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# **Policy Reforms, New University-Industry Links and Implications for Regional Development in Japan**

Kitagawa, Fumi ([fumi.kitagawa@circle.lu.se](mailto:fumi.kitagawa@circle.lu.se))

CIRCLE, Lund University

Centre for Innovation, Research and Competence in the Learning Economy (CIRCLE)

Lund University

P.O. Box 117, Sölvegatan 16, S-221 00 Lund, SWEDEN

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**Abstract**

This paper examines the changing roles of universities against current policy and institutional landscapes in Japan, given recent university reforms, the concentration of resources to the 'elite' institutions, and 'regionalisation' of science and innovation policies. The variety of forms of university-industry linkages and spatial relationships that universities are forming with regional stakeholders are illustrated. The development of a new research system in Japan throughout the 1990s has led to the emergence of new systems of innovation, in which university-industry linkages have been sought as a means to stimulate regional economic growth.

**Keywords:** university reforms, university-industry linkages, innovation systems, regional development, Japan.

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Policy Reforms, New University-Industry Links and  
Implications for Regional Development in Japan<sup>\*</sup>

Fumi Kitagawa

**1. Introduction**

Governments throughout the industrialised countries have launched numerous initiatives to link university research to industrial innovation more closely. Regional and national policy makers in search of such forms of engagement focus upon infrastructure development, education, effective industry-university partnerships and communications (Archibugi and Michie, 1997). In ‘successful regions’ such as Silicon Valley and Route 128 in the United States, in particular, universities allegedly play a big role in facilitating the innovation and learning processes (e.g. Saxennian, 1994). However, questions are raised as to whether or not the models based on Stanford, MIT and a few other successful cases can be applied to wholly different institutional contexts with varying national ‘industry-science relationships’ (OECD, 2002). There is also an increasing awareness that ‘one-size-fits-all’ innovation delivery models do not work, given different institutional and cultural contexts where universities are located (Drabenstott, 2008).

This paper presents a broad-brush picture of recent reform processes in Japanese S&T policies and regional economic development, and examines the wide range of universities’ roles in these processes. In Japan, just as many other OECD countries, policy makers and university administrators have started to embrace the discourse surrounding ‘entrepreneurial universities’ (Clark, 2001) and have sought to

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<sup>\*</sup> This manuscript was prepared for DRUID conference held in Copenhagen in June 2008.

promote university-industry links as a means to stimulate economic growth. The development of a new research system throughout the 1990s is seemingly leading to the emergence of new relationships and systems of innovation in which universities play more significant roles as *economic resources*.

Current policy trends which encourage the deregulation of university activities and the strengthening of competition between universities seem to induce forces which may be in conflict with some of the propositions underlying current local economic development policies. On the one hand increased competition between universities will arguably lead to more specialization of university activities and concentration of limited resources to specific institutions; on the other hand, there seems to be an excessive concentration of resources in metropolitan areas and a vital issue concerns perennial regional disparities. Reservations have been expressed about the role played by universities in peripheral areas, given high concentration of existing R&D efforts in core academic institutions such as the University of Tokyo and other former ‘imperial’ universities.

This article draws on the documentary analysis of recent government S&T, higher education and innovation policies over 10 years, review and secondary data analysis of recent university-industry linkages, national and regional S&T indicators, and some qualitative data gained through research visits to ministries, universities and secretariats of local cluster initiatives between the period of 2004 and 2007.

The following principal questions are addressed in this paper: What kind of new mechanisms for university-industry links and knowledge transfer are developing in Japan in response to the new policies and societal expectations to universities? In what ways are the relationships between industry-academia-government changing at local

and regional level? What are the barriers to universities playing a more active role in the development of their regions, especially in less advantaged regions? This paper situates these questions against current policy and institutional landscapes in Japan, given recent university reforms, ‘formalisation’ (Woolgar, 2007) of university-industry linkages, and regionalisation of science and innovation policies (Kitagawa and Woolgar, 2008).

The structure of the paper is as follows. Following this introduction, Section Two examines the changing policy environment and models of university-industry interactions. Section Three highlights the current Japanese policy context in which efforts have been made to improve university-industry links through various reforms of the S&T and higher education systems. Section Four illustrates the ‘regionalisation’ of science and innovation, including ‘cluster’ initiatives and policies promoting wider university-industry links at the regional level. Attention is drawn to the new mechanisms of university-industry linkages and various institutional strategies of universities to create spaces for regional innovation. Section Five, especially given the diversified and differentiated Japanese higher education system, describes some of the ‘bottom-up’ processes of regionalizing innovation with multiple actors that seek to link global knowledge flows into their local areas. The concluding section sums up the discussion, critically examines tensions within the system and problems caused by recent policy reforms, and suggests the emergence of new governance mechanisms of university-industry linkages at multiple levels.

## **2. Re-Conceptualising University-Industry Links**

History shows that the role of the university has been contested, with tensions between education, research, and services to the society, or ‘third stream’ activities.

Recent university reforms in Japan were accelerated to encourage further development of university-industry links which had hitherto been legally and structurally constrained in Japan. University-industry links had proceeded on a largely informal basis (Hicks, 1993) up until the mid 1990s. Legal frameworks to promote university-industry technology transfer were enacted in 1998 and 1999. However, echoing recent findings from the US literature (e.g. Mowery et al, 2001), Japanese literature has begun to debate the suitability of the new system against the old informal system (Nagata 2006; Woolgar, 2007). The widely observed recent policy direction in many countries to promote entrepreneurial activities by setting up formal mechanisms through ‘international emulation of the Bayh-Dole Act’ (Mowery and Sampat, 2004) may need to be tempered with more realistic expectations.

In general, university-industry interactions seem to have been subsumed into ‘broader analytical and normative policy debates for both technological innovation and local and regional development’ (Srinivas and Viljamaa, 2007). Much of the literature on innovation and technological change assumes that universities are part of the national and regional innovation systems (Kitagawa, 2005; Coenen, 2007). In general, universities are seen as integrated into regional innovation systems via the different mechanisms of academic knowledge transfers at local, national and international level. In this light, Etzkowitz (2002) has argued that ‘the triple helix’ interaction between university-industry-government moves towards a new global model for the management of knowledge and technology, where an internationalisation strategy emerges within domestic policy structures. However, despite growing interest among academics and policy makers worldwide, there are a number of gaps in the understanding of university-industry linkages (D’Este and Patel, 2007).

