7	Hydrograph gauge and constituent gauge based on hetero-core optical fiber sensor	Inter Action Co.	Optical fiber, optical measuring device	Hetero-core optical fiber sensor (including processing of micro-device)		Environment monitoring system	
	8	*Sagami mulberry tea* and its related products	Amco Co., Ltd.	Agri-business planning ability	Knowledge of mulberry leaf effect-efficacy	Ability to analyze physical characteristics & chemical		
		＜II Cases of project promotion for existing collaboration＞						
	9	Sodium hypochlorite activator	Seiko Electronic Co., Ltd.	Dialysate melter	Information on actual dialytic treatment		Downsizing designing capabilities	Evaluation ability of aseptic condition
	10	Super critical plating system	YP System Co., Ltd.	Plating processing, plating devices	Super critical electrochemical reaction theory			

Cases of TAMA member companies	TAMA Association	11	Highly-efficient magnetism measurement technology	Faber Co., Ltd.	Magnetism analyzer	Magnetism measurement evaluation			
		12	Highly-efficient measurement technology of magnetism in amorphous film, etc.	Faber Co., Ltd.	Magnetism analyzer	Magnetism measurement evaluation			
		14	Sales promotion system using e-Ads	Global Area Network Co., Ltd.	Know-how on promotion solutions for retails & services based on CRM (Customer Relationship			Data mining through factor analysis solution	
			<III Cases of providing meeting opportunities>						
		15	Inductively Coupled Plasma (ICP) etching equipment	Elionix Inc.	IBE (Ion Beam Etching) equipment	Needs in micro-machine processing devices			
		16	Microscopic hole processing technology for silicon wafers	Tosei Electrobeam Company Limited	Laser microprocessing	Plasma etching	Silicon substrate micro-fabrication theory	Micro-fabrication of silicon substrates	
		17	Motion vector digital video processor	YEM Inc. (Yamashita Engineering Manufacture Inc.)	Image processing equipment	Image analysis system based on motion vector			
		18	Supersonic Local Positioning System	Toyo System Co., Ltd.	Firmware etc.	Local positioning measurement &			
		19	Digital archiving system using high definition photography	Open Future System, Inc.	Communication system	Pattern matching, digital archiving related image			
		20	Administrative supporting business of housing complex with NPO	Media Plus Inc.	Software			Housing complex management support service	
		21	Hand-drawn animation tool and on-line learning activities presentation tool	Media Plus Inc.	Software	Animation creating software for PC			
			<IV Cases of partial cooperation>						
		23	Automatic flushing toilet	Aoki Precision Instruments Manufacturing Co., Ltd.	Super-precise machinery processing	Electronics, software-technology & evaluation			
		24	Sound reverberation adjunction machine (Advanced echo machine)	Japan Kyastem Co., Ltd.	Digital signal processor (DSP)	Mathematical acoustic technology			
		25	Lightweight material curving technique and automatic forming system	Yoneyama Manufacturing Co., Ltd.	Complex shapes processing	Lightweight material curving		Cybernation technology	
		26	Water jacket for semiconductor manufacturing equipment	Tosei Electrobeam Company Limited.	Electron beam welding			Precision machinery processing, precision jig parts	High-quality materials (cupronickel)
		27	Friction-electrification type coating device for insulation painting of micro motors, etc.	P, C, Rotors Co., Ltd.	Triboelectrification			Fine particle selectivity knowledge	Trial manufacture & production
		28	Automatic immunochemical analyzer	Sel Corporation Co., Ltd.	Computers, measurements, digital technology			Machine component designing, device designing	

