INTRODUCTION

The 1990s witnessed the conspicuous growth of interrelated theoretical works on knowledge, innovation and learning within the literature on regional development. This reflects the emergence of new approaches within the organisational and business economics literature epitomised by works on ‘national innovation systems’ (e.g. Lundvall, 1992; Nelson, 1994); ‘knowledge management’ (Nonaka and Takeuchi, 1995), and works developed in the ‘new growth’ or ‘endogenous’ school of economics focusing on different kinds of knowledge as factors of economic growth (Conceisao et al., 1994). Within economic geography and regional studies, these perspectives have developed into a view of regional development as dependent on innovation and institutional learning processes, notably found in the literature on ‘regional innovation systems’ (e.g. Braczyk et al., 1998; Cooke et al., 2000), and the notion of ‘learning region’ (Florida, 1995; Morgan, 1997).

This paper contributes to discussions on the geographical dimension of innovation systems by shedding light on recent policy processes of ‘regionalising innovation systems’ in one particular national setting, namely that of Japan. Among other countries, Japan is aiming to increase national competitiveness in the global knowledge economy by tapping into local innovative capability which may lead to new ‘industry-science relationships’ (ISRs) (OECD, 2002), triggering knowledge creation and innovation.¹ The importance of innovation as a stimulus to economic growth and wealth creation is now widely accepted. Now in the second decade of an economic downturn, a central focus of the Japanese national institutional reform effort concerns university-industry links directed at national innovative capacity. There is growing activity in the realm of commercialisation of university research results through licensing of intellectual property and spin-off firms.

The ‘region’ is increasingly recognised as a strategic site of policy implementation and knowledge creation, and regional economies rather than national economies are now the salient foci of wealth creation and world trade (see Ohmae, 1995). The region can be seen as an organic system where physical and social environments, relations, and trust interact. Some authors have referred to such a space as ‘tha’ (Nonaka and Konno, 1998), or ‘knowledge ecosystem’ (Brown and Duguid, 1998). For example, through the implementation of local production cluster strategies, complex patterns of inter-firm and inter-organisational relationships are promoted at the regional level. Nevertheless, precisely what ‘region’ means varies politically depending on national and trans-national contexts. Some authors (e.g. Cooke, 2000, p.61) situate regions within the multi-level governance (MLG) structure of innovation policies emerging within Europe. In this light, this paper examines the Japanese current political context in an international comparative framework, and put

¹ For more information on the notion of ‘Industry-Science Relationships’ see OECD (2002). Here, comparative perspectives are drawn from national institutional and policy mechanisms in the UK with which the author is familiar through her doctoral research.
that in perspective in view of the growing significance of trans-national regional economies elsewhere in the world.

The paper addresses the following principal issues:

• Whether or not the recent national industrial/science & technology policies encouraging local innovative capability (e.g. local cluster strategies) foster the development of regional innovation systems with new regional governance system of knowledge production;
• Whether or not the national technology and industrial policies are getting obsolete in a globalising knowledge economy; whether these policies encourage regional innovation through links developing with international actors; and
• Whether or not European models/experiences of innovation systems apply to the Japanese/East Asian context.

The paper consists of four parts. The first part comprises a brief literature background regarding the concept of national and regional innovation systems within a multi-level governance structure. In the second part, historical review of development of national/regional innovation systems in Japan is provided. In the third part, based on the historical context, the paper moves on to illustrate recent policy instruments that encourage regionalizing innovation systems forging links between universities and industry in Japan. Furthermore, recent Japanese cluster policies are examined and questions are raised as to the evaluation methods of these political instruments, given the scattered nature of provisions at varying geographical levels and across different ministries. In the fourth part, the current economic structure of Japan is examined in view of growing economic agglomeration in East Asian countries. The paper suggests to locate these national-regional initiatives into a wider international and global political economy of knowledge economies unfolding in East Asia, keeping in mind recent trends such as foreign direct investment (FDI) and public inter-national/ regional collaboration schemes. In this respect, some lessons can be drawn from European experiences. Finally the paper concludes with the assertion that the current policy environment in Japan fails to provide sufficient structure for holistic regional innovation systems to grow. Universities are seen as potentially useful actors in building up the knowledge economies of regions, but institutional mechanisms and human resources to achieve this goal are still limited- a constraint which similarly faces local governments. Entrepreneurial and innovative institutional strategies, combined with local and international initiatives to support knowledge creation and exploitation are imperative.

With a comparative framework situating national institutional processes in Japan from an international perspective, this paper may initiate a laboratory of sorts, whereby regionalising innovation policy may lead to complex spatial processes of re-articulation of the national/regional economies within the globalising knowledge economy.

BACKGROUND LITERATURE

In the age of globalisation and the knowledge economy, production of knowledge, particularly localised tacit knowledge, is viewed as a valuable regional asset (OECD, 2001 a). Consequently, there is an increasing emphasis on ‘regional level’ as a unit of economic policy implementation underlined by theoretical focus on ‘innovative milieu’ (Keeble et al., 1998), ‘regional innovation system’ (Cooke, 1992; Braczyk et al., 1998) and ‘learning regions’ (Florida, 1995; Morgan, 1997; Asheim, 1996). With the
processes of devolution seen as ‘a process that requires multi-level partnership and networking’ (OECD 2001b, p. 11) rather than as a simple transfer of power from central to the municipal to regional levels, the role of ‘knowledge institutions’ (Lawton Smith, 2003) (e.g. universities and public research laboratories) and other local organisations need to be re-examined in terms of institutional processes of ‘multi-level governance (MLG) structure’ (Cooke et al. 2000, p.61) in the knowledge based economy.

Systems approaches to innovation vary in emphasis and level, but share the common, core idea that: ‘the overall innovation performance of an economy depends not so much on how specific formal institutions (firms, research institutions, universities, etc.) perform, but on their interplay with social institutions such as values, norms, legal frameworks, and so on” (Smith, 1995, p.72, my emphasis). This contrasts with the linear model of innovation, which is a simple deterministic model that simply represents the sequence from basic and applied research to product and process development. The ‘regional innovation system’ concept originates from discussions about national innovation systems. However, this is not akin to translating the concept of national innovation systems to the regional level. Although the nation-state provides the overall organising framework, individual and often local institutional actors, operating in conjunction with nationally determined initiatives and strategies, comprise the framework of innovation systems operating at sub-national levels. The concept of regional innovation systems has been empirically described and widely tested (e.g. Braczyk et al. 1998; De la Mothe and Paquer, 1998), leading to the development of a typology of systems to assist in understanding structural differences in the ‘systemness’ of the regions (Cooke, 1998).

