*The 3rd International Conference on Business & Technology Transfer
December 9-11, 2006 Tokyo Japan*

“Achieving High Tech Convergence and Parity: US-Japanese Technology Transfer and Business Partnership Since 1980”

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While foreign technology imports encouraged through government policies and business dealings, particularly in conjunction with the United States, greatly aided Japanese technical recovery after World War II, important pathways leading toward high tech convergence, national self-reliance and international parity were also forged and achieved. The robust platform for technology transfer and exchanges that emerged from 1945 into the late 1970s stemmed largely from US Cold War aims to protect, strengthen and promote Japanese industrial and business development as a deterrence to the spread of communism in Asia. As Japanese firms did not pose even an imagined threat to US trade competitiveness in the early Cold War era, Japan gained essential and distinct technical advantages through transfer activities that fostered business parity later between the two countries in the 1980s and beyond. Japan's new status as an equal global competitor also drove subsequent changes in U.S. diplomatic efforts to foster a new framework of bi-lateral relations rooted in partnerships over paternalism.

Resulting changes in US and Japanese patent laws since the 1990s have led to the institutionalization of path-breaking technology transfer agreements fostered by sophisticated, new levels of technical exchange and convergence. While past US-Japanese technical ventures primarily supported consumer manufacturing, today both nations are increasingly involved in sensitive, interdependent ventures involving missile and satellite defense, energy and environmental technologies, and biotechnology. The shift toward the deliberate achievement of interdependent technical and scientific parity signals another significant evolution in US-Japanese relations.

Along with beneficial American policies, postwar technology knowledge development and transfer in Japan grew expeditiously through national efforts to increase internal collaborations among firms, business associations, and government agencies, and in the past decade, with the active participation of universities. This trend toward building an integrated, self-supporting infrastructure for national technological growth and self-reliance has led since the 1980s to new trends in business interactions and technology transfers between Japan and underdeveloped Asian partners. In all, Japan's astonishing technical advance both in the West and Asia has posed additional considerations, and in some circumstances, further concessions on the part of the United States in maintaining bi-lateral technology ventures and sharing. This study looks at the recent strides made by Japan to capture and enlarge its global position in relation to technology transfers and trade and the subsequent business and diplomatic challenges posed to the United States.

JAPANESE PARITY AND AMERICAN REACTIONS

Imitation and dependency dominated over creation and self-reliance in Japan's efforts to catch up with Western nations in the area of advanced technology from 1945 until the 1980s. Until the 1973 oil crisis, government promotion of consumer and electronics manufacturing aided by the aggressive import of foreign technology, especially from the United States, nevertheless allowed Japan to enjoy an astonishing annual economic growth rate on average of 10% for several decades. Technology imports, facilitated by US Cold

War interests to build a strong Japanese domestic economy, proved initially critical as Japan's pre-war manufacturing base had largely rested in military munitions. Swiftly plugging the technology gap then became a joint priority between the United States and Japan resulting in extensive technical assistance programs and technology transfers spurring new industries in such areas as synthetic and petrochemicals, consumer durable goods and electronics, and computer chips and hardware.

The cost of imported technology, however, was steep for Japan at levels 20 times more by the 1980s than that of the 1950s. Of the technology imported, some 80 per cent sat in machinery and chemical industries.¹ While technology imports helped Japan rapidly recover its industrial base and set positive conditions to compete with the West in manufacturing markets, nevertheless indigenous R&D expenditures required to move toward national technological self-reliance sat at only 1.2 % in 1960 of corporate expenditures.²

As in the pre-war Meiji era, the postwar Japanese government took concerted steps along with industry to break the cycle of over-dependence on foreign technology and move to greater self-reliance. Significant strides were made as policies which restricted foreign products imports, industry-wide protective measures, and targeted advanced technology transfers allowed Japanese domestic as well as export manufacturing to surge over Western competitors. The role of the Ministry of International Trade and Industry (MITI) proved the key in disciplining the Japanese manufacturing sector to hold down Western patent and licenses purchases in favor of producing indigenous brands marked by domestic R&D and technology solutions. At first, Japanese firms preferred technology imports over self-reliance as imitation reduced risk and enhanced technological competitiveness against the West in terms of immediate volume in products manufacturing and exports gains. According to Alfred Chandler, the licensing ventures precipitated "an unprecedented transfer of technology [which] permitted the nation [Japan] to adopt new, capitalist intensive processes of production on a scale reminiscent of ... the United States and Europe."³ However, the endless renewal of expensive licenses and innovation hampered by dependence on Western R&D timelines and frameworks led Japanese industries to bind closer by the 1970s to government goals to foster indigenous technologies and capabilities.

