Innovative Tokyo*

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Abstract

This paper compares and contrasts Tokyo's innovation structure with the industrial districts model and the international hub model in the literature on urban and regional development. The Tokyo model embraces and yet transcends both industrial districts and international hub models. The paper details key elements making up the Tokyo model—organizational knowledge creation, integral and co-location systems of corporate R&D and new product development, test markets, industrial districts and clusters, participative consumer culture, continuous learning from abroad, local government policies, the national system of innovation, and the historical genesis of Tokyo in Japan's political economy. The paper finds that the Tokyo model of innovation will continue to evolve with the changing external environment, but fundamentally retains its main characteristics. The lessons from the Tokyo model is that openness, a diversified industrial base, the continuing development of new industries, and an emphasis on innovation, all contribute to the dynamism of a major metropolitan region.

I. Introduction

Cities stimulate innovation but some cities more than others. Large numbers of people, from diverse backgrounds, working, living and interacting in dense proximity can spark new ideas and spread them rapidly. But human creativity also depends upon a nurturing institutional environment. The same social milieu that encourages innovation at one historical moment can, if success breeds complacency to changed circumstances, discourage it in the next.

The innovations triggering a new wave of economic development usually originate in one or a handful of places and spread from there as the new seed bed becomes a model for others to follow. Nowhere is this more evident than in the United States during the past decade. A handful of strategically important urban areas—Boston and San Francisco especially stand out—spawned innovations and business startups in computer, software, telecommunications and the Internet, triggering the "Fabulous 1990s" American economy. Unemployment fell to a low not seen in a generation. Growth in employment and productivity rose by a third over the preceding decade. Inflation was contained. And the stock market reached record highs (Blinder and Yellen 2004).

The 1990s American experience had a powerful demonstration effect on the rest of the world, and it elevated the relationship between cities and innovation to a critical development issue. [1] Why are some cities homes for innovation and not others? What are the sources of a city's creativity? What motivates innovation? What city-linked institutional and political mechanisms nurture creativity and channel innovations in particular directions? Does innovation in one or a few cities in a nation's urban hierarchy come at the expense of the others? Is a city's innovation pattern uniquely its own or can it serve as a model for other cities to follow? We ask these questions about Tokyo in this study.

Tokyo is one of the world's pre-eminent centers of creativity yet it sits uncomfortably with prevailing Western theories of urban innovation. In a benchmark study, James Simmie and his colleagues (2001: ch. 1) identify two contending models of urban innovation in the OECD countries. [2] *Cluster theory* emphasizes local production networks among small firms organized into industrial districts. *International hub theory* emphasizes vertically integrated corporations ensconced in the world's major metropolitan areas interacting with far flung clients and customers via the international market. Both extend traditional agglomeration theory and

accept many of its basic tenets. The debate is mainly over the direction of change and the relative weight to be attributed to various sources of innovation.

In traditional agglomeration theory local economies are collections of independent firms inter-linked in competitive markets. Firms aggregate in a limited number of locales because locally pooled factors of production, like land, labor, capital, energy, transportation and communication infrastructure, enable them to specialize and thereby enhance their productivity and reduce their prices. [3] Entrepreneurs find urban agglomerations advantageous for seeking out inventions, bringing them into their firms, and turning them into commercial innovations. Cities are crossroads for the exchange of information and they provide critical mass during the early stages of the innovation process. Large, diverse and densely populated urban environments stimulate quick reactions to new ideas and provide initial markets for commercial innovations.

Nineteenth century industrial regions were organized into dense, relatively self-contained networks of local firms. Competing firms cooperated with one another through subcontracting relations and common involvement in institutions regulating the municipal economy. From the mid-19th to the mid-20th century, the center of gravity shifted from small firm networks to the large company. Giant corporations came to integrate in one structure the activities formerly performed by many independent firms. The nation-state stabilized the large-scale production by propping up demand and underwriting a welfare safety net for the unemployed. Local and regional authorities became subordinate to national administrations.

However, according to *cluster theorists*, changes in the world economy since the early 1970s have reinvigorated flexibly specialized industrial districts. Slow growing national markets, rising international competition, fragmentation in demand for manufactured goods, steep fluctuations in exchange rates and prices for raw materials undercut the preconditions for mass production and thus the footing for giant, vertically integrated corporations (Zeitlin 1989). The volatility of global markets put a premium on flexible specialization, the ability to make varied products to satisfy changing tastes in record speed. Cluster researchers have identified several successful 20th century versions of the industrial district--small innovative firms concentrated in local production systems to accommodate continuous change and minimize networking and transaction costs--in Italy, West Germany, Japan, Denmark, Austria, France, and the USA (Sable 1989: 367; Rosenberg 2002).

The industrial district model projects a world economy in which productive activity is organized through a myriad of sub-national regional economies, each composed of interdependent networks of small firms, and all interlinked through relations of international trade. Intriguing though it is, this imagery is discordant with the equally ongoing internalization of world trade in global corporations. In the USA over half of all exports and imports occur within transnational corporations as product concepts, designs, components, and assembly operations are transferred from one national affiliate to another. Similar behavior is evidenced among Japanese and European multinationals. How does the persistent internationalization of production under the auspices of global corporate giants dovetail with the emphasis on disintegration of vertically integrated production systems and their reconstruction as localized production networks?

It doesn't, according to the *international hub* theorists. Firms are not vertically disintegrating, to the contrary, they are expanding via mergers and acquisitions. Innovative companies are much less concerned with local production systems than they are with international markets. Only a handful of industrial districts have been identified thus far and with some salient exceptions, like Silicon Valley, they tend to be populated by older, design and craft based industries which are not representative of the dominant high tech corporations in the new knowledge based, global economy. Innovation, in fact, is seeded most in world cities and other large metropolitan trading centers where large corporations and their major R&D operations congregate (Simmie 2001: 41-44).

Large firms adapt to market uncertainty by locating their headquarters and major R&D labs near advanced urban transport and communication infrastructure so they can turn them into hubs for their global information and communication networks. Innovative companies are most strongly attracted to world cities: major metropolitan regions at the peak of national urban hierarchies that are also hubs for the international exchange of knowledge. Firms in world cities are the first to receive new information from abroad, recombine it into innovations, and export the results to international clients and customers. Time proximity to world demand is a more critical ingredient for successful innovation today than spatial proximity to production.

Contrasting emphases between the cluster and international hub models can be briefly summarized as follows.

Industrial Districts	**International Hubs**
--in diverse places	--in the world's major cities
--small firms	--vertically integrated companies
--production networks	--market ties
--spatial co-location	--spatial separation
--localization economies	--urbanization economies
--spatial proximity to production	--time proximity to demand
--manufacturing	--services

Cluster theory finds innovative firms aggregating in a diverse range of places: from small towns, like Modena in the Third Italy, [4] to clusters in major city-regions, like Silicon Valley in the San Francisco Bay Area. International hub theory emphasizes the world's major cities, like London and New York. Cluster theory roots innovation in small firms networked in local industrial districts. International hub theory stresses large, vertically integrated corporations interacting with clients and customers via international markets. Cluster theory stresses the flexibility and transaction cost advantages of spatial co-location among firms performing specialized functions in a production system. International hub theory stresses the advantage of time proximity to world demand enabled by the spatial separation of functions in a transnational division of labor. Cluster theorists emphasize localization economies. International hub theorists stress urbanization economies. Cluster theorists focus primarily on innovative manufacturing firms. International hub theorists emphasize traded services.

Just as there is no one generally accepted model of urban innovation, empirical research suggests there is no one set of factors distinguishing highly innovative cities in the OECD countries. Each of the two models stresses a subset of factors found to be stimulants to innovation in particular places, but neither one covers the entire spectrum. The five city European study, by James Simmie and his colleagues (2001), is perhaps the most comprehensive recent attempt to specify place based sources of innovation. Part of an ESRC Research Program investigating urban and regional efforts to cultivate high technology industries, the authors compare and contrast five highly innovative European cities—Stuttgart, Milan, Amsterdam,

Paris and London—to uncover the elements external to firms that contributed significantly to their innovative activity. [5]

No one set of factors underpinned innovation in all five cities, the researchers found, but taken together, the cities revealed the following "essential elements of urban innovativeness" (Simmie 2001: ch. 7).

(1) A history of successful adaptation and reinvention in response to outside events.

(2) Strategic resources provided by large firms and inter-firm relations;

(3) "Urbanization economies" based upon city size, density and diversity, including scale economies, accessibility to transport and service infrastructure, and a wide variety of knowledge sources.

(4) "Localization economies" consisting of networks among small firms clustered into industrial districts, sustained by continuity and synergy in the exchange of specialized knowledge and skills, and benefiting from liaisons with public agencies.

(5) Location in a strong national system of innovation and a high ranking position in the national urban system. [6]

(6) Global linkages forged by city workforce's expertise in acquiring and adapting the world's best practices in their specialized fields, and a transport and communications infrastructure facilitating international exchange.

The ERSC study concludes that the innovative roles of small firms, industrial clusters, and regional milieu have been overemphasized in recent studies. Industrial districts are more important in some urban contexts than in others: among the five study cities, in Stuttgart and Milan more than in internationally oriented metropolitan cities that dominate urban systems, like London, Paris and Amsterdam. The relationship between local development and the globalizing economy is more strongly influenced by a national innovation system, national urban systems, and the strategies of large corporations than by local milieu and small business networks. Innovation, the authors conclude, is not primarily producer driven, as cluster theories claim, but market driven by international, service based demands for complex goods and services. In short, Simmie and his colleagues favor the international hub theory (2001: 240-241).

II. The Tokyo Model

Which innovation model applies best to Tokyo, cluster or international hub? Tokyo fits neither comfortably. Rather, Tokyo possesses elements found in both models and adds some distinctive features of its own.

Tokyo's innovative power certainly derives importantly from its status as a world city and this fits the international hub argument. And demand pull is the major stimulant to innovation in Tokyo, as in the international hub scheme. But whereas export markets are the engine of growth in international hub theory and innovative exporters value international networks above local connections, in Tokyo local demand is the stepping stone to international markets via the city's test markets. Japanese innovation and growth is stimulated in the first instance by the domestic economy.

Tokyo's innovative success also derives importantly from small local producers clustered in industrial districts and in this respect Tokyo fits squarely into the cluster model. Tokyo belies the International hub claim that local production networks are not important stimulants to innovation. And Japan belies the claim that industrial districts should be regarded as a "relatively exceptional, minority case" (Simmie 2001: 27-28), since such clusters are to be found in many parts of the country (Fujita and Hill 1993). International hub theory downplays the innovative role of small firms because large firms can internalize the product cycle within themselves. But Tokyo's large firms rely upon the technologies and expertise of small, foundation firms. Tokyo's innovative success is based upon dynamic and mutually reinforcing *relations* among large corporations and small firms. Spin-offs from large companies are a major source of small firm start ups and middle level corporate employees are a ready pool of potential entrepreneurs (Imai 2003).

Innovation in Tokyo, as in the cluster model, is vitally enhanced by spatial co-location among firms playing different roles in the production process. International hub theory argues that there are benefits from spatial separation among functions because in that scheme external trading networks are more important sources of innovation than local production networks. But local production and external trade networks complement one another in Tokyo.

The cluster model privileges innovative manufacturing firms, the international hub model emphasizes services. London is a prototype of the international hub and London's economy is based on services. Banking, finance and insurance, public administration, education and health,

distribution, hotels and restaurants account for two thirds of jobs in the London region; manufacturing for just 11 percent. London's manufacturing firms have mostly failed or left the region due, the argument goes, to the scale economies favoring local production and consumption of services and the agglomeration disadvantages for manufacturing industries that need space and access to international markets. Tokyo, by contrast, is the center of advanced manufacturing in Japan. Manufacturing accounts for 19 percent of total employment in Greater Tokyo and 25 percent in the city-region. And Tokyo's manufacturing base is organized, by and large, on a cluster model.

Tokyo's spatial distribution of innovative activity, employment and income contrasts strikingly with the Western cities modeled by international hub theory. In the Western world city, manufacturing innovation takes place in the peripheral suburban rings of metropolitan areas not the urban cores; income is polarized between wealthy outer districts and impoverished inner city areas; and disparities in development between innovative city-regions and other areas are large and growing. In Tokyo, by contrast, innovative activity frequents the city core as well as the suburbs, and there are no large disparities in income and opportunity among the city's districts and between Tokyo and the rest of Japan.

Finally, and most significantly, Tokyo's experience demands much greater emphasis on the role of the state in innovation and growth than is afforded either by the cluster or the international hub models. The advantages of a national capital location in a developmental state where government officials offer long range visions for the nation's economic future, back the visions with pivotal investments, demand performance standards from business groups in exchange for state subsidies and contracts, continue to regulate a large chunk of the economy, and all but require companies to seek their administrative guidance when implementing regulations cannot be underestimated.

Here then, in a nutshell, is how innovation is organized in Tokyo.

(1) Japan and Tokyo's comparative advantage rests on *manufacturing innovation.* The Japanese continue to believe that their nation's productive power, social stability, and competitive edge depend upon their manufacturing prowess, and Japanese exports, wage levels, productivity growth, R&D investment, and GDP reflect this emphasis.

(2) Manufacturing innovation rests less upon basic creativity of the kind that results in technological inventions, than upon *applied creativity*—innovative product ideas, product

planning, tools, methods of production, and ways to put new products to use by tailoring them to people's needs.

(3) Applied creativity rests upon *organizational knowledge creation*—"the capability of a company as a whole to create new knowledge, disseminate it throughout the organization, and embody it in products, services and systems" (Nonaka and Takeuchi 1995: 8). Innovation is not the responsibility of creative elite but of everyone in the organization.

(4) Tokyo is Japan's central nexus for the global conversion of knowledge from outside the company to inside and then outside again, identified by Nonaka and Takeuchi (1995) as the principal mechanism by which Japanese firms create new products and services.

(5) Manufacturing innovation in Tokyo is rooted in a *product pull* system of relationships among corporate headquarters, R&D labs, pilot production "mother" plants, and test markets. New products and materials are developed simultaneously with the processes and equipment needed to produce them. The aim is to maximize quality and speed to market. When new products and technologies prove successful in Tokyo's demanding test markets, higher volume production for domestic and global markets is mostly turned over to plants located elsewhere in Japan and abroad.

(6) The product pull system, functional integration and simultaneous development favor the *spatial co-location* of corporate headquarters, research and development labs, pilot production plants and test markets in Japan's large urban centers, and especially in Tokyo. Activities within each functional node in the innovation network cluster together in identifiable geographical districts, while all network nodes (co)locate in proximity to one another in greater Tokyo.

(7) *Industrial districts and antenna districts* play an especially critical role in Tokyo's production pull network and co-location system. Industrial districts are made up of *foundation firms:* small specialized producers enmeshed in intricate divisions of labor to supply the foundation technologies and prototypes demanded by corporate R&D centers and mother plants. *Antenna districts* are spatial agglomerations of commercial activity and culture, located near transportation hubs, often linked to specific industries, products and services, where companies and consumers test out the newest product ideas and set off fashion trends.

(8) Tokyo's manufacturing innovation is supported by one of the world's most powerful *urbanization economies* indexed by population size, density, and economic diversity. Extending

from the urban core, to the Tokyo metropolitan area, to greater Tokyo, and to the national capital region, Tokyo's space economy encompasses 42 million people, one third of the nation, and forms the world's largest urban region.

(9) Tokyo's manufacturing innovation is also supported by Japan's national innovation system, a nexus of relationships among firms, scientific research organizations, and governments at the national and local levels. In the Japanese innovation system, industrial innovation centers in major cities, and especially in Tokyo, the nation's capital. The private sector is the leading actor but in a framework established by the central state's national development policy. A wide range of targeted development policies are promoted and implemented by prefectural and local governments under the administrative guidance of the central state. A relatively homogeneous science and technology infrastructure spans the nation. Regional firms tend to use Tokyo as the gateway to national and world markets, while retaining their home production, R&D and cultural base. Innovation thus runs back and forth between Tokyo and outlying urban centers.

III. Creating Knowledge

Creativity. No one was better positioned to contrast Japanese and Western approaches to innovation than Akio Morita, the co-founder of Sony Corporation, and the person most responsible for establishing Sony's operations and prestige in the USA and Europe. Morita was fond of telling how Sony developed the transistor radio, the catalyst for the company's world wide success (Morita no date). Bell Laboratories in the USA invented the transistor and semiconductor. Sony was the first Japanese company to license Bell's transistor patent in 1953. The transistor was then being used in hearing aids and Sony was repeatedly advised to use the transistor to manufacture hearing devices. Instead, Sony made a new kind of transistor and built radios. The company devoted all its energies and huge sums to developing and marketing small radios.

Sony wasn't the first to develop the transistor radio, either; an American company also did that. But the U.S. firm quit the market after being rebuffed by consumers. Sony, by contrast, developed a different way of selling small radios. Sony created a marketing vision for the new product based upon the observation that in big cities, like Tokyo and New York, dozens of radio stations were simultaneously broadcasting dozens of different programs. If every one had their own radio, each person could tune in to their preferred program. "Don't be satisfied with one

radio for the whole family; get your own radio," became Sony's slogan, and Sony transistor radios became famous throughout the world.

Morita envisioned three types of creativity: the creativity resulting in technological inventions (the "transistor"); the creativity to translate the new technology into product planning, production and new products ("the transistor radio"); and the creativity to put the new products into actual use by tailoring them to people's needs and wants ("you can listen to your own preferred program by getting your own radio"). Japanese strength lay in the second and third types of creativity, Morita believed, "in finding many ways to turn basic technology into products and in using basic technology." As with the transistor radio, Japan has often relied on Western sources for basic technology. But Japan was unsurpassed in turning technology into products, and new products into profitable businesses. Different skills and social organization were required to excel in product planning, production and marketing innovation, Morita claimed, and that, more than anything else, set Japanese business organization apart from its competitors in the USA and Western Europe.

Organizational knowledge creation. Ikujiro Nonaka and Hirotaka Takeuchi (1995) help explain how and why Japan came to excel in the second and third types of creativity. As late industrializers, Japanese companies faced constant uphill competition which necessitated grueling persistence. Fear of losing, and the desire to catch up with the West, put a premium on anticipating change and coming up with something new: a design, a production process, a marketing approach, or a service to customers. Japanese companies succeeded in international competition because they were able to continuously break with the past and move into new and untried areas through a process of organizational knowledge creation: "the capability of a company as a whole to create new knowledge, disseminate it throughout the organization, and embody it in products, services and systems." (Nonaka and Takeuchi 1995: viii).

Japanese companies engage in continuous innovation by looking to the outside, and to the future, to anticipate changes in market, technology, competition and product. They turn to their suppliers, customers, distributors, government agencies and competitors for new insights. Knowledge accumulated from the outside is shared widely within the organization, becomes part of the company's repository of knowledge, and is utilized to develop new technologies and products. A conversion from outside to inside and then outside again takes place in the creation of new products, services or systems.

Japanese take a distinctive approach to knowledge creation, Nonaka and Takeuchi claim (1995: 8). Knowledge has explicit and tacit dimensions. Explicit knowledge is knowledge that is formal, systematic, and expressible in words and numbers, easily communicated and shared as hard data, scientific formulae, and codified, universal principles. Tacit knowledge is knowledge that is not easily seen or expressed, that is personal, experiential, subjective, intuitive and hard to formalize and communicate. Tacit knowledge and explicit knowledge are not opposites; rather, they complement one another. New knowledge actually emerges out of interaction between the two knowledge components in a spiral process, say Nonaka and Takeuchi. But Western epistemology and business practice emphasize explicit knowledge whereas Japanese philosophy and social organization focus on tacit knowledge.

Tacit knowledge has technical and cognitive dimensions. The technical component consists of informal skills or crafts, expressed as "know-how", accumulated through years of experience, and difficult to articulate precisely. The cognitive dimension consists of mental models, beliefs, and perceptions that are deeply ingrained and often taken for granted, including visions about what could and what ought to be in the future. Explicit knowledge can be taught through education and training. Tacit knowledge cannot so easily be transmitted to others, it has to be "felt". The most powerful learning comes from direct experience and through trial and error. Learning takes place with the body as well as the mind. The oneness of body and mind is an outgrowth of Zen Buddhism in Japanese thinking.

Those who focus on explicit knowledge tend to view organizations as machines for processing information. Those who emphasize tacit knowledge tend to view organizations as living organisms. The prototypical Japanese company attempts to integrate conception and execution in the workplace and blur distinctions among production workers, office employees and managers (Matsumoto 1991: Liker 2004). All employees are salaried, regardless of educational background. Unlike American firms, in which workers only take responsibility for their own work, as specified in corporate jobs descriptions and union rules, Japanese employees share knowledge and assume collective responsibility for company performance. Workplace integration in the Japanese firm is supported by corporate governance institutions, including the absence of shareholder dominance [7], interlocked share holdings by keiretsu member companies, a long rather than short term profit orientation [8], salaried status for all employees, and a commitment to life time employment. [9]

The Japanese believe sharing an understanding of what the company stands for, where it is going, what kind of world employees want to live in, and how to make that world a reality is more salient than processing objective information. Knowledge embraces ideals, values and emotions as well as images and symbols (Nonaka and Takeuchi 1995: 9).

Emphasizing tacit knowledge also changes one's outlook on innovation. Innovation is not just putting diverse data and information together in a new way; it is also a highly individual process of personal and organizational self-renewal in which the individual commitment of employees and their identity with the company and mission is crucial. Accumulated tacit knowledge is a corporate asset, which in the long run can be translated into patents and other intellectual properties. Japan accounts for 6.2% of the world's patent applications, more than any other country, and eighty-three percent of Japanese patent applications are filed by companies, not individuals. [10] The 200 largest Japanese corporations—mostly in the manufacturing sector— account for sixty percent of all patent applications (Japanese Patent office 2002).

Innovation in Japanese corporations is motivated by ideals and corporate philosophies (Liker 2004). The aim is to recreate the world according to a particular ideal or vision, and in the process, to recreate the company and everyone in it. It is not the responsibility of a select few but of everyone in the organization. Tadahiro Sekimoto, the former head of NEC, once observed that Japanese managers think of their companies as "eternal organizations" whereas it appears to them that American companies are "continually subleased"—purchased, made over, restructured, and sold. Japanese find the American way of management incongruous because Japanese companies stress motivation of people in the workplace, empowered to accomplish visions of the future (Boulton 1995: chapter 6, section 2, p. 7).

The product pull system. Excelling at Morita's second and third types of creativity also entails the integration and finely tuned coordination of manufacturing, research & development, and marketing based upon a "product pull" system of relationships. Japanese industry has a highly focused market orientation which tightly couples product design to customer need and all intermediary steps between the two. Japanese companies achieve the tight coupling between product realization and customer needs through a clear set of customer driven requirements called "market-in": by widely posting customer and society based mission statements; by establishing systems to ensure daily customer contact; by requiring all development programs to identify customer need; by involving customers early on, even at the conceptual stage of product

design; and by institutionalizing standing committees to solve customer problems. (Boulton 1995: chapter 6, section 2).

U.S. research & development is driven by technology push. Japanese research & development is driven by product pull. The U.S. believes technical innovations will, by themselves, sustain industrial growth and market strength. New technology and products often emerge from university and industrial research labs. Markets take over from there. By contrast, Japan believes new technology development should focus on continuously upgrading products to meet customer demands for highest possible quality and lowest cost. Eventually process technology can decide how fast product quality can be improved and cost reduced. An aggressive manufacturer can take the lead away from the product or technology innovator. [11] At a later stage, after the novelty wears off, process technologies and component upgrade technologies can become more important than the original technology innovations.