Concepts such as ‘learning regions’ and ‘regional innovation systems’ have developed in European policy contexts and the comparative analysis of ‘regional innovation systems’ have provided some guidance for policy makers as ‘policy-oriented innovation stimulation models’ (Hassink, 2001, p. 224). The ‘institutional thickness’ (Amin and Thrift, 1994, p.15) found in local systems such as Baden-Württemberg in Germany and northern Italy has provided models of regional innovation systems for other regions. The EU policy makers have adopted some elements of the ‘innovation systems’ approach which is evident in the broader view of innovation policy expressed in the 1995 Green Paper on Innovation (Edquist, 2001). However, question remains as to whether or not models of successful regions can be transferred to other ‘regional innovation systems’, particularly to those regarded as ‘less favourerd regions’. In European literature, it is regional and local innovation systems rather than national or corporate systems that stand out (Malecki, 2000). In Japan, literature on innovation systems seems to have centred at national or corporate levels rather than regional and local levels. This may reflect the fact that Japanese innovation systems have been characterised by its ‘technonationalist policies’ (Fransman, 1999, p.169). There needs to be more such policy-research interactions at regional and local levels in Japan and elsewhere.

There are new trends in industrial strategies in most of the industrialised countries, with universities being recognised as key players in generating the industrial competitiveness of regions as well as nations in the knowledge economy. Increasingly, co-operation among industry and universities is encouraged by many national

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2 The example of areas such as Baden-Württemberg shows that “leading edge large engineering companies (for example, Bosch) are said to rely on local subcontracting and supply networks for their flexibility and innovative excellence” (Amin and Malmberg, 1994, pp. 230-1).
governments to develop cutting edge technology and to promote technology transfer and innovation. Universities are seen to play a crucial role in the development of hi-tech districts, through the generation of knowledge, the training of labour, and the spinning-off of new business ventures (Castells and Hall, 1994). Governments exhort universities to be entrepreneurial and commercialise their knowledge. Estkowitz and Leydesdorff (1997) termed this as ‘a triple helix model’ of university-industry-government relations. The debate about the universities’ role in ‘systems of innovation’ since the late 1980s and 1990s has centred on the issues of arrangements and settings of university-industry co-operation, and the factors enhancing and facilitating this co-operation that would enhance innovation. The focus has been primarily on the issues of the creation of high-technology firms, technology transfer, technological changes and national competitiveness, with the university seen as providing R&D (i.e., primarily scientific and technological knowledge) in a system of innovation. Regional technology transfer has become a common policy objective, following the example of Japan’s excellent Kohsetsusushi centres (Shapira, 1996). It has been widely recognised that national differences in technology transfer programmes reflect differences in national innovation systems.

In light of the ‘regional governance’ of knowledge production in a multi-level governance (MLG) structure, a number of context-dependent factors are found. These include the geo-historical characteristics of regions, the knowledge infrastructure and knowledge transfer systems as well as policies at national and local levels, strategies adopted by individual institutions (firms, innovation support organisations, universities and research laboratories). The power structures in which these institutions are interacting affect how innovation systems operate at regional level in the globalising knowledge-based economy. It is notable that although some powers and responsibilities related to science and research policy are devolved to regional governments national (and transnational) governments still tend to retain significant influence. The paper now turns to look at those institutional mechanisms and their interaction with policies set against the current national setting of Japan.

**JAPAN: KNOWLEDGE GENERATION SYSTEMS AND REGIONAL GOVERNANCE**

*Historical Background*

Japan is known to have developed broad national technology strategies with long-term scientific and technology goals. In terms of the role of science and technology policy in the context of regional development, during the 1970s Tsukuba Science City was established to decentralise government science and engineering research institutes. In order to tackle regional disparities, several policy instruments such as industrial relocation promotion law and factory location law were enacted during this decade.

Japan’s Technopolis programme led by Ministry of International Trade and Industry (MITI) during the 1980s, is known as an example of utilising technology-led development policies as a means of promoting the expansion of peripheral regions. High-technology based local economic development was the key idea of this programme. Local universities made notable contribution in terms of R&D and the development of research infrastructure in these sites in conjunction with the Technopolis Foundation, one of the co-ordination and support organisations (Masser, 1990). Linkages were developed between university and industry, and public research
institute combined with improved social infrastructure. The conceptual, ‘triple-helix’ model, linking university-industry-government seems to have existed in the Technopolis programme and other early initiatives, strategically impacting local economic competitiveness. Incubator facilities were developed in most of the sites, and most of the national universities opened ‘local collaborative research centres’, which supported the combined efforts of local businesses and universities.3

Despite these promising developments, however, the triple-helix model and systems of local innovation which might have underlined the policy thinking behind the Technopolis programme did not function well in practice, with the result that the initiative did not adapt well enough to the changing needs of society throughout its 15 years’ existence. During the 1980s many science and technology parks were created, but links with university research were not strong enough; and support mechanisms for knowledge transfer to the local economy or the creation of venture firms from university research were insufficient. It is argued that this insufficiency of university-industry collaboration was due to the lack of co-ordination mechanisms among universities, industry and the policy makers (Kubo, 2001). Many of the problems were found in the ways which national universities had operated. Researchers at the Japanese national universities were prevented by their legal status from engaging in any formal co-operation with private firms. The university system was not open to society at large, and the insufficient human resources of support organisations without enough specialists equipped with co-ordination skills were the critical factors that explain the limited development of ISRs based on the Technopolis Programme. Furthermore, the globalisation of economy which was accelerating the growth in foreign direct investment (FDI) led to the hollowing out of the Japanese economy (see below).4 Consequently, the implementation of local development policy based on the framework of Technopolis Programmes was limited in order to revitalise Japanese industrial structure as a whole.5