Starting in the 1980s then, government and industry interests began to converge around substantial new R&D investments and ventures in high technology gained through basic as well as applied research. By the mid 1980s, Japan's R&D spending encompasses 2.5 per cent of the gross national product, a level only exceeded only by the United States. This commitment to indigenous R&D has transformed Japan from a technically developing nation to a net exporter of technology – a status held by few nations worldwide. However, the reduction of reliance on imported technologies led to a reciprocal need to increase the performance and productivity of firms to balance the additional technology and market development costs. According to the Institute of Investment Economics, Japan's rate of return on R&D in manufacturing industries dropped sharply from 22 per cent in 1965-1982 to 17 per cent in 1970-1982. Similarly,

¹ MITI, *Ko-shu gijutsu-dan chousa houloku* (Reports on Imported Technology), Tokyo: MITI, 1965.

² Agency for Science and Technology, *Kagaku gijutsu hakusho* (White Paper on Science and Technology), Tokyo: Government Printing Office, 1969.

³ Alfred Chandler, *Scale and Scope*, (Cambridge, MA: Harvard University Business Press, p. 617.)

the United States experienced losses in R&D returns from 14 to 16 per cent in the 1960s and 7 to 10 per cent in the 1970s.⁴

The higher cost of technology through development vs. importation as it emerged after the 1980s emerged as a source of concern and debate in Japan in the 1990s through today. While generally Japanese technologies and inventions are viewed by competitors as more adaptive than creative in origin and the end products of more applied than basic research, Japanese technological advances, in terms of global impact, have been profound in certain markets such as consumer electronics and computing. Consequently, Japan has gained parity with the United States and other Western nations in the world patent market and since 1977 its technology export levels have exceeded that of technology imports. As a result, Japan's dependency rate on imported technology fell from a high in 1970 of 16.7 per cent to 10.9 per cent in 1983.⁵ According to the Economic Planning Agency (EPA) in 1985, the surge ahead in R&D efforts by Japanese firms aided by government resulted in a significant and final closure in the historic technology gap between Japan and the US, especially in manufacturing. In a study conducted by the Electronic Association of Japan in 1986, Japan's processing and assembling industries, outfitted with indigenous systems, were operating overall at a comparable level to that of rival American firms and exceeded the United States in such sectors as semiconductor and computer chips production, automobiles, and consumer electronics.⁶

R&D WARS AND RENEWED COLLABORATION

The new conditions of technological and manufacturing parity subsequently forced the United States to repeatedly adjust its diplomatic approaches and business relations with Japan since the 1980s. At risk was not only eroding US market share at home and abroad against comparable, lower priced Japanese products, but also lost business revenues dependent upon Japanese technology imports, licensing fees, and patent purchases. In addition, Japan's growing strength in technology exports and transfer in developing Asian countries also endangered and began to displace American corporate and technological domination in the region.⁷

In terms of loss of technology transfer profits, the U.S. Conference Board reported in 1994 that Japan ranked first in foreign licensing agreements with American manufacturers, comprising double the share when compared with the second ranking country, the United Kingdom. In addition to licensing, U.S. firms also reported in 1994 two to three times the number of joint ventures in Japan than in other countries though only 3.3% of American majority-owned plants had been established concurrent to such agreements.⁸ As Japanese firms engaged in adaptive R&D efforts with high levels of government support, US companies realized fewer and fewer renewals of previously lucrative licensing and patent agreements. As Japanese productivity growth outstripped

⁴ Institute of Investment Economics, Development Bank of Japan, *Henbo sure kenkvuu kaihatsu toushi to setsubi toushi* (Changing Pattern of R&D and Investment), vol. 5-1. July 1984.

⁵ Ibid., vol. 5-1. July 1984.

⁶ Economic Planning Agency, *Current Economy of Japan*, Tokyo: EPA, 1985, pp. 125-134.; Electronic Industries Association of Japan, *Kaigai seisan houjin list*, 1986.