Different forms of cooperation in research and development between industry and academia constitute different spatial relationships. According to Feldman, 'knowledge spillovers are geographically bounded within limited space over which interaction and communication is facilitated, search intensity is increased, and task coordination is enhanced' (Feldman, 2003). Communities surrounding universities need to have the capability to absorb and exploit the science, innovation, and the technologies generated by the universities (Florida, 1999). However, not every form of university knowledge transfers requires spatial proximity. Industry-sponsored contract research, long-term university-industry research agreements and industry-financed university research centres channel university expertise between distant locations (Varga, 2000). Scholarly journal publications or faculty consulting in industry can convey knowledge from academic institutions to industrial firms over large distances.

The system of university-industry interaction needs to be discussed in terms of both a university's internal governance and questions related to external governance (Patchell and Eatham, 2003). Gunaskara classifies *generative* or *developmental* roles of universities (Gunasekara, 2006). While the generative role mainly refers to knowledge creation, the developmental role includes diffusion and exploitation processes, which is conditioned by the 'governance' dimensions that regulate the interaction of university in the regional innovation system (Chaminade et al, 2007).

Another important factor is flows of students and researchers. Universities' contribution to its local innovation system is not only through knowledge per se but a workforce capable of exploiting knowledge through retention of high quality graduates. For example, incentives and measures are needed to strengthen the links between higher education and the local labour market, filling the skill shortage and enhancing the

human capital of the region.<sup>1</sup>

The above mentioned different forms of linkages and relationships need to be embedded within specific institutional settings of the systems of innovation. Gibbons argues, ‘Much innovation, and hence economic development, depends less on original discoveries and more on the timely take-up, modification and marketing of knowledge solutions that already exist but need to be adapted to local environments’ (2004: 97). Japan has been the prime exemplar of such incremental innovation throughout the 1980s. However, there is a popular perception shared both by Westerners and Japanese that the Japanese innovation system has distinct weaknesses: it is weak in giving birth to radical innovations and is strong only in giving birth to more incremental innovations (Edgington, 2008). In the following section, it will be argued that this perception of weakened national innovation system in the 21<sup>st</sup> century, along with other societal and economic challenges such as the rapidly aging society and growing competitions with neighbouring Asian countries, underlined broader national shifts in models of innovation and economic governance. These societal changes in the universities’ external environment have put increased pressures on universities and other organizations to go through a number of reforms in the areas of S&T policies, higher education policies and economic development policies.

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<sup>1</sup> Greffe (2001) argues that to meet the challenges of the global economy in the context of the knowledge economy, it is important to have devolution of training policies and the formation of a local partnership combined with a national regulatory framework which shows both accountability and synergy.



### **3. S&T Policy Reforms and University-Industry Links in Japan<sup>2</sup>**

Over recent years, the Japanese innovation system has been subject to widespread reform.<sup>3</sup> One of the main reforms to achieve this has been to change the status of the national universities to ‘corporate’ entities, to provide greater autonomy and independence in order to become more entrepreneurial, responsive to societal needs as well as more diverse and efficient. Rising competition with other Asian nations and their universities has forced the Japanese government to place higher education high on the national policy agenda in order to maintain strategic competitiveness. The changing nature of university-industry linkages in Japan reflects wider industrial transformation of the nation. Recently, the increasing importance of ‘science-based industries’ (Goto and Odagiri, 1997) such as the life sciences, IT and nanotechnology with strong linkages with scientific research activities as their main feature reflects the increased contribution of academic research to industrial innovation.

The role played by universities thus far in the Japanese national innovation system has been a matter for speculation. While Japan boasts a powerful manufacturing sector supported by a very vigorous national innovation system (Freeman, 1988), it has a low number of ‘world-class universities’ and few Nobel laureates when compared to other countries (Moodie, 2006). In terms of research outputs such as the number of

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<sup>2</sup> This section is partly based on earlier works such as Kitagawa (2005, 2007) and Kitagawa and Lee (2008).

<sup>3</sup> This includes changes to the role of key ministries, changes to the decision making structures for science and technology as well as wide ranging reforms to the governance of institutions involved in scientific and technological research. See also ERAWATCH Research Inventory, Japan, for the details of policy changes.

<http://cordis.europa.eu/erawatch/index.cfm?fuseaction=ri.content&topicID=373&countryCode=JP&parentID=4>

publications and citation, Japanese top universities have performed rather well in the Asia Pacific region.<sup>4</sup> Japanese participation in international research collaborations is limited. Prevailing global perceptions hold that Japanese universities are inferior to their Western counterparts in terms of research, just as most advanced research in Japan is widely believed to occur not in universities, but in the research laboratories of leading private firms (Fransman, 1999). Research in Japan has been concentrated traditionally in-house within large *keiretsu* companies, and this feature has declined throughout the slow growth period. Consequently, there is new expectation on university-based research as a driver of innovation and economic growth.

The relative impoverishment of Japanese academic science has only recently begun to be addressed by the government (Nakayama and Low, 1997). Recent university reforms and new competition have changed the landscape of Japanese higher education. Japanese university reform since the beginning of the 1990s has reinforced the differentiation between institutions. Hicks (1993) argues that the system has been evolving in directions more favorable for university research excellence. New types of budgetary funds and project-based research funds established during the 1990s served to strengthen competition among universities by creating a mechanism for differentiated financial allocation which is justifiable to both universities and society (Asonuma, 2002).

In 2004 a ‘radical’ change (Yamamoto, 2004) was introduced to Japanese national universities through the National University Incorporation Law (2003), which

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<sup>4</sup> According to the 2007 Shanghai Jiao Tong University ranking, “Academic Ranking of World Universities”, six out of the top ten Asia Pacific universities are Japanese: Tokyo (1), Kyoto (2), Osaka (5), Tohoku (6), Nagoya (8) and the Tokyo Institute of technology (9).  
<http://www.arwu.org/rank/2007/ARWU2007TOP500list.htm> : accessed 2 October, 2007

granted them more autonomy from government (see Oba, 2005; Yamamoto, 2004). This Law intends to promote more active and socially engaged institutions with greater organisational diversity and distinctiveness, and may also indirectly promote inter-university competition (Woolgar, 2007). Since 2004, the 89 newly established National University Corporations (NUCs) have received two types of grants from the national government: grants for operating costs and subsidies for capital expenditures.<sup>5</sup> NUCs have full discretion to use the grant, while the flexibility of the capital subsidy is constrained. The government announced in 2006 that operating grants will be reduced by 1 percent each year for all NUCs.<sup>6</sup> Each institution is expected to develop supplementary income sources which may or may not include increases in tuition fees, competitive research funding and income from industry. The government encourages universities to generate such external incomes.