These problems and limits notwithstanding, the most interesting feature of the Technopolis Programme is said to be found in the way it provided a stimulus for ‘bottom up efforts at the local level’ within the national framework. Although it was limited in terms of enhancing the diversity of regional and local economies, the Technopolis Programme was ‘not an invention of a central agency but rather its effort to provide an organizational national framework for, and to reinforce different components of trends already ongoing at regional level’ (Stohr, 1985, p.10 as cited in Masser,

3 In the 1980s, whilst these initiatives encouraged local small and medium sized enterprises (SMEs) to interact with university research, their effects were rather limited. Most larger firms tended to conduct R&D in house, or work with universities overseas rather than with Japanese ones.
4 Japanese and other foreign companies are moving into East Asian countries deepening ties between Japanese and East Asian economic structures. These activities create horizontal specialisation among economic agglomerations in East Asian countries, which are getting increasingly specialised (METI, 2004).
5 In Japan, in terms of regional development policies, the extent to which R&D related activities have been heavily concentrated in the metropolitan Tokyo area has induced scepticism that technology transfer to peripheral regions is likely to be limited to activities such as simple parts production and assembly, rather than basic research. Although it is widely accepted that the links between high technology and regional development has been successfully accomplished through the Technopolis programme during the 1980s, spin-off effects of new technology on local economy proved limited (Masser, 1990). Some observers have expressed reservations as to the extent to which major technological universities would be created in peripheral areas given the high concentration of existing R&D efforts in core academic institutions. Problems were foreseen with regard to skill shortages in peripheral regions resulting from the existence of greater job opportunities in the national industrial heartland.
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1990, p.51). Despite not having been implemented to its full extent, this endeavour is nevertheless worth noting as one model of multi-level governance (MLG) structure for regional development.

Current Policy Changes
In 1995, with passing of the Science and Technology Basic Law by the Japanese parliament, the first Science and Technology Basic Plan (1996-2000) was formed. In December 1998, the legal framework which underlined the Technopolis Programme was abolished and in 1999 was taken over by a new law for promoting the creation of new enterprise, which provided local municipal and prefectural governments with far more autonomy and responsibilities. A new model, called the ‘local platform’ was created in order to respond to new demands in society stemming from globalisation of the economy and a perceived need to implement new regional development policies which were more oriented towards entrepreneurship and indigenous models of economic development. The geographical limitation which was applied to the Technopolis Programme was no longer valid, which means that every local government has an opportunity to develop a ‘local platform’ whereby local resources and characteristics can be utilised. This new law for promoting enterprise creation, combined with the model of local platform prepared the context to develop new cluster policies to revitalise the long suffering Japanese economy in the 21st century. One aim of the current Science and Technology Basic Plan (2001-5) is to promote science and technology in each geographic region. Furthermore, to encourage the development of university-linked incubators, the Ministry of Economy, Trade and Industry (METI) (reorganised in 2001 from MITI) provides support through the Japan Regional Development Corporation (JRDC), and the Ministry of Education, Culture, Sports, Science and Technology (MEXT) provides supplementary budgetary support. In 2001, Hiranuma Plan, aimed at increasing ‘venture businesses born in universities’ was launched, targeting to ‘create 1000 within 3 years’.

These new trends in industrial and science & technology policies have been accompanied by new sets of policy instruments aiming to forge new links between universities and industry. After the 1995 Basic Law, recent university reforms were accelerated to encourage further development of university-industry links which was hitherto legally and structurally constrained in Japan. A legal framework to promote university-industry technology transfer was enacted in 1998, and 27 Technology Licensing Organisations (TLOs) have been established as of April 2002. The number of filed patent application, patent grants, and licensing and option contracts all grew as a result of these government efforts. MEXT has created a budgeting scheme whereby

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6 There are notable successful cases growing from the Technopolis programme: for example, Kitakyushu Techno Centre is known for its entrepreneurial activities combining universities, private sector and local authorities. They are making networks with Korean companies and science parks (Kubo, 2001)
http://www.pref.fukuoka.jp/shoko/fukuokas_potential/incubate.html 03/04/04 Hamamatsu Area is another Technopolis programme which has experienced success with inter-organisational networks developed between firms, intermediary organisations and their links with the engineering department of Shizuoka University. While Yamaha, Honda and SUZUKI are well known international firms based in this area, new high-tech firms in the field of photonics constitute noteworthy additions to the area. The economic growth of Hamamatsu Area is characterised by its ‘indigenous’ development, rather than attracting large firms outside (Nishiguchi et al., 2003).

7 Some TLOs form private companies limited and some form incorporated foundations. The TLOs are separate organisations from the national universities in the legal term. Although there has been public funding for TLO activities, the public money is in decline. University staff have voluntarily made financial
national universities promoting university-industry co-operation and patenting can be allocated additional funds (OECD, 2002). To make the university system more open to society, a law prohibiting the exchange of personnel between universities and industry was amended, which facilitated national university faculty to conduct research or work as consultants with private companies.

**Research Systems**

The Japanese research system has been clearly identified in its Science and Technology Basic Plan. Between FY 2001-5, 24 trillion yen are to be spent on science and technology, assuming 1% of GDP and 3.5% of nominal GDP rate. (See Annex 1 which compares Japanese R&D with other nations). About 80% of Japanese R&D is performed in industry. Of the 20% of R&D performed by the public sector, universities play the primary role. MEXT is responsible for 64% of government R&D expenditure for 2002. METI is responsible for the second largest research budget (16.9%). New types of budgetary funds and research funds established during the 1990s strengthened the competition among national universities (Asonuma, 2002). Budgeting related to research activities continued to increase giving advantage to older research-oriented universities. In 2001, MEXT introduced the idea of “Top 30 universities towards global top standards”, which proved rather controversial and was later to be renamed as “Center of Excellence in the 21 century” (COE 21) scheme. The COE21 scheme can be seen as a ‘trial in performance funding’ (Yonezawa, 2003, p.19). This may indicate a gradual polarisation between ‘research intensive’ versus ‘less research intensive’ universities in the Japanese higher education system.

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8 In relation to this, organisations such as the Japan Science and Technology Corporation (JST) have started sponsoring programmes aimed at national universities and national laboratories to encourage the development of research into marketable products, with university administrators acting as liaison between the faculty members and JST. Pechter describe this as a ‘remarkable sweep of agreement’ (2001, p.7).