⁷ Saneh Chamarik and Susantha Goonatilake, *Technological Independence - The Asian Experience* (The United Nations University, 2004).

⁸ Charles Taylor and Witold Henisz, *U.S. Manufacturers in the Global Marketplace* (New York: The Conference Board, 1994).

the United States with annual manufacturing rates at a rate of 5% v. 2.5%, American policymakers were also forced to note that aggressive R&D spending had enabled Japan to capture “a competitive advantage in a number of high-technology products.”⁹

A return to protectionism under the Reagan and Bush Administrations first marked American policymaking attempts to address Japanese technological and manufacturing parity. Subsequent trade wars and imports quotas led to increased tensions and ruinous competition between the two countries. One such case emerged in the microchip industry in which Japan, through a massive investment in R&D, eclipsed IBM, Texas Instruments and other US chip developers. In the first crucial decade of chip development, Japanese electronics firms left behind past practices of US technology licensing and plowed nearly 19% of all microchip sales (approximately 250 million yen) back into R&D efforts and increased the number of R&D-related employees from 2,337 in 1973 to 5,695 in 1984.¹⁰ Empowered by corporate-owned R&D departments aided by researchers from national universities and public agencies, Japan had mounted a serious technological challenge, which led US firms to form Sematech, a billion-dollar cooperative manufacturing venture, along with pushing for stricter trade barriers. Initiated in 1980 through the Bayh-Dole Act, legislative efforts such as the Cooperative Research Act of 1984 and the Federal Technology Transfer Act of 1986 also extended new remedies in terms of grants, tax credits and intellectual property generation incentives aimed at dramatically increasing R&D collaboration and coordination between American universities, government agencies and corporate high tech industries. Nevertheless, the microchip wars, followed by similar challenges in automobiles and consumer electronics, swiftly introduced and escalated a new dimension of Japanese competitiveness beyond lower-priced imports and higher labor productivity rates that US producers had not anticipated or were prepared to meet – concentrating large R&D expenditures to capture a leading position in critical core global high tech markets.¹¹

While not immediately effective, such legislation, which signaled a new strategy in US trade protectionism, has bolstered overall levels of national R&D development, but more importantly promoted a more unified and measured advance on the part of companies and universities of American scientific and technical knowledge into global business markets. As a result of a general economic slump and renewed US manufacturing vigor since the mid-1990s, Japan recently responded by re-vamping its technology transfer system to come closer to the US model of increased university-corporate collaboration through the post-2000 Intellectual Property and Industry Revitalization laws.¹² As a further sign of shifting strategies in high tech global markets, biotechnology, not electronics, served as the industry that spurred Japanese legislative reforms to move closer to the US technology transfer model, linking universities, venture

⁹ U.S. Congress, Economic and Trade Policy Subcommittee, “Study of U.S. Competitiveness,” (Washington, D.C.: GOP, 1980), p. I-3.

¹⁰ *Japan Times*, March 6, 1987; Nihon Denshi Kougyoukai, *IC shuaseki-kairo gaidobukku*, Tokyo, 1986, p. 53-54.

¹¹ Gregory Tassey, *Special Report: Comparisons of US and Japanese R&D Policies*, Strategic Planning and Economic Analysis Group, National Institute Standards and Technology, (US Government Printing Office, March 1998).

¹² Toshiko Takenaka and Ichiro Nakayama, *Technology Transfer System in Japan*, Power Point Presentation, IP Innovations in Science & Tech E589, University of Washington Law School, Autumn 2004 – Spring 2005.

capital-backed start-ups, and large firms.¹³ As reported by Ichiro Nakayama, the new laws have spurred new avenues for indigenous technology creation and development in Japan as patent applications by universities rose by more than 50% between 1999 and 2000. Government targets also bounced up projecting 15 times the rate of technology patents and licenses filings by 2010 and commitments for support for 1,000 venture start-ups between public agencies and universities.¹⁴

While these legislative reforms, on the surface, look like predictable returns to the R&D/trade wars of 1980s, US and Japanese attempts to champion greater national consolidation and protection of high tech knowledge centers and industries has led conversely to path breaking new collaborations in sensitive, interdependent ventures involving FSX aircraft, deterrent missile and satellite defense technologies, energy, remote sensing and environmental technologies, and biotechnology.¹⁵ In 2004, the first Japanese technology transfer firm opened in the United States at Philadelphia's Science Center with the intention of partnering with American companies and researchers at the University of Pennsylvania to explore and promote collaborative intra-national high tech ventures.¹⁶