For example, the Japanese goal in consumer electronics competition is to meet customer product requirements for lower cost, higher reliability, better performance, longer battery life, lighter weight, and smaller size. All five depend upon making more integrated components. These in turn depend upon sophisticated assembly equipment that can put a large number of small components into smaller and smaller areas. Japan leads the world in the strategic area of electronic packaging, particularly in miniaturization and cost effectiveness. Product pull justifies large investments in manufacturing processes that assist all other electronic segments. Introduction of next generation products goes hand in hand with new and improved production equipment. Japanese suppliers of advanced components frequently provide the manufacturing equipment necessary for further applications of their components into final products. Key products, like cellular telephones, portable video cameras and portable computers spur demand for advanced materials, equipment, components and packaging technologies (Boulton 1995: chapter 5, section 1, p. 1).

After developing key component technologies, Japanese companies have been able to design and introduce a wide range of products based on those technologies. Huge industries have evolved from development of components for personal computers, VCRs, video disks, and cellular phones. [12]

Continuous innovation also requires on-site engineering know-how to increase equipment reliability and safety which in turn requires expertise in factory automation, equipment

development, production engineering and equipment oriented management. All are highly developed Japanese capabilities.

Concurrent engineering is a culture in Japan (Boulton 1995: 26). Product development and design are synchronized with production technology development and marketing through cross functional teams. Management is driven by cross functional committees covering product planning, product design, production planning, purchasing, manufacturing, sales and distribution. Individuals with varied technical backgrounds are grouped during the development process, then transferred to the manufacturing facility for implementation and to continue equipment improvements to maximize production efficiency. New products and materials are developed simultaneously with the processes and equipment needed to produce them. In the Japanese view, functional compartmentalization, the typical practice among Western firms, can't meet quality, cost and speed to market objectives.

IV. Manufacturing Innovation

Manufacturing matters. Japan has relied upon manufacturing for domestic economic growth and international comparative advantage since the nation's industrial takeoff in the middle of the 19th century. The state guided industrialization and officials emphasized industrial policies above all (Johnson 1982), especially programs to develop manufacturing technology. Industrial policy in the electronics industry exemplifies the approach. It began in 1957 with the Law on Temporary Measures for the Promotion of the Electronics Industry. The goal was to transcend low productivity and small scale production. The principal means were low interest loans to modernize equipment and upgrade process technology. The law was renewed repeatedly over the years in line with technological advances. Special tax incentives were added to encourage advanced manufacturing systems, including depreciation allowances for equipment using computer control technology. By the late 1970s, Japan had achieved world leadership in industrial assembly robots. By the early 1990s, Japan was operating over two-thirds of the world's industrial robots, as compared to 15 percent in Europe and 12 percent in the USA (Boulton 1995: chapter 5, section 1, p. 2).

The Japanese continue to believe that their nation's productive power, social stability, and comparative advantage depend upon their manufacturing prowess (Fingleton 1995). Japan is scarce in natural resources and depends upon manufacturing exports for the foreign exchange to

import the raw materials its industries require. Manufacturing accounted for 94% of the value of Japan's exports in 2001 (OECD 2001a). Six manufacturing industries—electrical machinery, general machinery, transport machinery, chemicals, precision instruments, and metal and steel account for 84% of Japan's export sales (METI, MHLW and ME 2003). Seventy-seven percent of the value of Tokyo's exports consist of electrical machinery and parts (35%), general machinery (24%) and transport machinery (13%) (TMG 2002a).

Manufacturing also leads the Japanese economy in wage levels and productivity growth. Manufacturing productivity grew 30 percent between 1990 and 2001 in comparison to 17 percent for services. Annual manufacturing wages average 37 percent higher than wages in services. (METI, MHLW and ME 2003:18).

Manufacturing accounted for 20.8% of Japanese GDP in 2001, considerably higher than Britain, the USA or France, where services play a more important role. (See Figure 1) If manufacturing related industries, such as distribution, transport, and electric power are included, manufacturing's share of Japan's GDP grows to 33.4% (METI, MHLW, and ME 2003:16).

Growth in service jobs is the trend in Japan, as in other countries, but manufacturing still provides a large share of employment. [13] One-fifth of Japan's labor force is employed in manufacturing [14], and the figure goes up to 34.4% if manufacturing related industries are included.

The bulk of Japanese investment in R&D flows into manufacturing. Eighty percent of Japan's R&D comes from private sources and 90% of private R&D is devoted to manufacturing.

Learning from the world. Learning from the outside world is a recurrent theme in Japanese history and the main stream of Japanese culture contains many foreign tributaries (Morishima 1982). Dwelling on a chain of islands distanced from other nations and cultures by surrounding seas, the Japanese since ancient times have sought to compensate for their feelings of isolation by traveling abroad in quest of new knowledge. Japanese companies continue to scan the world to anticipate changes in technology, competition and product. And the overseas movement of manufacturing further accelerates the need for global learning. Thirteen percent of Japanese manufacturing is now located outside the country, and the figure is much higher in certain industries: 21.9% in electrical machinery, for example, and 31.1% in the auto industry.

Tokyo is Japan's central nexus for the global conversion of knowledge from outside the company to inside and then outside again, identified by Nonaka and Takeuchi (1995) as the

principal mechanism by which Japanese firms create new products and services. As overseas operations acquire information from host countries, they transmit it back to their head offices in Tokyo, where it is collated and interpreted, and then disseminated to local branches in various parts of Japan. [15] Tokyo based agencies of the central state, like the Bank of Japan, and government linked third sector organizations, like JETRO, assist multinational companies in gathering information from overseas and transmitting it locally in Japan.

However, foreign direct investment flows to Japan are still a miniscule percent of Japanese GDP: 1.2% in 2001, as compared, for example, with 25.1% in the U.S., 38.6% in the UK and 14.2% in Germany (IMF 2003). World cities are sometimes depicted as global basing points for transnational corporations whose ties to any given nation-state are weak at best (Sassen 1991). Tokyo, by contrast, is mainly a national basing point for the global operations of Japanese TNCs (Fujita 1991; Hill and Fujita 2003). Tokyo's relationship to the world economy is not driven in the first instance by global market efficiency, but by a strategic concern to preserve national autonomy through global economic power. In Japan, economic power is indexed by the share of world markets held by the nation's industries, not by quarterly dividends and privately accumulated wealth (Matsumoto 1991; Dore 2000). Japanese learning from foreign firms based in Tokyo is limited in contrast to world cities like London where international investment is high (Simmie and Sennett 2001).

Manufacturing innovation. Manufacturing innovation in Tokyo is rooted in a product pull network of relationships among corporate headquarters, R&D labs, pilot production "mother" plants, and test markets. (See Figure 2). The process begins with market and customer analysis (Womack, et al 1990; Clark and Fujimoto 1991; Boulton 1995). Corporate headquarters plan and develop strategies for future growth based upon consumer research. Corporate R&D labs translate the plans into new research projects and product designs. Corporate divisions and smaller, specialized suppliers engineer and manufacture prototypes for new product models, parts and production technologies. Pilot production of new items is performed in corporate mother plants. The new products are tried out in test markets. When new products and technologies prove successful in Tokyo's demanding markets, higher volume production for domestic and global markets is turned over to plants located mostly elsewhere in Japan, and to factories abroad where necessitated by host country markets.

The product pull network is sustained by Tokyo's powerful urbanization economy, the historical result of Tokyo's national capital status and centrality in Japan's political economy. Tokyo's high quality transport and communication infrastructure speeds the flow of information among nodes in the network. Tokyo's agglomeration of finance and business services provide network actors with capital and specialized expertise. Tokyo's wide range of industries facilitates prototype production and market experimentation. Tokyo's vast "water trade" in bars, restaurants, and nightclubs, facilitate informal face-to-face communications. Tokyo's concentration of universities turn out a highly educated workforce. And Tokyo's central government agencies and third sector, public policy making corporations, provide access to government funds, administrative guidance and coordination.

As Japanese firms relocate their standardized, mass production operations to lower wage, higher growth markets outside of Japan, the comparative advantage of their Japan based operations turns upon the ability to produce ever greater product variety in ever shorter product cycles for higher value niche markets. Relentless pressures for flexible specialization enhance the need for market experimentation in Tokyo's sophisticated test markets and the strategic importance of the product pull system as a mechanism for continuous innovation.

V. The Co-Location System

Japanese firms engage in innovation through organizational knowledge creation and the product pull system. Both entail concurrent engineering, cross-functional teams, and tight coupling among functions. Functional integration and simultaneous development favor the spatial co-location of corporate headquarters, research and development labs, pilot production plants and test markets in large urban centers, like Tokyo. Activities *within* each functional node in the innovation network cluster together in identifiable geographical districts, while all network nodes (co)locate in proximity to one another in greater Tokyo (see Figure 3).

Japanese emphasis on tacit over explicit knowledge reinforces the value of spatial clustering. Tacit knowledge is "stickier" than codified knowledge and its transmission requires more face-to-face interaction and continuity in social relationships (Lambooy 2002). For example, researchers in Tokyo's R&D labs are inspired by Tokyo's information rich environment and by their proximity to other nodes in the innovation network. They especially take advantage of Tokyo's spatial locales for test marketing, like Akihabara, Aoyama, Shibuya and Harajuku,

where young people congregate, and where they can sense what attracts consumers. These "antenna districts" are places where they can see, hear, touch, experiment with, purchase and re-engineer the most advanced and potentially trend setting product designs, materials and technologies. [16]

Spatial proximity among functions enhances the coordination required for simultaneous development and reduces the time it takes to upgrade existing products and commercialize new ones. Take cell phones, for example. Efforts to upgrade cell phones in response to consumer demand for miniaturization, portability, increased functions, and lower cost require reduced part sizes and increased integration among technologies. Reduced part sizes require advances in packaging techniques, like surface mounting; integration of technologies requires hybrid assemblies; and both require forward and backward coordination among firms.

Headquarters. Over a third of Japan's 2.7 million firms headquarter in greater Tokyo, and 60 percent of Japanese companies with capital of more than 100 billion yen (TMG 2002b: 14). (See Table 1) Tokyo's central business districts (CBD) consisting of three central wards—Chiyoda-ku, Chuo-ku and Minato-ku—have the highest *overall* number of head offices. [17] Ota-ku, south of the CBD, has the highest concentration of *manufacturing* head offices, followed by the three central wards. In the electrical machinery industry, Toshiba, Sony, Hitachi, NEC, Canon, Fujitsu, and Oki are all headquartered in Ota-ku, or in adjacent Minato-ku, Meguro-ku, and Shinagawa-ku. [18] Small but globally competitive firms also headquarter in Tokyo, as do many suppliers to the large technology firms.

Research & development. Pressures to co-locate functions so as to flexibly respond to fast changing niche markets exist in a state of tension with national land policies and high central city land prices. The central government has prohibited construction of new manufacturing plants and university campuses in Tokyo's urban core to alleviate congestion. Steep land prices also make building large-scale R&D centers in central Tokyo all but prohibitive. Tokyo firms have tried to optimize the conflicting pressures, first, by locating new R&D centers outside but close to the central city, and second, by turning their existing high volume manufacturing plants in Tokyo into R&D linked mother plants performing pilot production of prototypes, and relocating their mass production facilities further out in greater Tokyo and elsewhere in Japan. A recent government survey of location preferences among Japanese firms demonstrates their

continued commitment to the co-location system: 86% claimed that geographical proximity between R&D labs and production facilities was a necessity. [19]

Corporate R&D centers cluster mostly in Tokyo's southern wards and suburban cities. R&D labs in the machinery industry, for example, concentrate in southern Ota-ku, Shinagawa-ku, Minato-ku, and the cities of Kawasaki and Yokohama along the Tama river, and in the western suburban cities of Mitaka, Chofu and Fuchu. Company examples include NEC, which is headquartered in the CBD (Minato-ku) and has built its R&D labs in close proximity to its production facilities to ensure that research is in line with current business activities. Eleven of Sony's 12 research labs are in central and greater Tokyo; ten are proximate to Sony's headquarters in Shinagawa-ku. Canon, headquartered in Ota-ku, has six out of its nine R&D labs in central and greater Tokyo.

Pilot production in mother plants. Ninety-four percent of corporate R&D in Japan goes into applied science and technology (Science & Technology Agency 2003). Rapid product development and commercialization require collaboration among R&D labs and centers for engineering and prototype production. Research results must be tailored to what can be engineered, and engineering blueprints must conform to manufacturing constraints. Cross collaboration among R&D labs and prototype makers helps fill gaps in perception among researchers, designers, engineers and manufacturing specialists about what can be made and what cannot. Prototype manufacturing, dubbed "pilot production" by the Japanese, is performed by corporate "mother plants," another wonderfully descriptive Japanese term, and by small, specialized, suppliers of customized parts and components. Mother plants and their expert suppliers cluster westward from Ota-ku, Tokyo's southern most ward, along the Tama and Tsutsumi river basins, as far as 50 kilometers from the urban core, into greater Tokyo and the national capital region, to form the nation's premier center of manufacturing innovation in the metal and machinery industries.

Tokyo, greater Tokyo and the national capital region. Tokyo's centrality in Japan's manufacturing innovation extends from the urban core, to the Tokyo metropolitan area, to greater Tokyo and the national capital region. Tokyo's central city (23 wards), where headquarters' offices, R&D labs and test markets agglomerate, has a population of eight million. Mother plants, supplier firms and more R&D facilities cluster in the rest of the Tokyo metropolis—where an additional four million people live in 27 cities, 5 towns and 8 villages

surrounding the central city—and in the greater Tokyo area, which adds three neighboring prefectures, Kanagawa, Saitama and Chiba, and 21 million more people to the urban agglomeration. But Tokyo stretches further yet, to form the national capital region, by encompassing four additional prefectures where Tokyo's mass production facilities now congregate: Yamanashi, Gunma, Tochigi and Ibaraki. Tokyo's population reaches 42 million all together, one-third of the nation, and the world's largest metropolitan region. [20] (See Maps 1 & 2.)

Occupational distributions by place of work and by place of residence reflect Tokyo's concentric spatial division of labor. The central city and metropolitan core, as the prime sites for corporate headquarters, R&D labs, and test markets, possess the largest percentages of professionals, managers, clerical and sales workers. Production workers, on the other hand, are a much higher percentage of the labor force outside the urban core, in greater Tokyo and the national capital region, reflecting the decentralization of mass production facilities. But fully one-fifth of central city Tokyo still work in manufacturing, indicating the continued importance of industrial districts in the urban core, both as places of residence and as places of work, for small prototype manufacturers. (See Table 2.) In fact, Tokyo's central city has the highest concentration of small manufacturing firms, with 1 to 4 employees, among cities in Japan (Fujita and Hill 1998).

Manufacturing jobs, as a percentage of total employment, fell from 30.3% to 12.8% in Tokyo between 1970 and 2001, as manufacturing production shifted into the outlying prefectures of Gunma, Tochigi, Ibaraki and Yamanashi, where a third or more of the labor force now works in production (See Table 3). Tokyo's declining manufacturing jobs, it must be emphasized, *is not* the result of de-industrialization, on the New York or London model, but an elaboration of a division of labor in manufacturing stretching from the urban core into greater Tokyo and the national capital region. Central Tokyo, whose population has been increasing of late (See Figure 4) continues to be the center of manufacturing innovation in Japan and the source of dynamism for the world's largest urban region.

VI. *Industrial Districts*

Foundation firms. Industrial districts play a crucial role in Tokyo's manufacturing innovation network. Small specialized producers, clustered in industrial districts, supply

foundation technology and prototypes to corporate R&D centers and mother plants. Two geographically identifiable districts feed into Tokyo's machinery industry. Sumida-ku and Koto-ku are located on Tokyo's east side; Ota, Shinagawa, and the adjacent cities of Kawasaki and Yokohama are located in the south. Both districts cater to Tokyo's electronics, auto, general machinery, and precision instrument firms. Both consist of dense networks of small and medium sized manufacturing companies. Fifty-six percent of all the manufacturing firms in Tokyo employ four or fewer workers, but the figure is even higher in Ota (58%) and Sumida (65%) (See Table 4).

Domestic competitive pressures in the 1970s and 1980s compelled Japanese companies to widen product variety and develop products more quickly. Firms required diverse and unique equipment for experimentation and testing, and vast permutations of work processes to build prototypes with new materials, production and process technologies. A company trying to handle everything in house faced staggering costs. Even the largest firms were unable to equip their mother plants and R&D Institutes with all that was needed.

Large firms turned to small, family run shops based in Tokyo's industrial districts for the multiplicity of sophisticated tasks required (Nishiguchi 1994). Tokyo's foundation firms have the craft expertise to develop one-of-a-kind prototypes across a wide range of machinery industries (Seki 1994; Fujita and Hill 1998; Karatsu 2001). By working in collaboration with neighboring workshops, they could handle a wide range of orders. And they could profitably produce the small batches required by the corporate mother plants.

Foundation firms tend to concentrate in specific local areas according to their specialization. Firms work closely together at each stage of production and across industry tiers, making possible the production of even the smallest lots and the implementation of any process. By pooling their know-how and working together, these small companies are able to undertake portions of large industrial projects quite beyond what any one could handle on its own. In combination they have outstanding development capabilities and provide the infrastructure for creating new products. (Fujita and Hill 1998).

Large companies use contract assembly and components outsourcing to manage the task complexity associated with rapid growth and product proliferation. Subcontracting allows them to focus their own resources on strategic activities, including product development, process innovation, and state-of-the-art manufacturing. By transferring various production and

development activities to subcontractors, they can shorten lead times and product cycles and still expand their product line. Collaborative manufacturing, in short, enables Japanese companies to flexibly adjust to shifting demand in a highly competitive and congested marketplace. [21]

Ota-ku. Tokyo's premier metal and machinery district spreads southwest from the city core through the wards of Ota, Shinagawa and Meguro and into the cities of Kawasaki and Yokohama. Ota-ku, an unpresuming mix of back street workshops and modest apartments girding the south shore of Tokyo Bay, is the heart of this vast industrial organism. Known for precision tooling of small parts, Ota-ku is home to 640,000 residents and 6,000 manufacturing companies; together they can handle virtually all fields of machining, metal working, and machinery manufacture. Ota residents like to say, "if you toss a good idea into the air, it will flutter back down to earth as a finished product." (Beech 2000).

Ota firms specialize in electrical and general machinery as compared to firms in Sumida, Tokyo's second major industrial agglomeration, which emphasizes metal products. [22] Over 80 percent of Ota's manufacturers employ fewer than 9 workers. These small firms network with one another to provide Tokyo's corporate R&D labs and mother plants with one-of-a-kind prototypes and small batches of pilot products.

Ota's firms specialize in a few production processes and are equipped with the latest technology. They are their own masters because their specialized expertise enables them work with a wide range of customers and avoid dependence on any one or a few parent companies. Many do product development and make capital goods, like industrial machinery and measuring instruments. Work sharing among acquaintances allows for narrow bands of expertise among firms, but taken together, these networks form a very large grouping of technologies.

Initiative in machinery production comes from manufacturers of finished products. Final makers are the nodes in the web of production activities that make up industrial districts. But it is the heterogeneous, lower tier, foundation firms that make possible the high quality, multivariety, small-lot production that gives Japanese manufacturing its special character. Foundation technologies require a craftsman's skill, which takes years to acquire. Industrial districts composed of small foundation firms, like Ota-ku, constitute a kind of community property, or urban asset, and are a prerequisite for advanced manufacturing in Japan. [23]

A quarter of Ota's shops have closed in the past decade as final makers who funnel contracts to Ota's workshops began shifting jobs to southeast Asia, and then to China, where

labor is cheaper and markets are booming. [24] But the district's comparative advantage continues. Southeast Asia and China may be able to bend metal and assemble goods more cheaply, but it is Ota's artisans who have the skills to refine precision equipment and create the molds used in Asia's complex assembly lines, and it is Ota's artisans who can make the wide variety of customized prototypes required by developed country markets.

Ota's craftsmen have fashioned unpretentious but useful creations, like the pull tab that doesn't cut fingers, or a mechanism that sucks air out of bottles before they are recycled (Beech 2000). But they also fashion some of the world's most advanced technologies. Ota is replete with "niche top companies," firms defined by METI as possessing a 50 percent or larger share of the domestic and overseas markets for their products. One Ota company, for example, produces core components for high pressure oil pump motors, and holds 80 percent of the domestic market and 70 percent of the world market in those particular components. Niche top companies, recent government research indicates (METI, MHLW, and ME 2003), possess high levels of skill, know-how and technology, invest heavily in R&D, are close in proximity, engage in frequent face-to-face communication with their customers, and have the capacity to cultivate their own market networks. Almost three-quarters fall into three industrial categories: materials (11%), components (31%) and devices and machines (30%). A third earned over 5 billion yen in 2002.

Niche top firms. Yasuhisa Koki and Okano Industrial Corporation exemplify Tokyo niche top companies in the medical equipment field. The Ota firm, Yasuhisa Koki Ltd., led by President Fumio Tanaka, is a world leader in making core components for artificial hearts. Ironically, in an age of high technology, computers can't make the most advanced scientific instrument in the medical field; it can only be done manually, using the craft skills of an artisan. An artificial heart must have the strength and endurance to pump blood without stopping, a surface smooth enough to prevent thrombosis, and a structure that facilitates blood circulation. Making such a complicated device requires as much time and patience as a traditional craft. "The first step is to thinly spread a solution of polyurethane on an iron pattern, which is rotated at a uniform speed for about 3 hours to dry, this process is repeated 30 times, over a total of 90 hours, to produce the outer casing of an artificial heart. The job of making membranes used to pump blood requires even more diligence and care, as a single bubble on a membrane could cause potentially lethal blood clots" (Nikkei Weekly 10 March 2003).

Yasuhisa Koki, in a joint project with Tokyo Women's Medical University and other research institutes, is teaching college students how to draft the designs and use the machine tools required to make an artificial heart. The company has nearly 50 partner firms in the artificial heart development project, most of whom do processing and look for materials.

Okano Industrial Corporation in Sumida is another innovator in the medical equipment field. The firm supplies needles to a major medical equipment maker, Terumo Corporation. Okano's needles reduce the pain of injections compared to conventional models, by reducing the length and diameter of the needle's tip. The Okano needle is shaped to prevent clogging, an impediment to reducing a needle's tip size in the past.

Okano's president has 40 years experience in metal mold manufacturing. It took the company two years to develop a production method for the needle, which involves cutting part of a metal ribbon at high speed and rolling it. The company is now turning out one billion needles a year, attempting to develop an even thinner needle, and applying for patents for its needle making technology.

Supporting institutions. Ota-ku is an industrial district : an intricately networked community of small producers sustained by continuity and synergy in the exchange of specialized knowledge and skills, and benefiting from liaisons with public agencies. To flexibly incorporate new knowledge, technologies and production requirements imbedded in the flow of orders from corporate R&D labs and mother plants, Ota firms must have capital for their own R&D and the ability to collaborate with a mix of complementary small firms.