9 MEXT provides the institutional funding for universities, supports varied research funding programmes open to researchers in universities, government institutes and industry, supports a range of its own research institutes which are at different stages of transition to becoming Independent Administrative Institutions (IAIs). Government spending on Japanese higher education is often said to be the lowest among advanced nations. The government’s contribution covers 38.1% whilst students cover 26.2% of the cost. The degree of financial burden on students and families in higher education in Japan is higher than in US and Europe. It is also interesting to note that the Japanese government intensively supports significantly smaller proportion of higher education institutions (HEIs) than the US government does for its public institutions (Asonuma, 2002).

10 During the 1980s, universities faced severe financial tightening with no increases in budgets. In terms of finance structure, ‘outside funds’ such as donations from private businesses and research contract revenues began to increase in the early 1980s induced by the national universities’ need to counteract the government’s lagging contributions, and due to government policies promoting industry-university collaboration (Asonuma, 2002).

11 MEXT has promoted assessment and evaluation in universities. National Institute of Academic Degrees and University Evaluation (NIAD-UE) was reorganised in 1999, and in addition to accrediting academic degree programmes of HEIs, NIAD is now also responsible for evaluating the education, research and other activities of Japanese incorporate universities. Universities are obliged to formulate 6 year plans and objectives, the implementation of which is assessed every year. The overall budget allocated from MEXT will be based on the results of these assessments.

12 In other national contexts, for example, in the UK, classification and terminology such as “research intensive universities” and “less research intensive universities” are expressed, strengthening the recognition that there is a hierarchy, both explicit and implicit in the higher education system (see DfES, 2003).
The 2004 Higher Education Reforms
The wave of current structural changes sweeping over the higher education system in Japan is unprecedented. As of April 2004, all national Japanese universities were transformed to ‘incorporate status’. Now there are 89 ‘incorporate’ (former national) universities, about 70 public (prefectural and municipal governments) and about 480 private universities. For the purpose of this discussion, most national universities can be considered as ‘research universities’. It is assumed that universities will find themselves in a more competitive environment with prospective cuts in public funding in general; there will hence be a growing need to find external sources of funding, combined with more efficient management approaches. The efforts of individual universities to strengthen university-industry links are very much in line with this new ‘corporate culture’ emerging within the Japanese higher education system, which is broadly influenced by the ‘new public management’ thinking.

Another legal change which may affect the geographical dimension of the university-based ISRs is that incorporate status universities 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. However, it has been pointed out that under the current financial constraints of the local public sector, most of the local budget will still flow into the public universities as before, rather than resources being diverting to former national universities. In other words, there may be growing competition between former national, public and even private universities for the scarce resource in their respective locality.

National, Regional and Sub-Regional Governance of Knowledge
The introduction of new local ‘platform’ was a significant turn in Japan’s regional policy from the ‘exogenous model’ assisting lagging regions by attracting firms and creating jobs to the ‘endogenous growth model’ aimed at inducing competition between localities. In 2000, the Local Devolution Law was enacted whereby responsibilities given to local authorities were substantially strengthened.

The responsibilities of national and local governments are as follows: the national government is responsible for formulating and implementing comprehensive policies for promoting science and technology; the local government is responsible for formulating and implementing policies for promoting science and technology corresponding to national policies and in accordance with the local characteristics. There is no institutional mechanism operating at regional level as such in research policy and funding terms. The only exception to this structure is the existence of nine METI regional economic bureaus which oversee economic and industrial policies at the ‘regional’ level across prefectures (see below). The nine bureaus are expected to develop plans, become nodes to co-ordinate local networking and alliances. In light of the growing economic activities which encompass narrow ‘local’ areas, this can be regarded as ‘regionalisation’ of innovation policies in Japan. Significant initiatives are currently being undertaken jointly by some prefectural governments, and the central government’s policy of developing regional research strength encompasses this level of government (OECD, 2002 b).

Local government operates at sub-regional level, including prefecture and municipal levels. The fifth National Institute of Science and Technology Policy

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13 80% of Grants-in-Aid for Scientific Research was distributed to national universities in FY 1999 (Asonuma, 2002).
(NISTEP) review of regional science and technology promotion policies shows that over 90% of prefecture governments adopted at least one key action programme for science and technology: e.g. regional council boards for the promotion of science and technology; basic plans for the promotion of science technology (OECD, 2002b).

**JAPANESE CLUSTER POLICIES, UNIVERSITY-BUSINESS LINKS IN THE 21ST CENTURY**

*Two Cluster Programmes*
National government’s initiatives since 2001, such as the ‘industrial cluster plan’ led by METI and the ‘intellectual cluster scheme’ led by MEXT rest on the conceptual cluster models developed by Michael Porter (1998), and are also based on models of successful local economic development in other countries, mostly those of the United States (Silicon Valley in particular), and Europe. These initiatives emphasise strengthening university-business linkages in a local context, which will arguably lead to the creation of high-technology venture business spin-off from universities’ research. This section reviews recent cluster policies in Japan including 19 industrial clusters, 13 intellectual clusters, and the more recent, integrated ‘Regional Cluster model’. Furthermore, it examines whether or not national industrial policies are encouraging the emergence of regional innovation systems. (See Annex 2 for a list and map of cluster projects in Japan).

The industrial cluster plan implemented by METI 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. Nine regional economic departments of METI oversee the development of clusters in each region with the support of the central bureau. The role played by the METI regional economic bureau in fostering the collaboration and networks is acknowledged in the successful development of locally based cluster (Nagayama, 2002). Targeted industry includes biotechnology, ICT, electronics, neo-manufacturing, new energy, ecology and recycling. Each cluster project promotes technology licensing, university spin-outs, incubation activities, and venture investments. It is expected that in implementing these activities, variety of governmental subsidiaries and grants will be utilised (Mitsui, 2003).

14 The budget for the industrial cluster plans amounts to 41.9 million yen for the FYs 2001 and 2002. The ultimate objective of the industrial cluster plan is to promote new business creation combined with existing local industrial strengths. It aims at preventing the ‘hollowing out’ of the economy, without depending too much on public and private inward investment. There are 19 industrial clusters across the nation: 3 Bio clusters, 5 IT clusters, 4 Nano-tech/manufacturing clusters, 3 environment technology clusters and 4 others (Nagayama, 2002). See also, Inoue, 2003.