Research commercialisation and income from industry through knowledge transfer activities had remained peripheral to many academic communities in Japan. As already mentioned, university-industry link had remained informal, invisible and non-contracting ones up until the mid 1990s.<sup>7</sup> This system was seen as relatively unpopular and inefficient with technology transfer proceeding through a donation based system using a ‘give and take relationship’ between firms and university faculty (Woolgar, 2007). Many university technologies granted to firms were underexploited with most interaction taking the form of basic science issues or narrowly defined tasks

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<sup>5</sup> Operating grants amount to 1.2 trillion yen; subsidies for capital expenditure amount to 1 trillion yen.

<sup>6</sup> The total amount of grants for operating costs for national universities as of FY 2007 is 1.2 trillion yen, reduced by 17 billion yen from FY 2006. The decision, called ‘Basic Principles 2006 for economic and fiscal management and structural reforms’, is known as the *Honebuto* (solid) Policy.

<sup>7</sup> In terms of IPR management, university invention committees determined whether a technology should belong to the nation or whether the intellectual property should be held by the researcher, and many universities failed to fully exploit their intellectual property (Kitagawa and Woolgar, 2008).

(Kneller 2007). Motivated by efforts to reverse this situation as well as through observation of the success of the US economy throughout the 1990s, a number of policy measures were introduced that have gradually formalized the Japanese innovation system and introduced organizations and a more legal structure to transfer activities(Woolgar, 2007).

New legal frameworks to promote university-industry technology transfer were enacted from 1998, and 44 Technology Licensing Organisations (TLOs) had been established as of 2007, which are either private companies, non-profit corporations or embedded within a university. This was designed to assist researchers to obtain patents on their inventions and to license those inventions to private industry. Many of the TLOs are run in close collaboration with local authorities. Some serve one university or others serving a number such as, for instance, Tōhoku TechnoArch which serves eleven regional universities (see Section Five).

The Law of Special Measures for Industrial Revitalization, enacted in year 1999, is a so called Japanese version of the US Bayh-Dole Act, making it easier to trade intellectual property rights derived from publicly funded research. In 1999 and 2000, enactment of series of new laws accelerated the formalisation of intellectual property frameworks and promotion of venture creation. As corporate bodies, universities now own and manage their intellectual property rights (IPRs). As of 2004, ownership and transfer of discoveries in most Japanese universities is ‘nearly identical to the US Bayh Dole system’ (Etzkowitz et al. 2005). The incorporation of the National Universities in 2004 has seen many universities seek to develop stronger local links and has also allowed universities to reform their institutional structures (Woolgar, 2007).

Since 2003, 43 universities have received financial support from the government to set up “Headquarters for Strategic IP Management” so that each institution can deliver its own policy for income generation based on their IPRs. In practice, many institutions have difficulties in setting appropriate mechanisms linking university departments, TLOs and such new IP Headquarters to develop a licensing culture within the university itself (Woolgar, 2007). While the number of patent applications increased following passage of the Technology Transfer Law in 1998, from 2006 the number of applications has begun to decrease. Against this background, it has been pointed out that for each university the income balance from intellectual property related activities has been modest, per case the processing time has been short with insufficient searches; and management mistakes have enlarged the problems faced by university TLOs; some excessive staffing issues and barriers have made the importance of amending the intellectual property exploitation strategy desirable (Woolgar, 2007; Kitagawa and Woolgar, 2008).

There was a sharp increase in the number of start-up firms based on university basic research and technology breakthroughs. This was bolstered by the year 2000 by the Law to Strengthen Industrial Technology, which legalized compensated consulting and also holding of line management positions in private companies by university faculty, provided permission was obtained in advance in the case of management positions (Edgington, 2008).<sup>8</sup>

The *Hiranuma Plan* published in 2001 set a target for the creation of 1,000

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<sup>8</sup> There have previously been very few economic incentives for Japanese academics to engage in licensing and other entrepreneurship activities (Yoshihara and Tamai, 1999; Woolgar, 2007). Disincentives for such activities arose from significant administrative, agent-related, maintenance and negotiation costs. MEXT has created a budgeting scheme whereby national universities promoting university-industry co-operation and patenting can be allocated additional funds.

start-up companies from universities, which the government has now met (Kondo 2007). Universities have been encouraged to develop Venture Business Laboratories where start-ups can use office space below market rates. In the data provided by MEXT, as of 2000, there were 127 new enterprises spun-off from universities, which compared to 368 in the US and approximately 200 in UK. By 2001, the cumulative number of university spin-off rose to 251, to 424 in 2002 and as of 2003, the creation of 614 small businesses could be attributed to Japanese universities. The number reached 906 in 2004, and rose to 1503 in 2005 with 200 billion yen turnover.<sup>9</sup>

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Figure 1 about here

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Kneller (in Etzkowitz et al 2005) points out that many of the university start-ups are virtual companies with low invested capital, sales and numbers of employees. However, some of these start-ups draw on the research of major university laboratories and networks of researchers that span several universities. Some of the most successful start-ups, in terms of market capitalisation following initial public offerings (IPOs), owe their success largely to the laboratories from which they arose and to the researchers in those university laboratories. The growth of university spin-off companies may have spatial implications for university-industry linkages. Recent study (Nakayama et al. 2005) points out that many of the university spin-out firms have close

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<sup>9</sup> This includes the number of small business companies created from universities (national, private, local) and specialised colleges, shared research centres and PRIs.

[http://www.mext.go.jp/a\\_menu/shinkou/sangaku/sangakub/sangakub6.htm](http://www.mext.go.jp/a_menu/shinkou/sangaku/sangakub/sangakub6.htm)

[http://www.mext.go.jp/a\\_menu/shinkou/sangaku/sangakub/sangakub7.htm](http://www.mext.go.jp/a_menu/shinkou/sangaku/sangakub/sangakub7.htm)

relationship with local industry.