Industrial districts offer institutional support for small firm risk taking. Small firms are often the first to venture into new businesses and technologies. Because they are small, they can make quick decisions. Place based, they tend to know their business environment very well. Lacking the large firm's reservoir of resources to fall back on, small businesses are compelled to make risky investments in new technologies, learn new production methods, and expand their prototype capabilities to protect their most important asset: the accumulated knowledge imbedded in their workforce. [25]

Ota's innovative capabilities are buttressed by local firm relationships with government agencies, industrial associations and chambers of commerce. Like Yasuhisa Koki, Ota firms engaged in new technology development often have ties to Tokyo universities and research institutes; Keio University and the Tokyo Institute of Technology are particularly important. The

Ota Small Business Center, a creature of Ota's industry association, runs a technology transfer license organization (TLO) program on the Internet, disseminating information on basic research from universities to its member firms. O-Net, created by the Ota Small Business Center, connects the districts small manufacturers to Ota's trade and industry associations, to the Ota-ward (city) government, to Tokyo Metropolitan Government agencies and to small business organizations elsewhere in Japan and the world. [[26]] But while the internet has extended the districts networks, Ota's way of doing business is still rooted in face-to-face contact and the physical sharing of work (Fujita 2003).

New technology development needs vigorous R&D, experimentation and testing, as well as a mix of different perspectives. In a regional economy with multiple industrial districts, competition and cooperation take place simultaneously, small and large firms coexist interdependently, and new and old industry clusters flourish side by side. For example, Hitachi, NEC and IBM began jointly developing the Linux operating systems as an alternative to Microsoft, and provide LINUX CPUs to their Internet users. NEC, Hitachi, and 20 other technology firms formed T-Engine Forum, an organization to jointly develop semiconductors and software for advanced digital home electronics compatible with the ITRON (The Real-Time Operating System Nucleus) platform (Nikkei Net 5 June 2002).

VII. Test Markets

Antenna districts. Tokyo is a vast market for testing new commercial ideas. The city's great size, density and diversity, excellent transportation system, and fluid accessibility to services and all kinds of knowledge, make it an ideal setting for social experimentation. But Tokyo's test markets come alive, on the ground, in the city's antenna districts. Antenna districts are spatial agglomerations of commercial activity and culture, located near transportation hubs, often linked to specific industries, products and services, where companies and consumers try out the newest product ideas and set off fashion trends. They attract consumers, "otaku" enthusiasts and business people in such fields as fashions, electronic products, and culture and entertainment.

Antenna districts share much in common with the hundreds of other commercial complexes clustered around Tokyo's train stations and subway nodes. But antenna districts, like Akihabara, Shinjuku, Shibuya, Ginza, Aoyama, and Harajuku are distinguished, in the first

instance, by the sheer number and density of offices, shops, bars and restaurants they contain. Inside and immediately surrounding the Shinjuku station, for example, are 1,319 retail shops, with annual sales of 10.8 billion yen, and 1,288 bars and restaurants. The Shibuya station houses 906 retail stores, with annual sales of 4.3 billion yen, and 579 additional bars and restaurants are available just outside (TMG 2002b: 112).

Antenna districts can achieve this scale because they cluster around transportation stations where multiple subway and train lines intersect and interconnect the cities of greater Tokyo with one another and with the central core. Millions of people flow into central Tokyo every day from greater Tokyo and the national capital region. More than four million passengers traverse Shinjuku station everyday and nearly three and a half million commuters daily pass through the turnstiles at Ikebukuro Station, the hub for eight rail and subway lines connecting the northern precincts of the city with the western suburbs (Andoh 2004; TMG 2002b: 114). These terminals draw even more people as final destinations for commerce and entertainment. Colleges are usually found in antenna districts, as well, giving young consumers yet another reason to spend time there.

Antenna districts are the trendiest locales in Tokyo. Here consumers are exposed to the widest possible range of luxury items, the highest quality goods, and the latest fashion. Clothing outlets, for example, spread all over Tokyo, but the highest concentration of boutiques is in Ginza and Shibuya, where the sheer number and density of clothes and international luxury brand shops attract young, fashion-oriented people. These districts have the highest fashion sales figures in Tokyo and the highest concentration of designer boutiques for women and children (MLIT 2003a: 53). The New York Times has called Tokyo "the real international capital of fashion" [27] and Japanese consumers are said to account for nearly 50% of worldwide spending on luxury goods (Ishibashi 2002). Young working women pay the most attention to international luxury goods. No doubt they buy luxury items partly for status but they also prize craftsmanship and they are willing to save to purchase their favorite brands and even spend months or years on waiting lists to secure the items they desire.[28]

Japan has one of the more egalitarian income distributions in the world and Tokyo does not suffer the extreme income polarization found in Western world cities, like New York, London and Paris. Nor does the average household income in central Tokyo differ much from the surrounding communities of greater Tokyo, a stark contrast to the pronounced city-suburban

disparities typical of metropolitan areas in the United States (See Table 5). Because Japan is a wealthy society, and because the overwhelming majority of Japanese are solidly middle income, an exceptionally large number of people possess the wherewithal to buy the latest "hit" consumer goods, and can thus underwrite continuous experimentation, high speed product development, and rapid product cycles.

Tokyo's antenna districts are not segregated locales offering high end products to exclusive consumer elite. They are genuinely popular districts frequented by a socially diverse population. Shops sell versions of the same item at different stages of the product cycle and at different price levels to customers who have the financial means to buy at the higher as well as the lower end. Japanese culture values perfection and texture, and Japanese consumers have a strong taste for craftsmanship. They choose goods according to their tastes and feelings, and according to the product's style and function, rather than according to their income. Japanese companies correspondingly emphasize product variety and niche markets.

Akihabara. Anything that uses electricity is for sale in Akihabara , Tokyo's "Electric Town." Clustering west of Akihabara station, a transportation hub on the JR Yamanote Line, thousands of shops sell home appliances, TVs, PCs, CDs, cell phones, digital cameras, karoke boxes, DVDs, video games, animation software, robots—all in all, Akihabara markets ten percent of Japan's total yearly electronics output. In Akihabara, consumers can buy electronic items unavailable anywhere else in the world: RCA vacuum tubes *circa* 1945 that went out of production decades ago; robot insects powered by solar panels that are so advanced they are still years away from Western markets; battery powered pogo sticks that count number of times jumped and are simply too eccentric to export (Scuka 2000). But first and foremost, Akihabara is a Mecca for early adopters and a way for marketers to figure out "what's hot and what's not."

"Japan is the global imagination's default setting for the future," says William Gibson (2001), author of the science fiction classic, "Neuromancer," and creator of the term, "cyberspace". To the extent that cultural change is technologically driven, one must pay close attention to the Japanese, Gibson believes, because Japan has been adapting early for more than a century and has a head start on the rest of the world. Japanese sensitivity to technological possibilities and singular adroitness at re-conceptualizing foreign product, absorbing it, and making it their own, result from the nation's history of traumatic, "temporal dislocations," theorizes Gibson. [29]

But the global success of Japan's electronics manufacturers begins in Akihabara. Akihabara is the sales and marketing home for many of Japan's best known electronic brand names, including Sony, NEC, Casio, I-Data, and Toei Electronics. Racing to be the first to market with the season's latest products, electronics manufacturers send prototypes of their new products to Akihabara to see if they will fly, accompanied by company engineers who question potential customers about color, shape, feel and function. [30] The rivalry is fierce, with some product lifecycles reduced to a few months, turning Akihabara into a churning, self-renewing agglomeration.

Today's famous Japanese brand names were unknown in the early postwar period and the firms' founders competed mightily to sell the most products, win the largest domestic market share, and catch up with the world's leading companies. The tradition continues today with New Economy companies, like NTT DoCoMo, J-Phone, and KDDI, vying in Akihabara to sell their mobile networks. But these Japanese electronics firms are not attempting to catch up with anybody today; their products already rank among the world's most sophisticated communication devices.

In Akihabara, big electronics chains cluster with family run stores and one person shops. Land is at a premium. The big stores jut several stories straight up from the street and sell the latest novelties on the ground floor to attract customers. The smaller shops, packed into Akihabara's back alleys and side streets, specialize in one or a few specific items and carry a remarkable variety of each. One person bulk components jobbers offer electronics enthusiasts a cornucopia of new and used jacks, resistors, capacitors, transistors, toggle relays, connectors, cables and coils. Akihabara offers even the most exacting technophiles the precise brand, model or part they are looking for.

Four sub-districts intermingle in Akihabara, defined by type of product, clientele, and consumer subculture. Japanese housewives and husbands peruse the latest dishwashers and dryers in the big chain stores. Foreign tourists pack camera shops and other duty free electronics merchandisers on the main thoroughfares. More astute bargain hunters frequent the black market spots selling cheap PC parts, videos, stereo equipment, and electronic toys in Akihabara's alleyways. But Akihabara's dynamic core and *raison d'etre* are the shops selling the latest and most sophisticated electronics products at stratospheric prices to Japan's high tech cognoscenti.

Akihabara's dynamism derives from its early adopter clientele. Gibson draws a direct lineage between Japan's 19th Century "Modern Boys" and the nation's 21st Century "Mobile Girls." The Modern Boys were the cadre of young aristocrats Japan sent off to England to assess the Western challenge. Their stories upon returning home, about an alien, disconcerting and extraordinary Western technological culture, catalyzed Japan's own industrial revolution. The Mobile Girl is the ubiquitous Japanese school girl, constantly messaging on her mobile phone, and living in a cellular youth culture stratified by the number of numbers in her phone's memory and the speed with which she can convert pad strokes to kanji. Tokyo's techno-cultural suppleness, Gibson (2001) theorizes, is reflected in the self confident dexterity with which these schoolgirls took up a new, and relatively innocuous feature of the cellular telephone and swiftly turned it into a micro-culture.

Electronics firms are inspired by the tastes and demands of their "otaku" clientele. There are many definitions of "otaku", a recent web site lists 43, but at root they all refer to someone who is passionately involved with a particular technology or cultural trend and who rejoices in and derives status from arcane knowledge about the object of infatuation. [31] Individuals passionate about one or another aspect of electronics have been congregating in Akihabara for over half a century, and companies look to their desires to foretell the next phase in the electronics industry.

The otaku is the information age's embodiment of the connoisseur, Gibson believes, and one of the keys to understanding the culture of the world wide web. Akihabara is a bee hive of youthful electronics enthusiasts, parading the streets and packing the shops, armed with their power-cell phones, Mini-Disc and MP3 players. They go to Akihabara as much for the scene—the district's sounds, colors and new ideas--as to buy a particular item. Akihabara closes its main boulevards on Sunday, cafes extend their tables into the streets, and the atmosphere is "wai wai gaya gaya", carnival like and festive. [32]

Akihabara is an "echoic" urban district in the sense in which Peter Ackroyd (2001) describes various London's milieu. Akihabara's present mirrors its past. Akihabara imprints itself upon its denizens with its texture and its history. And Akihabra has retained its underlying "electric town" identity through decades of technological change. [33] Akihabara became a hotbed of black market capitalism during World War II. A huge underground market for radio parts thrived around the Akihabara station, attracted by an electrical engineering college nearby.

After the war, Akihabara became famous as an electronics wholesale district. Most of the goods initially on offer were surplus items discarded, or otherwise acquired, from the American occupation forces.Akihabara is still home today to a thriving trade in pirated software and boxes of computer parts and appliances that have "fallen off the truck".

In Japan's high growth reconstruction era, Akihabara's center of electronics gravity shifted from radios to home appliances. Then came personal computers and software. Akihabara accounted for nearly half of Japan's PC sales until 1995 when suburban mass retailers began selling household appliances at steeply discounted prices. Akihabara's dynamism today is driven by internet and data processing technologies, by animation, and by robotics.

Information technology. 742 software developers, internet ventures, and data processing companies cluster within a one kilometer radius of Akihabara station, the densest IT concentration in Japan, according to a March 2003 survey by the Ministry of Land, Infrastructure and Transport. The Tokyo Metropolitan Government is encouraging the transformation of Akihabara into the IT hub of Tokyo, and Tokyo governor Shintaro Ishihara is leading the effort. A 100 billion yen IT development project is underway adjacent to Akihabara Station on the former site of a public fruit and vegetable market. An IT Center, including 31 story and 22 story buildings, both to be completed by 2006, will house offices for IT related firms, convention halls, showrooms displaying the latest IT devices, and platforms for industry-university cooperation. The goal is to speed IT product development.

Adjacent to the IT Center, Kajima Corporation is constructing "The Tokyo Times Tower", a 40 story condominium, in collaboration with Sony Corporation. The tower is targeting IT devotees by offering "near future living space," a Sony interior design concept that integrates audio-visual devices with home networking technologies. A glass partition in the living room and an artificial marble wall in the bathroom can both be turned into home theaters through use of projector screens. Residents can watch the news while taking a shower or view movies on the ceiling while lying in bed with the use of a small, wireless, liquid crystal "airboard' controlling a plasma-display panel television (Nikkei Net 25 August 2003).

Animation. In the digital economy, content and software are far more profitable than hardware, and anime otaku are the newest pilgrims to Akihabara. Yesterday's PC outlets are today's purveyors of comic books, videodiscs, and game software. The most popular items sell in the millions. Akihabara's specialty shops now market garage kits for making synthetic-resin

models of animated cartoon characters. Today it is gamers, instead of PC otaku, who camp out in front of their favorite Akihabara software shops the night before a major title release.

Also Bit City illustrates the change. Laox Company, an electronics chain, operates the eight-story building, which opened in Akihabara in October 2002, replacing a major PC outlet. The store sells animated plastic models, adult comic books and game software based on popular cartoons. On week-ends, anime devotees ascend to the building's top floor meeting halls to interact with voice narrators of their favorite cartoons and to attend costume parties. Over 500,000 people visit Aso Bit City every month (Naito 2003).

Robotics. Akihabara is also Japan's seedbed for robot makers. PC based robots, like Sony's Aibo pet robot and Honda Motor Corporation's Asimo humanoid are projected to become a 500 billion yen market by 2005, and some analysts believe the home use robot industry is at the same stage today as the PC industry was in the 1980s (Sugawara 2002).

Shinya Ono, a Liberal Democratic Party (LDP) member in Japan's Lower House, and a former University of Tokyo student of rocketry, has set up the Robot Salon in Akihabara, a forum for small business owners, corporate and academic researchers, engineers, and others with interests in robots, to train future leaders of the robot industry. Ono's immediate goal is to deliver caregiver robots to homes for 333 yen ($2.78) per day in fiscal 2004, with the support of Japan's public nursing insurance system. To this end, he has created an office allying 5 government divisions in a quest to obtain R&D funding and to construct a legal rationale to qualify robots as medical equipment covered by the nursing care insurance program.

Tsukomo Company operates Robocon Magazine Kan, one among the 550 retailers promoting robots in Akihabara, and a magnet for robot enthusiasts since opening in August 2000. Tsukumo's Robokan is dedicated entirely to building robotic devices from kit or from scratch. The emphasis is on sophisticated microprocessor-driven robots. Robokan sells over 900 motors, sensors and other components, all capable of obtaining a high degree of electromechanical integration (Sugawara 2002). The store attracts high school students who compete in national tournaments based upon the performance of robots they have assembled. Professional engineers account for 60 percent of Tsukumo's customers (Nikkei Net 3 December 2002).

The manner of functioning of Tokyo's test markets suggest that in an egalitarian urban society cultural innovation is not the prerogative of an elite cadre of creative artists,

entrepreneurs and visionaries; it is the creation of millions of ordinary people: artists who conceptualize possibilities, researchers and engineers who pick up new ideas from consumers and experiment with them, corporate employees who design and make new product prototypes, small producers with the skill to customize parts and components for the prototypes, marketers who can make the new items visible and accessible, and a quality conscious consuming public standing at the beginning and at the end of the process.

VIII. Urbanization Economies

Industry agglomeration. Tokyo's central city continues to attract new firms. One magnet is industry agglomeration. Tokyo's manufacturing firms cluster into industrial districts, as discussed above. Industrial districts in turn agglomerate on a wider scale and contribute to the size, density and diversity driving Tokyo's powerful urbanization economy. Industry agglomeration spurs competition and cooperation among firms and the institutional innovations that help sustain Tokyo's competitiveness.

Tokyo's electronics machinery agglomeration exemplifies the process. Rivalry among companies is fierce. If one company starts something new, other companies soon follow suit. Intense competition shortens product cycles and speeds the diffusion of platform standards for new products among competitor companies, either through quick imitation, or because product innovators sell their new design ideas as intellectual property to hedge their investment risks in a fiercely competitive market place. The diffusion of a platform standard invites more new firms into the competition and stimulates further innovation. Product innovations like Sony's Walkman, VTRs, camcorders, DVDs, digital cameras, and wireless Internet-linked cell phones all followed this pattern. [34]

New industry clusters. New industry clusters emerge along side old ones in Tokyo's urbanization economy. New and old clusters complement and stimulate one another and give further impetus to manufacturing innovation. Tokyo's newest industry clusters include information technology software, videogame software and digital animation. Twenty-eight percent of Japan's 35,207 IT related firms [35] are located in Tokyo and 60 percent of Tokyo's IT firms are located in the central city area: in Chiyoda, Chuo, Minato, Shinjuku, and Shibuya (MLIT 2002) [36]. Tokyo's IT firms typically cluster within 1 km^2 of major train and subway

stations around the Yamanote-line. They are attracted to the best transportation hubs as they need to be close to their customers and other Internet companies.

Competition is intense in the IT industry; firm turnover is 50 percent a year. (See Figure 5) After a decade of IT boom and experimentation with different Tokyo location, IT firms are gravitating to Akihabara for the district's long established and more supportive infrastructure. IT firms are typically small. They are called "sohos" by the Japanese because they tend to initially establish themselves in small offices, in vacant hotels and warehouses, and in home offices. Many are spin offs from larger companies: information service providers, electronics firms, banks, and trading corporations. [37]

Information hardware and software businesses are highly integrated and synergistic in Tokyo, both within and across company lines. Many IT software firms are spin offs from hardware companies, and competing companies collaborate on state of the art hardware and software products. For example, PlayStation2 is Sony's DVD console and is marketed by Sony Computer Entertainment Corporation. But PlayStation2 is the result of Sony's collaboration with its competitor, Toshiba, and the quality of the console owes much to Toshiba's processing technology.

DVD console hardware makers, like Toshiba and Sega, have stimulated the growth of videogame software firms. Several videogame software clusters have emerged out of older industrial districts specializing in toys, movies, and animation. Toy makers initially created animation to advertise their products on television. As TV advertisements increased demand for animation, the copyright of animation and character titles became significant sources of revenue for toy makers. The arrival of DVD players, like Sony's PlayStation 1 and 2 and Nintendo's Black Boy, turned toy makers into videogame software producers in the early 1990s. DVD software providers like Koei, Namco, Bandai and Square are located in Tokyo's southern and eastern industrial districts and supply Sony, Sega, Nintendo, and Microsoft's Black Box. When DVD console makers linked to the internet, even more business opportunities opened up for videogame software firms. [38]

Old industry clusters. As Japan's capital city, Tokyo attracts the national media. Forty-one percent of the nation's newspapers are located in Tokyo, as are 79% of publishing companies; 98% of major journals and magazines; 79% of comics publishing companies; 49% of

computer publication and software related companies; and 89% of music and recording companies [[39]] (TMG 1999).

Within Tokyo, media companies concentrate overwhelmingly in the central city, along with other kinds of business services. Together they draw a daytime workforce into the CBD that is twenty times larger than the resident population. Broadcasting stations and advertising firms locate in and around the Yamanote-line. Commercial production firms, movie studios and music recording companies spread westward from Tokyo's core. The media industry continues to provide traditional business services, like advertising and public relations. But it is also assuming new roles as a content provider to IT firms, videogame software makers, and digital animation producers, and in so doing is helping to sustain Tokyo's industrial dynamism.

Industry diversity. Mixing old and new industry clusters stimulates new technologies, services, business combinations and markets. Tokyo's manufacturing innovation often occurs at the intersections of different industries. The videogame software industry is a case in point. Videogame software is the product of interactions among several industries: animation and comic books, videogame consoled, electronics, computer, Internet, printing and publication, broadcasting, movies and music. Animation and cartoons are buttressed by Tokyo's huge printing and publication industry, and by broadcasting and other media. The videogame software industry expanded further with the arrival of the Internet as internet linked DVDs and cell phones demanded more videogame programs.

A wide range of firms representing Japan's most competitive manufacturing industries cluster in Tokyo: Fujitsu, Hitachi, Toshiba, NEC, Sony, Oki, Mitsubishi Electric, Ricoh, Canon, Pioneer and Advantest in the electronic machinery industry; Nissan, Honda, Fuji, Hino, Isuzu and Mitsubishi in the auto industry; Nikon, Pentax, Casio, Tokyo Electron, and Olympus in the precision instruments industry; Komatsu, Ebara, Makino, and Horiba in the general machinery industry; Okuma and Fuji Machine in the machine tool industry; JEF Group, Nippon Steel, Sumitomo Metal, and Hitachi Metal in the metal and steel industry; Sankyo, Yamanouchi, Chugai, Dai-ichi, and Meiji in the pharmaceutical industry; Toray, Teijin, Toho Tenax and Asahi Kasei in the textile industry; Asahi, Central, and Nippon in the glass industry; Nachi-Fujikoshi in the robot industry; Nippon Unipack and Oji in the paper and pulp industry; Konica-Minolta, Kanebo, Mitsui, Mitsubishi and Dai Nihon Ink in the chemical industry; Sumitomo, Hitachi, Fujikura, Showa and Mitsubishi in the electric wire and optical fiber cable industry. The

nation's leading service firms in media, information technology, advertising, insurance, retail and whole trade also agglomerate in Tokyo. These industries intersect in unexpected ways, driving innovation and creating new markets (Fujita 2003). In stark contrast to global cities like New York and London, which specialize in finance and producer services at the expense of manufacturing (Sassen 1991), industrial diversity plays an extremely important role in Tokyo's innovation and wealth generating capabilities. (See Table 6)

IX. The National System of Innovation

Tokyo's competitiveness is conditioned by the national innovation system in which it participates. A national innovation system, as Lambooy (2002) envisions it, forms a triangle made up of firms, scientific research organizations, and governments at the national and local levels. National innovation systems generate technical change. They span all industries. The system's core actors are private firms who both compete and cooperate with one another. Universities and public funds account for a significant fraction of R&D, but the percentage varies among countries.

The Japanese innovation system has several distinctive features. Industrial innovation centers in major cities, and especially in Tokyo, the nation's capital. The private sector is the leading actor but in a framework established by national development policy and state administrative guidance. A relatively homogeneous science and technology infrastructure spans the nation. Regional firms tend to use Tokyo as the gateway to national and world markets, while retaining their local production, R&D and cultural base. Innovation thus runs back and forth between Japan's capital city and outlying urban centers.

Cross national differences in R&D. Japan's national system of innovation contrasts markedly with North America and Western Europe. Japan invests more heavily in R&D than most developed nations in the West. The ratio of R&D spending to GDP in Japan was 3.29% in 2001, compared to 2.72% in the U.S., 2.18% in France, and 1.84% in the UK (OECD 2001c). Japan's R&D outlays on science and technology are overwhelmingly a private sector responsibility, however. Government's share of R&D spending is much lower in Japan than in most Western countries. Private companies accounted for 78.6% of Japan's total R&D spending in 2001, government contribution for 21% (Statistics Bureau 2003). (See Tables 7 & 8).