15 In terms of local economic development, there is a division of labour between prefectural government and METI regional economic bureau. The prefectural government oversees ‘local platform’ schemes whereas METI regional bureau administers wider cross-prefectural ‘cluster’ development. The METI industrial ‘clusters’ were chosen in light of this geographical administrative criteria, which don’t necessarily represent the most successful local industrial agglomeration in Japan.
The intellectual clusters plan supported by MEXT, and developed from the existing policies for the promotion of science and technology in regions, aims at the construction of ‘regional system of technological innovations’, based on triple helix industry-university-government collaboration by forming networks of Centre of Excellences (COEs) in regions. The plan assumes a bottom up approach, with action plans proposed by the local government rather than those from the central government imposed from above.

Questions may arise as to the relationship between these two cluster policies planned, implemented and evaluated by separate ministries. According to Harayama (2002), fostering the university-industry linkage made a ‘point of convergence’ for MEXT with its remit in university issues, and METI which is responsible for industry agenda. In order to co-ordinate science and technology agenda from a wider inter-ministrial point of view, General Science and Technology Council was established in 2001 directly attached to the Cabinet Office to function as a co-ordinator among ministries. The Council drew a ‘Regional Cluster Plan’ combining the two cluster policies, with the expectation that a greater collaboration between the industry and intellectual cluster plans leads to further innovation.

Arguably, the development of Japanese university-industry collaboration since the late 1990s is characterised by a growing co-operation between the two ministries, namely, METI and MEXT. The law for promoting a university-industry technology transfer (1998) was jointly prepared by MITI and MEXT in order to provide a legal basis to facilitate the technology transfer from universities to industries, which will lead to a ‘virtuous cycle of technology transfer’: faculty-owned inventions leading to patenting and licensing, which brings a financial return and induces reinvestment in research activities (Harayama, 2002). However, the evaluation of each cluster program is conducted separately by the two ministries, and this may cause unnecessarily ‘accountability burden’ on the local authorities and agencies which are already under severe financial and time pressure. The evaluation of the policy mechanisms is obviously influenced by the policy models underlying each policy. More collaborative approach should be taken from the planning, throughout implementation and the evaluation of the two cluster programs.

University Spin-Off Firms

The government has been supporting new spin-off company creation from national/incorporate universities by de-regulation and by providing subsidies to R&D activities. In the data provided by MEXT, as of 2000, there were 127 new enterprises spun-off from universities, which compares to 368 in the US in 2000 and approximately 200 in UK. In 2001, 251 and in 2002 424 small business companies were created from universities in Japan (Nakagawa, 2003). Japan has taken the ‘US model’ with emphasis on licensing and start-ups from universities for economic growth while,

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16 There are 13 “Cooperative Link of Unique Science and Technology for Economy Revitalization (CLUSTER) program encompassing 15 regions in Japan. The budget for CLUSTER program is £500million p/a. per region lasting for 5 years. Apart from CLUSTER, there are 19 areas designated as “CITY AREA” program (Cooperation of Innovative Technology and Advanced Research in Evolutional Area) focusing on smaller areas. See Nakagawa, 2003.

17 Presentation slides, December 2002. This section is based on the information from the presentation slides.

18 AUTM Licensing Survey FY 2000, [http://www.mext.go.jp/a_menu/shinkoku/sangaku/sangakub/sangakub6.htm](http://www.mext.go.jp/a_menu/shinkoku/sangaku/sangakub/sangakub6.htm) access date 01/01/03

especially in local contexts, it has tended to underestimate the role of existing informal links between universities and business.

The existing informal links that university researchers have nurtured with industry warrants more attention. It is important to recognise that institutional differences between countries require different generic models (Cooke et al. 2000:247), and that spin-offs and science parks are only one aspect of academic entrepreneurial activities. Intellectual property (IP) commercialisation is only one aspect of the wider institutional picture; sometimes fundamental differences in institutional arrangements are underestimated. For example, the conventional wisdom based on the US/Japan comparison is rather questionable if the informal relationships at the level of faculty members are taken into consideration, rather than the more formal links at the institutional level. Pechter (2001) argues that ‘the particular direction of reform is perhaps unjustifiably towards the American university-industry policy framework’ (p.4). He suggests that for Japanese policy makers, rather than making mostly bilateral comparison with the US, multilateral national comparison may be equally important and perhaps even more relevant to Japan’s policy formulation. A longer-term perspective should be taken, following the stages of development of these firms in order to make a reasonable sense of the statistics.

TOWARD TRANS-NATIONAL REGIONAL INNOVATION SYSTEMS IN EAST ASIA

As already mentioned, the offshore shift of Japanese firms prompted change in Japan’s local economic structure which has been characterised as the ‘hollowing out’ of Japanese economy. In recent years, a number of East Asian countries, and China, in particular, have emerged as the ‘world’s factory’ seizing top world production share for many products. Chinese development to date has centred on those industries located in local Japanese cities, imposing challenges to the development of Japanese local innovation systems. The transformation of Japan’s innovation systems depicted earlier needs to be investigated in relation to emerging trans-national innovation systems in East Asia, with growing inter-cluster competition and partnerships.

Competition to establish and maintain information and knowledge activities is becoming fierce in cities and regions in South Korea, China, Taiwan and Japan. Singapore, referred to as a business hub, is facing intense competition with other nations. Whilst competition is intensifying among East Asia’s economic agglomerations, inter-linkages between these regions are also growing. One factor encouraging inter-agglomerative linkages within East Asian regions has been the movement of multinational corporations into East Asia, including those of Japan. As far as Japanese firms are concerned, manufacturing and sales clearly comprise the bulk of offshore operations while in the R&D sector, companies have just started to shift their operations abroad (METI, 2002). However, this landscape may change as the Chinese strategy for translocation of global ICT production and R&D into the Beijing, Huamgong (Shanghai) and Guangzhou (Shenzen-Guangdong) regions has borne fruit, significantly on the back of an investment in engineering talent (Cooke, 2003).