Noninvolvement cases	29	Visual transmitter	Sel Corporation Co., Ltd.	Computers, networks, application development, digital technology	MPEG-4 image compression			
		Crystal device products based on photolithography technology	Hertz Technology Inc.	Vacuum sealing of quartz crystal units	Photolithography cutting			
	31	Surface Acoustic Wave (SAW) filter	Hertz Technology Inc.	Crystal filter			Surface Acoustic Wave (SAW) filter	
	32	Hybrid plastic mask processing technology	Process Lab. Micron Co., Ltd.	Metal mask	Plasma control/processing/management (providing research facilities & advices on experiments)			
	33	Low temperature carbonizer	Kyoritsu Kogyo Co., Ltd.	Large-scaled plate working technique, Vacuum system	Experiment evaluation			
	34	Carbon modification apparatus	Kyoritsu Kogyo Co., Ltd.	Large-scaled plate working technique, vacuum system	Experiment evaluation			
	35	High pressure gas cylinders using carbon fiber (FRP)	Kyoritsu Kogyo Co., Ltd.	Large-scaled plate working technique, vacuum system			Information, Testing, Assessment, Market cultivation	
	36	Low-noise, waste heat recovery type high quality air charging system	Fuji Kogyo Co., Ltd.	Precision plate processing, coating painting, spot welding, metal molds	Technological assessment on both downsizing & offering technical advantages to heat pipes & air blowers			
		＜Cases of testing machine manufacturers＞						
	41	Super-fine film scratch tester	Rhesca Co., Ltd.	Thin film measuring equipment	High-sensitive thin film strength measuring technology & patent using			
	42	Friction and abrasion tester	Rhesca Co., Ltd.		Manufacturing orders			
	43	Solder checker	Rhesca Co., Ltd.	Solder checker	Manufacturing order for upgraded version responding to lead-			
	44	Laser manipulating system	Sigma Koki Co., Ltd.	Optical instruments for lasers	Development orders for applying to new usage of research			
	45	Sealed-type low power CO2 laser	Onizuka Glass Co., Ltd.	Glass discharge tubes	Unspecified			
	46	Highly-efficient laser irradiation device using the fiber-stretching method	Onizuka Glass Co., Ltd.	Glass discharge tubes	Laser stretching device			

Cases of non-member companies	48	Rain sensor	Omega Technomodeling Co., Ltd.	Machinery/electric/electronic/engineering-related designing & trial manufacture			Basic design & mass production of glass associated parts for transportation machinery	
	49	Outsourcing of parts feeder system and reforming business	Giken Kaihatsu Group Co., Ltd.	Automatic feeders and conveyers			Automation technology	Reforming technique of existing equipment & information of customers
	50	Nursing care provision business	Giken Kaihatsu Group Co., Ltd.	Machine designing			Needs information on nursing-care products & services	
	51	Uses of paint-type insulation based products and service	Japan Telenics Co., Ltd.	Electronic parts & numerical control unit, Jig designing			Effective use of an American paint-type insulation, etc.	Designing & coating in each specialty of architecture & production
	52	Highly-efficient heat exchanger	Ucan Co., Ltd.	Air-conditioning equipment	Aluminum foil surface treatment processing			

(Table 8) Collaboration formation opportunities provided by those other than the TAMA Association

		Theme of product/technology and type of TAMA Association support	Core company	Partners of collaboration (any relevant)	Collaboration formation opportunities provided by those other than the TAMA Association	
TAMA Association supported cases	＜Ⅰ Cases of TAMA Association-led collaboration formation＞					
	4	Decentralized power conditioner for photovoltaic power generation system		Professor of Tokyo University of Agriculture and Technology	The president of TAMA-TLO participated in a seminar at a company about photovoltaic power generation by the professor of Tokyo University of Agriculture and Technology	
		Controller module	YEM Inc. (Yamashita Engineering Manufacture Inc.)	Professor of Tokyo University of Agriculture and Technology		
		Inverter module	Niwa Electric Co., Ltd. (non-member)	Professor of Tokyo Metropolitan University	An ex-engineer at customer company of the technical director's former job	
	6	Simple XML-EDI system	Busyukogyo Co., Ltd.	Professor of Hosei University, software developing companies, collaborating companies for validation and experiments	The Institute for Small Business Management and Technology, Tachikawa Superior Blue Return Taxpayers Association, Ome Association of Corporations, Ome Society of Commerce and	
	7	Hydrograph gauge and constituent gauge based on hetero-core optical fiber	Inter Action Co.	Professor of Soka University, Yokogawa Denshikiki Co. Ltd.	The professor of Soka University is one of the	
	8	*Sagami mulberry tea* and its related products	Amco Co., Ltd.	Professor of Tokyo University of Agriculture	Recruiting activities for collaboration partners by Sagamihara Incubation Center in which Amco resides	
	＜Ⅱ Cases of project promotion for existing collaboration＞					
	9	Sodium hypochlorite activator	Seiko Electronic Co., Ltd.	Manufacturers of precision examination/analyzing instruments, sales subsidiary of medical equipment	Two of them were members of a supplier's association for an electrical machinery manufacturer	One of them was introduced by another member
	10	Super critical plating system	YP System Co., Ltd.	Professor and a research associate of Tokyo University of Agriculture and	The president entered the Ph.D. course of the university after starting the collaboration	
	11	Highly-efficient magnetism measurement technology	Faber Co., Ltd.	Professor of Oita University	Making acquaintance with the professor in the academic society	
	12	Highly-efficient measurement technology of magnetism in amorphous film, etc.	Faber Co., Ltd.	Professor of Oita University		