The central government provides administrative guidance and offers tax incentives and subsidies for targeted types of private R&D, but it provides very little direct assistance. Government's share in national R&D is twice as high in the UK and in France as it is in Japan. Government is more directly active in R&D in the U.S. too, where most basic research is conducted in universities and federal government agencies, like NIH, NSF, and the Pentagon, and passes on to the private sector through technology licensing. [40]

Japan's national innovation system also contrasts with the Western pattern because Japanese manufacturing corporations tend to integrate the process of knowledge creation, from basic research to the commercialization of new ideas, within one organizational framework. In the United States, by contrast, individual inventors depend upon venture capitalists and the stock market to start up new businesses and commercialize research results. Since private companies account for most of Japan's R&D spending, and since the manufacturing sector is responsible for most private R&D, the product pull system essentially structures the national innovation system as a whole.

The product pull system also connects Tokyo to local cities. Once prototypes prove successful in Tokyo's test markets, they are mass produced in outlying factories. As innovative production technology flows from Tokyo mother plants to outlying manufacturing branches, it is acted upon and improved in local cities, and more advanced versions eventually flow back to Tokyo. In this respect, the relationship between Tokyo and outlying regions is less hierarchical than it is reciprocal and complementary.

National innovation policy. Private companies are the core actors in Japan's national innovation system but they act within administrative guidelines and policy parameters jointly worked out with the developmental state. Japan's national development strategy has shifted since the 1970s, from catch-up adaptation through industrial policies, to frontier innovation through advances in basic science and technology. The central government's national growth strategy currently emphasizes four "frontier areas": environmental technology, life science, information technology, and nanotechnology (Prime Minister's Office 2001). [41]

The frontier technology strategy lays out policy priorities and specifies reforms in higher education, industrial structure and corporate governance. The central government is especially targeting two American practices that Japan hasn't yet explored. It is expanding resources for university based basic research and it is creating transfer licensing organizations (TLO's) to

facilitate the commercialization of university generated innovations. Only 6% of Japan's expenditure on *industry* R&D goes into basic research, while 53% of Japan's *university* research is basic rather than applied. (See Table 9) But universities tend to leave the results of basic research un-commercialized because they lack the know-how and resources to apply for patents and licenses. [42] The TLO program is a mechanism for transferring basic research from universities to the private sector through the patent system and for returning patent fees to the university research labs. [43] Companies investing in targeted R&D areas receive tax reductions up to 20 percent of their R&D investment. METI plans to train 10,000 experts in the management of technology over the next 5 years and help generate 1,000 university spawned venture businesses (METI, MHLW and ME 2003: 262).[44]

National innovation policy and regional development. The government's national innovation policy is well integrated with its regional development plans. The current fifth and sixth national development plans target new science cities, research parks and industry clusters throughout Japan. Local science cities and research parks were originally designed to attract corporate R&D branches from Tokyo and other large metropolitan areas. Now the effort is to link them up with local universities.

METI's "19 industry cluster projects" embrace a wide swath of Japan and incorporate the TLO program mounted by METI, the intellectual property rights campaign led by the Prime Minister's Office, and the joint technology creation programs fostered by the Ministry of Education. The goal is to stimulate technological innovation by creating networks among industry, universities, local governments, and public research institutions. The 19 industry cluster project is overseen by METI regional bureaus but local governments are leading the effort. The program began in 2001 with 3,000 participating companies and 150 universities and rose to 3,800 companies and 200 universities in 2002. [45] The project includes 100 financial institutions to provide loans to new venture businesses through the local TLOs, and trading companies to help with marketing (METI, MHLW and ME 2003: 131).

One of the 19 projects is located in Tokyo, and is called TAMA, an acronym for "technology advanced metropolitan area." TAMA covers Tokyo's western suburban area and two prefectures, Kanagawa and Saitama. METI's Kanto Bureau coordinates TAMA and is encouraging local area governments, universities, corporate R&D centers, public research centers, financial organizations, R&D oriented small and medium firms to organize into a

technologically innovative cluster (Kodama 2003a). Kanagawa and Saitama have attracted an agglomeration of electrical machinery and precision instrument industries over the past three decades. Many of the area's R&D centers are spillovers from Tokyo, and many small- and medium-sized R&D oriented firms are spin-offs from large Tokyo companies. National land policy, which promotes decentralization, and Tokyo's high land prices led these firms to locate in Kanagawa and Saitama rather than in central Tokyo. METI recognizes that industry networks already exist in TAMA but ministry officials believe existing networks are not effective enough in creating new venture businesses and technologies. [46] METI wants to systematize the linkage between R&D oriented small businesses and universities through the TLO and other government incentives (Kodama 2003b).

Over 100 science cities and research parks have emerged in Japan since the 1980s (MLIT 2003b). They are linked to local and regional development policies; they help upgrade regional technology levels; and they dampen income gaps between large metropolitan regions and the rest of Japan. Tsukuba Science City and Kansai Science City are Japan's premier science city sites for basic research. Tsukuba, on the outskirts of Greater Tokyo, was initially established to relieve density in the urban core. The city's population reached 195,000 in 2003, close to the original target of 220,000. The city's researchers now number 13,500: two-thirds work in public universities and research institutes and one-third in the private sector (MLIT 2003b: 121). [47] The government expects Tsukuba and Kansai Science Cities to lead in the development of the new frontier technologies.

Tokyo and Osaka are both creating international biotechnology centers. Initiated locally, the centers were incorporated into national plans in 2002. The Tokyo Genome Center project brings together the Tokyo Metropolitan Government, neighboring cities like Yokohama and Kawasaki, Keidanren (representing corporate headquarters in Tokyo), and several government agencies. The Osaka Life Science City project brings together the Kankeiren (representing corporate headquarters in the Kansai area); the cities of Osaka, and Kyoto, and Kobe; the Osaka, Kyoto and Hyogo prefectures; Osaka, Kyoto, and Kobe universities; regional government agencies; and public research institutions.[48]

METI has clearly been influenced by the industry cluster model identified by Michael Porter (2002) and advanced by the OECD, but ministry officials are imbedding the model in a specifically Japanese policy framework in which local governments play a leading role in

promoting industry and innovation networks while the central government coordinates the overall effort. [49]

National small business policy. Small firms play a critical role in the Tokyo innovation process and national small business policies help foundation firms keep up with the technology frontier. Small business policies are the joint product of central and local governments in Japan. Local governments survey small businesses and provide the results to METI's Small and Medium Enterprise (SME) Agency. The SME Agency analyzes information on small businesses gathered from localities all over Japan, formulates policy guidelines, and disseminates the findings and policies through a small-business "white paper" every year.

SME Agency policies are implemented by local governments, chambers of commerce and industry, commerce and industry associations, and the central federation of cooperative unions. Small enterprises with 20 or fewer employees in manufacturing and 5 or fewer employees in commerce and service industries belong to commerce and industry associations. Cooperative unions are made up of businesses with fewer than 10 employees. Each prefecture has a central federation of cooperative unions. Local industrial policy is thus couched within a coordinated national policy framework. The framework enables the central government to identify local best practices and make them known to all localities. (Fujita and Hill 1998: 192-194).

Following the 1989 Fusion Act, the SME Agency rewards firms that combine across industries in fusion associations to share state-of-the-art technologies and managerial expertise about new product development and business lines. Fusion policy also promotes inter-firm networks to gather sales information and to place and process orders. The aim is to use networks to help small firms handle orders in smaller lots, across a wider range of products and models, in shorter product life cycles, with improved quality, and with decreased delivery time.

Tokyo metropolitan government's innovation policies. TMG's Bureau of Industry and Labor guides Tokyo's industry, and especially the city's small firms, in the new directions specified by national technology policy. Some Tokyo small firms have considerable R&D resources, but most do not. TMG can't emphasize frontier technology areas, like life science and nanotechnology, because they require a basic research capacity that most small businesses don't have. TMG focuses instead on the more applied side of environmental, medical and information technology. TMG hopes the concentration of universities and corporate R&D labs in the

suburban Tama area will be a catalyst for Tokyo industry and is disseminating the TLO program to Tokyo's small firms to help spur new start-ups and more jobs.

TMG works with Tokyo's Chamber of Commerce and Industry and other small business associations to facilitate information networks and joint R&D projects among small firms. TMG consultants and science and technology coordinators act as brokers between the ward governments and small businesses. Consultants offer advice on a wide range of issues affecting small firms, including loans, customer problems, machine purchasing, taxation, employment law, patents, marketing, and management. TMG also provides information and seminars on market trends, regularly surveys small businesses, and disseminates findings about best innovation practices.

TMG provides office and workshop space to encourage firms in targeted industries to expand into new business areas. For example, TMG helps support the Tokyo Digital Craft Shop, located in the bay area, which makes incubator rooms available to designers, producers and artists working in animation, videogame software and other internet mediums. TMG also backs the Creative Support Center, managed by the Tokyo Fashion Town Corporation, also located in the bay area, which offers color and video libraries and offices to fashion designers and coordinators at a low cost (TMG 1999). TMG also rents store space in antenna districts, like Aoyama, to enable young fashion designers to exhibit their products.

TMG provides targeted loans for start-ups, technology upgrading and new product R&D to small businesses in the environment, medical, social welfare, recycling, and information areas. Besides the usual policy linked financial support, TMG offers small firms a loan securitization program, called "Collateral Loan Obligation" (CLO). TMG disseminates information about the CLO through its "Sparkling Business Network" on the Internet. The CLO program encompassed 68 billion yen worth of loans to 1,700 firms in 2000 and 2001 (Fujita 2003).

TMG, like METI, worries that the shift of manufacturing operations to lower cost sites overseas will raise bankruptcy rates and discourage new manufacturing startups. To counteract the threat of de-industrialization, city officials are encouraging small firms to invent new products and technologies. TMG was the first local government to offer intellectual property right (IP) services to small business through its IP Promotion Center in Akihabara. [50] TMG could speedily launch the IP Center in 2003, even as the central government continued to revise the law, because it already had the consulting infrastructure in place. TMG supports the total

process, from developing patent applications, to commercializing patents into products, to marketing the new products. [51] The center promotes inventiveness but the primary goal is to encourage small firms to make use of patents already obtained but left unused by major corporations. TMG draws upon retired executives from trading, manufacturing and banking corporations to help provide patent advice to small firms.

TMG is also concerned that national population decline, projected to begin around 2007, threatens Tokyo's future test market and innovation capabilities. Officials believe more universities and R&D labs need to be brought back into the central city to sustain Tokyo's preeminence. At TMG's behest, the central state recently abolished the law prohibiting the construction of new universities and factories in Tokyo. City officials are promoting a global IT cluster on Tokyo's waterfront, and with the change in the land use law in 2002, TMG has already attracted some universities and R&D labs to the site. [52]

Also reflecting TMG's concerns, the central government recently created an Urban Renaissance Headquarters in the Prime Minister's Office to help coordinate TMG and central government policies bearing on Tokyo's urban redevelopment. [53] TMG is promoting redevelopment projects on public land vacated when central government offices decentralize outside of Tokyo. The city's redevelopment efforts continue to emphasize multi-function, mixed neighborhood designs that include retail, offices, entertainment, housing, and transportation hubs. The goal is "nigiwai", a place that attracts people, creates businesses, and exchanges information (TMG 2002b). The *traditional* Japanese concept of "nigiwai" can be seen in recent *post-modern* projects like Roppongi Hills, Marunouchi, Shiodome, and Akihabara where neighborhood shops, housing and small businesses are re-incorporated into a "high rise and high tech environment.

X. Genesis: History, Geography, Policy

How did the Tokyo innovation model emerge in Japan? What part did history, geography and policy play in the evolution of the system? Viewed historically, Tokyo has been the main stage upon which players have acted out the drama of Japan's national development. As a stage, Tokyo has been both a setting and a vehicle for human creativity, but also a structural presence to which actors must accommodate their purposes and behavior. The state has been the most forceful actor on the Tokyo stage, but it has receded into the background over time as the

prowess of other players has grown. Still, the state is the most respected performer in the troupe, and it remains the anchoring point for the whole drama of Japanese developmentalism.

By developmentalism, we mean a nation's efforts to catch up with and surpass more economically advanced states by forging cooperative relations among government and business, business and business, and business and labor to facilitate the adoption of new technology, the reduction of production costs and the expansion of global market share (Hatch & Yamamura 1996: 220).

Japan was a late developer and the first Asian nation to industrialize. It took off under different circumstances than in the West and the agents of its industrial revolution were influenced by a different ethos, driven by different motives, and operated within a different institutional framework than their western forerunners.

Internal pressures gave birth to industrial capitalism in Europe. Japan's industrial revolution was driven by external threat. The Japanese faced Western military conquest and economic domination by foreign companies. Japan met the challenge through the instrumentality of a strong nation-state, in both senses of the term: the Japanese drew upon their identity as one people and upon their capacity to exercise institutions of government. In taking a state led path to development, Japan departed fundamentally from the Anglo-American paradigm that vests economic governance primarily in markets and confines the state to setting the minimal conditions for effective economic competition. Instead, Japan followed the lead of another late developer, Bismark's Germany, and the approach enunciated by the German Historical School (Gao 1997: 3-40).

Max Weber famously claimed that Puritanism, an ethic which seeks rational control over the world, contributed to the rise of capitalism in England and the West, whereas Confucianism, an ethic which advocates rational accommodation to the world, thwarted the emergence of capitalism in China. Michio Morishima (1982), with considerable subtlety, argues that Japan developed modern capitalism despite its historic embrace of Chinese culture, because Japan evolved a different Confucian ethos. In much the same way as Protestantism split off from Catholicism in Europe and provided the ethical underpinnings for European capitalism, the Japanese variant of Confucianism split off from China and inspired the first industrial revolution in Asia.

Japanese Confucianism, like the Chinese ethic, rejects material gain as the driving goal of life. To be moved primarily by one's own interests is considered base. But where benevolence is considered the most important Confucian virtue in China, the Japanese came to prize loyalty; loyalty not in the sense of being true to one's own conscience, as in China, but loyalty as "sincerity aimed at total devotion to one's lord", even to the point of self sacrifice. Paradoxically, Japanese loyalty-centered Confucianism is also egalitarian. All people ought to be equal before the Emperor, the delegate of the gods, the Japanese believed [54], and decision-making should be governed by harmony or consensus. Western style individualism has never prospered in Japan nor has Western style liberalism ever been seriously advocated (Morishima 1982: 140).

Merchant-industrialists, driven by the profit motive, led the industrial revolution in the West. In Japan, it was samurai bureaucrats, competitively selected into state administration according to Confucian dictates, and bent on building a country with sufficient military and economic might to prevent defeat by Europe or America (Morishima 1982: 97). The Meiji Revolution overthrew the Tokugawa Bakufu [55], culminating nearly three centuries (1603-1867) of closed door, centralized feudalism ruled by a hereditary military bureaucracy. The revolutionary aim was to create a modern state that could deal effectively with the West. The former samurai at the core of the new Meiji government were acutely aware of the Western military threat. They were interested in weaponry and highly motivated to master Western natural science and technology as a basis for military strength.

The driving force behind Western industrialization, the capitalist bourgeoisie, remained weak in Japan. The Japanese bourgeoisie had no history of struggle against the government to acquire the freedom to do business nor did it take the initiative during the Meiji Revolution. It was not the internal strivings of a nascent capitalist class that forced the Japanese to consider economic competition and modern government, it was external confrontation with more powerful foreign nations. As the Meiji government instituted compulsory education, and inculcated Confucianism as the national ideology via the education system, the samurai class grew and metamorphosized into a governing class of intellectual-bureaucrats. In a Confucian society, people are distinguished most by their educational attainments. The Japanese did not develop a property based class system on the Western model after the Meiji Revolution, but a credentialed, "diploma society" (Morishima 1982: 50).

The Tokugawa Shogunate moved the national capital from Kyoto to Edo (Tokyo) in the 17th century. The move to Edo initiated 300 years of peace under a closed, centralized, feudal regime. Isolation protected internal industries, enabled the emergence of primitive manufacturing, and spawned a vibrant city system. By the end of the Tokugawa Era, the Bakufu possessed workshops for the manufacture of gunpowder, shipyards, and factories making various kinds of traditional goods. Handicraft skills were highly advanced. Castle towns populated the provinces. Roads and way stations connected the towns. And markets punctuated the transit routes (Nakamura 1993).

When Admiral Perry's gunships forced Japan to open her doors to world capitalism in 1853, Japan already had a solid infrastructure to build upon. Perry established his base at Yokohama, just south of Tokyo, along the bay. The Tokugawa regime designated the site an international trading port, and laid out a new planned city, including an enclave for foreigners engaging in export. After the revolution, the Meiji regime connected Yokohama's international port with the Tokyo's huge domestic market via telegraph and rail lines, and Tokyo has played a pivotal role in Japan's development efforts ever since.

Strengthening national production was the Meiji regime's top priority. To manufacture goods, resource poor Japan had to import raw materials and she had to export finished products to pay for her imports. Meiji officials viewed the economy strategically with the aim of building an industrial structure that would maximize Japan's gains from international trade. Japan experienced a remarkable growth in foreign trade between 1870 and 1920, mainly in silk and cotton textiles. Foreign trade stimulated the expansion of Japan's major port cities, Tokyo/Yokohama and Osaka/Kobe. [56] Burgeoning cities provided labor and commodity markets for industrialization. And industrialization shifted the locus of urban growth from the nation's interior and coastal periphery to the Pacific Belt.

The Meiji regime targeted a small nucleus of firms to achieve world class performance. The aim was to concentrate the nation's scarce resources in a few capable hands initially, and with success, to expand the circle over time. Japan's national champion firms were organized into industry groups, known as "zaibatsu" before World War II, and as "keiretsu" afterwards. [57] Cross-share holdings and umbrella coordinating committees allied the manufacturer of a strategic product with the firm's main upstream and downstream suppliers. At the center of each industry group was a "main" bank providing capital to members via loans from the Bank of

Japan. And the Bank of Japan operated essentially as a policy arm of the Ministry of Finance. [58]

The main bank system emphasized collective collaboration within each keiretsu group and between keiretsu groups and the government. Keiretsu facilitated large-scale investment projects which individual businesses wouldn't have been willing or able to take on. Cross share holding among affiliated banks and firms prevented hostile takeovers, reduced transaction costs, helped monitoring, and enabled a long term strategic outlook,

By the time of the Meiji Revolution, three centuries of insulated development under the Tokugawa Bakufu had deeply entrenched the production of traditional goods in Japan. After opening to world capitalism, the Japanese evolved a dual existence: they adopted a Western lifestyle in clothing, food, housing and other commodities but continued to live the traditional Japanese way, as well. Two sets of goods had to be purchased: suits and kimono, western tableware and traditional ceramics, apartments combining western style kitchens with Japanese style tatami rooms. This raised living expenses considerably, but Japanese preferred the double life, and it fit naturally with the state promoted slogan, "Japanese spirit and Western learning." Aiming to both assimilate Western technology, and sustain national identity, the government promoted both lifestyles simultaneously, urging the adoption of Western knowledge through the educational system while protecting the small, low productivity firms comprising Japan's artisan based industries.

Retaining a traditional artisan orientation in production and consumption helps explain the sophisticated and differentiated tastes of today's average Japanese consumer, the Japanese fondness for Western designer goods, and the willingness to save to pay premium prices for luxury items. A similar logic applies to the preservation of small, family based retail shops in Japanese cities, and to the persistently high density of employees in Japanese service firms. While inefficient by Western mass production and consumption calculations, these practices reflect artisan traditions of personalized service dear to the Japanese, and they contribute considerably to neighborhood vitality and the quality of urban life in Japan.

The national champion strategy opened up a gulf between state favored, outward looking, large companies in the modern manufacturing sector, such as textiles and steel, and small, low productivity, inward looking, traditional goods producing firms and service providers, exemplified by agriculture, fisheries, craft based industries making consumer goods,

construction, wholesale and retail trade; a duality that also prevailed initially between large firms and small subcontractors in the modern sector.

Japan achieved a national consensus on the national champion strategy, despite the unequal division among industries, firms, and workers, through the help of a loyalty centered Confucian ideology that considered devoted service an ethical, virtue and labor, even in less privileged economic sectors, an act of loyal service to the nation. The state also entered into an implicit social contract with businesses and employees in the traditional, secondary and service industries. In return for channeling their tax revenues to the national champions, the state committed to securing their livelihoods with subsidies when necessary, and by protecting them from foreign competition. The social contract was cemented politically after World War II as small businesses and employees in the inward oriented and protected sectors became the core electoral and financial base for the long reigning Liberal Democratic Party and well looked after constituencies of some of Japan's domestically oriented government ministries.

The large companies chosen to represent Japan were also obligated by Confucian ideology, and by state control over their investment funds, to be ever conscious of national purpose and ever mindful of the views of government. To be deserted by the government was to become a second rate enterprise. As a consequence, most major industrial and financial enterprises located their head offices in Tokyo and added former high officials from the Ministry of International Trade and Industry (MITI) and the Finance Ministry to their company boards to preserve close contacts with the government (Morishima 1982: 190). Keiretsu relationships among firms also favored spatial co-location among upstream and downstream companies, and among companies and their main banks. And the financial networks among the main banks, the central Bank of Japan, and the Finance Ministry added powerfully to the charm of a Tokyo location.

Japan possessed no military capability at the beginning of the Meiji Era but in a few decades time she had became the world's fifth largest military power. [59] As the role of military expenditures in Japan's economy increased, the connection between big business and the central government grew even tighter. Tokyo's modern fiscal and administrative powers date to the Meiji Era but state power did not translate into Tokyo's economic primacy until the 1920s. Before then, Osaka was the commercial and industrial hub of the nation. Tokyo displaced Osaka when the government extended its control over the economy to mobilize the nation all out for

war (Miyamoto 1993). [60] The gap grew wider during the postwar reconstruction and high growth periods as Tokyo's grip over the nation's command, coordination and innovation activities tightened (Hill and Fujita 1995).

The principles underlying Japanese developmentalism were pieced together over time, and not fully institutionalized until the war economy period (1931-1945), but they continued largely intact after the war, despite changes in the country's political institutions and national purpose (Sakakibara 1993; Gao 1997). The developmental state's [61] basic growth strategy was to progressively upgrade the nation's manufacturing base by shifting from labor to capital to knowledge intensive products and technologies in defiance of the principle of static comparative advantage; to use tariff and non-tariff barriers, direct and indirect subsidies, to protect fledgling domestic industries and promote exports; to use borrowed technology, after adaptation to domestic conditions, for development of new products and processes; and to generate a national consensus to support future oriented strategies despite their short term costs (Fajnzylber 1990; Lee and Yamazawa 1990; Huber 1994).

Japan has progressed through four sequential stages of industrial transformation since World War II: labor intensive manufacturing, from 1950 to the mid-1960's (e.g. textiles); heavy and chemical industries based upon scale economies, from the late 1950s to the early 1970s (e.g. steel, petrochemicals); assembly-based, mass production of consumer durables, from the late 1960s to the present (e.g. early electric and electronics, autos); and mechatronics based, R&D driven, computer aided flexible manufacturing of highly differentiated, multi-variety goods, from the early 1980s to present (e.g. HDTVs, advanced microchips, fine chemicals) (Ozawa 2002).

Japan's foreign investment follows the same sequence of stages. After adapting Western innovations to the special conditions of their own economy, Japanese firms initiated their own export and foreign direct investment cycles targeted to the markets of East Asian developing countries behind them in the industrial pecking order. Japanese officials supported import substitution investment in East Asia, viewing it as a stimulant and complement to the growth of higher value end products and parts in Japan (Inoue, Kohama and Urata 1993).