Japan is a late ‘globaliser’ as a nation. However, as globalisation of economy continues, the Japanese innovation system with its technology and science has been leaking same as those of other industrialised countries (Fransman, 1999). Having been the most advanced economic nation in East Asia, Japan may find itself in an strategic position to develop ties, especially in terms of creating further ‘knowledge value chain’ (Cooke, 2002) with East Asian economic agglomerations in terms not only of
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geographical location but also of various stages of development (see METI, 2002). Constructing knowledge hubs set within a wider framework of trans-national regional innovation systems may be key. The development of university-based ISRs (discussed above) also needs to be situated within such a wider geographical and intellectual paradigm, beyond the national framework. Recognising the importance of the commercialisation of innovation through an intermediary entity, Taiwan has developed a mechanism called Industrial Technology Research Institute (ITRI) since 1973 (Cooke, 2003). Taiwan has, furthermore, developed a ‘public-private consortia’ in managing international knowledge flows; it has been less dependent on basic research from indigenous higher education institutions than on forging alliances with multinational enterprises such as IBM and Motorola, then transferring technological knowledge to SMEs for commercialisation.

For the Japanese central government, local government, firms, universities and other support organisations, those varieties of technology and knowledge flows and international links pose new challenges as well as opportunities. National borders mean much less than they used to do regarding the flow of technology. Technonationalist policies are unlikely to succeed in a globalised world (Nelson and Wright, 1992). The Japanese government, MITI/METI in particular, has responded to the opening of the Japanese innovation system by internationalising its R&D programme (e.g. as to the biotechnology sector, see Fransman, 1999). In Japanese national innovation system, companies have been the ‘motor’ whilst the government has played a major supportive role. Now there are wider range of actors, including venture capital firms, various innovation support organisations, and ‘boundary crossing’ institutions at the local and regional levels. Developing partnership schemes for R&D collaboration and human resource development with universities, research institutes and those intermediary organisations not only within Japan but also within East Asian regions (e.g. ITRI in Taiwan; Regional Research Centers (RRC) in Korea; Information Technology Institute in Singapore) may be a way forward to construct new advantages in trans-regional innovation systems.

BARRIERS AND OPPORTUNITIES TO THE DEVELOPMENT OF REGIONAL INNOVATION SYSTEMS BASED ON UNIVERSITY-BUSINESS LINKS

In regard to constructing regional innovation systems, many problems of Japanese cluster strategies consisting of university-based ISRs have been revealed throughout the investigation.

First, while devolution of power to local authorities has been encouraged in terms of legal arrangements, in practice, there are varying levels of financial and human resource constraints at the local level. Japan benefited form highly centralised model of national innovation system through its economic development after the Second World War, but it is unlikely that this mechanism will work in the 21st century. In general, many local authorities will face severe problems, as the lack of professionals to be engaged in regional strategic policy formulation and implementation may hinder the organic development of regional networks. This is partly due to conventional Japanese employment practice within the public sector, which has encouraged the career path as ‘generalists’ with wider but unspecialised experiences, rather than acknowledging specialists with focussed expertise. There is already a widening gap between innovative local authorities and others in terms of the long- term human resource strategies in the
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areas of industrial policies, and university-business links. A multi-level governance structure has not been well developed in Japan. There exists no pattern of governance at the regional level. The economic bureaus are rather minor actors and the extent of their systematic engagement varies between regions. Clear division of labour and responsibility as well as the existence of collaborative relationships between local authorities and the METI regional economic bureaus, are other issues in constructing regional architectures of the knowledge economy.

Second, policy makers need to recognise that the danger of a cluster-based approach to policy is that it detracts from the need to take a more holistic view of regional development (Martin and Sunley, 2003). One issue concerns impact and sustainability of the policy; the central government has been promoting ‘endogenous model’ of local economic development through cluster policies with various financial support mechanisms, but the impacts of this policy direction warrants close investigation. The set of public funds encouraging local cluster development will come to halt after 3 to 5 years’ time, and the local authorities need to make the development sustainable. The other issue is remaining problems stemming from remaining regional disparities. Local economic development policy centring on cluster development has to be seen within a wider process of regional development, combined with provisions aimed at fostering skills appropriate to the future as well as existing local labour market and industrial structure. Policy makers, especially those at the local and regional levels, need to identify the real needs and strengths of each locality, rather than just following the ‘cluster brand’ (Martin and Sunley, 2003).

Thirdly, a fundamental point made by the example of the United States is that university-business links are only partly responsible for spurring an acceleration of innovation; benefits that can be expected from university-business cooperation are rather small and of varying effects, depending on the sector in question. Furthermore, only a small fraction of the flow of knowledge from universities to industry is mediated by formal licensing agreements involving university-generated patents. The widely observed, recent enthusiasm for promotion of these links by setting up TLOs and other formal mechanisms in Japan may need to be tempered with more realistic expectations. (Branstetter, 2004). The notion of university-industry links need to be considered with a broader vision than at present. Current emphasis of university-industry collaboration, however, rests principally upon promoting formal IP commercialising mechanisms. One of the most important functions played by universities in the innovation system is to provide graduates. Universities have traditionally produced graduates for a national labour market dominated by large employers with little concern for SMEs or graduate retention in local labour markets. This model has begun to break down in response to changing patterns of employer demands, such as the decentralisation of large corporations into clusters of smaller business units and the greater role of smaller businesses as sub-contractors, suppliers, franchisees (Charles, 2003, p.11). Such a trend has only started in Japan.

Ashamatsu, which is often referred to as an exemplar of a successful local innovative system, has adapted its economic structure and been able to construct support mechanisms for local innovation utilising different government programmes such as Technopolis and more recent funding for developing university-business links. These support mechanisms are embedded as part of the historical and social networks of the locality.

In general, the broader significance of labour-market processes for the technological and organisational dynamism including that of higher education has yet to be examined. The significance of local labour-market processes goes beyond transactional efficiencies in the matching of labour supply and
‘quality and research at the graduate level’ (Kodama and Branscomb, 1999, p.13) will be needed.