Cases of TAMA member companies	TA		14	Sales promotion system using e-Ads	Global Area Network Co., Ltd.	Consulting company	Using the mailing list of managers of venture companies via internet	
		<III Cases of providing meeting opportunities>						
			17	Motion vector digital video processor	YEM Inc. (Yamashita Engineering Manufacture Inc.)	Professor of Kanagawa Institute of Technology	Attended the Annual Meeting of the Institute of Image Information and Television Engineers	Members of the working group "Atsugi IT Consortium"
			18	Supersonic Local Positioning System	Toyo System Co., Ltd.	Professor of Soka University	The president entered the Ph.D. course of the university after starting the collaboration	
			21	Hand-drawn animation tool and on-line learning activities presentation tool	Media Plus Inc.	Professor of Tokyo University of Agriculture and Technology, collaborator for validation and experiments	The collaborating junior high school for validation/evaluation was introduced by the professor of Tokyo University of Agriculture and Technology	
		<IV Cases of partial cooperation>						
			23	Automatic flushing toilet	Aoki Precision Instruments Manufacturing Co., Ltd.	Professor Kiyosawa of Toyo University	Met when visiting the university	
			24	Sound reverberation adjunction machine (Advanced echo machine)	Japan Kyastem Co., Ltd.	Professor of Kogakuin University	A customer of the president in his former job (Iwatsu Electric Co., Ltd.)	
			25	Lightweight material curving technique and automatic forming system	Yoneyama Manufacturing Co., Ltd.	Professor of Tokyo Metropolitan Institute of Technology, manufacturer of automation mechanics	Found in the "proceedings of technology seeds of the university" of Tokyo Metropolitan Institute of Technology. Also attended a half-day lecture	Meeting of a society of commerce and industry
			26	Water jacket for semiconductor manufacturing equipment	Tosei Electrobeam Company Limited	Companies from the collaborating company group for development at this company, large supplier of materials	Formed a group of 40 collaborating companies for development	
			27	Friction-electrification type coating device for insulation painting of micro motors, etc.	P, C, Rotors Co., Ltd.	Vendor of supplying fine particles, manufacturer of mechanics, customer companies (auto parts, PC parts, etc)	Large customer companies had approached because of P, C, Roters' highly-established reputation	Experiences and acquaintances of the president are made good for development of products and formation of collaboration
			28	Automatic immunochemical analyzer	Sel Corporation Co., Ltd.	Partner company	Received acquaintances with the collaborating company at a society of commerce and industry. Both technologies and markets are complementary.	The development was started when a reagent manufacturer ordered to develop a bio-examination system