This "flying geese" strategy linked Japan and Asian Pacific countries together by product cycles and stages of specialization. Japan became the regional center of product and process innovation. The Asian Newly Industrializing Economies (NIEs) are middle countries importing advanced products, components and equipment from Japan and exporting more mature goods

and equipment to ASEAN and China. ASEAN and China occupy the lower steps of the escalator, importing technology intensive manufacturing from Japan and the Asian NIEs and exporting primary commodities and labor intensive manufacturing (Yamada 1990; Yamazawa 1990; Korhonen 1994).

The flying geese model has assumed a more complex pattern in recent years. Yen appreciation has compelled Japanese firms to transfer more advanced technological activities from Japan to East Asia (Yoshimatsu 2002). And, as intense competition has necessitated reducing time to market for advanced products in Japan, it has quickened the subsequent transfer of products to East Asia. For example, VCRs first entered the market in Japan in 1975 and production was transferred to Japanese subsidiaries in East Asia in 1983, eight years later. Wide screen TVs and mini-disk players first entered the Japanese market in 1992 and were transferred from Japan to East Asia in 1995, just three years afterwards (Song 2001). As a consequence, a growing number of overseas Japanese subsidiaries now emphasize integrated production of key components and local sourcing in host countries to reduce component costs, and some are transferring R&D and coordinating activities to "regional technology platforms". "RTP's" are nodal, overseas "mother plants" which modify product design and improve production technologies to support local market demand and manufacturing needs for sister plants in the region. This East Asian regional production strategy replicates, at a less advanced technological level, the product pull system in Japan.

Japan's development strategy has thus consisted of three types of product cycle modeled industrial policy: first, a policy for industrial upgrading from low value added to higher value added industries and product segments; second, a policy for substituting imports with domestic production using technology mostly acquired through licenses, followed by commercialization at home, and finally export abroad; and third, a policy to transfer comparatively disadvantaged industries or product segments through direct foreign investment into nearby Asian nations where factor and technological circumstances were still suitable for such industries. The goods produced overseas were then imported back home.

As summarized by Ozawa (2002), the three industrial policies lead to the following causal sequence: import > domestic production> export > overseas production via FDI > import. Resources released from the contracting product sector are shifted to newly emergent

competitive sectors or product segments. The industrial up-grading process was state guided and supported but fundamentally driven by market competition. [62]

Japan's ability to continuously upgrade and diversify the nation's manufacturing base, toward more technology intensive products and production processes and a more skill intensive labor force, has depended upon a system of collaborative manufacturing among prime contractor companies and supplier firms and upon a system of collaborative social relations among employees within companies.

Tokyo's small machinery manufacturing firms are a legacy of weapons making during the feudal Tokugawa Era. They emerged in the late 19th century in the city core and then expanded south along the bay shore. The big companies in the modern manufacturing sector emerged with the Meiji national champion strategy. The two joined hands in a subcontracting system distinguished at the outset by a considerable gap in profits, wages, work conditions and employment security between the large parent firms and their small subcontractors (Morishima 1982: 102-120).

Today's cooperative subcontracting system has its origins in a government strategy to upgrade industry production for the war effort. A 1940 notice from the Ministry of Commerce and Industry urged the war industries to make long-term subcontracts, help their contractors specialize, and give them assistance to improve their management and technology (Hall 1998: 465). The subcontracting system went through another major transformation beginning in the late 1960s when large companies started subcontracting assembly and components manufacture to manage the task complexity associated with rapid growth and product proliferation. Later, as product differentiation further increased manufacturing complexity, producers began to convert "simple processing" subcontractors (machining, sheet metal, stamping, surface treatment) into contract assemblers of system components (Seki 1994). Subcontractors also took on design, testing and parts procurement for relatively mature products (Yamada 1991).

Japanese style flexible manufacturing requires suppliers who can accommodate prime contractor requirements for diverse product mixes and variants, design changes, and make quick and frequent deliveries without incurring prohibitive costs (Nishiguchi 1994: 193-194). Suppliers must be able to take the initiative in developing and flexibly manufacturing components, and they must be able to deliver them as needed and "just in time" to customers.

Japanese flexible manufacturing intertwines two types of production networks: a research intensive, high tech, small batch "pilot" network located in the largest cities, especially in Tokyo, Osaka and Nagoya, and a more standardized, longer run, mass production network located in the provinces and abroad, a division of labor that also corresponds to the flying geese upgrading strategy. Corporate headquarters co-locate with R&D labs and mother plants assembling and testing prototypes, and with small, high tech suppliers networked in industrial districts who provide the precision parts for prototypes and equipment for small batch production. Spatial clustering among headquarters R&D labs, mother plants, and high tech suppliers facilitates "design-in", simultaneous development, and just-in-time manufacturing, all core principles of Japanese style flexible manufacturing.[63]

Flexible manufacturing in Japan is also rooted in a technically knowledgeable, multi-skilled labor force and a workplace culture encouraging employees to become involved in process and product improvements. Japanese companies draw upon a work-site oriented ethic, called "genba-ism" by Abo (1994: 253), a legacy of loyalty-centered Confucianism, which prizes being on the spot, involved, all members taking part in what is actually going on. Employees are expected to review their jobs and initiate and accept innovations. The continuous, incremental improvements (kaizen) at the heart of flexible manufacturing are everyone's responsibility (Matsumoto 1991).

Japanese employees traditionally build up, over a long period of time, a sense of oneness with their company, other firms within the corporate group, and even outside suppliers. Corporate employees are challenged to transcend their allotted roles and re-energize their workplaces. Employees thus charged and evaluated are predisposed to expand their area of responsibility indefinitely, limited only by their individual capabilities, and supported by their sense of belonging to the same corporate society (Abo 1994: 255).

Companies also foster worksite orientation through various institutional devices, including hiring and rotating employees in age cohorts, employment guarantees, a salary system which combines seniority with evaluations of individual performance, and a community of fate environment in which corporate employees share the risks of failure and the rewards of success (Matsumoto 1991). Labor isn't considered a cost of production to be minimized, as is typical in Western practice, but a resource to be augmented.

Japan closed the gap with its most advanced Western competitors by the middle 1970s. By the 1980s, Japan was ahead in many industrial areas. In recent decades Japan has been moving systematically toward research frontiers—spending progressively more on basic research while simultaneously committed to a long term strategic view, with government helping to identify new technologies and committing resources to the point where they can be commercialized. [64] For example, METI's most recent strategic vision specifies seven priority areas as the most likely sources for domestic demand-led future growth: fuel cells, robots, information appliances, software content, health and welfare equipment related services, environmental equipment related services, and business support services. METI is promoting public and private R&D and some de-regulation measures in these sectors (Nikkei Net 23 March 2004).

Research and development continues to concentrate in Tokyo drawn by the infrastructure for innovation already in place. Corporate headquarters are there, proximate to government bureaus, industry associations and public corporations that mediate between the government and business (Okimoto 1989). Simultaneous development and just-in-time management encourage spatial clustering between R&D labs and other links in the value chain. Skilled labor resides in the city's industrial districts. Hundreds of universities provide highly educated recruits. Opportunities to link up with other private and government R&D laboratories abound. And the technical, scientific and cultural atmosphere is vibrant.

The world offers at least two contemporary models of successful, innovative regional development, observes Peter Hall (1998: 496). Silicon Valley is a model of free entry and horizontal networking among small producers. Tokyo is a model whereby companies "internalize their externalities of innovation" by incorporating networking into the interior of the organization including quasi-exclusive relations with its specialized subcontractors nearby. The Tokyo model is considerably more than this, but Hall is right to argue that Tokyo's approach has thus far prevented the usual hardening of the bureaucratic arteries associated with large scale organization. [65]

Indeed, Tokyo's cycles of innovation in electric goods and electronics span the entire 20th century: light bulbs and telephones in the 1910s; radio in the 1930s; refrigerators and TVs in the 1950s; color TVs and video recorders in the 1970s; camcorders and laptop computers in the 1990s; and today's "three sacred treasures": digital cameras, DVD recorders, and flat panel TVs.

While the production of mature products continues to shift overseas, Japan's domestic production of consumer electronic equipment nonetheless rose 14.9 percent in 2003, with digital appliances driving the growth. Japanese companies control 90 percent of the world market for digital cameras and 80 percent of the world market for plasma TVs. Sharp Corporation alone controls 50 percent of the global market for LCD TVs. And the spread of digital electronic goods is stimulating a variety of related industries. [66] Digital cameras, for example, help expand demand for advanced parts, such as "charge coupled devices" (CCD's) and "liquid crystal display" (LCD) panels, and peripheral devices, such as printers and external memory components. Japan's domestic market for digital appliances is projected to reach 60 trillion yen in 2010, more than 10 percent of GDP (Foreign Press Center/Japan 2004a).

XI. The Tokyo Model and the "Creative Industries"

The Tokyo innovation model has both inspired and evolved with Japan's postwar phases of economic growth. Lately it has been argued that the world economy has entered a qualitatively new era, driven by "creative industries" made up of firms producing goods protected by intellectual property rights. How well does the Tokyo model fit the creative industries? Does it apply to all, to some, to none at all?

John Howkins, the British media executive, management consultant, and author of "The Creative Economy" (2001) has probably done the most to advance the claim that we are moving from a society where people spend most of their time handling information to a society where priority is placed on ideas, personal expression, and use of the imagination. Intellectual property (IP) is the "defining asset" of the creative economy, says Howkins, much as land defined the agricultural age and finance the age of stock market capitalism. Creative industries are those that generate or deal in intellectual property.

Howkins (2001: 116) identifies 15 "core industries of the creative economy." In total they produced 2.24 trillion dollars in global sales in 1999. Ranked by global market size in billions of U.S. dollars, and with the percent of total sales accruing to each industry in parentheses, they are:

R&D	$545	(24%)
Publishing	$506	(23%)
Software	$489	(22%)
TV and Radio	$195	(9%)

Design	$140	(6%)
Music	$70	(3%)
Film	$57	(3%)
Toys and Games	$55	(2%)
Advertising	$45	(2%)
Architecture	$40	(2%)
Performing Arts	$40	(2%)
Crafts	$20	(1%)
Video Games	$17	(1%)
Fashion	$12	(1%)
Art	$9	(1%)
Total	$2,240	(100%)

By Howkins accounting, creative industries add up to about 7.5% of global GNP. Throughout the 1990s the creative industries grew twice as fast as service industries, and four times as fast as manufacturing. Between 1987 and 1997 creative industries in the United States increased their output 5.8 percent a year compared to 2.8 percent for other industries, and increased their employment by 4.0 percent compared to 1.6 percent for the rest of the economy [67] (Howkins 2001).

The Tokyo model centers upon manufacturing innovation. What is the relationship between manufacturing and the creative industries? Howkins' answer to this question is ambiguous.

First, not all of the creative "industries" on Howkins' list are industries in the conventional sense. Many do not conform to standard industrial classifications. For example, the largest creative "industry," R&D, does not produce a specific product, it is a segment of most industries. The second largest, Publishing, does refer to a product category and is an industry in the usual meaning of the term. Crafts is a broad designation covering a wide range of possible products, while video games is a quite specific product category. This mix of apples and oranges makes systematic comparisons among the creative "industries" next to impossible.

Second, manufacturing firms are intimately involved in several creative "industries" on the Howkins' list, including R&D, design, toys and games, crafts and fashion. R&D, the largest creative "industry," accounts for a quarter of the total output of the fifteen industries, but the overwhelming share of R&D is done by manufacturing firms: approximately 90 percent in Japan; 90 percent in Germany; and nearly 80 percent even in the USA. So it cannot be argued that creative industries replace manufacturing in some sort of evolutionary sequence. Howkins (2001) acknowledges as much, but at the same time he claims just the opposite when he asserts

that the world is moving from a manufacturing and service economy to a knowledge and creative economy.

Third, treating "Software" as a separate industry can easily obfuscate the way innovations in hardware and software feed upon one another within the same firm and industry. This is especially problematic for Japanese firms that have an integrated and simultaneous approach to hardware and software development. [68] To take just one salient example, the world's most widely used operating system isn't Windows, Unix or Linux, but ITRON, originally developed by the Japanese electronics manufacturer, Matsushita, to run the firm's BTRON personal computer, and subsequently redesigned by a consortium of Japanese firms to become the *de facto* standard for the small-scale systems embedded in mobile phones, digital cameras, CD players and countless other electronic devices (Krikke 2003).

Fourth, while the creative industry concept refers to *all* industries that generate or deal in intellectual property, the term is often used to refer only to those industries with an artistic or cultural bent. This practice favors certain kinds of IP over others. [69] The World Intellectual Property Organization (WIPO) draws a distinction between two types of IP. *Industrial property* includes patents for inventions, trademarks, and industrial designs. *Copyright* includes literary and artistic works, such as novels, poems, plays, films, music, drawings, paintings, photographs, sculptures, and architectural designs. Patents, trademarks and industrial designs are most germane in manufacturing. Copyrights are most widely used in cultural "content" industries.

We have already demonstrated the applicability of the Tokyo model to creative manufacturing industries defined by industrial property, particularly the electronics industry. How well does the Tokyo model apply to the cultural and artistic segment of the creative industries, to those "content" industries whose intellectual property consists primarily of copyrights? We address this question through a case study of animation, one of Japan's premier creative content industries.

The Tokyo model and the animation industry. Japan produces 65 percent of the world's animation and nearly all Japanese animators cluster in Tokyo. [70] Why in Tokyo? Because the national media agglomerates there. Media firms gave birth to the animation industry and are its most important suppliers, distributors and clients. Tokyo's comic book publishers spawned animation. Tokyo's music, film, publishing, printing and communication companies supply the animation industry. Tokyo's broadcasting, advertising, game, movie and Internet service firms

are animation's most important clients. Tokyo's university art departments and studio schools train animators. And Tokyo's electronics firms make the state-of-the-art equipment animators use to envision, design, compose and play their products. Toei Animation Studio, for example, networks with Asahi Broadcasting, Tokyo Broadcasting and Fuji TV; with Dentsu and Yomiuri Advertising companies; with Kadokawa and Kodansha book publishers; with the videogame software maker, Bandai; with Dai Nippon and Toppan Printing firms; with Sony Entertainment and King recording companies; with Nippon Columbia music company; with the mobile telecommunication company, NTT East Japan, and with more than 500 additional, Tokyo based media enterprises.[71]

Hardware and software R&D feed upon one another in the digital content industry and Tokyo's electronics firms provide animators with the tools and network infrastructure they need to produce and distribute their work. [72] Tokyo's expertise in miniaturization and packaging technologies, developed for digital electronic appliances, has reduced animation production costs and stimulated small firm startups. Liquid crystal and plasma displays, three dimension computer graphics, and charge-coupled devices have simplified and speeded up the production of animation and enabled talented, "otaku" amateurs to enter the industry. And Tokyo pioneered digital networking technologies enable animators in Japan, South Korea, Taiwan and China to engage in virtual divisions of labor, reducing the exchange of physical materials and the need for long-distance travel.

Production. The production of animation conforms in many particulars to the Tokyo innovation model. Animation makers cluster near to one another in Tokyo. They collaborate in making their product. They take an integrated approach to their industry's division of labor. And their overseas production follows a flying geese development pattern.

Animation is divided into three main production segments. Pre-production involves planning, script making, and overall production management. The actual production process consists of the original ink drawings, motion picture drawings, background making and painting. Post-production involves filming, editing, voice effects, dubbing and music composition. Pre-production is done in-house by the company with the original idea, like Studio Ghibli, led by Hayao Miyazaki, the famed maker of "Princess Mononoke" and “Spirited Away.” The actual production process may be performed entirely by artists in the lead company or the firm may outsource some elements to nearby animation studios and abroad. Outsourcing overseas is rare

in small studios, like Studio Ghibli, where the workforce seldom numbers more than seventy-five; but big animation companies, like Toei Animation Studio, often outsource more routine tasks, such as motion picture drawings, background and painting, to firms in South Korea, Taiwan, China or the Philippines. Post-production is done in-house by the lead company.

Tokyo's animation makers also depend heavily on local supporting industries. Animation is classified as a "digital content industry" in Japan, along with movies, video, game software, music, publications, newspapers and broadcasting. There is an especially close family relationship among animation, comic books and games software. Directors, creators and artists often move back and forth among the three industries. [73]

Nearly nine in ten of Japan's animation production companies are located in Tokyo, three hundred and seventy firms in all (TMG 2003). Digital animation clusters along the JR Chuo-line; Suginami, Nerima, Shinjuku and suburban cities in Tama area. Clusters have developed around major animation studios like Tezuka Production (in Shinjuku), Toei Animation (in Nerima), Walt Disney (in Suginami), Studio Ghibli and Tatsunoko Production (in Koganei city and Kokubunji city in Tama area) (TMG 2002b: 143). The Institute of Animation, located in Yoyogi on the Chuo-line, and a training ground for animation artists, has also spawned digital animation clusters as students of the Institute tend to stay near the Chuo-line after graduation. Akihabara, Tokyo's "electric town", is yet another locale favored by otaku animators, as noted above. [74]

The "project," is the basic production unit in the animation industry, a collaborative relationship among a small number of big media producers and a large number of small animation firms. A small creator firm usually comes up with the original idea. The final product is distributed by a large mass media company in the movie, broadcasting, publications or communications industry. A producer, usually belonging to one of the major mass media firms, oversees the network of animation firms, obtains sponsors, assigns funds, looks after distribution, and collects revenues. Depending upon the nature of the animation, the creator firm, its parent company, or one of its partners may license copyrights to broadcasting stations, video makers and video game software firms and sell character trademarks to toy, food and apparel companies.

Animators also engage in collaborative social relations inside the studio and manifest the characteristically Japanese work-site orientation. For example, the director and script writer Hayao Miyazaki and his staff at Studio Ghibli, worked together day and night for three years on

"Princess Mononoke," experimenting with and mastering new methods, colors, and technologies. [75]

Digital broadcasting has boosted the number of animation programs aired weekly on Japanese television. [76] As demand for animation has grown, so has the use of overseas subcontractors. But the incorporation of digital and Internet technologies into the production of animation also provides a leverage point for overseas animation companies trying to out grow their follower relationship with Japanese firms. South Korean companies are especially bent on catching up with and surpassing Japan.

Most Japanese animation is done by small studios in rented offices, and small firms can be slow to adopt state-of-the art technologies. The national government is promoting animation in South Korea, and thirty animation courses are available at universities where students can learn a range of digital technologies. The Tokyo International Anime Fair is a traditional gateway to success for Japanese animators. Thirteen South Korean firms participated in the Tokyo Anime Fair in March 2004, and won 3 of the 11 awards given. South Korea's influence is also growing in the Japanese game software market, particularly in online games allowing multiple player participation. Ragnarok Online, a game run by South Korea's Gung Ho Entertainment, Inc., and created by South Korean cartoonists influenced by Japanese animation, has nearly half a million fee-paying Japanese subscribers (Nikkei Net 9 April 2004).

Consumption. The market dynamics in the animation industry also conform in many details to the Tokyo innovation model. Animation is driven by the product pull system. Animators test their products in Tokyo first before marketing them in Japan and overseas. And animators look to Tokyo's participatory antenna districts for new product ideas and strategies.

Japan's success in the world animation, comics and games software markets derives from fierce firm competition inside of Japan for the attention of a large, demanding and diverse range of consumers. The market for Japanese popular culture is segmented by gender, age, and social status and subdivides further within each category. The popular culture market extends even to public relations documents and legal handbooks put out in comic format by government agencies and to users' guides accompanying Japanese appliances (Nakamura 2004).

The egalitarian and participatory culture of the Japanese consuming public is also visible in animation. Techniques of story making and ways of expression trace back to 12th century picture scrolls and to 19th century "ukiyo-e" woodcut prints. These were not upper class arts but

expressions of the common people. The notion that everyone draws pictures and tells stories has been cultivated throughout much of Japanese history. The Japanese do not draw sharp, Western style distinctions between elite and mass culture. Creators of commercially successful animation films and comics are regarded as established artists in Japan (Howe 2004).

The development of Japan's popular culture industry thrives upon audience participation, including adults as well as children. The Comic Market, referred to as "Comike" in Japan, is an annual festival held by talented amateurs ("otaku"). Here they can buy and sell their own, hand-crafted comics, magazines, animations and related products. The Comike in August 2002 attracted 370,000 visitors in two days and 9.8 billion yen in sales, an amount surpassing the total receipts from soccer tickets sold in Japan for the last World Cup (Nakamura 2004).

New trends in comics and animation often stem from Comike, like the recent "pretty girl" series (Nakamura 2004). Comike participants create original stories using popular comic characters, and some dress the part as well, referred to as "costume play" in Japan. The Comic Market eliminates the distinction between creators and consumers. Publishers are always on the lookout for new talent there. As digital and internet technologies put the basic tools of popular culture production into more and more hands, and at the same time facilitate peer-to-peer interaction, the Comic Market is becoming a model for a growing segment of Japan's popular culture industry.

National innovation and state policy. Animation also fits the Tokyo model in that it has recently been designated a strategic industry by METI and commercial development now takes place within the framework of state industrial policy. Japan, like its counterpart nations in the OECD, envisions the 21st century as an "Era of Intelligence," and is promoting intellectual property rights and the digital content industry as a source of future economic growth. METI's policy efforts to promote Japan's digital content industry began with a study group, composed of representatives from the industry, universities, research institutes, trading companies and state agencies, charged with studying other countries policies and uncovering the strengths and weaknesses in Japan's approach. [77] Based upon the study's findings, METI made several policy recommendations: nurture movie and animation producers by making available venture capital to small studios and scholarships to would-be-producers in graduate art departments; rewrite copyright laws so that current revenues, whose lion share are presently taken by major studios and distribution companies, will be more evenly distributed over the entire industry, with

fair compensation to creators and artists; set up "window offices" to protect and promote Japan's copyrights in China, Taiwan and other countries where piracy rates are high; and promote the contents industry through international fairs and other public events (METI 2003c).

The government also introduced an "Intellectual Property Promotion Plan." The goal is to raise the international competitiveness of Japanese industry by strengthening the protection of property rights in the content industries. The Intellectual Property Policy Headquarters, chaired by Prime Minister Junichiro Koizumi, will officially decide on the plan. The Prime Minister's involvement indicates the substantive and symbolic importance the government attaches to IP reform. (Foreign Press Center/Japan 2004b).

One reform target is Japan's patent examination system. A patent application in Japan averages 24 months as compared to 16.7 months in the USA, and 22.6 months in Korea. Based upon the rising number of patent applications, absent change, the application process is projected to take over 60 months a decade hence. Because it impedes timely marketing of new technologies and products, this would inevitably lower the competitiveness of Japanese industry. The government's draft plan proposes to speed up patent examinations by giving blanket approval to an estimated 500,000 backlog of cases and by hiring hundreds of temporary inspectors.

Another concern highlighted by the plan is the growing number of Japanese employees filing lawsuits against their companies to gain compensation for patents resulting from their inventions. The general legal interpretation has been that a patent obtained by a company for an invention by one of its employees belongs to the company, even through current patent law specifies employers must provide "fair compensation" for a researcher's invention. Patent lawsuits are presently handled the same as other lawsuits, beginning in local district courts before going to one of Japan's eight high courts. The lawsuits are not treated uniformly because many judges are unfamiliar with patent law. The draft plan proposes a high court to deal exclusively with lawsuits relating to intellectual property, and it urges companies to conclude contracts with employees ahead of time specifying payments for inventions.