Fourthly, structural and cultural issues are brought to bear in relation to current university reforms, which allegedly will give more autonomy to universities and have opened up opportunities for some universities to engage in entrepreneurial activities. Having relied upon national research budgets for so many years, however, most of the former national universities have nurtured neither entrepreneurial culture nor organisational mechanisms to achieve this end. Some universities have created new incentive mechanisms for university researchers to conduct business oriented research, but an emphasis on commercial orientation with a short timescale may serve to hamper the overall research capability of a university if it is not integrated as part of the long-term strategic mechanisms of the whole institution. Strategic institutional support for entrepreneurial activities would be imperative, rather than seeing these as short-term, income generating activities.

Finally, regarding the construction of regional advantage, the transformation of ISRs in Japan needs to be situated within a wider geopolitical context in East Asia. The change in Japan’s national industrial structure parallels that in local economic structure, which is connected to the transformation of economic structure in East Asian countries. Attention should be drawn to economic structural change within the trans-national area, and issues for public policies within a wider geographical scope need to be identified.

Turning an eye to the EU policy provisions, there are several lessons to be learnt in regard to public policy provisions in promoting trans-regional innovation and learning while forging knowledge value chains outside the regions. One of the priorities for the new generation of regional development programmes in the European Union is the promotion of innovation whereby the key challenges for policies involve assisting firms and localities to change by enhancing their learning capabilities. In the European Union, various innovation networking programmes at the regional level have grown, and more regional authorities seem to have greater competence and confidence to implement the relevant learning processes at regional level (Cooke, 2002, p.11). The European Commission is increasingly building a regional dimension into its support for innovation systems since 1994 through several programmes. One is from the Innovation Directorate DG 13, in the form of the Regional Innovation and Technology Transfer Strategies (RITTS) Programme. The other is through joint action between DG 13 and the Regional Policy Directorate DG 16 under the Regional Innovation Strategies (RIS) programme. These innovative actions rely on ‘the principle of helping regions to help themselves through initiatives to mobilise local knowledge in a process of collective social learning’ (Henderson and Morgan 1999 cited in Lanbasado et al. 1999, p.10).21

At the regional level, there are a number of examples in the EU countries which show practical application of industrial cluster model and policy measures to promote science based industry growth. For instance, recent experiences of Scotland warrants close attention in view of the emerging MLG structure of knowledge demand. The movement of workers and students is a central pathway for the transfer of knowledge and experience (Angel, 2000, P.127-8).

21 The emergence of RIS signified the first step towards building ‘soft’ or intangible, network-form, infrastructures in less favoured regions to complement more typical past investments in transport and energy infrastructures (Cooke, 2002, p.60). The main objective of innovative actions under the ERDF is to ‘influence and improve European regional policy in order to make it more efficient in terms of its content and policy action’ (Landabaso, Oughton, Morgan, 1999, p.10).
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Economies. Hitherto, Scotland has benefited from its capability in attracting the production end of global value chains in ICT, known as ‘Silicon Glen’. However, with current trend of globalisation in the knowledge economy and with the disappointment with current FDI trends, Scotland has embarked on new strategies consisting of: “Global Connections”; “Growing Business” and; “Learning and Skills”. Cooke (2003) argues that a ‘regional innovation system’ which Scottish Enterprise is constructing consists of two sub-systems, namely, Knowledge Generation and Knowledge Exploitation sub-systems. In order to promote science-based industry, Intermediary Technology Institute (ITI) is now planned for Bioscience, ICT and Energy exploitation and commercialisation. This may provide an example of regional initiative to become ‘knowledge exemplar’ (Cooke, 2003) with an attempt to bridge earlier cluster approach and the creation of innovation systems in the globalising knowledge economy.

CONCLUSION

The Japanese government has embarked to construct regional innovation systems in the knowledge economy which centre on the creation of university spin-off firms and licensing activities in relation to national higher education reforms. However, this is only part of the total of mechanisms to promote innovation systems, and there are inherent constraints at both local governments and agencies and knowledge institutions such as universities.

Universities are seen as potentially useful actors in building up the knowledge economies of the regions, but their institutional mechanisms and human resources to achieve this goal are still limited. Constraints are found at local governments in terms of limited devolution of power and human resource strategies. Lack of governance at the regional level seems to have had major impact on the development of ISRs in Japan. The structure of multi-level governance (MLG) structure does not exist explicitly in the current Japanese political environment. It is up to individual local governments’ initiatives, but some of them are disempowered under the highly centralised innovation systems. Systemic process of devolution of power to local governance is needed with consideration of prospective regional governance system. For universities, new institutional mechanisms such as TLOs and IP strategy offices will have to be strategically positioned within the overall structure, strategies and budgeting of each university. The remit of the TLO is exclusively concerned with the management of IPs, and the need for the extension of service coverage to such activities as a liaison function and supporting incubator facilities is seen as essential.

For policy makers and those agencies concerned with policy evaluation, there is a huge task lying ahead given the complexity of the whole process of creating regional innovation systems linked through over-arching national industrial, science and technology policies within the globalising economy. Entrepreneurial and innovative institutional strategies combined with public initiatives enabling global and local knowledge flows, and establishing knowledge creation and exploitation sub-systems within trans-national regional innovation systems are imperative. The process of economic restructuring in Japan needs to be investigated in relation to trans-national regions in East Asia. Regionalisation of innovation policy needs to be strategically linked to the international geo-politics where the nations and regions are situated.

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22 The ITI approach, developed from the economic successes of Asian ‘Tiger’ economies, such as Taiwan’s ITRI.
The importance of cross-regional perspective within multi-level governance structure of innovation systems in the globalising knowledge economies should be highlighted. The concept of multi-level governance (MLG) structure, and the industry-science relationships (ISRs) have proved to be useful in explaining the dynamic processes of constructing regional innovation systems as encompassing different geographical scales. Regional innovation systems are predominantly influenced by national policy initiatives, but as the European experiences might show, there are increasing number of trans-regional collaborative learning and innovation processes taking place. The paper has discussed some noteworthy, trans-regional collaborative endeavours emerging in East Asia, and suggested a new way of linking local industrial structures with wider global political economy.
References


http://www.cf.ac.uk/cass/staff/academic.html access date 14/08/02.