A recent survey conducted by RIETI gives an overview of R&D collaboration between firms and universities (Motohashi, 2005). Although Japan's national innovation system is characterised by a focus on in-house R&D conducted mainly by large firms, the survey results show that external collaboration in R&D efforts is becoming fairly widespread. One of the most common routes of the information flow from academic research to industrial innovation is through the publication of papers. However, university-industry links take a variety of forms such as joint research, consultation, commissioned research as well as licensing and spin-out. Benefits that can be expected from university-business linkages are of varying effects, depending on the sector in question. Collaboration is not uniform for all types of companies, with small and medium sized enterprises (SMEs) facing the greatest barriers in university-industry engagement (Aoki and Harayama, 2003; see also, Section Four).

Walsh et al. (2008) examine the commercialization of university research since the mid-1990s. Using data from a national survey of university engineering and biomedical faculty the authors examine changing relations between professors and outside firms and compare outcomes with North American findings. They conclude that informal ties between faculty continue to have informal ties with firms, and they also raise the issue of whether too much emphasis on university patenting can be detrimental to the progress of science and ultimately to industry and society as a whole (Edington, 2008). The next section now turns to investigate the policies promoting innovative capability of local production including university-industry linkages at local/regional level.

#### **4. Top-down Regionalisation of Innovation and Bottom-up Local University-Industry Linkages**

Since the late 1990s, the emphasis of industrial policy in Japan has shifted to revitalizing industry in order to overcome the hollowing out of the manufacturing base caused by the shift of production from domestic to overseas sites, located primarily in China and other Asian countries (Kitagawa, 2005; 2007). Policies inducing regional industrial agglomeration to raise industrial competitiveness (e.g., cluster strategies) have emerged in this political economy. Since the end of the 1990s, through the implementation of local cluster strategies, complex patterns of inter-firm and inter-organisational relationships have been promoted at local and regional levels, with universities being recognised as key players in generating the industrial competitiveness of regions.

It is important to understand the specific historical context of cluster policy implementation in Japan. Until the mid-1990s, policies focused primarily on maintaining networks of SMEs in the manufacturing sector. Japan has the highest proportion of SMEs and employment of any major industrialized country. Provision of SME support was until recently provided under the Small and Medium Enterprise Law of 1983, which tended to concentrate on the growth and development of existing firms, endeavoring to improve their performance, innovation and competitiveness. A regional focus to these efforts has been maintained by *Kohsetsushi* centres, which comprise public research institutes funded by local authorities in each of Japan's 47 prefecture and large cities, such as Yokohama and Osaka. These usually concentrate on practical technical issues for SMEs, including adopting new techniques and often specialize in particular sectors, e.g. ceramics, textiles, metals and machinery (Edington, 2008;



Shapira, 1992, 2008). However, given the ongoing ‘hollowing out’ of the manufacturing sector, such an approach was deemed insufficient. The new policy focus targeted the creating linkages between different groups of actors including, SMEs, large enterprises, universities and other research institutions (see Motohashi, 2005), promoting innovative capability of local production.

In Japan, the regionalization reform drive has come largely from the centre, which can be described as a form of ‘a top-down decentralisation’ (OECD, 2005). Earlier policies to local technological development such as Technopolis programme in the 1980s exemplified the limitation of such top down approaches. The evaluation of these earlier initiatives in terms of their impact on local economic competitiveness varies, and some observers have pointed out many constraints and limitations in terms of the development of locally embedded skill development. Local linkages within the Technopolis areas were not strong, partly due to the fact that most branch subsidiaries retain strong vertical links with their headquarters rather than opening up new production spaces for local firms (Abe, 1998). Industrial policy instruments such as tax incentives, inexpensive loans, large-scale infrastructure investments were most useful for large firms plans.

Recent Japanese policy reform processes have witnessed a strong push to promote regional innovation. Following passage of the Science and Technology Basic Law in 1995, local government has held responsibility for “formulating and implementing policies with regard to the promotion of S&T corresponding to national policies” and each of the three successive Science and Technology Basic Plans implemented since 1996 have contained a section which has outlined objectives for the regional level (Kitagawa and Woolgar, 2008). The *First Science and Technology Basic*

*Plan* (1996-2000) emphasised an increase in the Science and Technology budget, and enforced links between universities and industry, emulating the US policy frameworks (Pechter, 2001). The ‘regionalisation’ of science and technology policies was outlined in the *Second Science Basic Plan* (2001-5). In Japan, the regional innovation system (RIS) idea is relatively new and, relative to the situation in European countries, did not receive much attention in policy frameworks until very recently. The idea of building RIS is explicitly emphasised in the current, *Third Science Basic Plan* (2006-10). One of the core objectives of the Third S&T Basic Plan (2006-2010) is to promote academia-industry-government links at regional level and support regional innovation through network mechanisms.

Recent study shows that interactions between universities and SMEs have increased in a recent decade (Nakayama et al, 2005). This might reflect the new policy focus targeted to create linkages between different groups of actors including, SMEs, large enterprises, universities and other research institutions. The Small and Medium Enterprise Basic Law was radically revised in 1999 with a new focus on promoting business innovation and new business start-ups more generally. Subsequently, the government established a Small Business Innovation Research Program (modeled after a similar scheme in the USA) to allow subsidies and other fiscal incentives for SME research that hitherto had made principally only to large firms (Edgington, 2008). Specific programmes are in existence, such as the New Regional Consortium Research Development Programme funded by METI, or Regional Concentrated Collaborative Research Development Programme operated by JST (Japanese S&T Agency).

Today, many of limitations to develop locally embedded industry-science relationship still exist (Cowling and Tomlinson, 2003). It is also important to note that

in Japan, there is no formal institutional mechanism operating at ‘regional’ level as such in terms of research policy and funding. This lack of governance at the regional level has constrained the development and regionalisation of innovation and effective university-business links in Japan (Kitagawa, 2007). Authors point out that while Japan’s prefectures are very active in innovation support policies, they continue to be substantially financed by central government subsidies (Hassink, 2002).

Since the end of the 1990s, through the implementation of ‘local cluster strategies’, complex patterns of inter-firm and inter-organisational relationships have been promoted by the central government at the local and regional levels, with universities being recognised as key players in generating the industrial competitiveness of the regions. National government initiatives since 2001, such as the ‘Industrial Cluster Project’ led by METI and the ‘Intellectual Cluster Initiative’ led by MEXT, have formed the basis of the regional approach to cluster development in Japan. Recent cluster policies in Japan include 17 Industrial Cluster Projects (Second Phase, 2006-2010) promoted by METI (the Ministry of Economy, Trade and Industry, re-organised in 2001 from MITI), 18 Knowledge Cluster Initiatives promoted by MEXT, and the more recent, integrated ‘Regional Cluster model’. Fostering the university-industry linkage represents a ‘point of convergence’ for MEXT with its remit in university issues and METI which is responsible for the industry agenda.