Japanese animation firms depart from the Tokyo innovation model in at least one major respect: they lack the ability thus far to promote and distribute their creative content in overseas markets, especially in the USA. Japan's digital content market is worth about 11 trillion yen annually, roughly equivalent to total domestic sales in the nation's steel industry. But digital

content companies are still poor at selling their products overseas, with exports as a percent of total revenue only 3 percent in 2000, as compared to 17 percent for the same industry segment in the USA (Nikkei Net 8 April 2004). [78]

XII. Conclusion

Tokyo's innovation model is based upon a remarkably cohesive, well thought through, and effective system of relationships. But what of the future? Will the new economy and globalization force the Japanese to fundamentally alter their innovation philosophy and practice?

Creativity. The world is moving from an organizational era of corporations to an occupational era of creative individuals, claims Richard Florida (2002). Captivated by their organizational routines, metal bending cities in the United States, like Buffalo and Detroit, fell victim to "institutional and cultural sclerosis" and began shunning people with new ideas. But it is a city's pool of creative people that drives industry today. To grow their new economies, cities must emanate a culture of entrepreneurship and offer creative individuals diverse lifestyle possibilities. [79]

Japan is the prototypical organizational society and Tokyo is the nation's leading high tech manufacturing metropolis. Is Tokyo's innovation model becoming anachronistic in an era dependent upon creative human capital and globalization of the economy? Japanese business leaders and government officials worry about this possibility and they are trying to stimulate more individual creativity and initiative.

A new idea always begins with an individual. But the sequence from abstract idea to concrete product follows a much different path in Japan than in the United States. The Japanese emphasize collaborative manufacturing and innovation throughout the value chain—from research to design to engineering to pilot production to test marketing to manufacturing to sales. In the new economy model, by contrast, "super creative stars" throw their new ideas onto the market and look to separately functioning categories of market actors--venture capitalists, managers, support service firms--to develop and realize the commercial possibilities. True, Japanese firms are offering greater incentives for individual creativity and entrepreneurship today, but they also continue to emphasize collaboration and a circumscribed distribution of earnings among employees. Rewards continue to be widely shared within the corporate

community, and employees continue to strive primarily for company recognition rather than for monetary riches.

NEC Laboratories, in Kawasaki city adjacent to Tokyo's Ota-ku, is a case in point. NEC Kawasaki is the company's world headquarters for research and development. NEC has traditionally recruited graduates from top universities, like the University of Tokyo, Keio and Waseda, distinguished by their energy, willingness to collaborate, and overall knowledge comprehension. The company then nurtures its human capital in-house through intensive training and socialization. The result is an employee with an acute overall understanding of organizational goals and practices but not one anxious to take personal risks or motivated to realize his or her own personal, research ideas.

NEC would like to see more risk taking and individual entrepreneurship among its R&D staff. But the company continues to take a corporate training approach to innovation. Research managers believe creativity can be nurtured in-house if the environment is right. To that end the company is bringing together managers with diverse experiences and backgrounds: some with an exclusively business mind set drawn from other units in the NEC group; others drawn from R&D centers but with some previous business experience; and still others with only R&D experience. The company has also reorganized its R&D layout to provide more open spaces where researchers can interact and debate ideas with one another and with superiors. [80]

NEC's research managers are more or less indifferent about current efforts to reform Japan's higher education system to stimulate more creativity among students. They are basically content with the uniformly high standard of basic skills, teamwork capabilities, and subject comprehension among Japan's university graduates. They believe corporate education can guide recruits in the right direction. In short, NEC's managers continue to believe that creativity is largely a function of social relations and is not an inherently individual trait. The firm's collective approach to innovation dovetails with the Japanese belief in the "eternal organization"—creating new markets and expanding market share are first and foremost means to the survival of the firm and to the well being of employees; profits are a means to that end, not an end in themselves.

Sony has gone further in encouraging originality among its researchers. Sony CSL, the company's basic research lab, is located near JR Gotanda station in Ota-ku. It is a small lab with 28 international researchers. CSL researchers are on one year contracts; they are paid annually;

they choose their own individual research projects; their average length of stay with the company is six to seven years; and their compensation is largely merit based. [81]

But like NEC, Sony values and rewards research results that potentially contribute to society. Sony researchers, like those at NEC, have commercial prototypes most in mind, and like their NEC counterparts, they collaborate with Sony's other units, particularly with the company's design center. Like NEC, Sony believes that corporate policy can best promote creativity and that originality is rooted in social relations. And Sony CSL, like NEC Kawasaki, is attempting to stimulate more open mindedness and individual risk taking with designated lab spaces for face-to-face communication; general meetings once a week with the research director; 2-day long discussion sessions once a year, off site, where all researchers present their projects for collective consideration and critique; and by mixing together researchers from different disciplines and nationality backgrounds.

Sony CSL's management style seems closer to the American model than to the Japanese, but in fact, the unit's research director sees CSL as more of a collective than American labs, and closer to the Japanese philosophy. Japanese researchers don't want to promote themselves at the expense of others, he says, and he believes the Europeans working at Sony CSL have the same attitude. [82]

Will Tokyo hollow out? Is the Tokyo innovation model, based upon manufacturing prowess and (co)localized product pull networks, becoming anachronistic in an era of globalization? As future market growth gravitates to China, other East Asian countries, and the USA, won't Japanese companies decide to co-locate R&D, manufacturing and headquarters adjacent to the expanding new markets? And isn't Tokyo bound to lose manufacturing and population as a consequence?

Japan's Ministry of Economy, Trade and Industry (METI) voices much the same concern in its 2001 White Paper on the International Economy. China's emergence has disrupted the orderly "flying geese" catch up process led by Japan, followed by the NIEs, ASEAN members and China, the Ministry announces. Receiving massive flows of DFI, China has been gaining competitiveness in labor intensive products, but also in IT and other technology intensive goods. So the here-to-fore complementary international division of labor has given way to stiffer, zero-sum competition.

But a follow up project to the 2001 White Paper by METI's Research Institute of Economy, Trade & Industry, finds no evidence that Asia's flying geese pattern of economic development has been disrupted by China. A comparison of trade patterns among countries in the region indicates that Asian trade structures are "broadly in line with their respective levels of economic development" (Kwan 2002).

Although manufactured goods now make up the bulk of China's fast expanding exports, the country's competitiveness still relies on low value added products. Even in China's fast growing IT product sector, the country's export competitiveness still lags far behind not only Japan, but also other Asian countries. There is a clear division of labor between Japan and China, with the former specializing in high value added products and the latter in lower value added products. There is little overlap, especially in the high value added categories. Consequently, Chinese exports do not directly compete with Japanese exports, rather they complement one another, the study concludes.

Japanese semiconductor manufacturers, for example, are fast strengthening their chip design and development operations in China, but they nonetheless continue to follow the flying geese trajectory. Toshiba has increased the number of engineers at its Shanghai chip development center from 40, at its start up in 2001, to 1,000 today. The Center develops software to enhance the audio and image-processing functions of system chips used in home electronics and information equipment (Nikkei Net 29 January 2002).

Toshiba is shifting chip design and development operations to China because it does not have enough software engineers in Japan, because personnel expenses for Chinese engineers are about one-fourth those of Japanese engineers, and because electronics and information equipment makers—chipmaker's largest customers—are also shifting their chip design and development operations to China. Chipmakers need to strengthen their operations in China to work closely with corporate customers in the early stages of chip design. Mitsubishi Electric Corp., Fujitsu Ltd., and NEC Corp. are all increasing staff at their Beijing chip design centers, as are Matsushita and Sony Corp (Nikkei Net 9 February 2002).

But Toshiba is also boosting the number of software engineers for system chips in Japan from 500 to 1,000. Toshiba's strategy is to develop software for semiconductors used in general electronics equipment in China, while focusing on developing state of the art technology, such as video processing, in Japan (Nikkei Net 24 January 2002).

The future. Manufacturing innovation has a long history in Japan. Tokyo has continuously modified its innovation system in response to global economic and geopolitical challenges. Current "new economy" demands are unlikely to alter Tokyo's basic path. The factors discussed throughout this study—philosophy of knowledge, the product pull and co-location systems, test markets, industrial districts, a sophisticated consumer culture, permanent learning from the outside world, urbanization economies, and government policies—will continue to support Tokyo's manufacturing innovation. (See Figure 6)

Tokyo's manufacturing firms will continue to innovate by gaining inspiration from Tokyo's test markets. The product pull system will continue to align manufacturers with consumers in accord with an innovation philosophy of "bringing actual benefits to people and society." Firms will continue to develop basic technology with the vision of its actual application to society in mind. [83] Government officials will continue to guide the economy and coordinate the nation's innovation efforts while attempting to facilitate more risk taking and the commercialization of public research results.

Transferring R&D centers overseas simply extends the Japanese corporate strategy of producing closer to local markets in host nations. Japanese companies are strategically concentrating R&D labs in North America, Europe, Southeast Asia and China, so they can design products to fit local tastes and specifications. [84] But this doesn't indicate erosion in Tokyo's own co-location system. Rather, Japanese companies are organizing their international division of labor in R&D, as they have in production, according to the flying geese model. Firms are performing basic research and applied R&D on new products and technologies in Japan, and shifting R&D on market tested and more mature products overseas. The flying geese model is rooted in Japan's continuing successes in upgrading technology, skill and labor productivity; in the nation's unmatched expertise in making specialized components and intermediate technologies; and in Japan's product and process divisions of labor with other nations in the world.

Replication. Can other nations replicate the Tokyo model? No system born and grown in one country is wholly transferable to another. Cities are nested in a world order divided among differently organized regional formations and national systems. Tokyo's innovation model grows out of the entire multi-level configuration—global niche, regional formation, national development pattern and local historical context—in which the city is embedded.

A city's maneuverability is constrained by the position it holds in a stratified world. For most of its modern development history Japan was technologically subordinate to and sought to catch up with Western nations, particularly the USA. The absorption of foreign technologies and institutions was a negotiated process. Japan opened its markets to foreign competition and pursued national and regional industrial policies simultaneously. For many East Asian nations today, Japan is the principal catch up target.

No country can progress which disregards its own past. Shared historical experience, cultural expectations and past strategic choices structure a nation's search for new solutions and color the problems to be solved. Fortunately, there is no one unique mapping between the functions institutions must handle and the form these institutions can take. Japan and the USA are both successful capitalist economies but their labor markets, corporate governance, social protection and finance institutions differ greatly. Japan didn't seek to replicate Western development models; it sought to learn from them while retaining its own national spirit. Japan created a system of innovation that adapted new ideas, whatever and wherever their source, to its own local circumstances and once commercially successful at home, exported the products to international markets.

We can't specify the "necessary conditions" for replication of the Tokyo innovation model but we can indicate certain core features of the Japanese system that any serious attempt to adapt the Tokyo model to local circumstances must take into consideration.

Managed openness. Japan experienced three centuries of closed door, autonomous development under the Tokugawa regime before being forced to open up to the world economy in the middle of the 19th century. From that point on Japan pursued a catch up development process based upon dynamic comparative advantage and product cycle modeled industrial policies. Growth was consciously framed in an evolutionary, staged model of industrial upgrading through teacher-learner relations (Ozawa 2001). Japan basically caught up with the West in the 1970s, and took the lead in some industrial sectors in the 1980s. Since then, Japan has incrementally liberalized its relations to the world market but always in the framework of a strategically managed openness (Cowhey and Aronson 1993).

A collectivist national ethos. Japan's loyalty-centered Confucian ethic, an amalgam of Chinese Confucianism and indigenous Shinto-ism, is in many ways fundamentally at odds with

Western liberalism. Japan is basically an egalitarian society, and Japanese retain a strong sense of loyalty and obligation to their own groups.

A developmental state. The authority of the Japanese state depends upon its capacity to coordinate social groups to achieve collective goals. Government officials continue to offer long range visions for the nation's economic future, back the visions with pivotal investments, and benchmark performance by competitive market standards. A network of third sector, mixed public and private organizations bridge government and industry to raise revenues for development and social infrastructure, channel funds for industrial targeting, gather information from abroad, promote trade and investment, and do industrial research (Okimoto 1989).

A toyota-ist production system. The Japanese production system is based upon product pull, collaborative manufacturing, integrated development across the value chain, and communal social relations inside the firm. By treating employees and subcontractors as "brain workers" who can figure out the operational problems they face daily and improve the functioning of their workplaces, the Toyota-ist production system has arguably become the world's leading flexible production paradigm (Womack, *et.al.*,1990; Liker, 2003).

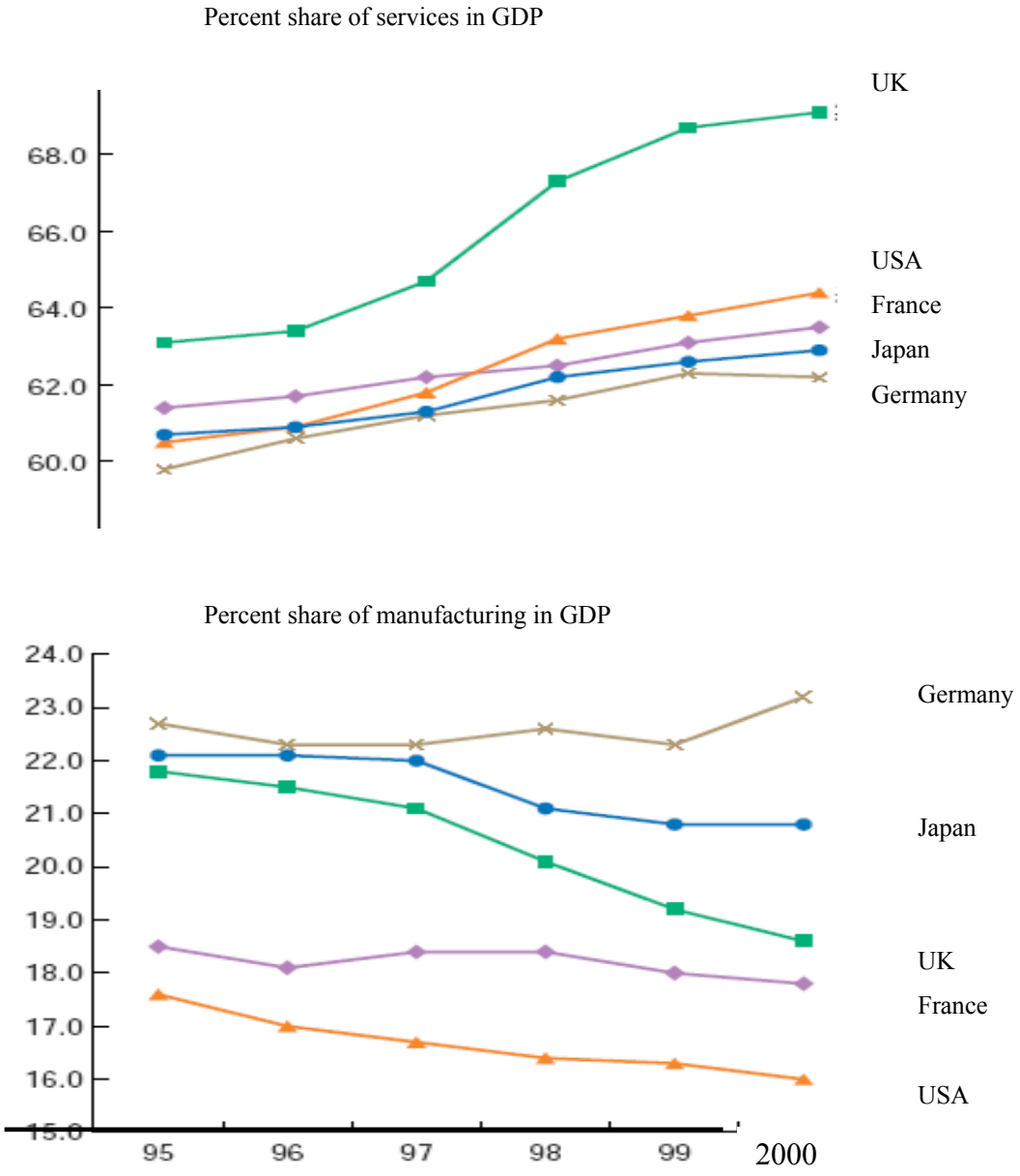
National capital of a developmental state. Tokyo is simultaneously a world city and the national capital of a developmental state; but the latter counts most in Tokyo's success as a setting and vehicle for innovation. Tokyo's national political stature underpins its functional (but not demographic) primacy in Japan's urban system and the city's potent urbanization economy. The Tokyo Metropolitan Government (TMG) plays an important part in the innovation model. National policy is actually the joint product of central and local governments in Japan. The national government disperses functions to local governments while maintaining central oversight. The central government gives local officials discretionary powers to encourage their initiative, and then monitors the results. The TMG makes policy recommendations and often secures concessions from the central government. Local officials have leverage because they have their own political constituencies and the central state depends upon them to implement national policies (Muramatsu 1997a; 1997b).

The geography of innovation. Just as when a child struggling to take its first step on its own instinctively reaches out for the hand of its mother, the tension between independence and interdependence is an inherent part of human life. How a society balances the two conflicting needs says a lot about its ethos and mode of functioning. In "The Geography of Thought,"

Richard Nisbett demonstrates how differences in Aristotelian and Confucian ways of thinking live on today in the minds of college students in the USA and East Asia. The same can be said about the geography of innovation. The U.S. celebrates independent, individualistic, elite, "big brain" innovative behavior. Japan values interdependent, collaborative, participatory "small brain" solutions. But the inherent tensions between independence and interdependence live on in both societies. [85]

Figures, Maps and Tables

Figure 1: Percent shares of manufacturing and services in GDP, 1995-2000



Source: OECD, *National Accounts*.