THE CHALLENGE OF PAN ASIAN TECHNOLOGY TRANSFER

Beyond such gestures of technical collaboration, the rapidly emerging technical needs and capabilities of developing Asian nations poses new technology transfer challenges between the United States and Japan. While initially limited to outsourcing chip production, Japanese and American firms now compete head on for burgeoning consumer and military markets, especially in South Korea, Vietnam and China. One could argue that indeed technology transfer, over all other economic factors, e.g. consumer spending, financial trading, venture capital, etc., has led the ever escalating growth and convergence of a Pan Asian trading bloc since the 1990s. As noted by in a recent United Nations report, the recent rise of Republic of Korea as one of the newly industrialized countries (NICs), was made possible by the "current electronics technological revolution and the international transfer of technology", not only in industry terms but in the exposure and use of high tech products by Korean consumers. While Japanese technical transfer has been a strong influence, Korea as a major exporter of microchip technology has also shown remarkable "spillover" development of other technical industries and manufacturing in such sectors as electric appliances, iron and steel, petrochemicals, automobiles, shipbuilding, electronics, high-precision machine tools, aviation, computer and communications, biotechnology-related industry, and robotics. Taiwan, Singapore, Malaysia, and Thailand have joined Korea as major exports of microchip technologies and show remarkable progress in terms of catching up with Japanese and US technical

¹³ Leonard H Lynn and Reiko Kishida "Changing Paradigms for Japanese Technology Policy: SMEs, Universities, and Biotechnology" in *Asian Business and Management*, December 2004, Volume 3, Number 4, Pages 459-478

¹⁴ Ichiro Nakayama, "Patent Ownership and Rewards for Inventions in Japanese Public Research Organizations" for the Research Center for Advanced Science and Technology, University of Tokyo, 2005.

¹⁵ Capt. Franklin P. Mills, US Air Force, "Japanese Remote Sensing Organizations, Research and Technology," Report for the Air Force Office of Scientific Research, Asian Office of Aerospace Research and Development, June 14, 1994; BR Inman and Daniel F. Burton, Jr., "Technology and Competitiveness: the New Policy Frontier", *Foreign Affairs*, Spring 1990.

¹⁶ *Business Wire*, "First Japanese Tech Transfer Firm in U.S. Establishes HQ at The Science Center", April 13, 2004.

knowledge, R&D efforts, and manufacturing capabilities.¹⁷ While Japan lags significantly behind the United States and other Western nations in technology ventures in China, the obvious efforts of the People's Republic of China to gain rapid industrial and technical self-reliance further cements the independent technology path developing among Pan Asian nations.

CONCLUSION

While initially dependent on imported technologies, Japan swiftly moved in the post-World War II era to a strategy of technical self-reliance by developing an indigenous base of R&D through firms and public agencies and gradually reducing its acquisition and renewal of US patent and licensing agreements. These efforts allowed Japan to gain technical and manufacturing parity with the United States by the 1980s, which forced American policymakers and executives to re-assess the national structure of industrial competitiveness, scientific knowledge generation, and technology transfer.

The subsequent intensification of R&D and trade wars between the United States and Japan in the 1980s and 1990s led both nations to usher in significant legislative reforms intended to create closely coordinated national networks of technology knowledge generation and transfer between companies, universities and government agencies tied to targeted global market strategies. While initially nationalistic in direction, the reforms have led to greater levels of joint cooperation in "super high tech" industries, as the United States and Japan face new competition from emerging Newly Industrialized Countries (NICs), especially in Asia. The rise of such NICs, in particular China, Korea and India, have ushered in a new era of global technology transfer and competition that will require more cooperative ventures involving high levels scientific and military R&D and intelligent design projects between the United States and Japan. Only then can the United States and Japan preserve unique trajectories of national and intra-national technical parity necessary to protect home industries which have become reliant upon interrelated high tech trade, consumer activities and manufacturing economies of scale.

¹⁷ Saneh Chamarik and Susantha Goonatilake, *Technological Independence - The Asian Experience* (The United Nations University, 1994).