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The Industrial Cluster Initiative implemented by METI, based on the so-called ‘business approach’ (Sanz-Menendz and Cruz-Castro, 2005) to innovation policies, aims

at revitalising regional economies and promoting industrial accumulation through promoting networks between industry, university and public research institutes (e.g., Regional R&D Consortium), and through supporting the creation of new businesses and new industries. The ultimate goal is to promote new business creation combined with existing local industrial strengths. While the financial scale of the Industrial Cluster Project is rather limited, it is expected that in implementing these activities, a variety of governmental subsidiaries and grants will be utilised.

The Knowledge Cluster Initiative supported by MEXT, based on the so-called ‘academic approach’ (Sanz-Menendz and Cruz-Castro, 2005) to innovation policies, was developed from existing policies for the promotion of S&T activities in regions. The initiative aims to construct a ‘regional system of technological innovation’, based on industry-university-government collaboration by forming networks of Centre of Excellence (COEs) in regions. This policy initiative is funded by the central government but assumes a bottom-up approach, with action plans proposed by local governments rather than being imposed from above by the central government.

Both of these two cluster initiatives emphasise strengthening university-business linkages in local contexts, which will arguably lead to the creation of high-technology venture business spin-off from universities’ research. Each region has established a Regional Cluster Promotion Association, consisting of representatives of both initiatives. METI regional bureaus also serve as focal points to link various actors in their regions. For example, the Industrial Cluster Initiative in the Kanto region, the ‘Technology Advanced Metropolitan Area’ (TAMA), has been seen as a successful case developing inter-firm linkages among product developing SMEs, and promoting academic-industry linkages across three prefectures surrounding the Tokyo

Metropolitan Area, through the support of an effective intermediary organisation (Kodama, 2004).

In response to the top down regionalization of innovation by the central government, a more 'bottom-up' regionalizing process of science and innovation is emerging. Recent policy to regionalise innovation and science governance and promote local industry-academia- government collaboration is beginning to change the dynamics of provisions of local skills and competencies. Development of high-tech clusters requires a larger number of highly educated scientists as well as people with multiple skills and experiences with both industry and academia. For example, a number of intermediary organizations and coordinator positions have been created with public funding to enhance better integrated approach to local innovation. Eighteen core organisations have been set up as Knowledge Cluster Headquarters and staffed with a Project Director, a Chief Scientist, S&T Coordinators and other experts to manage intellectual property rights as well as to promote university and local business linkages. However, it has been pointed out that it is difficult to attract highly skilled individuals with hybrid skills to work for the regional public sector or universities.

Recent research by Sakata et al (2006) investigates different nature of networks developed within different clusters (e.g. medical cluster in the Kinki region and semiconductor cluster in the Kyushu region) in relation to the location of high tech firms, nature of the industry, and linkages with research intensive universities. They found that the two cluster initiative have formed 'small-world networks' spreading across wider local areas. In such networks, research intensive universities and core firms serve as 'connector hub' (Sakata, et al.2006). It is also pointed out that large research

intensive universities tend to be located in metropolitan areas, and they may not easily function as a hub for local technology networks.

Question remains as to the impact of the cluster policies/initiatives. It is beyond the scope of this paper to discuss indicators/metrics for such measurement and it is too early to judge policy effects of these recent developments (c.f, Diez, 2001). However, it is evident from existing quantitative studies (Nakayama, et al. 2005, 2007; NISTEP, 2003;2005; NISTEP/MRI, 2005; Sakata et al.2006) and qualitative cases (see next section) that new forms of university-industry linkages have been formed at local/regional levels since the mid 1990s, creating horizontal as well as vertical relationships.

## **5. Differentiated Forms of University-Industry Linkages and Roles of Universities in Regional Development**

Japanese society has been able to sustain a unique mix of elite and non-elite national universities, a large number of private universities with a few exceptional research oriented institutions, as well as public local universities. In this section, varieties of forms of university-industry linkages are illustrated, exemplifying differentiated roles of universities with different missions, resources and strategies. The spatial linkages each university is developing with its region would be conditioned by such relational factors as well as government policies and the size and concentration of the allocation of public research funding.

The main structure of the current higher education system in Japan was established in 1949, with the upgrading of various types of higher and post secondary institutions into the university system. The Japanese government established at least one

comprehensive university in each of the 47 prefectures designated as a ‘national university’. It has been observed that Japanese higher education is been going through ‘the biggest higher education reforms in more than 100 years’ (Goodman, 2005). As of 2006, there were 568 private universities, 87 national universities and 89 public (municipal and prefectural) universities with degree awarding power (MEXT, 2006).<sup>10</sup> Eades (2005) points out the changing division of labour between the three sectors of HEIs: up to 1998, the tripartite division between national, public and private universities was that ‘national universities should meet the needs of the nation, public universities should meet the needs of the local communities that established them and private universities should be mainly responsive to the market’. Arguably, such a division is becoming more complex through ‘deliberate erosion’ (Eades, 2005) of the difference between the three sectors as the pace of university reform accelerates.

The recent change to the legal status of national universities and their staffs may affect the geographical dimension of interaction: National University Corporations (NUCs) can now receive financial support from local authorities, which was prohibited in the past when they were national institutions. This may trigger new relationships between universities and their localities, as there will be more financial incentives for universities to work closely with their surrounding regions, triggering innovation at the regional level. As of 2003, 18 local authorities provided financial support to NUCs (NISTEP, 2003). Some NUCs are known to be very active in technology transfer activities with local firms in their respective regions. For example, Yamaguchi

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<sup>10</sup> MEXT (2006) *Gakko kihon chosa*.

[http://www.mext.go.jp/b\\_menu/toukei/001/06121219/002/001/001.htm](http://www.mext.go.jp/b_menu/toukei/001/06121219/002/001/001.htm) access 26 November 2007.

University in the Chugoku region has recently seen some success in increasing royalty income from local industry.

There is a very strong sense of crisis among ‘non-elite’ national, private and local universities in peripheral areas, and the perception of a growing gap between institutions in urban and rural areas both in terms of student enrolment and research capacity. Indeed, the growing economic gap between urban and rural areas (or centres and peripheries) is a sensitive issue in current policy debates in Japan. National universities in non-metropolitan areas increasingly see contributing to regional development as central to their core organisational missions. With fewer public resources available for higher education, there will be a need to place a higher priority on responsiveness to local and regional needs and on demonstrating usefulness to society in order to receive public support. However, this may have adverse effects in their research capabilities in the long term.