Figure 2: The Product Pull System

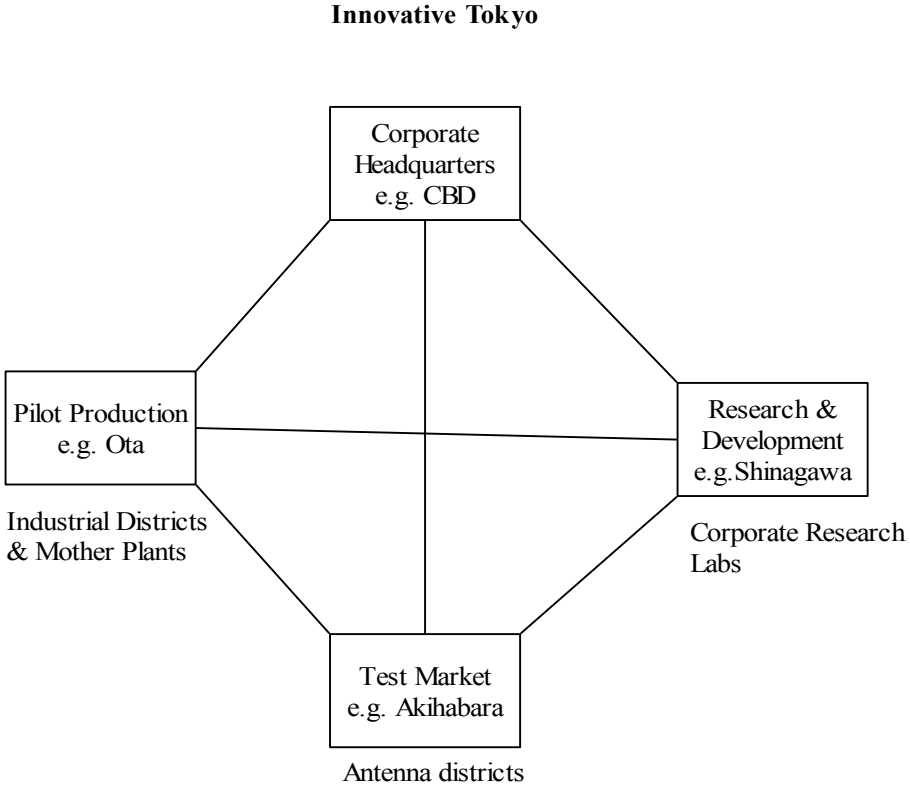


Figure 3: Spatial Image of Innovative Tokyo

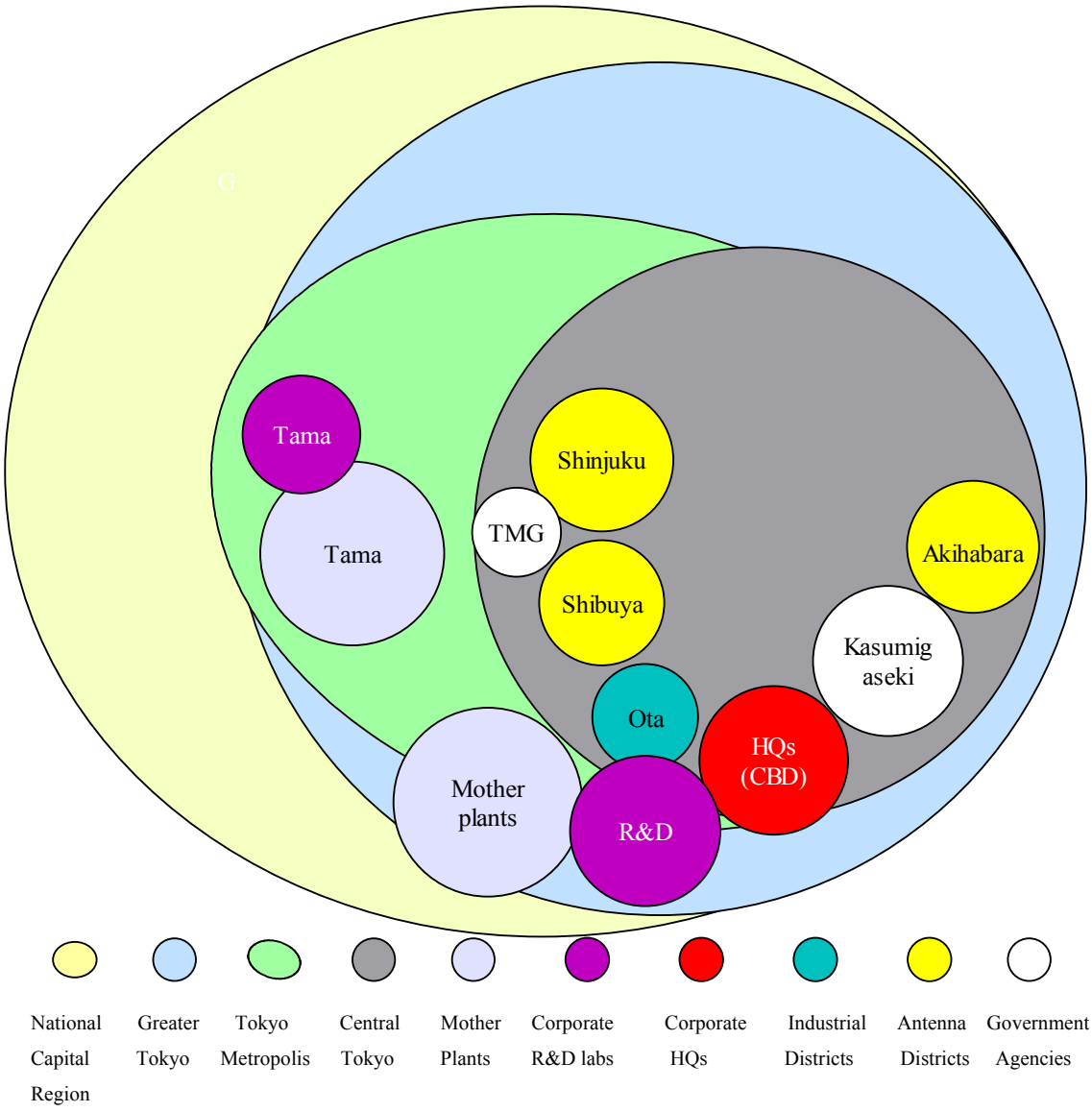
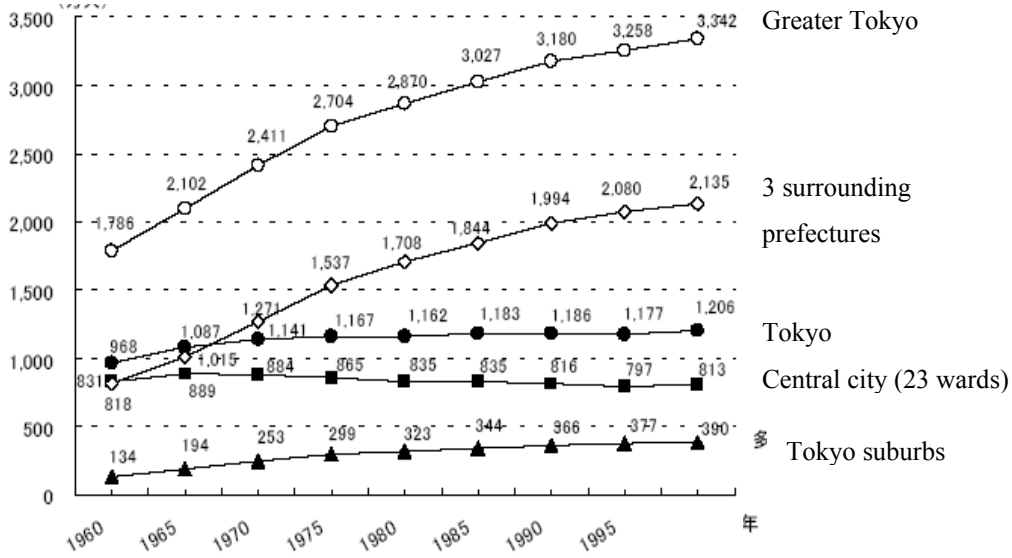
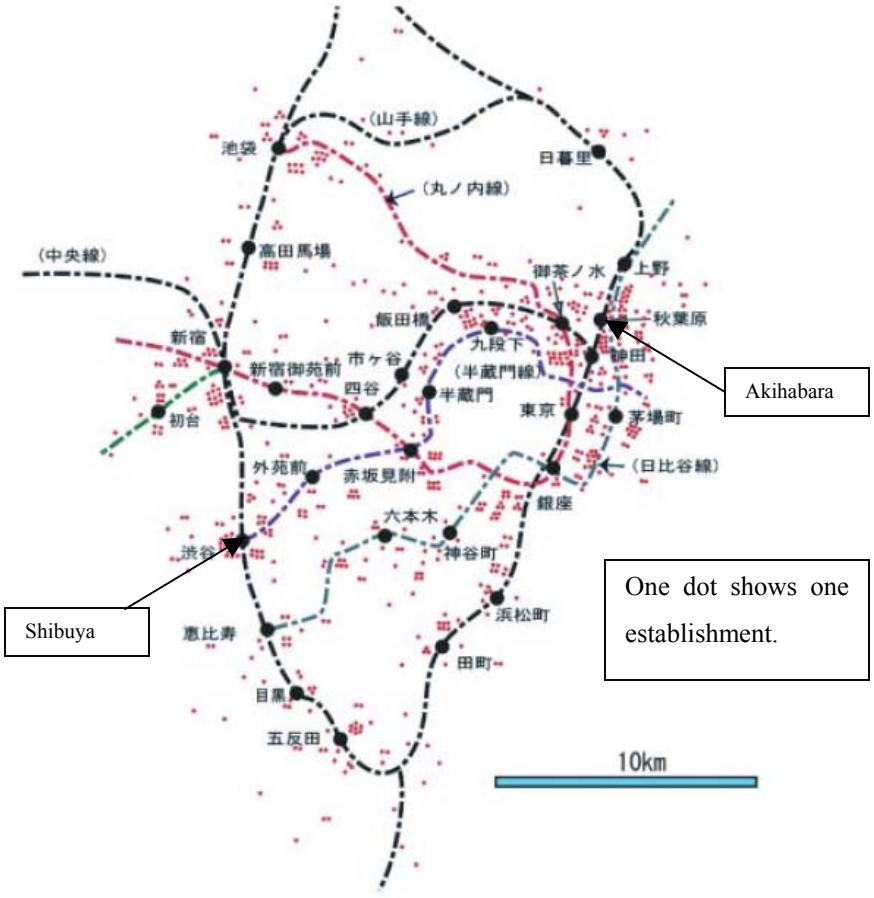


Figure 4: Population changes in Tokyo, Tokyo's Central City, and Greater Tokyo, 1965 and 2000



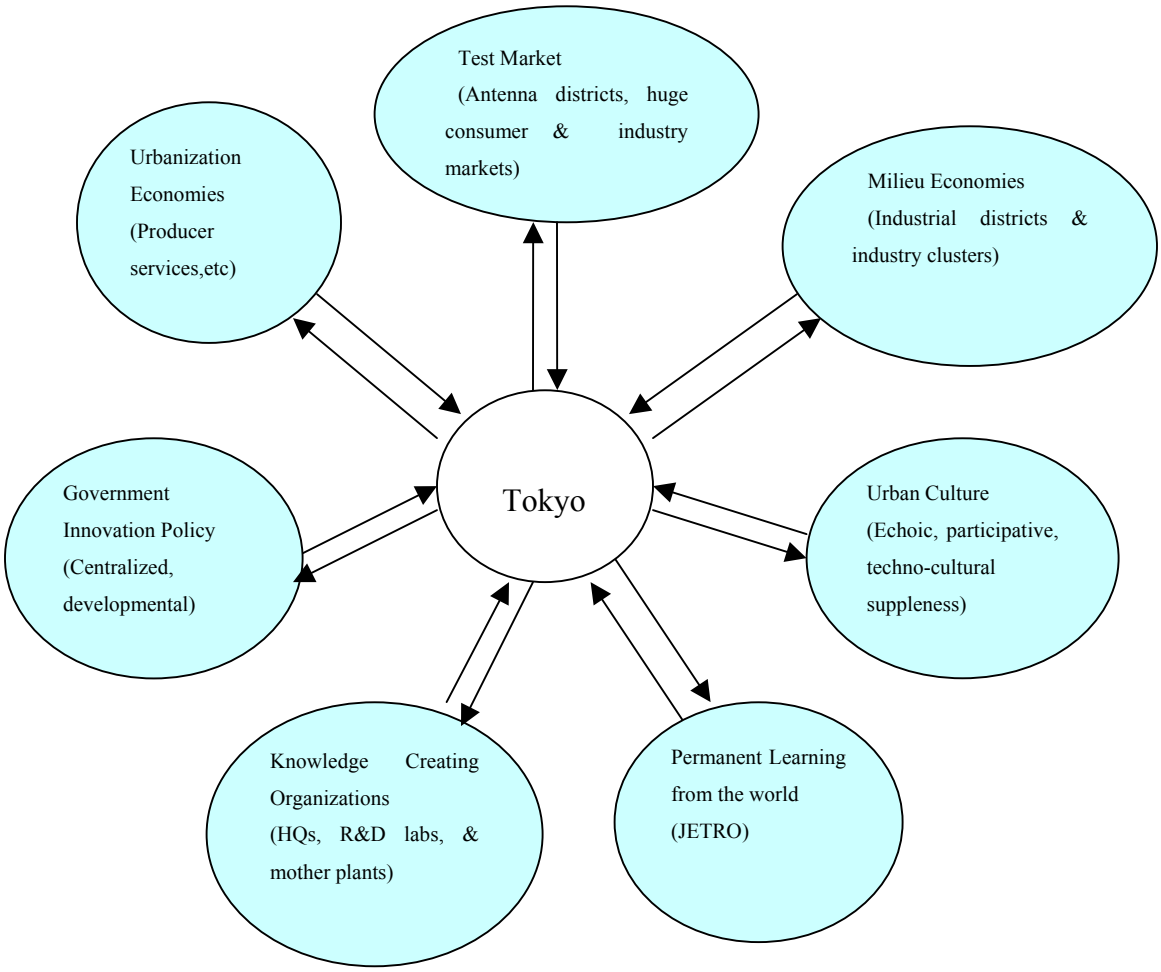
Source: Tokyo Metropolitan Government, *Urban White Paper on Tokyo,* 2003.

Figure 5: Opening Rates of IT Software Firms around JR Yamanote-line
Between March and September 2002

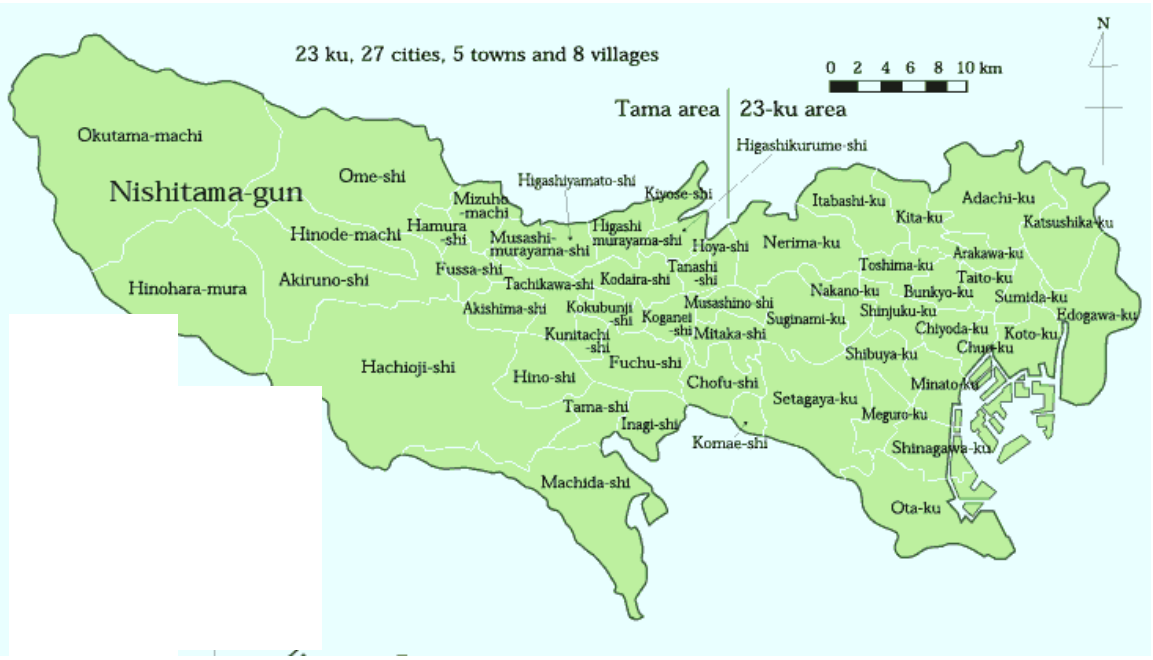


Source: Ministry of Land, Infrastructure and Transport, *White Paper on the Capital Region*, Tokyo, 2003, p. 58.

Figure 6: Factors Supporting Innovative Tokyo



Map 1: Tokyo


23 ku, 27 cities, 5 towns and 8 villages
0 2 4 6 8 10 km
N
Tama area
23-ku area
Okutama-machi
Nishitama-gun
Ome-shi
Higashiyamato-shi
Kiyose-shi
Higashikurume-shi
Mizuho-machi
Hamura-shi
Hinode-machi
Musashi-murayama-shi
Higashi murayama-shi
Hoya-shi
Nerima-ku
Itabashi-ku
Kita-ku
Adachi-ku
Katsushika-ku
Arakawa-ku
Toshima-ku
Taito-ku
Hinohara-mura
Akiruno-shi
Fussa-shi
Tachikawa-shi
Kodaira-shi
Tanashi-shi
Nakano-ku
Bunkyo-ku
Sumida-ku
Akishima-shi
Kokubunji-shi
Koganei-shi
Musashino-shi
Suginami-ku
Shinjuku-ku
Edogawa-ku
Kunitachi-shi
Mitaka-shi
Chiyoda-ku
Koto-ku
Fuchu-shi
Shibuya-ku
Chuo-ku
Hachioji-shi
Hino-shi
Chofu-shi
Minato-ku
Setagaya-ku
Tama-shi
Inagi-shi
Meguro-ku
Komae-shi
Shinagawa-ku
Machida-shi
Ota-ku

Map 2: Tokyo, Greater Tokyo, and National Capital Region

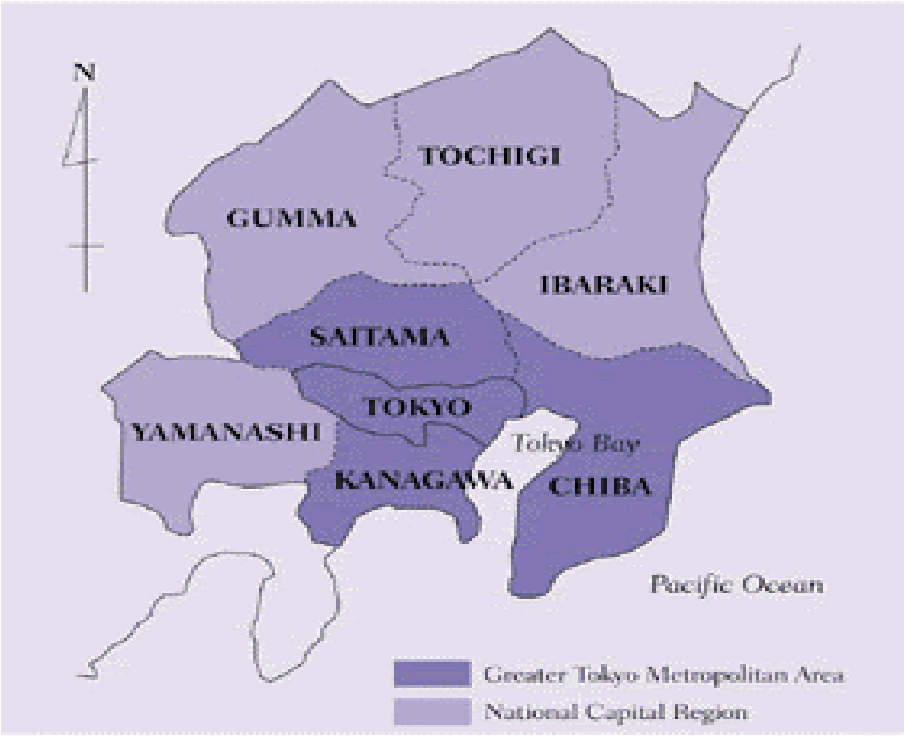


Table 1: Population, Workforce, Occupation, Enterprise Head Offices and Students in Higher Education: Tokyo's Central City, Tokyo Metropolis, Greater Tokyo, National Capital Region and Japan

	Central City (23 wards)	(a) Tokyo Metropolis	(b) Greater Tokyo (a) + 3 Pref.*	National Capital Region (b) + 4 Pref.*	Japan
Population (millions)	8	12	33	42	127
(percent share)	(6.3%)	(9.5%)	(26.0%)	(33.1%)	(100%)
Workforce (millions)	7	8.5	24	28	62.9
(percent share)***					
(11.1%)	(11.1%)	(13.5%)	(38.2%)	(44.5%)	(100%)
No. of Business Establishments	587,000	725,000	1,508,000	1,191,000	6,350,000
(percent share)	(9.2%)	(11.4%)	(23.8%)	(30.1%)	(100%)
Enterprise Head Offices	35,032	39,572	64,988	75,140	217,047
(percent share) in 2001	(16.1%)	(21.0%)	(30.0%)	(34.6%)	(100%)
No. of corporations with capital of more than 100 billion yen in 1998		682	759		1,255
(percent share)		(54.3%)	(60.5%)		(100%)
Percent share of students in higher education		23.6%	39.2%	42.8%	(100%)

*3 prefectures include Kanagawa, Saitama and Chiba around Tokyo.

**4 prefectures include Gunma, Tochigi, Ibaraki and Yamanashi surrounding greater Tokyo.

***At place of work

Sources: Statistics Bureau, *Population Census in 2000*; *Jigyosho.Kigyo tokei chosa hohkoku (Survey on Establishments and Enterprises in 2001)*

; Kagaku gijutsu hakusho (White Paper on Science and Technology in 2002), Tokyo, Japanese Government; TMG, *Urban White Paper on Tokyo in 2002*, p. 14

Table 2: Percent distribution of jobs by occupation at place of work and place of residence: Tokyo's central city (23 wards), Tokyo, greater Tokyo, national capital region and Japan

	Central City (23 wards)	Tokyo	Greater Tokyo (3 prefectures only*)	National Capital Region (4 Prefectures only**)	Japan
At Place of Work					
Production	16.8	18.4	30.3	34.5	29.2
Professional & technical	16.5	16.8	16.7	12.1	13.5
Managerial	4.2	3.9	2.5	2.5	2.9
Clerical	27.6	26.1	19.5	16.9	19.2
Sales	19.8	19.0	13.7	12.4	15.1
Services	8.2	8.6	8.6	8.7	8.8
Security	1.5	1.5	1.7	1.2	1.6
Agriculture, forest & fishery	0.1	0.3	5.1	7.9	5.1
Transport & Telecommunication	3.0	3.1	3.0	3.3	3.5
Unclassified	2.3	2.3	1.7	0.5	1.1
Total %	100.0	100.0	100.0	100.0	100.0
Total No (in million)	7.0	8.5	8.5	4.0	62.9
At Place of Residence					
Production	20.1	20.9	26.5	34.0	
Professional & technical	15.9	16.6	14.4	12.1	
Managerial	3.9	3.7	2.9	2.5	
Clerical	23.4	23.2	21.9	17.2	
Sales	18.1	17.6	16.2	12.6	
Services	10.8	10.3	8.5	8.6	
Transport & telecommunication	3.3	3.2	3.6	3.4	
Safety	1.2	1.4	1.8	1.3	
Agriculture, forest & fishery	0.2	0.5	2.5	7.8	
Unclassified	3.1	2.8	1.7	0.5	
Total %	100.0	100.0	100.0	100.0	
Total No. (in million)	4.2	6.2	10.8	4.0	

*3 prefectures include Kanagawa, Saitama and Chiba surrounding Tokyo.
**4 prefectures include Gunma, Ibaraki, Tochigi, and Yamanashi around greater Tokyo.
Source: Statistics Bureau, *Population Census 2000.* Tokyo. 2003.

Table 3: Percent distribution of industries by establishments (A) and by jobs (B):

Tokyo's Central City, Tokyo, Greater Tokyo, National Capital Region, and Japan in 2001

	Central City (23 Wards)		Tokyo Metropolis		Japan	
	A	B	A	B	A	B
Construction	5.6	5.8	6.5	5.9	9.6	8.2
Manufacturing	11.8	12.2	10.9	12.8	10.3	18.5
Utilities	0.1	0.5	0.1	0.5	0.2	0.5
Transport & telecom.	4.2	6.7	3.9	6.5	3.0	6.2
Wholesale, retail trade, restaurants & water trades	40.9	30.9	40.8	30.8	41.0	29.3
Finance & insurance	1.7	5.0	1.7	4.6	1.6	2.8
Real estate	6.7	2.7	6.7	2.6	4.6	1.5
Service	28.6	33.3	29.1	33.6	28.8	29.3
Agriculture, forest & fishery	0.0	0.0	0.0	0.0	0.3	0.4
Government & Others	0.4	2.9	0.3	2.7	0.6	4.5
Total %	100.0	100.0	100.0	100.0	100.0	100.0
Total No. (in 1,000)	587	7,135	725	8,609	6,350	60,158

Source: Statistics Bureau, *Jigyosho.kigyo tokei chosa houkoku* (Survey on Business Establishments and Enterprises in 2001). Tokyo. 2002.

Table 4: Industrial Districts of Tokyo: Ota and Sumida

	Ota	Sumida	Tokyo	Japan
Total no. of establishments	35,367	19,342	724,769	6,350,101
Total no. of jobs	327,584	167,811	8,608,794	60,158,044
Manufacturing establishments	7,117	5,658	79,374	650,950
(Percent share in the total establishments)	(20.1%)	(29.3%)	(10.9%)	(10.3%)
Manufacturing jobs	73,676	43,480	1,097,984	11,126,145
(Percent share in the total jobs)	(22.5%)	(25.9%)	(12.8%)	(18.5%)
Manufacturing establishments with fewer than 4 employees	4,145	3,651	44,158	319,277
(Percent share in manufacturing)	(58.2%)	(64.5%)	(55.6%)	(49.0%)
Manufacturing jobs in establishments with fewer than 4 employees	9,953	8,584	106,193	765,822
(Percent share in manufacturing)	(13.5%)	(19.7%)	(9.7%)	(6.9%)

Source: Statistics Bureau, Jigyosho.kigyo tokei chosa houkoku (Survey on Business Establishments and Enterprises in 2001. Tokyo. 2002.

Table 5: Average Annual Household Income in 1999: Central City, Tokyo, Greater Tokyo, National Capital Region and Japan

	Central City (23 wards)	(a) Tokyo Metropolis	(b) Greater Tokyo (a) + 3 Pref.*	National Capital Region (b) + 4 Pref.*	Japan
Annual Income*** (1,000 yen)	6,502	6,592	6,860	6,849	6,494

*3 prefectures include Kanagawa, Saitama and Chiba around Tokyo.
**4 prefectures include Gunma, Tochigi, Ibaraki and Yamanashi around greater Tokyo.
*** Based on total households (including single person households)
Source: Statistics Bureau, Kenmin Keizai (Economic Conditions of Prefectures).

Table 6: TMG's Corporate Income Tax Revenues by Industry, 2001

	Taxable Income (1 million yen)	Percent Shares
Total	8,620,822	100
Manufacturing	2,075,887	24.0
Wholesale, retail trade	1,910,211	22.1
Services	1,808,722	20.9
Transport, telecommunication	979,798	11.4
Real estate	554,525	6.4
Finance	372,216	4.3
Construction	326,022	3.8
Others	612,078	7.1

Source: Tokyo Metropolitan Government, Bureau of Taxation.

Table 7: Percent Shares of Industrial R&D investment by Industry and Universities & Public Research Institutes, 1999

	Industry	Universities, Public Institutes & Others	Total National Spending on R&D	Government's Assistance to Industry R&D in GDP
Japan	73.1	26.9	100	0.07
USA	71.6	28.4	100	0.27
Germany	66.2	33.8	100	0.135
UK	53.9	46.1	100	0.135
France	53.4	46.6	100	0.135

Source: OECD, Basic Science and Technology Statistics.