Noninvolvement cases	29	Visual transmitter	Sel Corporation Co., Ltd.	Professor of Pusan University and its venture company	Using the network of the president and an employee who have transferred from a large enterprise	Technologies and markets of both parties are not competing but complementary
	30	Crystal device products based on photolithography technology	Hertz Technology Inc.	Professor of Tokyo National College of Technology	Ex-president was one of the council members of Tokyo National College of Technology	Ability of coordination of the head of president office who entered the company after retiring from a large enterprise
	31	Surface Acoustic Wave (SAW) filter	Hertz Technology Inc.	Japan Steel Works, Ltd.	Introduced by the security company as an M&A matter	The audit by an audit company according to the request of collaborating company contributed the formation of reliance
	32	Hybrid plastic mask processing technology	Process Lab. Micron Co., Ltd.	Associate Professor of Toyo University	A college-day friend of the research and development division-director is the collaborator	
	33	Low temperature carbonizer	Kyoritsu Kogyo Co., Ltd.	Head of Nodai Research Institute	An R&D center of the company is a resident of the Sagamihara Incubation Center (met with a specialist of pressurized vessels). The Kanagawa Small and Medium Company Center, etc. introduced subsidy schemes and processing companies.	
	34	Carbon modification apparatus	Kyoritsu Kogyo Co., Ltd.	Professor of University of Yamanashi		
	35	High pressure gas cylinders using carbon fiber (FRP)	Kyoritsu Kogyo Co., Ltd.	Toyota Motor Co. Ltd., IHI Co., Ltd., Toho Rayon Co., Ltd., Tokyo Gas Co., Ltd., Showa Highpolymer Co., Ltd., High Pressure Institute of		Gained reliance by supplying test plants that were independently manufactured by the company
	36	Low-noise, waste heat recovery type high quality air charging system	Fuji Kogyo Co., Ltd.	Professor of Tokyo Metropolitan University	Cross-industrial group "Sagami Technomix"	
	＜Cases of testing machine manufacturers＞					
	41	Super-fine film scratch tester	Rhesca Co., Ltd.	Professor of University of Tokyo	Formerly had been developing measurement instruments for universities and research institutes, and had joined activities at academic societies such as the Society of Precision Mechanics, the Physical Society of Japan, the Society of Polymer Science, Japan, and the Imaging Society of Japan.	Obtained the patent execution from the professor's laboratory
	42	Friction and abrasion tester	Rhesca Co., Ltd.	Mechanical System Group of National Institute of Advanced Industrial Science and Technology		An order for manufacturing by a research institute
	43	Solder checker	Rhesca Co., Ltd.	Joining Welding Research Institute of Osaka University		An order for manufacturing by a research institute

		44	Laser manipulating system	Sigma Koki Co., Ltd.	Customer universities and institutes such as RIKEN (The Institute of Physical and Chemical Research)	Formerly had been developing analyzing instruments for universities and research institutes	Activities at academic societies such as the Japan Society of Applied Physics
		45	Sealed-type low power CO2 laser	Onizuka Glass Co., Ltd.	Customer universities and institutes	Formerly had been developing glass tools for universities and institutes	
		46	Highly-efficient laser irradiation device using the fiber-stretching method	Onizuka Glass Co., Ltd.	Professor of University of Yamanashi	Introduced by Yamanashi TLO	
Cases of non-member companies		48	Rain sensor	Omega Technomodeling Co., Ltd.	Nippon Sheet Glass Co., Ltd. (equipments of logistics)	Relationship between the boss and his employee for 30 years since working at Nippon Sheet Glass Co., Ltd.	
		49	Outsourcing of parts feeder system and reforming business	Giken Kaihatsu Group Co., Ltd.	Specialized trading company in mechanics, manufacturer of designing and trial manufacturing of automation mechanics	The network gained at the former workplace of the staff now involved in the new business promotion	
		50	Nursing care provision business	Giken Kaihatsu Group Co., Ltd.	Agency for nursing and personal care facility	Cross-industrial group "Mumeikai", formed of approximately 100 small and medium venture companies in Shinyokohama	
		51	Uses of paint-type insulation based products and service	Japan Telenics Co., Ltd.	Foreign consulting company, designing and building company, manufacturers of related equipment	Cross-industrial seminar	Person from the same prefecture
		52	Highly-efficient heat exchanger	Ucan Co., Ltd.	Foreign consulting company, designing and building company, manufacturers of related equipment	Cross-industrial group in Hachioji area by Tokyo National College of Technology	
			Nondisclosure cases			Interchange at university reunion parties as alumni	
						Cross-industrial group	
						Seminar by Tokyo Metropolitan Small Business Promotion Agency	