Among 87 national universities, seven former ‘imperial universities’ have been historically developed as national elite institutions. The old elite status of former imperial universities was transformed into the idea of ‘research excellence’ after the Second World War. The elite status seems to be strengthened through recent policy changes which include increases in total research funding, the introduction of competitive research funding (combined with the decrease in basic funding in the form of operating grants), increases in external funding, and the strengthening of graduate schools along with their research and training function.

Table 1 shows the top 10 Japanese universities with the highest research income from external sources (joint and commissioned research with industry). These



consist of research intensive seven former imperial universities (Tokyo, Kyoto, Tohoku, Osaka, Hokkaido, Nagoya, Kyushu), the Tokyo Institute of Technology and two research intensive private universities, Keio and Waseda. Many of these research universities made comprehensive agreements with firms and are developing interdisciplinary research consortia with the firms.

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Insert Table 1 about here  
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In the case of the University of Tokyo, the top research university in Japan, the total operating budget was 188 billion yen as of 2005.<sup>11</sup> In order to increase financial autonomy from the central government, the University established the University of Tokyo Foundation in 2004, through which the University is able to engage in long-term borrowing.<sup>12</sup> There is a novel ‘support triangle’ to champion industry cooperation at the University of Tokyo. First, the University –Industry Liaison Headquarter is responsible for managing the overall activities related to commercialisation activities of the university research including intellectual property management (see Miyata and Tamai, 2007). The University has established a new programme, *Proprius 21*, which enables strategic planning and support for collaborative industrial research. Second, ‘Todai TLO’ was established in 1998 and now is a limited company. It is the operating entity for creating intellectual property and is involved in marketing licences to

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<sup>11</sup> Of this sum, 51 percent was from the national government (including operating grants), 29 percent was from the University’s own revenues (including 17 percent from a university hospital and 9 percent from tuition fees), 20 percent was from external revenue (including commissioned research funds and donation). <http://www.u-tokyo.ac.jp/fin01/pdf/H17kessannogaiyou.pdf> accessed 03/10/07

<sup>12</sup> The University Foundation aims to receive 1.3 billion yen in donations by the end of FY 2007. This is rather small compared with Keio University, which has 3.6 billion and Waseda University with 2.4 billion. These numbers are far less compared with US research universities such as Harvard, Yale and Stanford.

companies. Thirdly, the University established its own venture fund, the University of Tokyo Edge Capital, supports start-ups from the university research and university-oriented venture businesses. The University of Tokyo is nationally and internationally oriented and of sufficient size to create new technologies for use throughout the country. The University had 1595 joint and commissioned research projects with industry which brought 21 billion yen in income in 2004. Figure 4 shows recent increase in joint research with industry.<sup>13</sup>

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Insert Figure 4 about here  
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The University of Kyoto, the second most research intensive national university in Japan, reorganized and strengthened its university-industry functions in 2007. The University of Kyoto has a specific strategy to link international research networks to regional innovation. Recently, the University has made an international strategic alliance with Tsinghua University in China, in relation to the development of Katsura Innovation Park in Kyoto, which is funded by the MEXT Knowledge Cluster Initiative. The Innovation Park is a base for the Advanced Nanotech Support Network programme, also funded by the MEXT. Under this programme, the University is developing inter-regional university-industry networks with two other research intensive specialized technology graduate schools (Japan Advanced Institutes of Science and Technology in Hokuriku and in Nara).

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<sup>13</sup> [http://www.u-tokyo.ac.jp/res01/d04\\_04\\_h14\\_j.html](http://www.u-tokyo.ac.jp/res01/d04_04_h14_j.html) : accessed 03/10/07 The level of joint research stayed low from the 1970s to the 1990s. Other industrial funding such as scholarship donations and contracted research increased in the 1980s and 1990s respectively (Hatakenaka, 2003).

The other former imperial universities in local major cities such as Universities of Tohoku in Sendai, Kyushu in Fukuoka, and Nagoya in Nagoya, all top research universities in Japan, are expected to play major roles in the regional cluster initiatives by providing international research excellence and attracting foreign researchers and students to their localities (see Kitagawa and Woolgar, 2008). At an individual level, however, there is insufficient incentive for university academics to engage in regionally relevant research, especially with small and medium enterprises.

Universities in the Tohoku region have built up collaborative relationships over the decade. In 1998, Tohoku Techno Arch was established as inter-university/technical college Technology License Office (TLO). At Tohoku University the New Industry Creation Hatchery Center (NICHe) was established in April 1998 with an aim to vitalize domestic industries by collaborating with outside organizations of industry through the utilization of intellectual resources accumulated at the university. Currently, there are 17 spin-off firms from the University. In other areas of the Tohoku region, there are a few local innovation hubs of smaller scale. In Iwate Prefecture, there is Iwate Network System, which is an informal network of linking university research into local business needs. Iwate University has 170 collaborative research projects with firms and 60 percent of which is with SMEs in Iwate Prefecture. In Yamagata Prefecture, the engineering department of Yamagata University in Yonezawa has long been serving as centre of knowledge transfer. Regional Innovation System in Tohoku region is not 'dirigist' any more (see Abe, 1998). There are a number of endogenous knowledge hubs within the region.

There is a group of universities in metropolitan areas which are less research intensive than the former imperial universities, but with strong research profiles and

renowned for being particularly strong in developing strategic university-industry linkages, at a smaller volume than those of big top research universities. Three cases are briefly illustrated here, a national incorporated university, a private university and a local public university (see Miyata and Tamai, 2007).

Tokyo University of Agriculture and Technology (TUAT) started to make a specific institutional effort to promote university-industry links in the mid 1980s before intellectual property policies drew attention.<sup>14</sup> Today TUAT has the highest number of joint research project with industry per faculty member among Japanese universities. In 2003, TUAT Incubation facilities were opened, and as of 2004, there are 20 university spin-off companies from TUAT.