Table 8: Who Pays R&D Costs? Percent Distribution of R&D Among Industry, Universities, and Public Research Institutes, 2001

R&D cost bearers / R&D carriers	Government	Industry	Non-Japanese	Total
Industry	1.4	98	0.5	100
Non-profit & public Research institutes	90.6	9.3	0.1	100
Universities	50.9	49.1	0	100
Total R&D spending	21	78.6	0.4	100

Source: Statistics Bureau, Statistics on Japan's Science and Technology Research, Tokyo. 2003. http://www.stat.go.jp/data/kagaku/4-03.htm

Table 9: Percent Distribution of R&D Spending by Sectors and Research Categories*, 2001

	Basic Research	Applied Research	Development Research	Total
Total Spending	14.6	23.4	62	100
Industry	5.8	20.4	73.9	100
Non-profit & public Research Institutes	28.3	26.7	44.9	100
Universities	53.5	37.5	9	100

*Based on R&D spending on natural science only.
Source: Statistics Bureau, *Statistics on Japan's Science and Technology Research*, Tokyo. 2002.

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Endnotes

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[1] Whether such a demonstration effect is objectively justified or not has become controversial after the crash of the U.S. stock market in early 2000, stagnant employment growth since then, and findings that at least half of the upsurge in U.S. productivity in the 1990s was due to the performance of "older era" rather than "new economy" style companies (Nordhaus 2004: 30). Controversy notwithstanding, the myriad attempts among localities in various parts of the world to "clone Silicon Valley" is well documented (Rosenberg 2002).

[2] Following the European Commission's Directorate XIII, Simmie (2001: 1-2) defines innovation as "the commercially successful exploitation of new technologies, ideas or methods through the introduction of new products or processes, or through the improvement of existing ones" and he assumes innovation results from "an interactive learning process that involves several actors from inside and outside the companies". We employ the same definition of innovation in this study.

[3] Firms also agglomerate because of the internal economies of scale accruing to individual companies.

[4] “Third Italy” refers to the central and northeast Italy, including Venice, Bologna, and Florence. First Italy comprises the old industrial areas defined by Milan, Turin, and Genoa. Second Italy is predominantly the agricultural south.

[5] The researchers conducted sample interviews with innovative companies in each of the five cities and investigated a variety of supplementary materials.

[6] According to the authors, a national urban system consists of cities of various sizes and functional bases, and a national system of innovation structures the ability of cities, at each level of the urban hierarchy, to respond to national and international competitive opportunities. The stronger the performance of the national innovation system and the higher the city ranks in the national urban hierarchy, the more the city's environment facilitates innovative activity among resident firms.

[7] The Japanese corporate governance system has changed quite a bit, but the changes are home grown and do not mimic the American model.

[8] The corporate governance system is changing in Japan. Main banks have been selling shares in their keiretsu affiliated corporations to cleanup nonperforming loans and to conform to new accounting standards. And many Japanese corporations listed on the Tokyo Stock Exchange have been buying back their own shares unloaded by banks. The cross-shareholding system may be shrinking but whether this will force Japanese corporations to replace their emphasis on employees (the corporate community) with shareholder value remains to be seen.

[9] After a decade of flat domestic economic growth, most large Japanese companies still retain their life time employment systems. Instead of firing their employees, corporations have adopted various employment policies,

including early retirement, freezing new hiring, reallocation of employees within the keiretsu group and work-sharing programs.

[10] Between 1980 and 2003, Japan's growth rates in industrial patents revenues rose from 12 to 21 percent (Broad 2004).

[11] Matsushita did this in the VCR market and Compaq with PCs (Boulton 1995: chapter 3, section 3, p. 5).

[12] Sharp's transfer of liquid crystal display (LCD) technology to home entertainment and medical equipment is an excellent case in point.

[13] Employment in services was 63.9% in Japan in 2000 compared to 75.2% in the US; 73.4% in the UK; and 62.6% in Germany (OECD 2001b).

[14] As compared to 14% in the US, 16.5% in UK and 24.1% in Germany (OECD 2001b).

[15] Not all Japanese transnational corporations are headquartered in Tokyo, of course, but many who are not, like Toyota Motor Corporation, maintain internationally oriented head office functions in Tokyo. Toyota also has a Design and Styling Research Center in Tokyo to take advantage of the city's test markets.

[16] Interview with Sony CSL researchers on August 29, 2003.

[17] Tokyo's central business districts (CBD) are the prime location for corporate head offices. Chuo-ku houses 16.1%; Chiyoda-ku 14.2%, and Minato-ku 14.3% of Tokyo head offices in manufacturing, services, finance & insurance, and telecommunication & transport (TMG 2002b: 135).

[18] Fuji Electric, Mitsubishi Electric, Yaskawa Electric, Alps, Yokogawa Electric, and IBM Japan, are also headquartered in Tokyo.

[19] The survey was done by Japan Policy Investment Bank between July and December 2001. The survey covered 208 manufacturing firms, of which 25% were in the electrical machinery and 14% in the auto industry (METI, MHLW and ME 2003: 90).

[20] Tokyo's industry, population, higher education and commerce continue to decentralize to greater Tokyo and national capital region while Tokyo's central city continues to attract corporate head offices (MLIT 2003a: 21).

[21] According to Nishiguchi (1994: 214) the Japanese implemented their networking strategy through a number of institutional innovations in subcontracting between 1960 and 1990, including joint pricing through value analysis, joint designing through value engineering, profit-sharing rules, resident engineers, quality-grading schemes, and just-in-time delivery conditioned by bonus-penalty programs.

[22] The number of manufacturing plants in Ota-ku peaked at just over 9000 in the early 1980s, then fell incrementally to a low of 6000 in the late 1990s, but has recently begun rising again. (METI 2002).

[23] Ota's tight woven community and shared artisan knowledge go back to the district's origins as a fishing village, where men collaborated to cast their fish nets and women to dry seaweed. "For Ota people, the factories are not just a workplace, they are the foundation that holds things together," Tessai Sako, a former government official who grew up in the neighborhood, has been quoted as saying (Beech 2000).

[24] Adding to Ota's woes, easy loans made during the bubble years suddenly came due. And with Japan's population growth at a record low, there are fewer young people to take over family businesses and assume craft jobs.

[25] Interview with officials at TMG Small Business Promotion Center on Sept 3, 2003.

[26] The O-net has also set up a web site, "International Call," where any member company can put an advertisement to sell products or propose a joint venture. International Call links Ota member firms to global business organizations—including the Global Management Center Trade Information network (run by the Global Commerce Consortium), TradeMatch (run by a British information provider, and World Access Network Direct.

[27] Douglass McGray (2002), the author of the article, "Japan Gross National Coolness", mentioned it in his speech in Tokyo (Nikkei Net 9 November 2003).

[28] Antenna districts also possess the greatest variety of entertainment: movie theaters, discos, underground and experimental theaters, opera and music halls, art galleries, jazz bars, ethnic restaurants and popular coffee houses.

[29] In the 1860s, Japan was forced to open up to the world after two centuries of cultural isolation. Japan was the first nation in Asia to industrialize and the results were catastrophic: imperial expansion to obtain the requisite raw materials to feed the industrial machine, decades of war mobilization to sustain the imperial drive, crushing military defeat, and occupation by a foreign, Western power. These temporal dislocations gave birth to the "techno-cultural suppleness that delights, disturbs and fascinates the world about Japan today," says Gibson.

[30] Interview with H. Watanabe, NEC Laboratories, Tokyo, September 4, 2003.

[31] For example, *Newtype Magazine* has been a magnet for anime otaku in Japan. The magazine's title is taken from the anime epic, "Mobile Suit Gundam" in which Newtypes were pilots of giant mechanical robots with psychic powers. The magazine and its readership thus identify with a new, more highly skilled breed of humanity (Ruh 2002). Otaku has contradictory images and implications. One image is that of an acquisitive, anti-social recluse. Another, more positive view, is of a "liminal traveler" who departs into fantasy worlds to obtain knowledge and growth. For William Gibson (2001), otaku is a sign post for the future, an intelligent way of comprehending the ever escalating flow of information, and one key to understanding the culture of the worldwide web (Ruh 2003).

[32] Interview with H. Karatsu, Tokay University, Tokyo, September 1, 2003.

[33] Echoic cities like London (and Tokyo, we believe) are living, breathing organisms with their own laws of growth, argues Ackroyd. Such cities are subject to a "territorial imperative" in which certain areas "seem actively to guide or to determine the lives of those who live within their bounds. In that sense all its previous existences exist simultaneously, engendering a power that links the present with the past." (Ackroyd 2001: 2-3).

[34] Sony, for example, first came out with VTR technology in the 1970s and wanted to produce everything on its own. But Victor challenged Sony with its own VTR technology. The two companies decided to get together and created a product platform, and let other consumer electronics companies make their own VTR brands. Victor earned 100 billion yen by selling the VTR as intellectual property to other companies. Victor followed this strategy because the company didn't want to invest heavily in mass production facilities (Interview with H. Karatsu, Sept 1,

2003). The same process applies to DVD, which became a hit product in 2001 after Matsushita sold its DVD technology platform to other companies. Sometimes the central government gets involved, as with high definition television in the 1990s, in creating the standard platform. The government disseminated HDTV findings by state-led research consortiums to the leading electronics companies in Tokyo and Osaka.

[35] IT related industry consists of Internet, software and information data services.

[36] 90 percent of Japan's IT firms were in the Internet business.

[37] Soho entrepreneurs come from various industries, including information technology services, manufacturing, and banks. They have organized themselves to achieve a better tax and insurance system and lower cost telecommunications.

[38] Videogame software industry clusters are located in Tokyo's east (covering Sumida, Koto and Katsushika), Tokyo's central part (Akihabara, Ginza, Akasaka and the ring of the Imperial Palace moat), the area along the northern Yamanote rail line between Shinjuku and Ikebukuro, the area along the southern Yamanote rail line between Shinjuku and Gotanda, and in Tokyo's suburban cities along the Chuo rail line (including Suginami ward, Musashino city, Koganei city and Kunitachi city).

[39] Tokyo also accounts for 41% of Japan's radio station sales; 49% of TV station sales; 100% of satellite broadcasting head offices; 59% of video software makers; 67% of game consoles and game software makers; and 30% of Internet providers (TMG 1999).

[40] Basic research in universities is also funded by NIH, NSF and the Pentagon. MIT and 350 other American universities and colleges, for example, receive more than 60% of defense basic research funding (Turse 2004).

[41] Nano refers to one-billionth of a meter. Nanotechnology—often called the manufacturing technology of the 21st century—is expected to revolutionalize essentially all manufactured products, from computers to medical instruments to solar cells to batteries to planes and rockets. See Watanabe on Japan's promoting nanotechnology as a national strategy (Watanabe 2001).

[42] One METI official said that Japanese university professors should be more like Americans who take risks and are not afraid of failure. The stigma of failure is very strong in Japan and banks won't lend money to those who have failed. But he thinks that professors should be "a little bit more risk taking." He advocates creating supporting environments within which professors can take risk—"the Japanese way of risk taking." He said the American way won't work in Japan. He also said that there were many people who emphasized the American way of doing business in METI (Interview on Sept 2, 2003).

[43] The government created 33 TLOs between 1998 and 2002. License applications to TLOs grew to 3,980 and university ventures under TLO programs grew to 531 (METIa 2003). The number of joint researches between national universities and industry has also increased from 2,632 in 1997 to 5,264 in 2001 (METI, MHLW, and ME 2003: 262).

[44] The 2003 government budget expended 3.6 trillion yen on science and technology; of that, sixty-four percent went to the Ministry of Education for R&D in universities and research institutes. In the 2004 budget, METI

is targeting the four frontier technology areas through its "Focus 21" R&D projects, which are geographically scattered throughout Japan, and overseen by METI's regional bureaus (METI 2003a).

[45] By 2002, it included about 100 public R&D institutes and 970 researchers.

[46] The TAMA Industrial Vitalization Council, which began in 1998 with 328 members (193 companies, 22 universities and 17 local government administration units), grew by 2001 to 590 members (290 companies, 34 universities and 20 local government administration units) (Okazaki 2003:7).

[47] The government renewed Tsukuba's growth plan. The city is now expected to expand to 350,000 residents.

[48] See more on http://www.kankeiren.or.jp/lifesci/bio/bio_04.html

[49] The Ministry of Education promotes its own "13 Intelligent Clusters" program (ME 2003). The Kyoto Cluster that emphasizes R&D on nanotechnology, for example, consists of three Kyoto universities (Kyoto, Kyoto Crafts and Textile, and Ritsumeikan), and a group of Kyoto based high tech companies. It was formed in 2003 to conduct joint research on nanotechnology and facilitate the transfer of research findings to the private sector. The research areas include nano basic technology, nano processing, nano bio fusion devices, and nano optical and electronic devices. The long term objective is to revitalize Kyoto's manufacturing base through the application of nanotechnology.

[50] The IP Promotion Center's services are divided into two major businesses: one covers general business consultation; Patents, design and trademarks; Contracts and dispute courts; and technological problems which can be consulted with certified technology specialists. The other provides seminars and forums to promote IP rights and data-based information on patents. Seminars and forums are offered in cooperation with chambers of commerce and industry, ward government offices, and informal study groups. Information on patents is also offered by using Japan Patent Agency's data base.

The Center engaged in over 1,000 consultations between April and September 2003, of which 60 – 70% concerned patents; 10% designs; and another 10% trademarks (Interview with officials at TMG Small Business Promotion Center on Sept 3, 2003).

[51] When individuals actually apply for patents, the Center introduces them to lawyers and covers part of their patent application costs.

[52] Interview with officials at TMG Small Business Promotion Center on Sept 3, 2003.

[53] According to TMG officials, the Urban Renaissance Headquarters was created by request from TMG. They mentioned the close relations between Governor Ishihara and Prime Minister Koizumi. A few TMG bureaucrats were sent to the Headquarters Office to work with central government officials. This Headquarters Office will be reevaluated in 10 years. It is not a permanent agency (Interview with TMG officials on Sept 5, 2003). See also http://www.kantei.go.jp/singi/toshisaisei/

[54] The Emperor system derives from Shinto-ism, Japan's oldest religious tradition, and her egalitarian ethic melds Shintoist and Confucian beliefs.

[55] "Bakufu" refers to government, as does "Shogunate", and both are used interchangeably in the discussion that follows.

[56] The urbanizing effects of international trade intermingled with the urban system carved out during the feudal Edo era to produce a unique set of rank size relations among Japanese cities. Japan's system of cities corresponded neither to the classical rank-size rule nor to primacy or bi-primacy patterns. Rather, Japan has two sets of twin cities—Tokyo/Yokohama and Oska/Kobe—with a third metropolis, Nagoya, located in the geographical middle between them. A fourth city, Kyoto, the nation's historic cultural capital, is nestled alongside Osaka and Kobe (Nakamura 1993).

[57] The family owned and run zaibatsu companies were eliminated by the Occupation forces and then reborn after the war as corporate management run keiretsu groups.

[58] The state guided, bank based, finance system curtailed capital markets and eschewed deficit based borrowing from overseas. Instead the central Bank of Japan created internal loan funds. To control credit expansion the government prohibited corporations from issuing bonds. Bond issue privileges were mainly granted to long term credit banks and utilities specifically designed to finance public purpose, long term projects. Corporations thus had no choice early on but to borrow from banks (Ozawa 2002). The government's postal savings system was also a mechanism for channeling domestic savings into business investment instead of into consumer credit.

[59] Japan fought 10 major wars between 1868 and 1945 covering a total of thirty years. As Japan took control of Korea, then Manchuria and finally a large part of Asia, military expenditures reached huge proportions, averaging 10 percent of GNP between 1886 and 1945, and over 12 percent between 1915 and 1945 (Morishima 1982: 137).

[60] Osaka's share of the nation's manufacturing was twice Tokyo's in 1920 but Tokyo surpassed Osaka in the late 1930s.

[61] Chalmers Johnson (1987: 145) suggests Japan's activist, developmental state can be defined by four elements: (1) stable rule by a political-bureaucratic elite strong enough to deter rent seeking that would undermine economic growth; (2) cooperation between public and private sectors under the overall guidance of a pilot planning agency; (3) sustained public investment in education for all citizens and the equitable distribution of returns from high speed growth; and (4) a government that respects and uses methods of economic intervention based upon market incentives, including most especially, we would add, product cycle modeled industrial policies. The Japanese state demanded performance standards from business groups in exchange for subsidies and protection from foreign competition. The process was reciprocal and developmental because the state was strong enough to impose productivity and investment norms on enterprises receiving public support (Johnson 1982: 318).

[62] Learning based catch up isn't new, but East Asia is distinctive in that leader and follower nations have more deliberatively and cooperatively engaged in regional growth and the growth process has been more multi-layered among nations in the region (Ozawa 2002).

[63] For example, in the corporate mother plants, engineers work closely with assembly line workers to raise product quality and lower production costs. Designing the process for making the product is as important as designing the product; there is, in fact, a counterpoint between the two. Often a product must be changed to achieve a process goal, making it easier to assemble or easier to test for defects (Whitney 1995). Only when product and process have reached quality and cost standards are "mass production" factories opened. Such factories from the beginning can produce high-quality, low-cost goods in large quantities (Huber 1994: 83-84).

Huber illustrates how designing perfect factories, not just perfect products, can have dramatic results. Between 1972 and 1980, the time required to assemble a Japanese color television set fell from six hours to one and a half hours. At the same time, the number of defects was greatly reduced. This was achieved by reducing the number of components in a set, by increasing automation of component insertion, by reducing the number of circuit boards in a set, and by configuring components to allow automation of testing for defects. In other words, "by contrapuntal redesign of a product and process by engineers elbow to elbow with workers on the factory floor (1994: 84).

[64] Hall (1998: 482) finds precedents for this approach to innovation in late 19th century Germany, an early model for Japanese industrialization, and in the USA in the Cold War period. But American attempts at technological leadership were never so systematic or comprehensive or, ironically, so market driven, as the Japanese.

[65] Why does the "bureaucratized model" need an urban support system, asks Hall (1998: 497)? "IBM stood alone in its remote upper New York state headquarters because it "internalized its externalities". But even with off shore production to other regions and countries, Japanese corporations continue to "lock both administrative control and R&D into the Tokyo innovative milieu." Perhaps there are wider synergies within the Japanese urban innovative system that Western researchers have failed to penetrate, Hall queries? This is precisely the question we attempt to answer in this study.

[66] The functions and capabilities of digital appliances depend upon the development of proprietary semiconductors and the embedded software capable of displaying characters on screen and storing and managing data. Japanese corporations have extensive experience in developing semiconductors through products like electric appliances and video game consoles, and the domestically created ITRON operating system is coming to be used in the embedded software for digital appliances. (Foreign Press Center/Japan 2004a).

[67] The U.S. share of the total comes to $960 billion or 42.8 percent. This accounts for the predominant focus on the USA as a model of the creative industries.

[68] The creative economy argument has been most vigorously promoted by British and American writers. This is one indication that the Anglo-American notion of creativity may be insufficiently robust to encompass Japanese understandings of knowledge creation.

[69] As Howkins (2001) tells it, the definition of creative industry originated in Australia then was given a boost in the late 1990s by the UK Department of Culture, Media and Sport (DCMS) and its "Creative Industries Task Force." The UK DCMS is responsible for culture and media and wanted to highlight their contribution to the

British economy but the narrowing was problematic. "According to DCMS," says Howkins, science is not creative. Advertising is but not marketing. Craft making, small scale manufacturing, is creative. This is confusing "jargon" and violates common sense," concludes Howkins.

[70] An even higher, 80 percent, portion of the animation played in Europe comes from Japan (METI 2003b: 260).

[71] See Toei Animation Co. Ltd's web site http://www.toei-anim.co/jp

[72] For example, the U.S. was the center of the game industry throughout the 1970s, but after the launch of the "Family Computer" by Nintendo in 1980, both the games hardware and software markets have been led by Japanese manufacturers (Nakamura 2004).

[73] Animation, comics and video games account for 10 percent of Japan's media entertainment market, and for 30 percent if character products are included (METI 2003c: 260).The comic book industry has 4,000 writers and 28,000 assistants. Two of the largest sellers of comics, Shonen magazine and Shonen Jump, both publish 3.5 million issues a week. Tokyo is also home to sixty-five percent of the videogame industry, consisting of 147 companies employing a workforce of 18,500. (Nakamura 2004).

[74] The Nerima-Suginami cluster began when the former employees of Toei animation, the largest animation company in Tokyo, and headquartered in the Nerima ward, were fired in a 1972 labor dispute over rationalization, and they started up their own businesses (METI 2003c).

[75] Studio Ghibli's web site offers a diary on the production process of Princess Mononoke from 1994 to1997. http://www.ntv.co.jp/ghibli/mononoke.html

[76] By 29 percent between 2000 and 2003 (NikkeiNet 2004 9 April)

[77] The study group on international strategy consisted of representatives from universities (Tokyo and Waseda), electronics companies (Toshiba and Ushio), publishers (Shogakkan and Kadokawa), broadcasting (TBS), movies (Shochiku), advertising (Dentsu), trading companies (Mitsubishi), animation (Toei), newspapers (Nikkei Keizai), music (Abex), computer entertainment (CapCon), communication (Gaga), international consulting (Boston Consulting Group), the Japan Foundation, and JETRO (METI 2003c). The study group on movies included professors from Tokyo University, Senshu University (in Tokyo), and UCLA, and Japanese and Hollywood movie companies.

[78] For example, the American firm, 4Kids Entertainment, has played a major role in getting Japanese anime into the U.S. market. The U.S. firm acquires rights to broadcast Japanese animated films in the U.S., licenses for the production and sale of character goods, and promotes sales through its wide range of contacts among major American retailers and TV stations. The American publisher, Tokyopop Inc., plays the same role in the U.S. market for Japanese manga. Japanese weakness in the international marketing of digital content reflects the here-to-fore overwhelmingly domestic orientation of Japanese media companies (NikkeiNet 9 April 2004).

[79] The "rise of the creative class" is by no means an unmitigated blessing. By Florida's own admission, members of the creative class are "inward looking and selfish" and have yet to develop a vision of society in which

all citizens can participate and benefit. Individual mobility divides the United States into the "have regions" favored by the creative class and the "have not regions" it abandons (Dreher 2003).

[80] Interview at NEC Laboratories, Sept 4, 2003.

[81] As measured by number of publications and citations, IP and patent applications, invitations to give lectures, and influence in the researcher's discipline. As in universities, researchers submit their plans for the coming year and pay is based upon meeting mutually agreed upon performance goals. If they don't meet expected performance levels, they are asked to leave Sony CSL and given a year's notice to assist them in finding new employment. Publication in Japanese is not valued as much as publication in prestigious international journals, like *Nature* and *Science*. (Interview with the Sony CSL director on August 29, 2003).

[82] Interview with the Sony CSL director on August 29, 2003.

[83]The application of nanotechnology to the IT, medical and textile industries is a case in point. Tokyo firms are on the verge of harvesting a decade-long investment in nanotechnology, projected to create a 2 trillion yen market by 2005 (Nikkei Net 12 January 2004)

[84] For example, Japanese corporations are producing value added products like 3G cell phones simultaneously in Japan, China, Europe and North America. But R&D centers in overseas markets modify the basic 3G phone technology developed in Japan to fit overseas markets. Overseas R&D labs by no means indicate that Tokyo based cell phone makers, like Fujitsu and Hitachi, will shift the core of their R&D operations outside of Japan.

[85]John Howkins (2001), for example, defines creativity as having a new idea, and having a new idea, he says, must be "personal," meaning "it is yours," it is "owned by the person." Yet elsewhere, Howkins seemingly contradicts himself, claiming that creativity is collaborative and "most ideas are developed in groups." The Japanese emphasize the collaborative nature of creativity, "everyone is in it together." But at the same time, the Japanese are trying to modify their institutions to enable more individual freedom of expression and compensation for individual inventiveness.