(Table 9) Careers of managers in collaboration case companies

1. Managers who started business after a spin-off from an existing company
Started business in 1971 with friends after working for the technology department of a connector maker.
Started business in 1973 after working for Hitachi Electronics Ltd. (now, Hitachi Kokusai Electric Services Inc.) for 15 years in the field of VTR, where the most advanced image processing technology was required. Nowadays, the company has grown into a self-designed product maker from an order initiated development base.
Started business in 1973 after working as an engineer for an NEC-affiliated measuring instrument maker.
Took part in the establishment of the company in 1975 after working as a design engineer for JEOL Ltd. Later became president.
Started business in 1975 after working as an engineer for 20 years for several metal mold manufacturing companies.
Started business in 1977 after working in Fuji Automobile Corp.'s production and several management divisions, as the subsidiary president, and as the director of the electronic beam division of the parent
Started business in 1982 after working as an engineer in several companies for 16 years.
Started business in 1985 after experiencing circuit design, process design, assembling, and marketing at a coil machine maker for a total of 22
Started business in 1990 after working as an engineer for an information service company.
Started business in 1991 after working for a trading company affiliated with Japan Aviation Electronics Industry Ltd. Recently switched the business line from electronic parts assembling to agri-business.
Started business in 1992 after experiencing various working fields including technology, manufacturing, quality control, marketing, and mainly production control, at Iwatsu Electric Co. subsidiary.
Started business in 1992 after long serving as an engineer of a company specializing in parts feeders.
Started business in 1993 after leaving a software development house and working as a freelance programmer.
Started business in 1999 after retiring from Nippon Sheet Glass Co., Ltd.
Was a recognized authority of area marketing since working at a construction company. Started managing venture companies in 1997 after leaving the construction company and started the current business
2. Manager who transferred from another company
Joined the company as vice president in 1968 from Ajinomoto Co. Inc. Now, chairman of the company.
3. Managers who joined the company straight after graduating from school
Joined the company run by his father after graduating from the faculty of engineering of his university, and later became the president.
Joined the company run by his father after graduating from industrial high school in 1967 and became president in 1980.
Started business in 1987 by purchasing the company he joined right after graduating from university.

(Table 10) Manpower securing methods taken in collaboration case companies

1. Key personnel in product development by collaboration = Core personnel for each company's technology	
	Senior managing director who joined the company as a technology consultant, after retiring from a large machine maker.
	Deputy director of the company's product development department who joined the company straight after graduation.
	Invited an employee of an electronic parts maker as a technology adviser with the purpose of starting an original product development, and later formally recruited him as the director of the technology group department.
	Senior managing director who is the president's son and who joined the company from a large pharmaceutical maker.
	University of Electro-Communications-graduated engineer, who was also the president's colleague under their former employer (Iwatsu Electric Co.).
	Technology manager scouted from a large enterprise works as the core in the technological field, and the head of the president's office scouted from another large enterprise is the core in the management field.
	Technology section chief who has been engaged for more than 20 years in crystal filter-related design and production since his former company.
	R&D department director who joined the company after working for another semiconductor maker and a precision machine maker.
	Executive director of development department who joined the company after working for two housing equipment makers.
	Development director scouted from a medical laser maker.
	Machinery engineering university-graduated engineer who joined the company from TDK Corporation.
	Engineer who was re-employed after leaving an air conditioning equipment maker, one of the company's business acquaintances, at mandatory retirement age.
2. Securing R&D and engineering staff	
	Took in vacuum technology engineers by purchasing San-ei Riken in 1999 and established the technological base for product development.
	Recruited a large number of excellent Ph.D.-class engineers from large enterprises after the collapse of the bubble economy.
	Recruited a young engineer by using a headhunting company.
	Recruited a new graduate from Tokyo University of Agriculture & Technology.
	Obtained cooperation from a graduate student of the university with which the company is engaged in collaborative research.
	Planning to employ a middle-aged worker of a large enterprise on a partner contract basis.
	Has been recruiting new graduates from a specific engineering field technical school in order to compensate for the company's low name recognition among new graduates.