Ritsumeikan University in the Kinki region is one of the top private comprehensive universities established in the late 19<sup>th</sup> century. Ritsumeikan exemplifies ‘entrepreneurial university’ in Japan with strong international profile as well as links with industry. Ritsumeikan has developed a strong strategic trajectory of university-industry linkages since 1994, when the science and engineering faculty was relocated to a new campus in Shiga prefecture. In 2005, according to the survey conducted by the METI, Ritsumeikan was nominated by businesses as the best university for industrial collaboration. It received support from regional partners and plays a role in local economic development by interacting with Shiga based manufacturing firms. In 2007, Ritsumeikan University had 22 firms operating in its incubator. The University provides programmes to foster local entrepreneurs, through

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<sup>14</sup> This was done in the form of organizing events for disseminating the research outcomes from TUAT to industry. There has been a steady increase in terms of number of joint research with industry throughout the 1990s. In 2003, prior to the incorporatisation, TUAT created a research consortium with 12 large firms in collaboration with a public research institute, National Institute of Advanced Industrial Science and Technology (AIST).

special classes and a student venture enterprise competition.

Osaka Prefecture University, a local public university was established in 2005 by merging three public universities in Osaka prefecture. The University has an extensive university-industry linkages and a steady increase in external funding, based on the institutional IPR management mechanisms. The Intellectual Property Bridge Center centrally aggregates all the intellectual properties including the seeds for research and patents invented by our faculty members, oversees the staffing of coordinators for enhancing the use of these properties, and, in cooperation with local financial institutions, invigorates the center's role as a bridge between the university and various local and private-sector companies and other enterprises.<sup>15</sup>

At the institutional level, it should be remembered that specific mechanisms to implement effectively the missions of each university must change by taking into account various factors that surround the university. It is up to each institution how to formulate their own missions and implement innovative institutional strategies. While the University of Tokyo and former imperial universities have national and international orientation, many other universities have a smaller and more regional or local focus. The variety of forms of university-industry linkages and spatial relationships are not exclusive to each other, and may encompass both local, regional, national and sometimes international levels. Certain university-industry linkages are locally specific, whilst in some cases, linkages could be at any level. Universities increasingly see contributing to regional development as their missions, but institutional contexts and the extent of their strategic resource allocation varies substantially.

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<sup>15</sup> <http://www.osakafu-u.ac.jp/english/research/cooperation/index.html> 30/11/07

## **6. Concluding Remarks**

With industrial change and recent government policy shifts (as seen in following the 1995 enactment of the S&T Basic Law, for example) the structure and the financing of S&T activities in Japan have been experiencing profound change over the past decade. This change can be briefly characterised as a tendency towards a) a dynamic innovation process with science-based industries; b) a gradual ‘regionalisation’ of innovation policies through decentralisation of S&T governance; and c) a stronger emphasis on academic entrepreneurship with enhanced local university-industry links.

Recent series of legal changes in Japan are affecting the geographical dimension of university-society relationships in general, and university-industry linkages in particular. In recent years, universities have been focused as one of the central players promoting regional innovation. There seems to be an emergence of both bottom up as well as top-down approaches to local economic development. Universities, along with other regional stakeholders, are creating regional advantage through collaboration, by appropriating the rapidly changing policy environments they are in and by building partnerships through which they can gain wider societal support.

Many universities are being called upon to act not only as regional hubs; but drawing on their prominence, international hubs for regional development. In this many universities are facing significant hurdles and the process of implementing organization change is has just begun. Constructing knowledge hubs set within a wider framework of transnational regional innovation systems is of key importance (Kitagawa and Woolgar, 2008). The development of industry and science relationships centred on universities and other training and research institutes is also perceived to need situating within such a wider geographical and intellectual paradigm, beyond the national framework albeit

from the local–regional base. The existing diversity of the higher education system which provides a wide range of university-industry linkages, human resources and skills is a formidable societal asset to the Japanese tradition of innovation.

The adoption of a US style legal framework for university-industry technology transfer seems to be promoting an entrepreneurial culture within Japanese universities in terms of the number of university start-ups, patent applications and royalty income. However, evidence suggests that the process of knowledge transfer between university and industry occurs through multiple channels such as personnel mobility, informal contacts, consulting relationships and joint research projects. Patenting and spin-offs play a comparatively small part in this process. Spin-offs are one way of transferring technology from university to industry, but this transfer mechanism is far from being universally successful. Judgement needs to be reserved about whether or not these activities will be sustained in the long term. Local institutional contexts and sector specificity need to be carefully considered, and appropriate support mechanisms need to be built to make sustainable innovation spaces. Careful monitoring is required as to the long-term effects of such a legal framework within Japanese institutional contexts.

An emphasis on commercial orientation as short-term income generating activities may only serve to hinder the overall research and educational capability of a university if it is not integrated as part of the long-term strategic mechanisms of the whole institution. It is also important to ensure ‘external governance’ of the university allows appropriate partnership to work with various stakeholders.

To accomplish the connection between external and internal policy, promoting government-university-industry linkages, appropriate internal governance and mediation mechanisms need to be created at the institutional level. Simultaneously, it

must be ensured that the balance can be struck between incentives for commercial and academic activities done by faculty members (*e.g.*, managing intellectual property rights, developing new sources of revenue, conducting academic research, disseminating research findings and teaching students). Such institutional mechanisms serve as the key to understanding the evolution of triple helix interaction at regional, national and transnational level.

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Table 1 Top 10 Japanese Universities with Highest Income from Joint and Commissioned research with Industry in FY2004 (million yen,)

1	University of Tokyo*	21,151
2	University of Kyoto *	9,868
3	University of Osaka *	9,595
4	University of Tohoku*	5,895
5	Waseda University ***	5,270
6	University of Kyushu*	4,952
7	Keio University***	4,852
8	Tokyo Institute of Technology**	4,076
9	University of Hokkaido*	4,038
10	University of Nagoya*	2,760

(MEXT, 2006)<sup>1</sup>

\*Former Imperial University (NUC)

\*\* National University Corporation (NUC)

\*\*\* Private University

Figure 1 Cumulative number of University Spin-off (Source: MEXT)