Annex 1
Comparing R&D: UK, Japan, US and the OECD average

<table>
<thead>
<tr>
<th></th>
<th>UK</th>
<th>Japan</th>
<th>US</th>
<th>OECD average</th>
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</thead>
<tbody>
<tr>
<td><strong>Investment in knowledge 1998</strong></td>
<td>3.9 (R&amp;D 1.8; Software 1.3; HE 0.8)</td>
<td>4.7 (R&amp;D 3.0; Software 1.1; HE 0.6)</td>
<td>6.0 (R&amp;D 2.6; Software 1.5; HE 1.9)</td>
<td>4.7 (R&amp;D 2.2; Software 1.2; HE 1.2)</td>
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<tr>
<td>As a percentage of GDP</td>
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<tr>
<td>Average annual growth rate of</td>
<td>3.6% of GDP</td>
<td>2.6% of GDP</td>
<td>3.9% of GDP</td>
<td>3.4% of GDP</td>
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<tr>
<td>Investment in knowledge 1998</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>The government spending on</td>
<td>0.7%</td>
<td>0.5%</td>
<td>1.1%</td>
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<tr>
<td>higher education of GDP 1997</td>
<td></td>
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<tr>
<td>R&amp;D expenditures as a percentage of GDP 1999</td>
<td>HE 0.37</td>
<td>0.45</td>
<td>0.37</td>
<td>0.38</td>
</tr>
<tr>
<td></td>
<td>Business 1.27</td>
<td>2.15</td>
<td>2.00</td>
<td>1.54</td>
</tr>
<tr>
<td></td>
<td>Government 0.20</td>
<td>0.30</td>
<td>0.19</td>
<td>0.23</td>
</tr>
<tr>
<td>R&amp;D expenditures by source of funds</td>
<td>Business</td>
<td>72.2%</td>
<td>66.8</td>
<td>63.2</td>
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<tr>
<td></td>
<td>49.4%</td>
<td>19.5</td>
<td>29.2</td>
<td>29.8</td>
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<td></td>
<td>Government 27.9%</td>
<td>7.9</td>
<td>4.0</td>
<td>4.3</td>
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<td></td>
<td>Other national source 5.1</td>
<td>0.4</td>
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<td></td>
<td>Abroad 17.6</td>
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<tr>
<td>R&amp;D expenditures by main sectors of performance 1999</td>
<td>HE 20.0%</td>
<td>14.8%</td>
<td>14.1</td>
<td>17.0%</td>
</tr>
<tr>
<td></td>
<td>Business 67.8%</td>
<td>70.7%</td>
<td>75.7</td>
<td>69.9</td>
</tr>
<tr>
<td></td>
<td>Government 10.7%</td>
<td>9.9%</td>
<td>7.2</td>
<td>10.6</td>
</tr>
<tr>
<td></td>
<td>Private non-profit 1.4</td>
<td>4.6%</td>
<td>2.9</td>
<td>2.5</td>
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<tr>
<td>University funding</td>
<td>1999 source of funds</td>
<td></td>
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<td></td>
<td>DTI-OST 24%</td>
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<td>HEFCS-35%</td>
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<td>Gov deps 10%</td>
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<td></td>
<td>UK industry 7%</td>
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<td></td>
<td>Foreign 9%</td>
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<td></td>
<td>UK charities 14%</td>
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<tr>
<td></td>
<td>Other 1%</td>
<td></td>
<td></td>
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<tr>
<td>The Government Science and Technology Budget</td>
<td>1.25 billion pounds additional investment by 2005-6; average 10% increase in real terms for the Science Budget</td>
<td></td>
<td>1% of GDP 24 trillion yen 2001-5</td>
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</tr>
</tbody>
</table>
Annex 2

Cluster development in Japan

### Industrial Clusters

<table>
<thead>
<tr>
<th>METI Regional Bureau</th>
<th>Cluster Project</th>
<th>Industry Area/ number of firms and universities</th>
</tr>
</thead>
</table>
| Hokkaido Bureau      | 1) Hokkaido Super Cluster Promotion Project | Biotechnology/IT  
About 280 companies; 15 universities |
| Tohoku               | 2) Promoting Industries in response to Aging Society | Health and welfare  
About 180 companies; 19 universities |
|                      | 3) Promoting Recycling Oriented Society | Environmental technology  
About 200 companies; 17 universities |
| Kanto                | 4) Regional Industry Revitalization Project TAMA | Manufacturing  
About 260 companies; 28 universities |
|                      | 5) Fostering Bio Ventures | Biotechnology  
About 170 companies and 9 universities |
|                      | 6) IT Venture Forum | IT  
About 170 companies |
| Chubu                | 7) Creating Manufacturing Industry in Tokai Region | Manufacturing  
About 480 companies; 28 universities |
|                      | 8) Creating Manufacturing Industry in Hokuriku Region | Manufacturing  
About 120 companies; 11 universities |
|                      | 9) Creating Digital Bit Industry | IT  
About 90 companies; 10 universities |
| Kinki                | 10) Bio Five-Star Company & Tissue Engineering Project | Bio  
About 220 companies; 36 universities |
|                      | 11) Active Manufacturing Industry Support Project | Manufacturing  
About 360 companies; 25 universities |
|                      | 12) Information Technology Business Promotion Project | IT  
About 260 companies; 4 universities |
|                      | 13) Energy & Environment Cluster Promotion Project | Energy  
About 120 companies; 20 universities |
### Intellectual Clusters


See also the map below

### Bio Cluster Plan  (Including both Industrial and Intellectual Clusters)

<table>
<thead>
<tr>
<th>METI Industrial Cluster</th>
<th>Hokkaido Bureau</th>
<th>Super Cluster</th>
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</thead>
<tbody>
<tr>
<td>Kanto Bureau</td>
<td>Fostering Bio Venture</td>
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<tr>
<td>Kinki Bureau</td>
<td>Bio Industry Cluster</td>
<td></td>
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<tr>
<td>MEXT Intellectual Cluster</td>
<td>Kansai wide-area</td>
<td>Bio medical Cluster</td>
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<td></td>
<td>Kobe medical Cluster</td>
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<tr>
<td>Hiroshima area</td>
<td>Bio Cluster</td>
<td></td>
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<tr>
<td>Takamatsu Area</td>
<td>Sugar Bio Cluster</td>
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</tr>
</tbody>
</table>

See the map below
Boundaries of 9 METI Regional Bureaus and MEXT Intellectual Cluster Projects