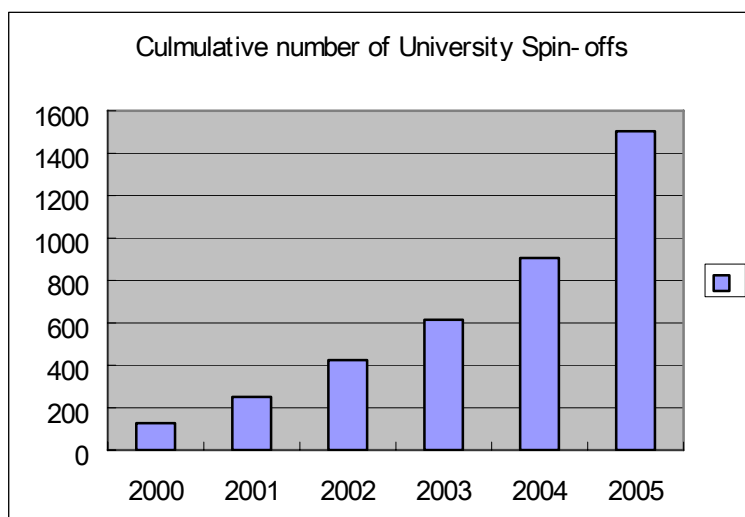




Figure 1 Industrial Clusters  
(Phase II 2006-2010) Source: METI

Industrial Cluster Program Phase II: 17 projects

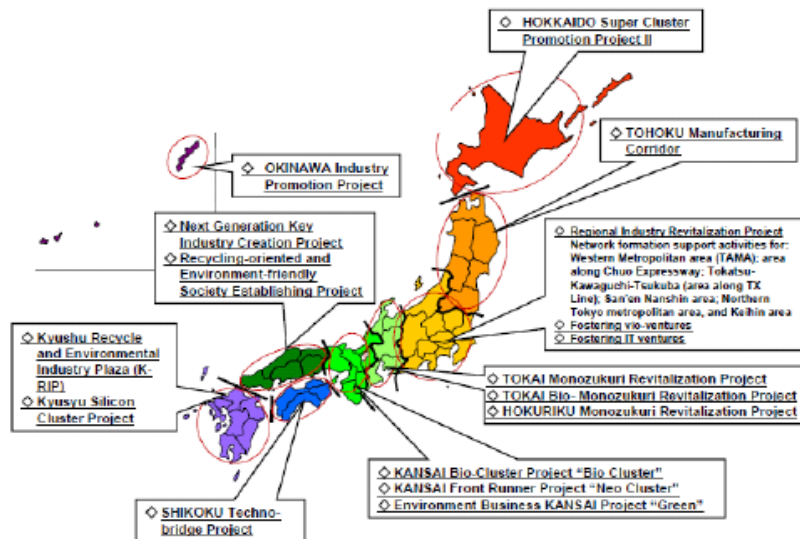


Figure 2 Knowledge Clusters Source: MEXT

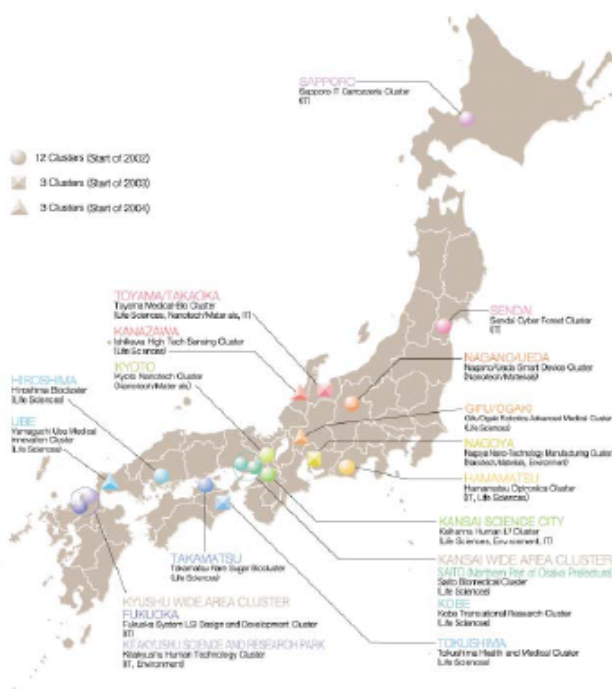
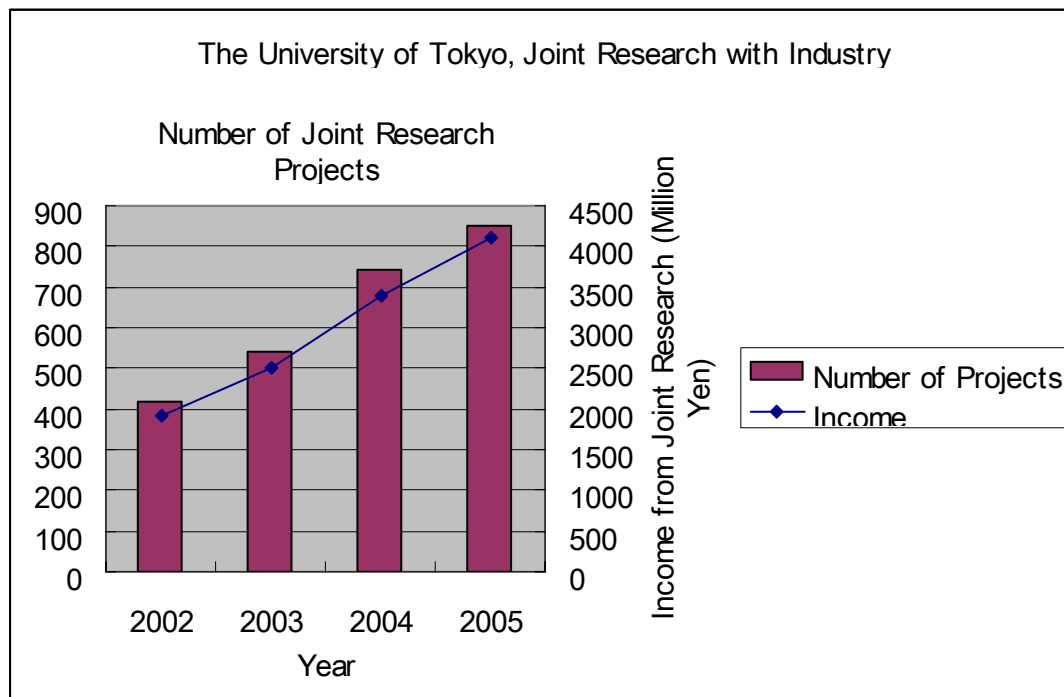


Figure 4 The University of Tokyo, Joint Research with Industry ( Source: the University of Tokyo )



<sup>1</sup> [http://211.120.54.153/b\\_menu/houdou/17/06/05062201/001.htm](http://211.120.54.153/b_menu/houdou/17/06/05062201/001.htm) access 03/10/07

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Hommen, Leif; Doloreux, David; Larsson, Emma

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Malmberg, Claes